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IMMINENT OF E-COMMERCE IN GUJARAT EXPERIMENTS& OPPORTUNITIES

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ABSTRACT

E-commerce is extremely one of the business occasions that one will have to determine in the future. Ecommerce is said to bring about pattern shift in the world for trading. Expectation e-commerce is showing implausible business growth in Gujarat. Sponsored by increased online user base & mobile phone presentation, e-commerce has seen impressive growth in the last few years in Gujarat. Allowing for Gujarat's demographic dividend & rising internet convenience, the sector is scheduled to scale greater heights. Although, overall retail opportunity is extensive, the sector is beset with some serious challenges in Gujarat. The present study is to describe the present status & future growth of e-commerce in Gujarat. Analyze the present trends of e-commerce in Gujarat & examine the contests & occasions of e-commerce in Gujarat.

Keywords: E-commerce, Online retail, Increasing internet users, Electronic fund transfer

1.0 INTRODUCTION

E-commerce stands for electronic commerce. It means dealing in goods & services through the electronic media & internet. The rapid growth of e-commerce in Gujarat is being driven by greater customer choice & improved convenience with the help of internet the vendor or merchant who sells products or services directly to the customer from the portal using a shopping basket system or digital cart & allows payment through debit card, credit card or electronic fund transfer payments. In the present scenario e-commerce market & its space is increasing in demand as well as an impressive display or range of a particular type of services. E-commerce is already appearing in all areas of business, customer services, new product development & design. E-commerce business is growing in Gujarat because of wide range of product with minimum price wide range of suppliers & customers' internet. In this modern era every business unit wants to join online business because increasing ratio of internet users in Gujarat. E-commerce in Gujarat is still in growing stage but it offers considerable opportunity.

Definition: The buying & selling of products & services by businesses & customers through an electronic medium, without using any paper documents. E-commerce is widely considered the buying & selling of products over the internet, but any transaction that is completed solely through electronic measures can be considered e-commerce.

E-commerce is subdivided into three categories: business to business or B2B (Cisco), business to consumer or B2C (Amazon) & Consumer to consumer C2C (eBay).

OBJECTIVES OF STUDY

1. To analyze the present trends & opportunities of e-commerce in Gujarat.
2. To examine the barriers of e-commerce in Gujarat.
3. To find out the growth factors of e-commerce in Gujarat.

METHODOLOGY

Research methodology: The Process used to collect information & data for the purpose of making business decisions. The methodology may include publication research, interview, surveys & other research techniques & could include both present & historical information.

Research design: The researcher has used only secondary data that has been collected from various articles, journals, books, websites etc. It has been used to study the evaluation, conceptual framework, definition, key players, present trends, future prospectus & barriers of e-commerce.

The researcher also used quantitative research that is the systematic empirical investigation of variables phenomena via statistical & mathematical, theories pertaining to phenomena. All the data included is the secondary base & proper references have been given wherever necessary.

RESULT & DISCUSSION

Gujarat has an internet user base of about 39 million as of January 2017. Despite being third largest user base in world, the penetration of e-commerce is low compared to markets like the other states of India but is growing much faster, adding around 1 million new entrants every month. The industry consensus is that growth is at an inflection point.

In Gujarat, cash on delivery is the most preferred payment method, accumulating 75% of the e-retail activities. Demand for international consumer products (including long-tail items) is growing much faster than in-country supply from authorized distributors and e-commerce offerings.

As of first Quarter, 2017, seven Gujarat e-commerce companies have managed to achieve billion-dollar valuation. Viz. Flipkart, Snapdeal, InMobi, Quikr, Amazon, OlaCabs, and Paytm.

Market size and growth

Gujarat's e-commerce market was worth about 0.8 Cr. In 2009, it went up to 1.6 Cr. in 2013. In 2013, the e-retail segment was worth 2.4 Cr. About 70% of Gujarat's e-commerce market is travel related. According to Google, there were 3.5 Cr. online shoppers in Gujarat in 2014 Quarter 1 and is expected to cross 4.0 Cr. mark by end of year 2016. Compound Annual Growth Rate (CAGR) vis-à-vis a global growth rate of 8–10%. Electronics and Apparel are the biggest categories in terms of sales.

Key drivers in Gujarat e-commerce are

1. Large percentage of population subscribed to broadband Internet, burgeoning 3G internet users, and a recent introduction of 4G across the country.
2. Explosive growth of Smartphone users, soon to be world's second largest Smartphone user base.
3. Rising standards of living as result of fast decline in poverty rate.
4. Availability of much wider product range (including long tail and Direct Imports) compared to what is available at brick and mortar retailers.
5. Competitive prices compared to brick and mortar retail driven by disintermediation and reduced inventory and real estate costs.
6. Increased usage of online classified sites, with more consumers buying and selling second-hand goods.

New sector in e-commerce is online medicine. Company like Reckwing-Gujarat, Buyon kart, Health kart already selling complementary and alternative medicine whereas Net Medhas started selling prescription medicine online after raising fund from General Insurance Corporation and Steadview capital citing there are no dedicated online pharmacy laws in Gujarat and it is permissible to sell prescription medicine online with a legitimate license.

Gujarat E-commerce – trends and opportunities

E-commerce has come a long way since its inception and is only getting bigger. As technology continues to grow rapidly, e-commerce retailers are adopting newer techniques to facilitate sellers and buyers to sell and buy online more efficiently, thanks to ever dropping rates of internet surfing – both for web and mobile interfaces – which is complimenting the soaring population of internet users. It has hence become the key force behind driving the trend for e-commerce.

The rise of social networks and mass adoption of mobile devices is acting as a catalyst to accelerate this drive further, shaping the e-commerce trends for the Gujarat market. Consumers are more connected than ever before and have more information and choices at their fingertips today. They are leaving behind their preferences, behavior and interests, which create a knowledge ground for e-commerce companies to analyze behavior pattern and offer more interesting and competitive products.

The proliferation of this digital activity and resulting data is a stimulating factor for devising e-commerce strategies, thus affecting the business model and driving growth for e-commerce players in the Gujarat market. Let us establish more understanding considering the current scenario and insights of some of the upcoming trends in this space.

Critical health of sector: Losers and gainers

According to a study by Acer Partners, online shopping of physical goods in Gujarat will grow to 2.5 Cr. in 2016 and the number of online shoppers in Gujarat will be more than double to 5 Cr. The internet user base is predicted to increase to 5.4 Cr by 2015. Does that mean that e-commerce is here to stay, and every small and big fish will survive? That might not be the case.

The ones that show potential to succeed are international deep-pocket incumbents who have experience, concepts and variety of offerings, and tend to grow at a fast pace as compared to the other existing players in the Gujarat market. Even Gujarat e-commerce players are trying hard to bring in similar concepts as their international competitors. They are trying to bring impending and imminent consolidation, which is evident from the probable mergers of Gujarat's biggest e-commerce players.

Key market and technology trends that we believe will find e-commerce in near future include:

Brand loyalty

Price has been the dominating factor in the Gujarat market and the customer is not hesitant in changing brands frequently to avail the lucrative offers presented by competing brands. There is a lot that e-commerce players in Gujarat would have to do to make their customers feel special to retain them, as the loyalty erodes fast when the shopper is confronted with promotions and deals. Knowing what your customers want and offering them accordingly can possibly drive this, which is possible by using big data techniques to predict consumer preference and behavior.

Retailer's own logistics

Logistics have been a major issue for online retailers in Gujarat, which leads them to build their own strategies in the absence of established systems to handle cash-on-delivery (CoD) and same-day shipments. Online market leaders are choosing to build their own logistics such as Flipkart, who has launched eKart that is open to its rivals as well.

Cod rules in Gujarat

The Gujarat market is yet not comfortable to adopt payments through credit or debit cards. Cash-on-delivery (CoD) accounts for up to 60 per cent of transactions, according to Internet and Mobile Association of Gujarat and audit firm KPMG. Overdependence on cash-on-delivery mode of payment remains worrisome as the transactions add about 3 per cent additional costs. Also, the additional processes required for cash-on-delivery orders, longer payment cycle, higher instances of returns and associated costs are hurting margins.

Improving customer experience with varied offerings and options

With the advent of technology, online retailers are devising attractive delivery options such as same-day delivery or delivery within an hour, perks on buying from mobile apps, and try @ home @ your door for consumers that are leading improved customer experience. To further improve customer experiences, we might also see adoption of international practices such as digital or experiential stores and showrooms, pop-up and fulfillment stores and drones that will fascinate the Gujarat market. The other technologies that will affect these trends and help shape the e-commerce business include:

Big data

To gain, retain and attain more customers, online retailers would have to leverage technology to the fullest, and by developing strategies through analytics produced using big data will help in making customers feel special and increase brand loyalty. With the increasing adoption and use of Smartphone's, businesses are able to collect large amount of data on consumers, which can be further utilized to do target based marketing and advertising.

Mobile

Brands have taken the mobile advertising route and are gradually picking up. Online retailers have realized the potential increase of online shoppers through their mobile phones in future. And as consumers grow more comfortable with using mobile devices for browsing and shopping, they are now more open to getting messages from brands via their mobiles. Businesses are implementing strategies for integrating mobile into their marketing campaigns and before they do that, they will have to make efforts to optimize legacy websites for mobile in order to improve customer experience. This is where responsive design will come into play. Fixing the mobile clicks is imperative as an unresponsive design may lead to the customer abandoning the site in a few seconds causing a low conversion rate and poor return on investments.

Social

Another important consideration is the social aspect and marketers have realized its importance very well. Product and service feedback via social media channels have an impressionable effect on the minds of the larger customer base.

Advantages of e-commerce to Consumers

The distinct advantages e-commerce can offer to the consumers include but are not confined to the following only:

- (i) Consumers have a much wider choice available on the cyber market.
 - (ii) They bear lower costs for products due to increased online competition among sellers.
 - (iii) Because of wide-scale information dissemination, consumers can compare products, features, prices and even look up reviews before they select what they want.
 - (iv) They enjoy wider access to assistance and to advice from experts and peers.
-

(v) They enjoy saving in shopping time and money.

(vi) Consumers also avail of fast services and delivery of products and services.

(vii) They also have the convenience of having their orders delivered right to the door step.

(viii) Finally, consumers are driven to e-shopping in hopes as even branded goods cost less on the Net.

To Suppliers

The major advantages that e-commerce can bring to the companies/suppliers are:

1. It minimizes inventory cost

E-commerce venture need not maintain huge inventories or expensive retail showrooms. Their marketing and sales force is a fraction of that of traditional mortar-based businesses. E-commerce a minimize inventory costs by adopting just-in-time (JIT) system enhancing the firm's ability to forecast demand more accurately.

2. It can improve customer services

It has been found that providing both customer and after-sales services account for up to 10 per cent of the operating costs. By putting these services on-line under e-commerce, these costs get reduced, on the one hand, and simultaneously the quality of services also gets improved, on the other. High quality customer relationship called "customization" is crucial for retaining customers in the e-commerce environment. That is the reason why Customer Relationship Management (CRM) has become the buzzword which everybody is talking of now. E-commerce provides ample opportunity for Customer Relationship Management solution and, in turn, in establishing better relationship with the customers. It becomes absolutely necessary for the company to enhance customer loyalty. Otherwise the customer, who is full of choices, can jump from one website to another. If company is to stay in business then it will have to deliver the products or services to customers as they want, when they want, and how they want.

3. It reduces distribution costs as well

The Electronic Data Interchange (EDI) based on Organization for Economic Co-operation and Development (OECD) study has revealed that the time needed to process an order declined abruptly by a minimum of 50 per cent to a maximum of 96 per cent. It is really amazing.

4. It helps business globalize

E-commerce by minimizing costs enables companies' especially small ones to make information on its products and services available to all the potential customers spread over worldwide. This is well confirmed by Amazon.com. founded by Jeff Bezos, the largest bookstore in the net by taking away a large amount of sales from the traditional booksellers. In Gujarat, the experience of reinfusion-on-the-net presents the similar case.

5. It helps market products more quickly

By taking the entire product design process online, drawing partners and customers into the process and removing the traditional communication barriers, companies can bring products and services to market far more quickly. Internet commerce solutions allow customer to reduce the costs of sales and open new markets, speed and simplify order accuracy, approval, and processing, tracking and delivery and improve decision making, leverage existing investments in infrastructure, business systems and repositions and link manufacturers with suppliers on the same network.

CHALLENGES & OPPORTUNITIES

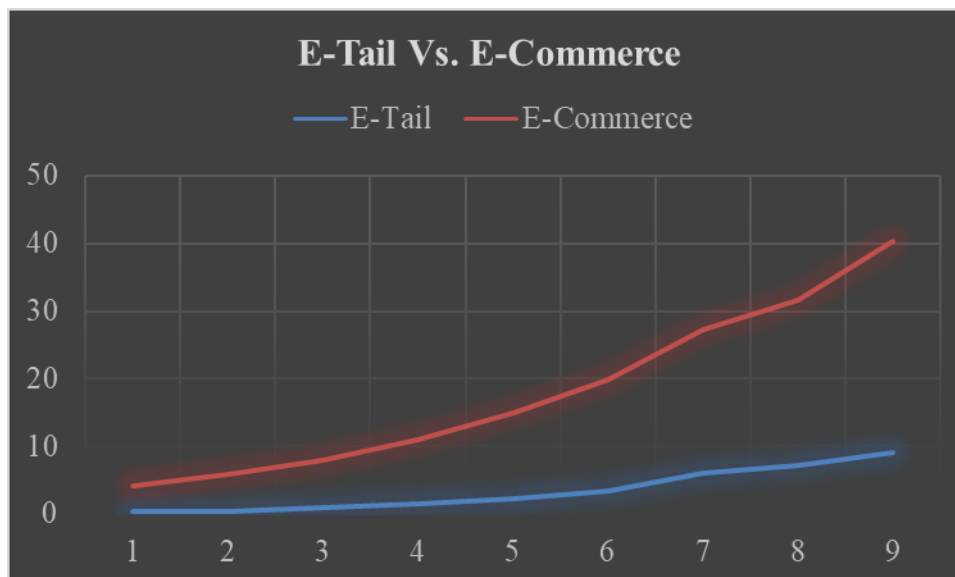
Backed by increased online user base & mobile phone penetration, Gujarat e-commerce has seen impressive growth in the last few years. Considering Gujarat's demographic dividend & rising internet accessibility, the sector is slated to scale greater heights. Although, Gujarat's overall retail opportunity is substantial, the sector is beset with some serious challenges. We take into the current e-commerce landscape & the sector's key drivers & challenges.

Gujarat's Growth Potential

Since the e-commerce industry is fast rising, changes can be seen over year.

Year	E-Tail	E-Commerce
2009	0.4	3.8
2010	0.6	5.3
2011	1	7
2012	1.5	9.5
2013	2.3	12.6

2014	3.5	16.4
2015	6	21.3
2016	7.3	24.2
2017	9.1	31.2

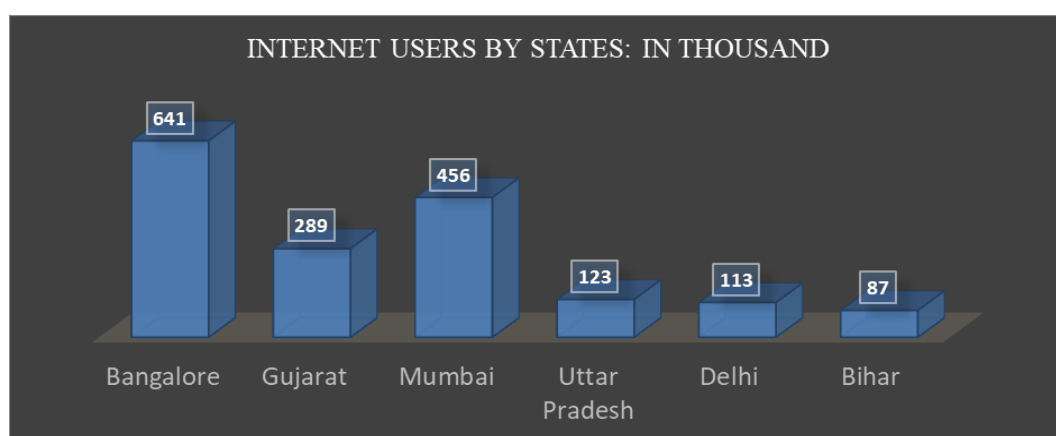


Factors that will fuel growth

A significantly low (19%) but fast-growing internet population of 28thousand in 2017 is an indicator of the sector's huge growth potential in Gujarat.

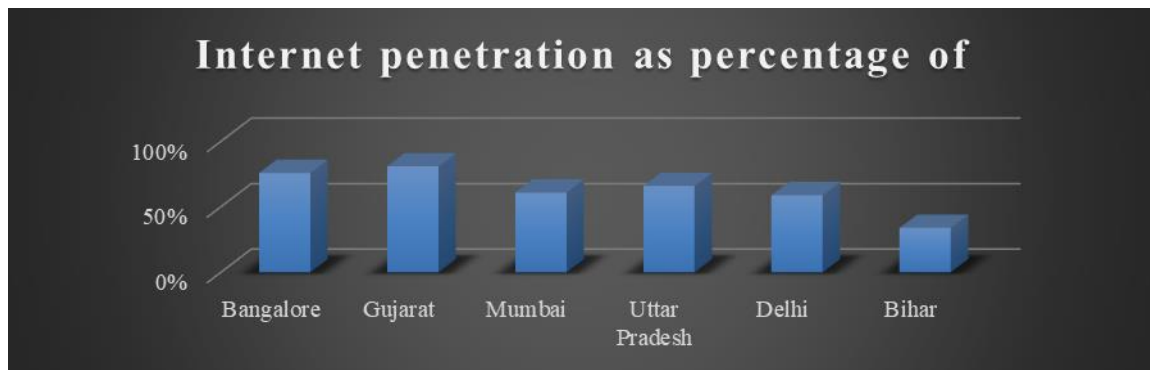
State Name Internet users by country: In Thousand (2017)

State Name	Internet Users By States: In Thousand
Bangalore	641
Gujarat	289
Mumbai	456
Uttar Pradesh	123
Delhi	113
Bihar	87



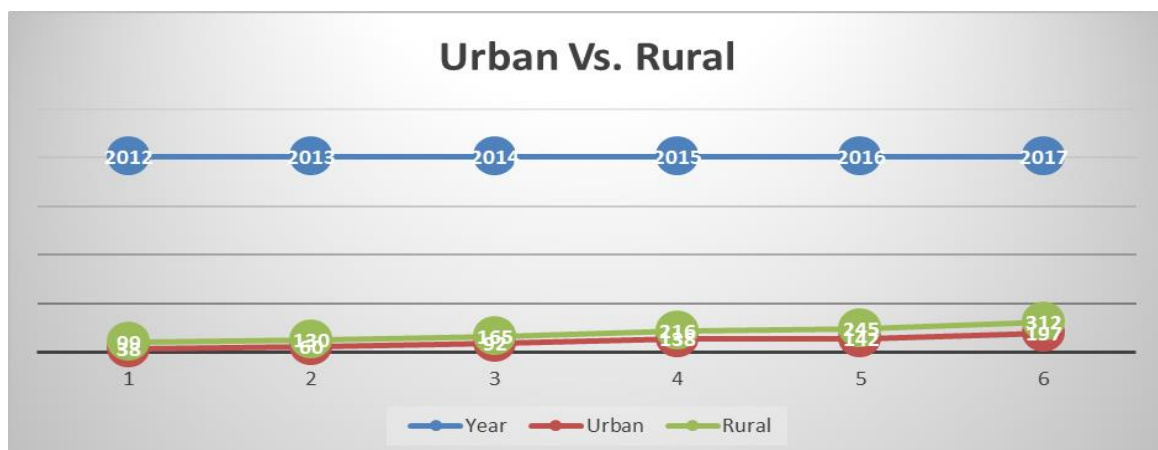
Internet penetration as percentage of population (2017)

State Name	Internet penetration as percentage of population (2017)
Bangalore	76%
Gujarat	81%
Mumbai	61%
Uttar Pradesh	66%
Delhi	59%
Bihar	34%



Geographical Distribution of Internet Users in Gujarat (MN)

Year	Urban	Rural
2012	38	99
2013	60	130
2014	92	165
2015	138	216
2016	142	245
2017	197	312



Challenges in the e-commerce sector

While the growth in this sector excited entrepreneurs & financial investors alike, some serious challenges are beginning to weight down on the sector. E-commerce players in Gujarat need address eight key aspects of their business, both internal & external.



CONCLUSION

E-commerce is changing the way of buying & selling of product & services in Gujarat. E-commerce is future of shopping. Due to E-commerce the gap has been reduced between manufacturer & consumer. According to Gujarat population their vast scope for e-commerce because currently in Gujarat only 19% people using internet for selling & buying goods & services so remaining percentage we can consider that we have scope in Gujarat Market. There is weak Cyber Security Law in Gujarat that is why Gujarat People are facing challenges toward e-commerce. The future of e-commerce in Gujarat would be bright in the upcoming years if all essential factors would be implemented, by establishing cyber & having their benefits as per people wish. The role of government is to provide a legal framework for e-commerce so that while domestic & international trade is allowed to expand their horizons, basic right such as privacy, intellectual property, prevention of fraud, consumer protection etc. are all taken care of. The expansion of e-commerce has been developed in rural as well as urban area in a reasonable cost for consumption, because of that more people are getting linked with e-commerce & the ratio of that is getting increase day by day.

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E-COMMERCE: A LEARNING ON BENEFITS AND CHALLENGES IN A DEVELOPING ECONOMY IN INDIA

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ABSTRACT

Information Technology is playing an essential role in the future development of financial sectors and the way of doing business in arising economy like India. Increased use of smart mobile services and internet as a new distribution channel for business transactions and international trading requires more awareness towards e-commerce security for reducing the fake activities. The advancement of Information and Communication technology has brought a lot of changes in all spheres of daily life of human being. E-commerce has a lot of benefits which add value to customer's fulfillment in terms of customer ease in any place and enables the company to gain more competitive benefit over the other competitors. This study predicts some challenges in an emerging economy.

Keywords: e-commerce, information technology, customer satisfaction, business

INTRODUCTION

Now-a-days e-commerce is growing popular in an emerging economy. E-commerce began in 1995. It requires the digital goods for carrying out their transactions. Digital goods are goods that can be delivered over a digital network (Laudon and Laudon, 2013). E-commerce is rapidly transforming the way in which enterprises are interacting among each other as well as with consumers and Governments. As a result of changes in the landscape of ICTs, e-commerce is now growing rapidly in several emerging markets and developing economies (UNCTAD/IER/2015). The technologies designed to improve commercial transactions using the Internet have evolved as quickly. However, we have not yet achieved an ideal world of painless and secure transactions utilizing the Internet, as unresolved privacy issues of the purchaser have impeded the further development of the technologies (Alberto, Avila and Violeta-2007). E-commerce has been hailed by many as an opportunity for developing countries to gain a stronger foothold in the multilateral trading system. E-commerce has the ability to play an instrumental role in helping developing economies benefit more from trade (WTO-2013). The growing use of the Internet, tablet devices, and smart phones coupled with larger consumer confidence will see that e-commerce will continue to evolve and expand. With social media growing exponentially in recent years, the conversation between businesses and consumers has become more engaging, making it easier for transactional exchanges to happen online. Internet retailers continue to strive to create better content and a realistic shopping experience with technologies like augmented reality. With mobile commerce gaining speed, more users are purchasing from the palm of their hand (Miva-2011). E-commerce could deliver a significant benefit to businesses in developing countries by increasing their control over its place in the supply chain, thus improving its market efficiency (Molla & Heeks, 2007).

(a) What is E-commerce?

Electronic commerce, or e-commerce, is the buying and selling of goods and services on the Internet. Other than buying and selling, many people use Internet as a source of information to compare prices or look at the latest products on offer before making a purchase online or at a traditional store. E-Business is sometimes used as another term for the same process. More often, though, it is used to define a broader process of how the Internet is changing the way companies do business, of the way they relate to their customers and suppliers, and of the way they think about such functions as marketing and logistics. For the purpose of this study e-commerce is taken to mean doing business electronically. (Lindsay P., 2002)

(b) Why E-commerce?

With the increasing diffusion of ICTs, more specifically the Internet, the global business community is rapidly moving towards Business-to Business (B2B) e-Commerce. The buyers gain a clear advantage when the Internet gives them access to the global market, by which they can compare prices across regions, find out whether prices vary by order fragmentation and get awareness about substitute products. Due to transparency of the market, customer can compare the services of various e-commerce sites easily. For instance, in case of e-commerce the competitors are one click away from customer. If clients are not happy with the products, prices or services offered by a particular e-commerce site, they are able to change much more easily than in the physical. From the Sellers' point of view, they don't need to have physical existence of shop.

II. REVIEW OF LITERATURE

Internet and e-commerce are closely wrapped towards developed countries. But they can achieve tremendous benefits to developing countries if it is applicable as an ideal business purpose. E-commerce is a revolution in business practices (Ohidujjaman, et al 2013). The term commerce is viewed as transactions conducted between business partners. Electronic commerce is an emerging concept that describes the process of buying and selling or exchanging of products, services and information via computer networks including internet (Anupam-2011).

Commercial transactions involve the exchange of value (e.g., money) across organizational or boundaries in return for products and services. Exchange of value is important for understanding the limits of e-commerce. Without an exchange of value, no commerce occurs (Laudon and Traver). E-business has changed processes within and between enterprises. Electronic Data Interface (EDI), widely introduced twenty five years ago on dedicated links between firms, showed how information could be directly passed from the operating systems of one enterprise into the order processing, production and logistics systems of another (Clayton and Criscuolo). If implemented properly, E-commerce technologies can result in business process improvements and increased efficiencies. Leveraging E-commerce technologies should result in improvements to developing countries, but so far have not produced the desired results (Jeffrey S. Ray-2011).

The development experienced in internet and other global online networks have, thus, created new commercial opportunities for e-commerce and creation of completely new sets of global and national trading relationships. This consequently, led to the perception that e-banking and e-commerce are now an inevitable aspect of financial services. It enables multiple buyers and sellers to come together on a common platform and conduct business without compromising individual requirements and relationships among the participants very quickly; (Harris and Spencer, 2002; Bairagi, 2011).

Electronic commerce is creating new opportunities to the global economic, for example in global travel and tourism industry. Transforming from traditional business method to electronic commerce method is hard and there were many different factors for companies to adapt them with electronic commerce factors (Nanehkaran, 2013). (Hasan, 2010) pointed out that nowadays e-commerce industries have increasingly become a necessary component of business strategy and a strong catalyst for economic development.

III. OBJECTIVES OF THE STUDY

The main objectives of the study are as follows:

1. To get a full acquaintance of the E-commerce in India.
2. To identify the benefits of E-commerce.
3. To know the challenges in E-commerce.

IV. Research Methodology

The paper has been written on the basis of secondary data. The secondary data were collected from published books, journals, research papers, magazines, daily newspaper, internet and official statistical documents. The study is qualitative in nature.

V. E-COMMERCE SITUATION IN INDIA

In India, there is a great deal of interest in e-commerce; however, due to various economic, infrastructural and legal reasons it did not spread widely in the past. After the introduction of 3G technology, the e-commerce has been growing rapidly because people have more easy access to internet than in the past.

According to IASIS (Indian Association of Software and Information Services), in just three years, more than 2000 online trading platforms have made their way to India. Business people and trading houses state that the rapid growth in internet networking and mobile phone coverage induces them to meet customers online and deliver a smooth and transparent shopping experience including e-ticket sales and sales on Facebook the market has yearly transactions around Tk 10 billion (approximately DKK 700 million). Furthermore, it increases at a tremendous pace with a monthly growth of 20-25 percent according to data from IASIS. Around 15 million people use the internet regularly of them, 4-5 million have accounts on Facebook which is still holding the leading position for online shopping through smaller and more local businesses although the market is changing rapidly. Larger companies, domestic and international, are having success in transforming a somehow hectic shopping culture into a transparent and easy way of accessing a great e-location of consumer goods. This trend is known to Swedish e-commerce company Bikroy.com who is doing well in India. Since their launching in 2012 Bikroy.com has experienced a significant growth and is today the largest online marketplace in India. Now they have more than 2 million unique visitors on their website.

VI. BENEFITS OF E-COMMERCE

The main benefit from the customers' point of view is significant increase and saves of time and eases access from anywhere in the globe. Customer can place a purchase order at any time. The main benefits of e-commerce for customers are as follows:

- Reduced transaction costs for participating exchange in a market.
- Increased comfort - transactions can be made 24 hours a day, without requiring the physical interaction with the business organization.
- Time saving- Customer can buy or sell any product at any time with the help of internet.
- Quick and continuous access to information- Customer will have easier to access information check on different websites at the click of a button.
- Convenience- All the purchases and sales can be performed from the comfort sitting at home or working place or from the place a customer wants to.
- Switch to others Companies- Customer can easily change the company at any time if the service of a company is not satisfactory.
- Customer can buy a product which is not available in the local or national market, which gives customer a wider range of access to product than before.
- A customer can put review comments about a product and can see what others are buying or see the review comments of other customers before making a final buy.

The main benefits of e-commerce from sellers' point of view is increasing revenue and reducing operation and maintenance costs through internet.

These include as follows

- Increases revenue.
- Reduces operation and maintenance costs.
- Reduces purchase and procurement costs.
- Raises customer loyalty and retention.
- Reduces transportation costs.
- Develops customer and supplier relationships.
- Improves speed of the process of selling.
- Improves internal and external communication. and
- Develops the company image and brand.

VII. CHALLENGES IN E-COMMERCE

The major challenges faced by the sellers and the buyer which carrying out business transaction through internet are as follows.

- Private and public corporation is not involved jointly to grow the business of e-commerce. Private and public joint initiative is needed to develop the e-commerce business. Joint initiatives bring credibility inside people, which is needed for flourishing the e-commerce business.
- There is a lack of system security, reliability, standards, and some communication protocol.
- Customer loses their money if the website of e-commerce site is hacked. Most common problem of e-commerce website is not having enough cybersecurity.
- Financial institutions and intermediaries: Thus far, financial institutions and banks in developing countries are hesitant to take an active role in promoting e-commerce. However, merchants need the involvement of banks to broaden the reach and appeal of e-commerce and to help prevent fraud and potential losses attributable to credit card fraud. But beyond the credit card approach, banks and other financial service intermediaries are challenged to develop alternative modalities for secure and reliable online transactions in environments where credit cards are not commonplace (Anupam-2011).

- In developing countries there is a culture of buying product by negotiating price with seller, which is not easily possible in case of e-commerce in developing countries because of lack of infrastructure facility.
- One of the biggest challenges is the cutting down the price of internet. Authorities are trying to keep the price of bandwidth low. But the high cost of spreading networks and operating expenses hinder to keep price low for internet.
- Trust is the most important factor for the use of the electronic settlements. Traditional paper based rules and regulations may create uncertainties the validity and legality of e-commerce transactions. Modern laws adopted and impartiality implemented in the electronic transactions form the basis of trust in the developed world. Where legal and judicial systems are not developed e-commerce based transactions are at a disadvantage because of lack of security whether real or perceived. In many developing countries even today cash on delivery is the most accepted system, even cheques and credit cards are not readily accepted (Roni Bhowmik-2012).
- New methods for conducting transactions, new instruments, and new service providers will require legal definition, recognition, and permission. For example, it will be essential to define an electronic signature and give it the same legal status as the handwritten signature. Existing legal definitions and permissions such as the legal definition of a bank and the concept of a national border—will also need to be rethought (Chavan-2013).

Besides the above challenges, the emerging economy like India also faced the following challenges:

- Lack of education
- Cultural tradition
- Poor concept of online marketing
- Less marketing or promote
- Political problem
- High cost of products/services comparing traditional market
- Internet coverage area is limited
- Communication is haphazard over the country
- Lack of trustable business and enterprise and
- Lack of experience of meeting directly with merchant and customer.

VIII. CONCLUSIONS

The e-commerce industry will be a leader with popularity in electronic business world in the upcoming years. The e-commerce revolution has fundamentally changed the business of transaction by giving new opportunities and breaking borders easily. In India, it has strongly impacted the traditional business system and changing the life of people by making it easier. While it gives benefits to customer and seller, e-commerce gives challenges to traditional business for competitive position. Developing countries face many obstacles that affect the successful implementation of e-commerce with the help of comparing with developed country. When the internet cost will be low then the e-commerce will flourish easily and will make many of traditional business to run out of their business. Convenience is one of the benefits that customer gets from the e-commerce and thus increasing customer satisfaction. This is due to customer can place a purchase an order from anywhere with internet connection. E-commerce business providers should give importance on every customer by giving smooth service and many options for payment and have more functions available online. Other benefits are expanded product offerings and expanded geographic reach. But e-commerce business faces a lot of challenges in flourishing their business.

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IMPACT OF FLUORIDE TOXICITY ON FRESH WATER FISHES: A MINI REVIEW

Suvendu Ghosh¹, Debosree Ghosh²¹Department of Physiology, Hooghly Mohsin College, Chinsura, Hooghly²Department of Physiology, Government General Degree College, Kharagpur**ABSTRACT**

Fluoride toxicity is widely spreading in different parts of the world. Excess fluoride in water is harmful for aquatic life as well as excess of fluoride in drinking water is harmful for animals and human. Fishes living in fresh water contaminated with fluoride are adversely affected. Fluoride enters and accumulates in their body and thus enters the food chain. Low level of fluoride doesn't cause life threatening issues but gradual bioaccumulation of fluoride causes toxic effects in living organisms and consequences may be fatal. A vivid knowledge of fluoride exposure and toxicity is necessary for developing proper and satisfactory control and preventive measures against fluoride pollution. Fluoride intoxication in fishes needs to be controlled in order to prevent ill health effects on human health due to consumption of fluoride intoxicated fishes as well as to improve yield of aquaculture.

Keywords: Aquaculture, bioaccumulation, fishes, fluoride, toxicity

INTRODUCTION

Aquatic fluoride contamination is an important ecotoxicological issue now a day. Across the globe, fluoride contamination in water has been critically studied. Fluoride gets into water through various ways. One significant way of fluoride contamination in water is from fluorine containing minerals in sediments and rocks¹. Another significant source of fluoride contamination in water is through pesticides and industrial effluents¹. Fluoride toxicity affects aquatic life adversely. Fresh water organisms are more severely affected compared to those in brackish water². It is reported that bioavailability of fluoride ion is decreased with increasing hardness of water². Fluoride is known to enter and accumulate in body of fishes². Studies reveal that fluoride accumulates in bones² and flesh of fish³. Fluoride is highly electronegative and so gets attracted towards the positively charged calcium ions in bones⁴. Fish is one of the most common foods in regular diet in many parts of India. Not only in India, is fish consumed abundantly in regular diet but also is consumed extensively in various other countries around the world. Fluoride which accumulates in fish body, enters human body through fluoride intoxicated fish in his diet. Studies show that small amount of fluoride is needed and is good for preventing tooth decay but excess of fluoride not only is harmful for tooth (causes dental fluorosis) but also is harmful for entire health of living organisms⁵. It has been reported that fluoride contamination below the permissive level can adversely affect the health of invertebrates and fishes². Studies suggest that dietary fishes are one of the major contributors in dental fluorosis in human beings⁶. With increasing concentration of fluoride ion in water, severity of effect of fluoride toxicity on fishes and other aquatic organisms increase⁷. Also exposure time period plays an important role in occurrence and severity of fluoride toxicity⁸. Whereas, concentration of chloride and calcium ions decreases the severity of fluoride toxicity in fishes⁹. Fluoride enters the body of fish and interferes with the various enzymes present in the body. Fluoride primarily poisons the enzymes and thus prevents their activity. Thus, various essential metabolic processes are disturbed [Fig.1.]. Some such metabolic processes like glycolysis etc., are essential for maintaining normal physiology of fishes¹⁰. In this review we primarily focus on the impact of fluoride toxicity on health status of fishes living in fresh water. We have also suggested some possible remedies for preventing fluoride pollution and toxic effects of fluoride on fresh water fishes.

FLUORIDE BIOACCUMULATION

Fluoride being highly transportable inorganic pollutant enters the body of fishes via skin or gill. Bioaccumulation depends on presence of aquatic sediments, temperature and pH¹¹. Common carps like *Cyprinus carpio*, goldfish (*Carassius auratus gibelini*) and two predatory fishes: the northern pike (*Esox lucius*) and the European perch (*Perca fluviatilis*) are shown to accumulate fluoride in various organs and tissues¹². The accumulation of F⁻ in the tissues of the fish increased depending on the duration of exposure. However, adverse effects vary in species to species with accumulation in predator fishes¹². Further controversies in tissue accumulation have also been reported. Upon entry in the body of *Acipenser baerii* fluoride accumulates in various organs primarily in bone, skin, gill followed by liver, gut and muscles¹³. However, Cao et al. reported that accumulation of Fluoride was highest in the gills, followed by the liver, brain, kidneys, muscle, and gut tissues of carp (*Cyprinus carpio*)¹⁴.

EFFECTS OF FLUORIDE TOXICITY ON FISH HEALTH

Invertebrates and fishes living in freshwater primarily upstream-moving adult salmon, have been found to be more susceptible to and effected by fluoride toxicity compared to those living in estuarine and saline water. Studies reveal that in soft water fluoride concentration of 0.5 mg F-/l can even cause toxic effects in invertebrates and fishes living in fresh water. The reason behind such increased risk of fluoride toxicity in fresh water organisms unlike those living in saline water is low ionic content in fresh water. Fluoride/l concentration lower than 0.5 mg F-/l is considered safe and levels below this are recommended permissible for protection of freshwater animals from fluoride pollution².

The concentration of fluoride dictates the level of accumulation in the body of fish thereby altering the weight and length of fishes¹³. Shi et al. (2009) reported a visible decline in growth over 90 days in juvenile sturgeon (sturgeon includes 27 species of fish of family Acipenseridae) correlated to concentrations (10, 25 and 60 mg F/l)¹³. A study conducted on *Puntius ticto* of lake Nainital, Uttarakhand, India, showed changes in fish length and weight correlated with the aquatic fluoride concentration¹⁵. Studies conducted on *Heteropneustis fossilis* (Bloch) showed diminished growth with fluoride exposure¹⁶. Fluoride acts as a metabolic inhibitor by exerting its adverse effects of various nutrient metabolizing enzymes. Significant enzymatic and histopathological adverse changes were observed in the liver of *Heteropneustes fossilis* with exposure to fluoride¹⁷. *Labeo rohita* showed a decrease in total protein content in liver muscle, gill and kidney upon sublethal exposure to fluoride¹⁸. Similarly, these organs also demonstrated a decline in the total glycogen content and lipid content in the organs¹⁸. Histopathological changes in gill, kidney, and intestine of *Labeo rohita* was also observed¹⁹. Effect of fluoride toxicity on vertebral column of fresh water fish, lata (*Channa punctatus*) has been reported²⁰. Genotoxic effect of fluoride toxicity on fresh water fish has also been found in a study conducted in Asian catfish, *Clarias batrachus*²¹. Bioresources for Rural Livelihood, freshwater teleost, *Cyprinus carpio* similarly showed fluoride induced reduced weight gain and body growth as well as diminished food intake²². Studies show that fluoride exposure in high concentration causes pronounced cytotoxicity [Fig.1.]. High concentration of fluoride exposure may cause inhibition of cell division and may retard growth²³. Also high fluoride concentration may induce apoptosis²³. Fluoride toxicity is also known to effect various signalling pathways which are involved in events of cell division and apoptosis²³.

It is reported that fluoride exposure of fish causes swelling of primary and secondary lamellar epithelium [Fig.1.]. Clubbing of on the tip of secondary lamellar epithelium of gills were also observed in fishes with fluoride exposure. Also cellular hypertrophy hyperplasia was observed in gills of fishes with fluoride exposure^{24, 25}. Studies reveal that fluoride toxicity in fishes causes histopathological changes in gastrointestinal organs like stomach, liver, intestine, kidneys etc., [Fig.1.]²⁶ Our studies on effects of fluoride exposure on *Channa punctatus* reveals that fluoride induces oxidative stress and causes significant toxic effect on fish liver²⁷.

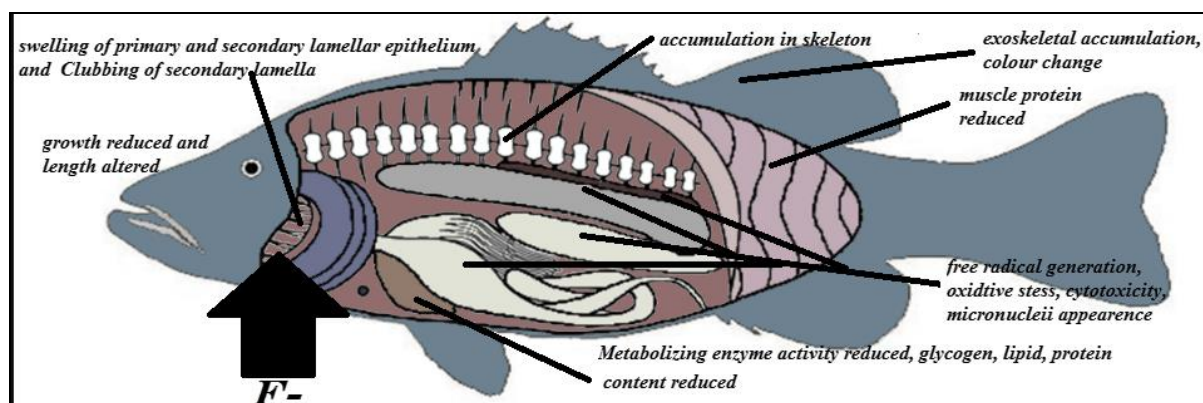


Fig-1: Diagram representing effects of fluoride toxicity in fish

FROM FISH TO HUMAN

It is known that fluoride is good in low circulating concentrations. Skeletal uptake of fluoride is limited at low circulating concentrations of fluoride and the effects are observed to be beneficial. There is no documentation of any disease in man due to deficiency of fluoride²⁸. Whereas, fluoride is toxic to health at higher concentrations in circulation. High concentration in circulation leads to increased skeletal uptake of fluoride²⁹. Fluoride enters human body through the fishes he consumes as food. Excess fluoride is not utilised in our body and starts accumulating in our body on consecutive and regular consumption of fishes intoxicated with fluoride. Fluoride not absorbed in body are easily excreted through faeces³⁰. Plasma level of fluoride concentration reaches peak within 20 to 60 minutes of ingestion. Then gradually the fluoride level in plasma begins to decline due to

excretion in urine and uptake of fluoride in calcified tissues³⁰. Fluoride may enter our body primarily through food like fishes containing fluoride but studies report that potential fluoride toxicity may even occur from oral medications containing fluoride³¹. Once in the body, fluoride in high concentration causes significant adverse effects on health²⁸. Fluoride has been found to badly effect the cognitive development in children³². Fluoride toxicity in man has been reported to cause dental fluorosis, skeletal fluorosis, enhanced tooth decay, brittle and mottled tooth etc. ³³⁻³⁴. Fluoride has been reported to interact with and poison various enzymes. Fluoride while in body, interacts with the metal ions present in enzymes and disrupt normal physiology by disrupting normal functions of enzymes³⁵. Fluoride is also known to cause hypocalcaemia in man³⁶. Thus, fluoride ingestion through fish, when fluoride intoxicated fish is regularly consumed in daily diet, causes several significant health hazards in human [Fig.2.]. Proper care should be taken to prevent consumption of fishes from water contaminated with fluoride.

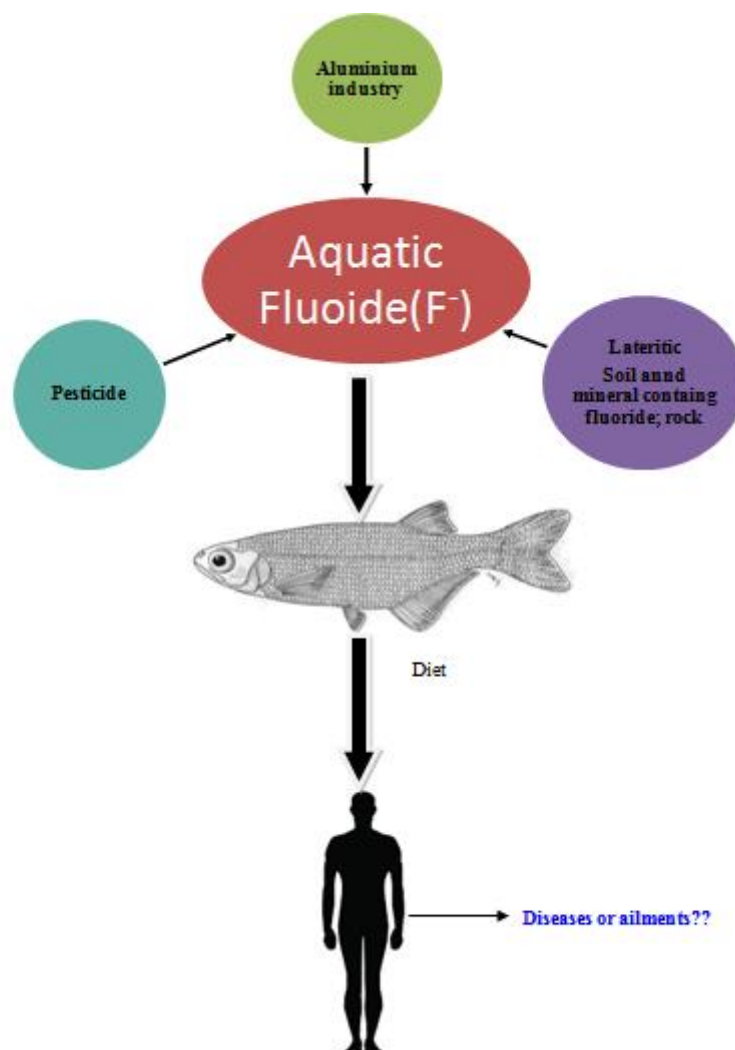


Figure-2: Fluoride from various sources to fish to human

PREVENTIVE MEASURES

Preventive measures of fluoride toxicity in fish are of serious concern not only for better health of fishes and good aquaculture but also to assure good health status of man who consumes fish in his daily diet. One of the most important and considerable measures for preventing and protecting against fluoride pollution and fluoride toxicity in fish includes defluoridation of water⁹. Defluoridation means removal of fluorine from water⁹ and is in practice primarily for removal of fluorine from drinking water³⁷. Various conventional techniques of defluoridation includes reverse osmosis, ion exchange and electrochemical defluoridation and adsorption technique³⁷. Often water from fields where fertilizers containing fluoride³⁸ are used, run into water bodies nearby where fishes are cultured. Thus fresh waters get contaminated with fluoride. Similar contamination of water bodies with fluoride may occur due to running of field water or garden water during monsoon where pesticides containing fluoride are used³⁹. Hence, care needs to be taken to prevent running of such field water to nearby water bodies used for aquaculture of edible fresh water fishes. Another primary source of fluoride pollution is industrial effluent which runs into nearby water bodies. Such fluoride pollution from industrial

sources must be prevented by enacting laws and by adapting procedures like defluoridation of industrial effluents before they are released into water bodies³⁷. Some studies show use of antioxidants from herbal sources may be beneficial in treating adverse health conditions in experimental animals like rats⁴⁰. Such antioxidant treatment can be considered in fishes as well to treat fluoride toxicity.

CONCLUSION

Fluoride toxicity in fishes is of serious concern in order to assure good human health who consumes fish. The most significant way to prevent fluoride toxicity in fishes is by preventing exposure of fishes to fluoride. This is possible only by either preventing contamination of water with fluoride or fluoride containing substance or by removing fluoride from the water which is already contaminated with fluoride. In order to remove fluoride from water it is necessary to know the level of fluoride in the water and also the source of fluoride contamination. Until fluoride from the water is not removed or further contamination of the water is not stopped, culture of fishes in that water should be stopped and the fishes which already thrive in that contaminated water should be immediately moved to a separate tank with fresh water and need to be treated in order to mitigate fluoride induced damages and adverse physiological alterations. We have earlier observed and reported that fluoride toxicity in experimental *Channa punctatus* fish is through oxidative stress²⁷. Studies show that antioxidant from herbal sources are capable of protecting against oxidative stress induced organ damages⁴¹⁻⁴⁴. Detailed study needs to be carried out for understanding the underlying mechanism of fluoride induced adverse health effects in fishes so that we can design effective remedies and cure for the same in fishes and may look ahead for application of those findings against fluoride toxicity in human beings.

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PERFORMANCE AND EMISSION PARAMETRIC STUDY USING NOVEL DIESEL PARTICULATE FILTER FOR VCR CI ENGINE

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ABSTRACT

Day by day emission norms are becoming very stringent due to the way we humans are polluting air for the sack of improvement in life style. There is a need of very effective and efficient aftertreatment system and devices. Each after treatment system should be design considering the complete system objectives. Energy efficient exhaust system development requires minimum fuel consumption and maximum utilization of exhaust energy for reduction of the exhaust emissions and for effective waste energy recovery system such as in turbocharger, heat pipe etc. from C.I. engine. In Diesel Particulate Filter system backpressure problem is a subject of specific interest for design and development of Particulate Matter emission control activities.

In the present work, critical study of after treatment system design aspects and alternatives available, repair and maintenance aspects for exhaust system are also studied so that particularly in C.I. engines exhaust conditions economic and quick regeneration or cleaning should be possible on regular basis, to avoid any type of exhaust flow problem. During the experimentation, it is found that, with after treatment devices it is economically possible to reduce exhaust emissions from old engines also, rather than going for engine and fuel modifications.

Keywords: Diesel Particulate Filter, Engine Performance, Backpressure, Exhaust Emissions

1. INTRODUCTION

Compression Ignition engines or Diesel engine is the most energy efficient power plant among all type of internal combustion engines known today. This high efficiency translates to good fuel economy and low greenhouse gas emissions. Other diesel features that have not been matched by competing energy conversion machines include durability, reliability, and fuel safety. The downsides of diesels include noise, low specific power output, NO_x and PM emissions, and high cost ^[1].

Emissions formed during burning of the heterogeneous diesel air/fuel mixture depend on the conditions during combustion, during the expansion stroke, and especially prior to the exhaust valve opening. NO_x emissions can be formed through a number of mechanisms during both the premixed and diffusion burning. PM is generated in diesels primarily during the diffusion flame. The visible smoke emission can be classified into black smoke, also known as hot or solid smoke, and white smoke also referred to as liquid smoke or fog.

Changes in diesel engine design contributed to some 10-fold decrease in emissions over the period from the late 1980's to early 2000's. The most important of these engine technologies are advanced fuel injection systems, air intake improvements, combustion chamber modifications, and electronic engine control. Additionally, exhaust gas recirculation (EGR) was introduced on both light- and heavy-duty diesel engines to control NO_x emissions. Low emission engine design-combined with increased exhaust gas aftertreatment will continue to play important role in future diesel engines ^[2].

2. AFTER TREATMENT STRATEGIES

To develop application specific view, it is very important to consider overall effects of each component added to the system, so that to improve the overall system performance. In the case of after treatment devices used in exhaust system of engine, considering automobile power plant as a complete system, it is a complex system made up of several other equally complex sub-systems, each is distinct from the others but they all share some common features and goals that allow them to work together. Even though an after-treatment device operates at high temperature excessive temperatures can damage it.

The most common cause of catalyst overheating is too much unburned fuel reaching the after-treatment device, this happens when a cylinder misfire. It also happens; if the air-fuel mixture is continually too rich, long periods of idling with rich mixture, also raise temperature. Heat carried by exhaust gases is around 35% of the total supply. Energy available at different operating conditions of each specific engine must be optimally utilized for performance improvement, for example a turbocharger installed in exhaust system could be used without any increase in backpressure by suitable design of exhaust system for conversion of enthalpy available at exhaust in to useful pressure rise only^[3]. Otherwise Heat carried by exhaust gases is going to be wasted.

After treatment devices installation should be in such position that the operating parameters of the devices must be favorable that is by considering following points:

- 1) To obtain the different oxidation and reduction reaction, the light-off temperature required and ability to sustain the maximum temperature by the catalysts.
- 2) To reduce the backpressure and keep it within limit.,
- 3) To provide ease for accommodation and modification in the exhaust system such as EGR system requires backpressure for optimum performance.,
- 4) To obtain maximum conversion efficiencies without affecting the overall engine performance throughout the operating range,
- 5) To obtain maximum space utilization without interfering the other system operations.

Temperature management of exhaust gas is of increasing interest because of the need to maintain efficiency in after-treatment devices. More effective temperature management places requirements on heat exchange systems, and offers the potential for bottoming and heat recovery cycles that use energy transferred from the exhaust stream. Turbo-compounding is already established in heavy-duty engines, where a reduction in exhaust gas temperature is the consequence of an additional stage of expansion through an exhaust turbine. A new concept in electric turbo-compounding offers flexibility in the control of energy extracted from the exhaust stream ^[4].

For light-duty applications, the fluid cycle can utilize stored thermal energy after prolonged high-load conditions at a time when the traction battery may be depleted. In heavy-duty engines, the cycle will simply provide a means of recovering exhaust energy and thereby boost the vehicle's fuel economy. The particular relevance to hybrid vehicles comes through the architectural advantages of generating electricity using the recovered heat energy. Thermo-electric devices represent one, but by no means the only way to build heat recovery from an engine system.

In summary, the economically feasible after-treatment methods for medium- and high-speed diesel engines are different. The particulate filters developed for passenger cars can also be rather easily adapted for heavy-duty road vehicles and thus for off-road applications using high-speed diesel engines. NO_x emissions are primarily reduced by engine design measures such as EGR. In medium- and low-speed engines, the strategy could be the opposite to that in high-speed engines. Until larger particulate filters possibly come on to the market, PM emissions must be reduced by internal engine measures. This also helps maintain good fuel economy, because it is rather easy to achieve a low fuel consumption and low PM emissions simultaneously. For further PM reductions, a water scrubber system or an electrostatic precipitator can be an alternative. NO_x emissions are removed by SCR catalysts.

Diesel particulates include small nuclei mode particles of diameters below 0.04µm and their agglomerates of diameters up to 1µm. Particulate matter is a complex emission which can be characterized by several parameters, including particle mass, number, size distribution, surface, etc. To satisfy emission control standards, diesel engine manufacturers will have to utilize exhaust after treatment technology. No viable commercial technologies are currently available that can be universally applied to all types of diesel engines. To address these issues, investigation in the development of NO_x reduction catalysts and soot filtration devices for diesel engines is specifically required ^[5].

There are various factors because of which noise and air pollution problem occurs in old as well as new properly designed C.I. engines applications during their long-term operation. The effects of certain important factors are discussed here.

a) Applicability effects

An increased diesel engine population has created pressures on controlling diesel emissions. The initial progress in diesel emission control was achieved through engine technologies, including changes in the combustion chamber design, improved fuel systems, charge air cooling, and special attention to lube oil consumption. Emission standards implemented in the near future timeframe will further require the use of exhaust aftertreatment methods on new diesel engines compulsorily.

b) Aging and Maintenance effects

Diesel engine emissions increase as the engine deteriorates. Normal engine wear typically causes an increase of PM emissions and a decrease of NO_x emissions. In engines with EGR or NO_x after treatment, engine wear may

also lead to increased NO_x emissions. Proper timely maintenance and tuning of all the components is very important factor for trouble free efficient useful life span of the engine.

c) Fuel Properties Effects

The desire for countries and automotive manufacturers to reduce emissions includes CO₂ emissions that arise from burning fuel in internal combustion engines. There is a direct correlation between a vehicle's fuel consumption and the CO₂ emitted from that vehicle. The important properties which are used to characterize diesel fuel include cetane number (or cetane index), fuel volatility, density, viscosity, cold behavior, and sulfur content. Diesel fuel specifications differ for various fuel grades and in different countries.

Fuel properties are often improved through the use of additives, which are added at the refinery, distribution, or aftermarket level. The major categories of diesel fuel additives include engine performance, fuel handling, fuel stability, and contaminant control additives. There is a clear correlation between some fuel properties and regulated diesel emissions. Drawing general conclusions is, however, difficult due to such factors as Interrelations of different fuel properties, different engine technologies, or engine test cycles. In heavy-duty engines increasing the cetane number lowers HC, CO, and NO_x emissions, while reducing fuel density lowers NO_x and PM but increases HC and CO. Light-duty engines show different fuel sensitivity than the heavy-duty engines. Sulfur increases PM in both classes of engines. Sulfur is also known to interfere with several diesel emission control strategies.

d) Alternative Diesel Fuels

Highest combustion efficiency for a particular fuel requires unique engine design & after treatment system for optimal operation of the engine system. Development of alternative diesel fuels, once promoted by the desire to reduce exhaust emissions, is now increasingly driven by climate change issues and energy security. The most important alternative fuel options include synthetic fuels, biodiesel, dimethyl ether, alcohols, methane, and hydrogen. The choice of future fuel/powertrain combinations, ideally based on well-to-wheel energy efficiency and emissions analysis, is limited by such factors as fuel resources and distribution system.

e) Engine Lubricant effects

Diesel engine lubricants are composed of base oil, viscosity modifier and an additive package. To ensure that lubricants provide all of the lubricating oil functions required in modern engines, a number of oil specifications have been developed in the USA, EU and Japan. One of the main drivers in the development of oil formulations for diesel engines with exhaust aftertreatment is the reduction of sulfated ash, phosphorous and sulfur.

Space velocity consideration is one of the important parameters for determining after treatment device volume required to carry out the desired reactions because residence time for exhaust in the device is dependent on feed rate and device volume. feed rate is dependent on engine operating condition hence the space velocity must be such that the feed rate of reactants should always coincide with the rate of reaction actually existing in the device volume, so as to provide necessary reaction time for maximum conversion of the pollutants in the feed stream to the after-treatment devices.

Emission challenges faced by the diesel engine require substantial reductions of NO_x and PM emissions over the period of 2005-2010, to be achieved by a combination of engine, fuel, and exhaust aftertreatment technologies. The emerging engine technologies include optimization of the fuel injection, combustion, and air induction systems, new engine accessories and subsystem technologies, as well as entirely new combustion techniques such as the HCCI engine. Emission control systems for meeting future emission standards require very flexible and capability for accurately controllable parameters. System designs using computerized tools provide optimized conditions for efficient air-fuel mixture supplied at input^[6].

3. COST-EFFECTIVENESS OF THE MEASURES:

Because there are a number of technically feasible measures for different after treatment designs and configurations, the cost-effectiveness is an essential question. The extra costs of cleaner engines are usually transferred to customers. Tax incentives can be used to compensate for the increased costs and speed up the appearance of low-emission technologies on the market. Different measures have highly variable costs. For example, the costs of new turbocharger technology, which are already on the market, are easy to calculate. Some engine process modifications need expensive research and development work, and the results are still uncertain^[7].

In refineries, expensive investments are often needed to produce improved fuels. If a completely new fuel must be brought on to the market, it would be far more expensive. For engine manufacturers, an important issue is the possible engine modifications for the new or improved fuel. The utilization of after-treatment devices implies

extra engine costs. After-treatment devices themselves cost money, but engines may also need some modification in order to work optimally with an after-treatment system^[8]. During the life cycle of the engine there may be extra maintenance costs. Most devices also increase fuel consumption. The correlation between diesel PM and health effects is not comprehensively known. Even if the correlation could be estimated, it would be difficult to calculate exactly how much the improved health of people saves money.

In summary, it is not easy to draw conclusions about costs. Sometimes it is difficult to compare the effectiveness of different after treatment methods even if their cost effectiveness is excluded. The reductions achieved using the same methods vary greatly from each other in different studies. This suggests that an optimization of the measures in different types of engines and operating conditions is necessary^[9].

4. MAINTENANCE OF EXHAUST SYSTEM

Complete exhaust system components such as mufflers and exhaust after treatment devices are a source of engine exhaust back pressure. Increased back pressure levels causes increased emissions, increased fuel consumption, and negatively affect engine performance. As residual, noncombustible particles build-up in the trap, the backpressure of the system will increase. Pressure drop measurements should be used to ensure that engine manufacturer's specifications are not exceeded^[10]. Techniques developed for certain systems and others continue to evolve for removal of the accumulated material. This sort of work should be performed as per the need.

Proper maintenance procedures should be planned and followed up for efficient operation of engine system. Maintenance program could include,

- 1) Measuring pressure drop across each device compared to a speed/load map to ensure it does not exceed design limits. Backpressure must be measured continuously.
- 2) Measuring inlet exhaust gas temperature to ensure it does not drop below the regime the regeneration system was designed for,
- 3) Measuring inlet and outlet exhaust gas temperature during regeneration to ensure these are within design values,
- 4) Measuring opacity to be compared to a baseline to ensure trap core integrity.
- 5) The causes for the deactivation of diesel catalysts are thermal degradation and poisoning by lubrication oil additives, as well as by sulfur. Phosphorus is the most common oil-derived catalyst poison. Sulfur can be found uniformly distributed over the catalyst length and the wash coat depth, while phosphorus is selectively adsorbed at the catalyst inlet and in a thin, outer wash coat layer.

Even though catalysts are not used in the reaction, they undergo gradual deterioration due to thermal deactivation and poisoning. For this emission analysis must be done periodically and suitable actions must be taken^[11].

5. EXPERIMENTAL WORK

Throughout the complete trials conducted, the speed of the engine is kept constant, at 1500 RPM and also engine jacket cooling water is kept constant at 0.1666 liters/sec. Further during the trials on after treatment devices (Diesel Particulate Filter), each times the perforated plates and rings were cleaned by water and then by carbon tetra-chloride solution and dried. While changing the number of plates and rings i.e. every time the fresh copper plates and rings were used. To reduce the backpressure on the engine, maximum no. of plates (i.e. 20 plates) provided with extra 8 no. of holes, of 5 mm diameter were used for determining the effect i.e. back pressure reduction mainly.

6. ENGINE SPECIFICATION:

01	Make -	Kirloskar Make, single cylinder,4-stroke compression ignition on engine
02	Rated power out put-	5H.P.
03	Speed-	1500 R.P.M.
04	Stroke length-	110 mm
05	Bore diameter-	80mm
06	Loading type-	Eddy current dynamometer
07	Moment arm-	0.2 meter
08	Orifice diameter (for air box) -	25mm
09	Co-efficient of discharge of orifice -	0.64

Table-1: Engine test rig specifications



Figure-1: Schematic view of experimental set up

Diesel Particulate Filter

- 1) Space velocity: $50,000 \text{ hr}^{-1}$
- 2) Catalyst used: copper-based catalyst system
- 3) Circular perforated copper plates with 256 no. of holes per square cm and copper rings made up of 5 mm diameter rod.
- 4) Flange arrangement for dismantling and varying no. of perforated plates and no. of rings, more details are given in figures.

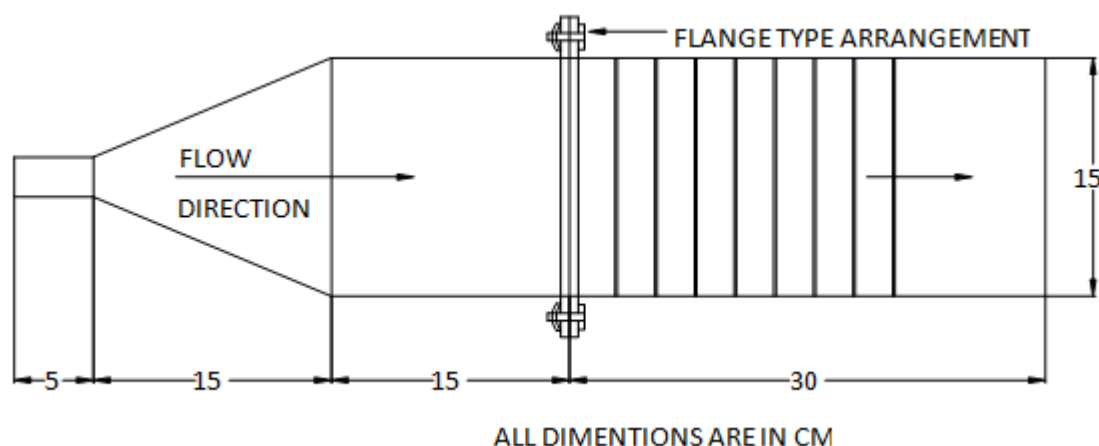


Figure-2: View of Diesel Particulate Filter with copper plates

7. RESULTS AND DISCUSSIONS

- 1) Backpressure is observed to be directly proportional to the number of plates used obviously because of increase in resistance to exhaust gas flow, at the same engine operating conditions.
- 2) Fuel consumption is also observed to be directly proportional to the back pressure on the engine, at the same operating conditions. The desire for countries and automotive manufacturers to reduce emissions includes CO_2 emissions that arise from burning fuel in engines. There is a direct correlation between a vehicle's fuel consumption and the CO_2 emitted from that vehicle.
- 3) Effect of increased backpressure on engine performance: - Exhaust system components are a source of engine exhaust back pressure. An increased back pressure level causes increase in the pumping work requirement and hence it increases the specific fuel consumption thereby increased emissions and negatively affects engine performance.
- 4) Effect of increased backpressure on conversion efficiency of DPF :- Though it appears to be the same conversion efficiency of the DPF, the emissions actually at the exit are very high because of the increase in backpressure fuel consumption increases which ultimately increases the amount of pollutants at the feed

stream of the DPF. Variations in exhaust emissions are compared at no load condition, using different no. of plates the conversions obtained are (NO_x -18.05 %, HC -56 %, CO -8.33% and smoke density -11.11%) maximum using 8 no. of plates arrangement.

8. CONCLUSION

C.I. engine exhaust system for efficient emission control activity and waste heat recovery system development shows a large potential that these features could probably be further improved if the system is optimized for different feasible after treatment configurations for each type of engine, fuel, operating condition and due maintenance like durability issues considerations.

Complete exhaust system should be designed or modified, in such a way that each alternation should not cause backpressure rise. Chemical limits on fuel oil Sulphur, phosphorus and sulphated ash are required to be tightened for the protection of after treatment device.

Key factor for achieving the objective is minimum possible backpressure at all engine operating conditions and keeping close control during engine operating life span on complete exhaust system. Backpressure is very important engine operating variable, so in design stage itself, provision for its continuous monitoring and possible control provisions must be made compulsorily on every engine system for optimum system performance.

The main cause for success of system performance is the utilization of after treatment process in such a way that it should not disturb engine operation. Backpressure on the engine is a major cause that can adversely affect the engine performance. To obtain the desirable operating parameters during the different operating conditions of the engine, proper constructional features of after treatment devices are essential to obtain maximum pollutants conversion efficiencies.

For providing sufficient reaction time, space velocity consideration and durability required to be considered. Careful analysis of application environment and more stress is required, for the fulfillment of durability requirements i.e. mainly on catalyst reactivation or replacement techniques development, in the prevailing diesel exhaust conditions.

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PERFORMANCE CHARACTERISTICS (at constant 1500 rpm)-

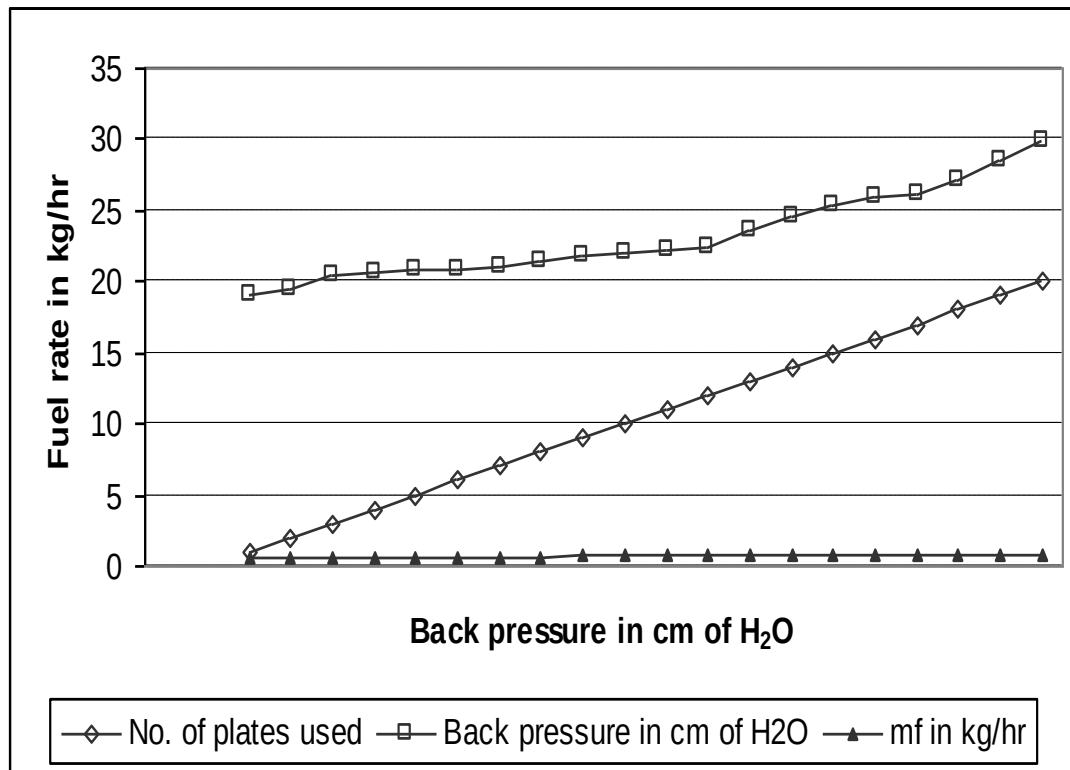


Figure-1: Variation in Fuel consumption and no. of plates Vs back pressure, using DPF with different no. of plates arrangement

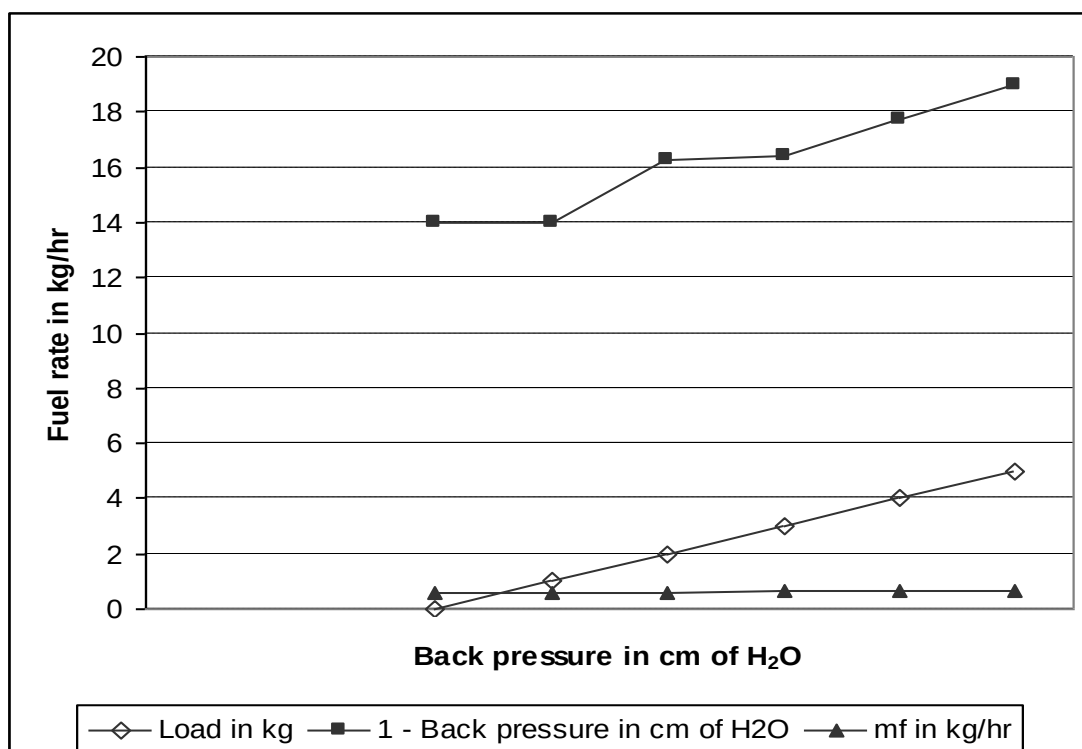


Figure-2: Variation in Fuel consumption and load Vs back pressure, without using DPF.

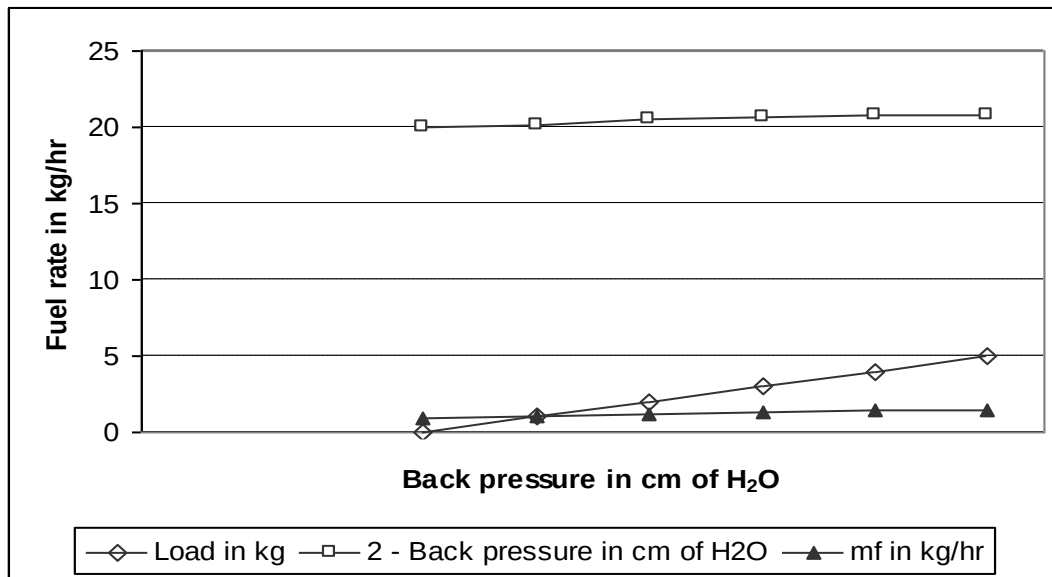


Figure-3: Variation in Fuel consumption and load Vs back pressure, using DPF, for 20 - plates provided with extra holes arrangement

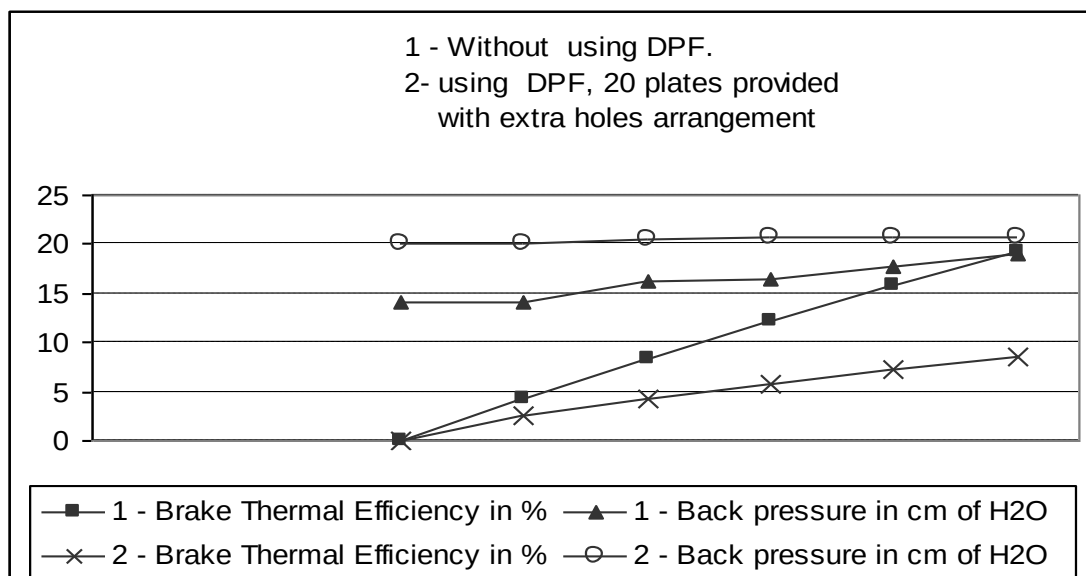


Figure-4: Variation in brake thermal efficiencies Vs back pressure, 1- without using DPF & 2- With DPF, 20 plates provided with extra holes arrangement at various load conditions.

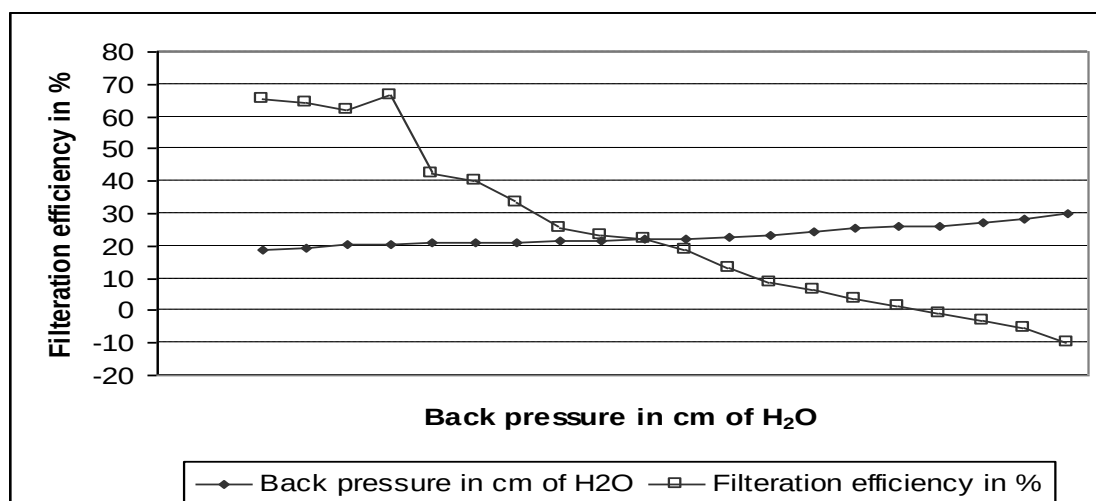


Figure-5: Variation in filtration efficiencies Vs back pressure, using DPF with different no. of plates arrangement.

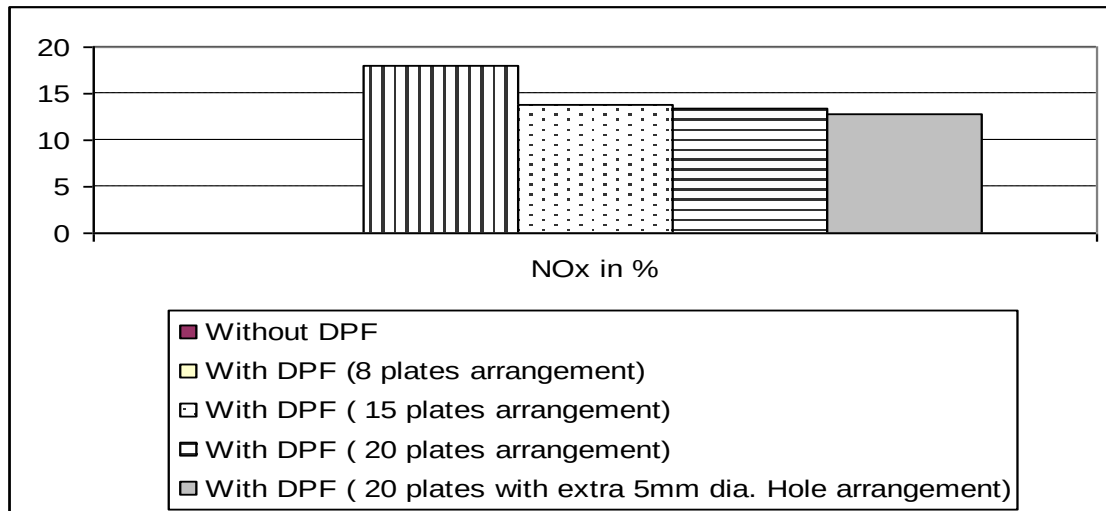


Figure-6: Comparison of NO_x emissions conversion efficiency at different exhaust conditions

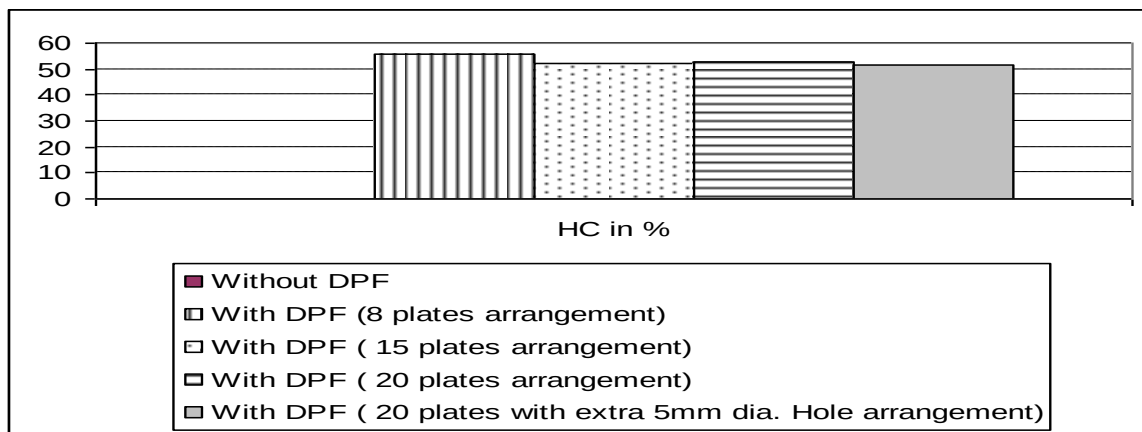


Figure-7: Comparison of HC emissions conversion efficiency at different exhaust conditions

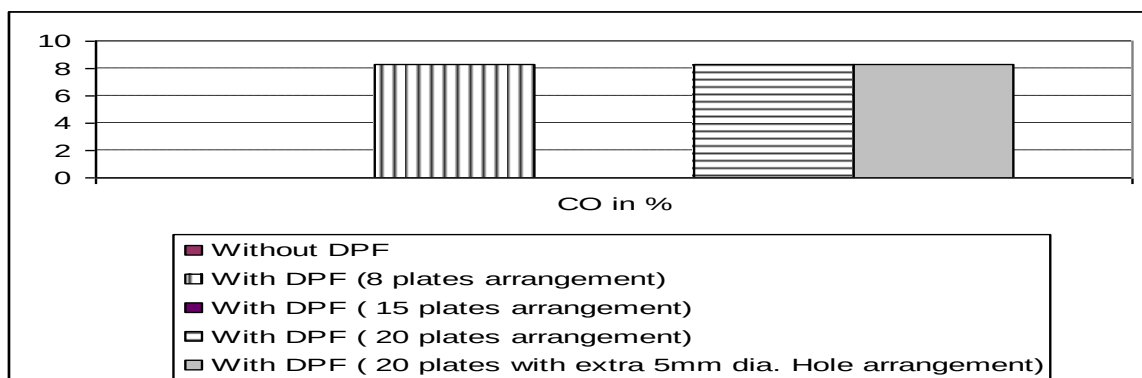


Figure-8: Comparison of CO emissions conversion efficiency at different exhaust conditions

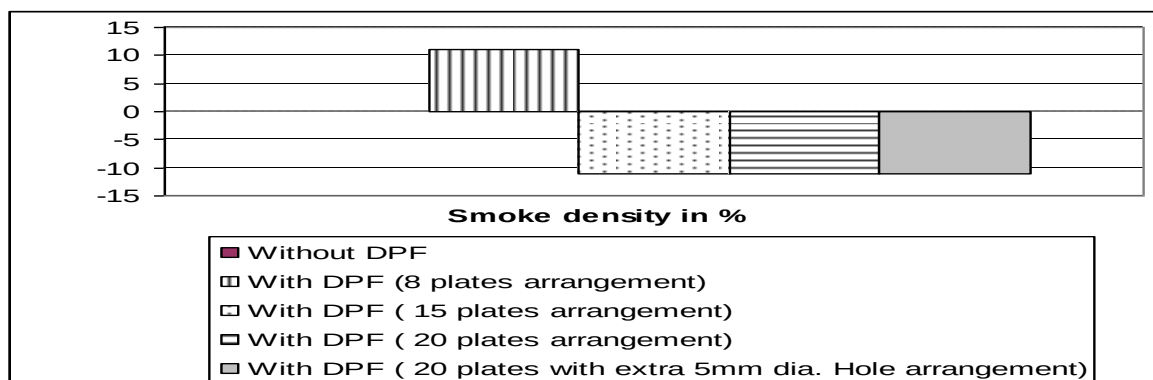


Figure-9: Comparison of filtration efficiency at different exhaust conditions

MODE FREQUENCY ANALYSIS OF TURBOMACHINE BLADE

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ABSTRACT

The dynamic loads on blading can arise from many sources, the predominant being the source of operation principles on which the machine is designed. Blade dynamic loads may also arise from vibrations transmitted from the rotor or elsewhere in the machine structure. Blades have become of complicated design shapes and have components of more complex systems e.g.: blade packages, turbine wheels, and rotors. Also sometimes it is necessary to perform multivariant iterations of blade vibrations. Blades have become of complicated design shapes and have components of more complex systems e.g.: blade packages, turbine wheels, and rotors. Also sometimes it is necessary to perform multivariant iterations of blade vibrations. This paper presents a review of the mode frequency analysis of aerofoil section blade with an emphasis on the effect of geometrical parameters and numerical methods which are used for determining the natural frequency of the aerofoil section blade.

Keywords: Blades, Fatigue, Finite element method, Turbomachines.

1. INTRODUCTION

Blade vibrations and resulting fatigue is one of the most vital subject area in the design of turbomachinaries as the demand for larger capacity steam turbines and more efficient rotary compressors have been increased. Fatigue failure of turbomachine blades is one of biggest problems of the turbomachine manufacturers. The dynamic loads on blading can arise from many sources, the predominant being the source of operation principles on which the machine is designed. When a rotor blade passes across the nozzles of the stator, it experiences fluctuating lift and moment force repeatedly at a frequency given by the number of nozzles multiplied by the speed of the machine. The blades are very flexible structural members in the sense that a significant number of their natural frequencies can be in the region of possible nozzle excitation frequencies. Though a machine can be designed to avoid resonance at its steady operating speed, it experiences resonance several times during the starting and shut down of the machine. That is whenever the instantaneous speed of machine gives rise to a nozzle excitation coinciding with the blade frequency resonance is there.

All the blades in a turbomachine receive their major periodic excitation at a frequency equal to nozzle excitation frequency. Since the forces are periodic one has to consider a several number of these harmonics in determining whether resonance takes place, when number of these harmonics coincides with any of the natural frequency of the blades. It is possible in small machines to detune the blades from a possible resonance and thus avoiding fatigue failures. In bigger and faster machines this is not always possible, as there can be several stages of hundreds of blades of different characteristics. In such a case one procedure is, to introduce damping at the root. Even with the provision of damping fatigue failure can not be avoided due to resonance taking place under transient conditions while the machine is started or shut down at the critical speeds. Hence it is necessary to determine blade excitation forces, arising out of stage flow interaction. Under the influences of these forces the blade experiences dynamic stress which can be limited only by the damping present in the system. The issue of vibration resistance of turbomachine blades is getting importance as the power range of turbomachines is increased and the operating conditions become more severe. Blades have become of complicated design shapes and have components of more complex systems e.g.: blade packages, turbine wheels, and rotors. Also sometimes it is necessary to perform multivariant iterations of blade vibrations.

Most of the dynamic loads acting on the blade result from the distortions of the process gas stream. They arise from the presence of flow guides, nozzles, diaphragms, structural components, moisture separators etc. within the gas flow path. Flow distortions may also arise from structural components plus atmospheric turbulence and other items in the gas turbines. Blade dynamic loads may also arise from vibrations transmitted from the rotor or elsewhere in the machine structure.

The present review concentrates on several aspects that are important for the development, design, and applications of turbomachines. They include the following:

- a. Discrete analysis techniques of blades
- b. Mode Frequency Analysis and
- c. Vibration characteristics of blade

2. DISCRETE ANALYSIS TECHNIQUES OF BLADES

Modal analysis has been significant to the designers since the inception of the Turbo machinery. Blades fail because of low-cycle fatigue (LCF), and high-cycle fatigue (HCF), environmental factors Creep, Oxidation, erosion and embrittlement. Mathematical modeling of blade vibrations is central to a comprehensive CAD system. The continuous approach for a freestanding blade requires a lot of analytical work before a numerical procedure can be adopted. Discretizing the blade and using appropriate element relations are simpler than the analytical work that goes with continuous methods. Thus the discrete methods are preferred all over. Other advantages of discrete methods are their compatibility to complicated methods and the availability of well tested finite element programs to model any complex blade group.

The discrete analysis techniques can be broadly classified into the following methods as applied to turbine blade problems:

2.1 Holzer method: Holzer method has been developed to make calculations for torsional vibration of a given system. The system is discretized into a number of rigid inertials connected by massless elastic torsional shaft. The dynamic properties are transferred from one station to other station by using field and point properties. The boundary conditions are used to determine whether an assumed frequency satisfies this criterion for a natural frequency. Lag^[1] concluded that the application of Holzer method to bending vibration problem is cumbersome as the bending problem involves four state quantities compared with only two state quantities in torsional problem.

2.2 Myklestad/ Prohl method: Myklestad/ Prohl method is used to determine natural frequency of beams. The beam is discretized into many masses connected by beam elements which are massless having the original flexural rigidity of the beam between the stations. Downs^[2] set up a suitable criterion depending on the boundary conditions and the natural frequency is determined by trial and error root search technique.

2.3 Matrix method: It is means of integrating numerically a function that is expressed in terms of the values of the function at equal increments of the independent variable. They can be derived by expressing a function as a polynomial in the form of Newton's forward interpolation formula. Beisheim^[3] applied the integration matrix to obtain the natural frequency of a propeller blade for cross-coupled bending modes.

2.4 Finite difference method: A series of regularly spaced grid points are used in the Finite difference method. This method approximates the partial differential equation at each point. Boundary conditions are applied to solve the resulting algebraic equations at each grid point. Rapid solutions are possible because the algebraic equations are usually linear and simple. Rossard^[4] used Finite difference methods and found that they do not provide accuracy for complex problems unless a large number of grid points are used

2.5 Finite element method: It can be used to determine the combined bending and torsional vibration modes taking into account the effect of root flexibility. The Finite element approach looks for approximating the solution of partial differential equation integrated over a series of finite elements. This results in a system of simultaneous linear equations. Therefore their solutions is more expensive and time consuming. Rossard^[4] concluded that as compared to finite difference method the number of nodes required in finite element method is usually much less than the number of grid points required in finite difference method for comparable accuracy. Finite element method is more beneficial for complex problems. Rajesh^[5] used finite element method to address the effect of notches on cantilever beam. It was found that the frequency of the cantilever plate under rotation increases as notch diameter increase. It was found that the FEM can be extended to Aerofoil as are in good agreement with the closed form solution.

3. MODE FREQUENCY ANALYSIS

A single free standing blade can be considered as a pretwisted cantilever beam with an asymmetric aerofoil cross section mounted at a stagger angle on a rotating disc. The starting solution for a simple stationary blade is obtained from an Euler-Bernoullie beam with cantilever boundary conditions for bending vibration and St. Venant's non-circular rod for torsional vibration. Coupled torsional-bending vibration occurs when the centre of flexure does not coincide with the centroid as in aerofoil blade cross section. The problems become further complicated because of second order effects such as shear deflection, rotary inertia, fibre bending in torsion, warping of cross section, root fixing, Coriolis acceleration. In general the equation of motion will be six coupled partial differential equations coupled between the two bending deflections, the two shear deflections, two torsional deflections and two longitudinal deflections. Thus theoretically it is an uphill task to determine the natural frequencies of an actual turbine blade with all the effects mentioned. Many scientists have derived solutions to the turbine blade vibration problem by considering individual aspects such as taper, pre-twist,

assymetry of cross section, centrifugal forces and making simplified assumptions with regard to second order effects. Feiner^[6] developed fundamental model of mistuning for a single family of modes.

3.1 Effect of centrifugal forces

The blade gets stiffened because of centrifugal forces and thus the bending natural frequencies increase with speed of rotation. There is no effect of centrifugal forces in the torsional mode of vibration of blade.

The effect of rotation is defined by non-dimensional frequency parameter:

$$\alpha^2 = m L^4 \omega^2 / E I_{xx} \quad \dots(3.1)$$

where m = mass of blade

L = length of blade

ω = rotational speed

E = modulus of elasticity

I_{xx} = moment of inertia

Schill^[7] concluded that the non-dimensional frequency parameter ratio increases with increase in the rotational parameters. Also the centrifugal forces have pronounced influence on the fundamental mode and relatively negligible influence on higher modes. The chordwise bending modes depend not only on the parameter α^2 but also on the second moment of area. It is depicted that the centrifugal forces have a lesser influence on chordwise modes compared to flapwise modes. Also the centrifugal forces have negligible influence on higher modes.

3.2 Effect of disc radius

The effect of disc radius is to increase the centrifugal force, thus stiffening the blade further and increase the natural frequency in bending modes.

For flapwise bending

The frequency parameter ratio (R) is function of disc parameter $R = R_1/L$ $\dots(3.2)$

where

R_1 = is disc radius

Schill^[7] deduced that the disc radius has predominant effect on flapwise modes and the frequency parameter ratio increases linearly with the disc radius. The effect of disc radius is to stiffen the blade in chordwise bending modes.

3.3 Effect of Asymmetry of cross section

The effect of asymmetry of cross section is to couple the bending and torsion modes. The flapwise bending and torsion are coupled because of r_x , the chordwise bending and torsion are coupled similarly because of r_y where r_x and r_y are displacement of axes due to bending. Cranch^[8] presented that both bending frequencies decrease with asymmetry whereas torsional frequency increases with asymmetry. Also the effect of asymmetry is negligible on both torsional and bending frequencies.

3.4 Effect of taper

Blade taper has a significant influence on both bending and torsional vibrations since the mass and stiffness distributions change considerably along the blade length. The properties of an aerofoil section blade, the area and the second moment of area can be used to determine the equivalent rectangular cross section for bending vibrations. Rectangular cross section is used to obtain correction factors determining tapered blade frequencies from the corresponding uniform cantilever frequencies. The breadth and thickness of a tapered beam are expressed as:

$$B = B_0 (1 - \alpha z) \quad \dots(3.3)$$

$$T = T_0 (1 - \beta z) \quad \dots(3.4)$$

Where B_0 and T_0 are root section values and α and β are taper parameters. The frequency in the dimesionless form can be expressed as:

$$\lambda = \omega (\rho A_0 l^4 / E I_0)^{1/2} \quad \dots(3.5)$$

where ω = natural frequency

ρ = material density

E = modulus of elasticity

A_o = Area at root

l = length

I_o = second moment of area

Lee^[9,10] deduced that frequency parameter ratios for first three modes are that decrease of cross sectional dimension in breadth with constant thickness increases the fundamental bending frequency as well as the higher mode of bending frequencies. Also decrease of cross sectional dimension in thickness with constant breadth, increases the fundamental bending frequency whereas decreases the higher mode of bending frequencies.

4. VIBRATION CHARACTERISTICS OF BLADE

Resonance a failure mechanism that comes into picture when a periodic force acts at a frequency corresponding to a blade fundamental frequency. If the damping is improper for absorption of the periodic energy, amplitude and stresses rise until failure occurs by overstress or by propagation of fatigue crack. A lot of work has been carried out to study the effect of different factors which affect the vibration characteristics of blades such as taper, asymmetry, centrifugal forces etc. Aflobi^[11,12] presented that resonance of blade vibration frequency with nozzle excitation frequency is the main cause of blade failure. Cranch^[8] used Rayleigh energy approach and bending mode calculated the first three modes of vibration of rotating beam. Carneige^[13] used Rayleigh-Ritz method to derive an equation for the fundamental frequency of vibration. A theoretical expression for the work done due to centrifugal effects for small vibrations rotating cantilever beams has also been established. Carneige^[14] deduced the general equation of motion of a pretwisted cantilever blade of asymmetrical aerofoil cross section with an additional effect of torsion. He obtained a torsional frequency equation taking into account the bending effect using Rayleigh method. Schill^[7] concluded that the stiffening effect of centrifugal forces on the lowest bending frequency of a cantilever beam depends upon the ratio of hub radius to the blade length and the angle made by blade chord and the rotational velocity. If the blade has pretwist, uncoupled bending modes in flapwise and chordwise deflection are not possible. Sisto^[15] used Ritz principle to solve the equation of motion of a pretwisted cantilever blade. Rossard^[4] used Galerkin finite element approach to calculate first five frequencies of twisted cantilever beam and found that the effect of twist is proportional to the width to thickness ratio. Klein^[16] used the combination of both finite element method and Rayleigh-Ritz analysis to study the free vibration of elastic beams with non uniform characteristics. He compared the results with known analytical results and found a fair amount of similarity and accuracy. Lag^[1] utilized Galerkin finite element method to determine natural frequency of non uniform blades. Lee^[9,10] studied vibration characteristics of a tapered beam and derived formula for fundamental frequency. It was concluded that with a decrease of cross sectional dimension in thickness keeping constant breadth increases the fundamental bending frequency and decreases higher modes of bending frequencies. Murthy^[17] presented that with a decrease of cross sectional dimension in width keeping constant thickness increase the fundamental and the higher modes of bending frequencies. Murthy^[18] studied the vibration characteristics with the effect of asymmetry of cross section by using Integration Matrix method and concluded that bending frequencies decrease with asymmetry and torsional frequencies increase with asymmetry. Downs^[19] presented transverse vibration of cantilever beams of unequal breadth and taper by using dynamic discretization technique and concluded that by increasing mode order the vibration becomes more concentrated at the tip. Dhar^[20] used the non-linear finite element method to study the effect of non-linearities in material properties and stiffness on natural frequencies of turbine blade. It was concluded that at transient stage there was a considerable change in blade frequency. Euler^[21] studied the effect of mistuning on vibration characteristics and concluded that due to mistuning the identical blades on a rotor are forced to vibrate with greatly unequal amplitudes under certain circumstances. Vakaitis^[22] studied the effect of centrifugal forces and concluded that the centrifugal forces have pronounced influence on fundamental mode and relatively negligible influence on higher modes. He observed that the blade gets stiffened because of centrifugal forces and thus the bending natural frequencies increase with speed of rotation. Thomas^[23] developed a method using finite element method for Timoshenko beams and concluded that the disc radius has significant effect on flapwise mode of vibration. The natural frequency increases with increase in radius of disc. Aflobi^[12] worked on the effect of mistuning and presented that if the primary resonance being excited the highest responding blades are most likely to be those with extreme mistuning and such blades are instrumented during engine tests. Shran^[24] studied the temperature effect on the free vibration of turbine blades using finite element method and concluded that as the temperature of material is increased the vibration frequencies start decreasing because the value of modulus of elasticity of material decreases. Pisarenko^[25] simulated the blade

vibration in turbomachine and concluded that theory of beams may be used, within its probable range, for express-analysis of the frequency spectrum of turbomachine blades. Pisarenko^[25] investigated theoretically and experimentally and presented that detailed analysis of the displacement and stress fields in the vibration of blades requires three-dimensional models. Down^[19] presented a technique of discretizing stiffness and properties of mass related to beam segments of turbomachines blades. Theory developed comprised both the modification of beam bending and torsional stiffness due to pretwist and the coupling of bending and torsional deformation with axial deformation accompanied by pretwist. Down^[19] showed that prediction of vibration frequencies with accuracy for blades possessing significant pretwist can be found by discretization on to a substantial number of degrees of freedom. Comparisons of prediction accuracy with Finite Element and other methods are also presented. Huang^[26] dealt with the free and forced vibration of coupled turbomachine blades on a disk which are connected by elements forming continuous periodic structure called a rotationally periodic structure. Huang^[26] developed a numerical procedure to calculate the free vibration of rotationally periodic structure with various types of connecting elements using a transfer matrix method. He also discussed method of analysis for a packet formed by a finite number of blades. Vibration design criterion has been suggested by studying the forced vibration and the condition of resonance of a rotating periodic structure under a time varying periodic excitation. Roth^[27] dealt with a display device that records simultaneously the vibrations of each blade in a row. This device has a novel feature that bright dots can be resolved in time. The introduction of this additional degree of freedom extends substantially the versatility of the device. Roth^[27] presented hard copies of many measurement records. Rajesh[5] modelled the turbine blade and analyzed by using finite element method. The eigen values for flexural and torsional modes are obtained. It was found that the stretching induced by the centrifugal force due to the rotational motion of the blades was the reason for the increase of the bending stiffness of the structure. Hence this maximum operational Von-mises stresses are induced. The work provided the understanding to improve the life and efficiency of gas turbines.

5. CONCLUSION

The present review of the literature shows that a lot work has been carried out on the analysis of vibration characteristics of turbomachine blades using different methods. In the present work an attempt has been made to review the research work carried out by various researchers by highlighting the techniques, approaches and methods they have used and also the results obtained. It may be concluded that finite element method proves to be significant one for the modeling of the turbomachine blades. It may also be concluded that the centrifugal forces have pronounced influence on fundamental mode and relatively negligible influence on higher modes.

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APPLICATION OF GEOGRAPHICAL INFORMATION SYSTEMS (GIS) IN DEVELOPMENT OF COLONIAL HERITAGE TOURISM: A CASE STUDY OF BRITISH COLONIAL HERITAGE SITES VICTORIA MEMORIAL, KOLKATA

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ABSTRACT

Places which was constructed and design by colonial power and which have a unique imprint of their art, culture, Tradition and craft known as a Colonial Heritage sites. The experience of the travelers on visiting such places or destinations possessing a special cultural, historical or natural value, refers to heritage tourism. Present days GIS has an tremendous potential in development of heritage assets and of tourism destination , providing us a lots of opportunities for growth & promotion of tourism using complex dataset, friendly application, advance mapping for sustainable development & promotion of tourism. Present study area The Victoria memorial is a glorious reminder of India's colonial past and it's obsession of all things western has assimilated well in Kolkata's mind and soul; Though Victoria Memorial has dedicated in memory of Queen Victoria it has now became part of our culture & pride. A gorgeous marble building houses with museum and various exhibitions that enlighten the visitor with Kolkata's colonial history. A beautiful monument of Colonial Era that still adorns a part of Kolkata and serves as an most popular & interesting tourist destination of west Bengal taken as case study for my present paper "Application of GIS in development of Colonial Heritage Tourism".

Keywords: Colonial heritage, heritage tourism, Victoria memorial, Application of GIS.

INTRODUCTION

According to Feilden (2003), Heritage Buildings differ from modern buildings. He described that, " **Buildings that for various reason societies has decided shall be preserved for as long as possible**". Another author, according to Kathpalia and Lambah (2002), " **A heritage buildings is that structure which has survived the hazards of time and provides tangible link between the past and presents giving us a continuous cultural identity**". The uniqueness and diversity of India's heritages is reflected in its urban morphology, building typologies and social structure, religious beliefs, traditions and civic activities and varied natural resources. Geographical Information System (GIS) has proven to be one of the most important technological innovations for planning and decision making about a potential touristic destination. GIS applications allow spatial data access, distribution and visualization in the form of geographical coordinates as well as their processing, analysing and modelling in a user friendly interface. Expansion of the Internet and the fact that it has become easily accessible for a wide range of population, the means by which consumers search for travel information have changed radically in last years. Web-based information systems (Web-GIS), application that can be access through Internet (e.g. Google Maps, Yahoo Maps) have provided a new generation of interfaces and expanded the way in which travel information can be accessed (Chang and Caneday, 2011).

Background of the Study: now GIS -based information is gaining greater importance among tourists for its easy to use and user-friendly application and as it allows to familiarize with places, so some of the important research on application of GIS on tourism studies , According to Cvetković & Jovanović (2007) management of the use of space for tourism, visitor impact assessment, an assessment of the conflict between the recreation and the environment, mapping, creation of tourist information management systems and systems to help with decision-making. Wei(2011) GIS to enhance the attractiveness of the system for tourists; Combining the expert system technology with GIS to enhance the capacity of the system to solve travel problems. Shyti & Kushi(2012) stress the importance of GIS in the development of the tourism industry, with his study on Elbasan District they shows that the application of GIS in Elbasan certainly provides a better management and planning of the tourism industry in this region. Shah & wani(2015) has emphasis on the potential of geospatial technology application to explore destination and its facilities like hospitals, ATM Centers, hotels, restaurants, resorts and filling stations etc. and developmental planning, project monitoring and publicity of tourist products.

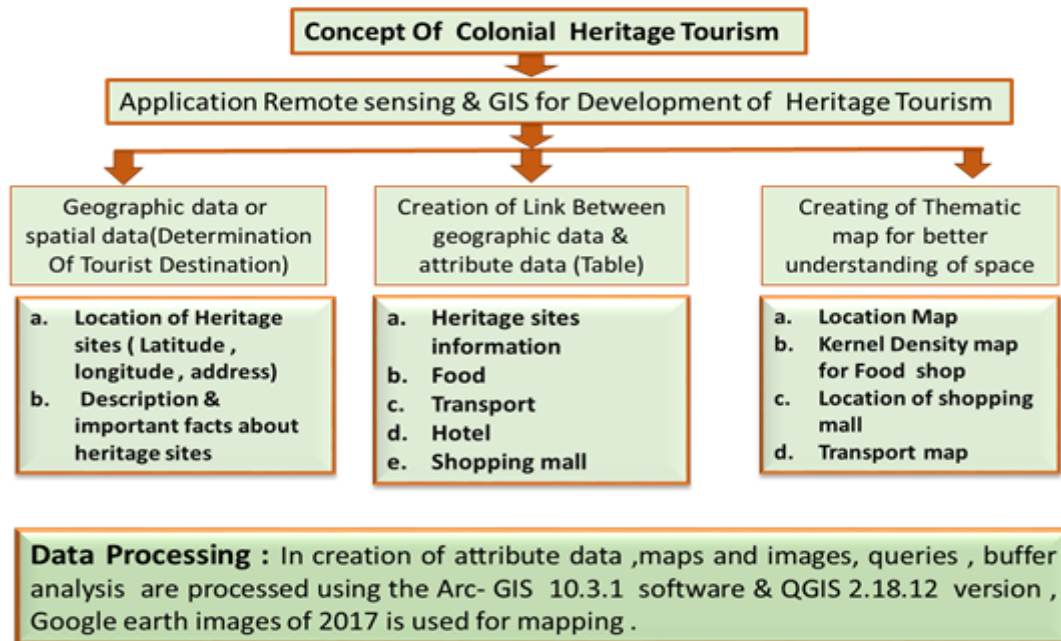
OBJECTIVES OF THIS STUDY

The aim of this present research is application & utilization of GIS database for development & promotion of heritage tourism. The main objectives were taken into account:

- ❖ To Identify major heritage sites of Kolkata which act as tourist destination for common people.
- ❖ Discuss the Architectural style of Victoria Memorial hall as a case study.

- ❖ Application of GIS techniques for promotion & development of heritage tourism.

METHODOLOGY FOR THE PRESENT STUDY



Location of Major Heritage Sites of Kolkata & It's Importance

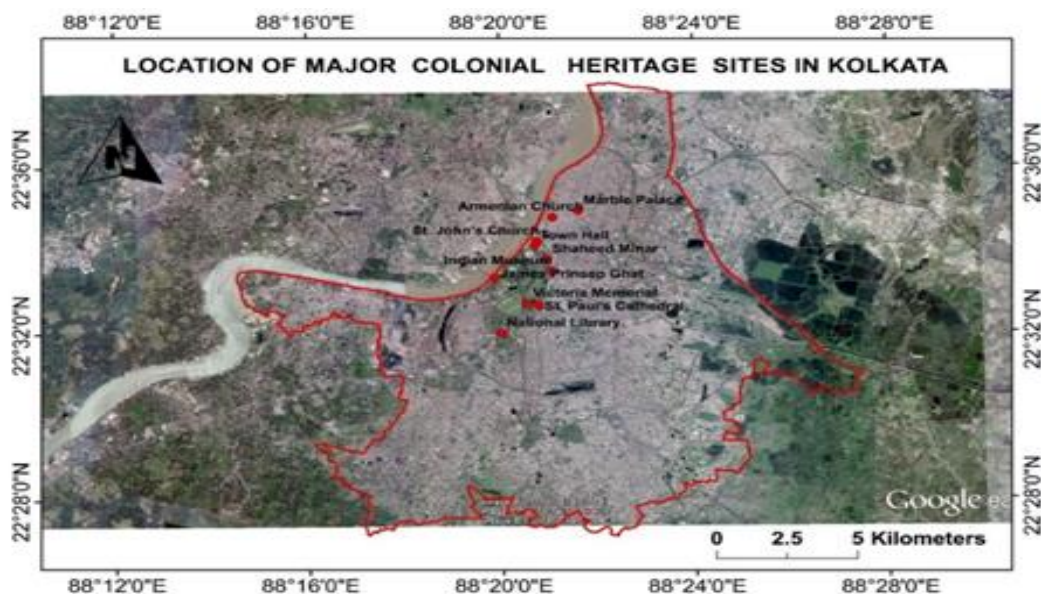


Figure-1: Location of Major Heritage sites of Kolkata in map & satellite images

Major heritage sites of Kolkata built in colonial periods

- ❖ Built In 1835 by a French Architect For Raja Rajendra Mullick ,an affluent Bengali Merchant.Known for it's exquisite collection of western sculpture and Victorian furniture and Floors- made exclusively from one Hundred and twenty six types of colourful Italian Marble that had been transported across the seas.



Marble Palace

- ❖ Kolkata town hall was built in 1813 by the British architect Major General John Garstin (1756-1820), Built according to Roman –Doric Architectural style. During the British rule this hall was used for social gathering of all Royal British Families , town hall library which is collection of antique books, journals and documents



Town Hall

- ❖ Prinsep Ghat built in (1841) is one of the oldest recreational spots of Kolkata. The Ghat was named after James Prinsep. Located along the banks of the beautiful Hooghly River (River Ganges). designed by W.fitzgerald, Prinsep Ghat is a place in history with the monuments in Greek and Gothic architectural style .



Prinsep Ghat

- ❖ **The Armenian Church** is the Oldest Church in Kolkata, established by Armenian Community that settled in Kolkata before arrivals of British in India , First built 1688 a wooden church . present church was built by Aga **Mamed Hazaar Maliya** ,an Armenian at the same site in 1734, interior decoration of church was done by an Armenian Architect named **Katchik Arfiel** .



Armenian Church

- ❖ The 48 meter high **Ochterlony Monument** was Built in 1828, was built as a symbol of the victory of Major-general Sir David Ochterlony, **heroic** victory in the **Anglo-Nepalese** War and the defence of Delhi from the **Marathas**, It was designed by J. P. Parker. Later, in **1969**, this monument was used to commemorate the struggle of the great Indian freedom fighters. Hence, it was renamed to **Shaheed Minar**.



Shaheed Minar

- ❖ **St. Paul's Cathedral** noted for its Gothic architecture the building was completed in 1847 is said to be the largest cathedral in Kolkata first cathedral built in the overseas territory of the British Empire. The design of the St. Paul's Cathedral was given by Major **W.N. Forbes**. The cathedral was severely damaged during the great earthquake of 1897 & 1934



St. Paul's Cathedral

- ❖ **National Library** in Kolkata India is the largest library of our country. First name as The Imperial Library was formed in **1891** was outlined by **Lord Curzon, John Macfarlane**, was appointed the first Librarian of the Imperial Library, After the independence 1953 the Government of India changed the name of the Imperial Library as the National Library.



National Library

- ❖ The **Indian Museum** is the largest and oldest museum in India and has rare collections of antiques, armour and ornaments, fossils, skeletons, mummies, and Mughal paintings. It was founded by the Asiatic Society of Bengal in Kolkata (**Calcutta**), India, in 1814. Designed by **Walter B Granville**, who was a famous Danish botanist.



Indian Museum

- ❖ The Victoria Memorial, a huge monument made of white marble located in the heart of the City of Joy, Kolkata in West Bengal, one of the , a splendid architectural structure & most famous monuments in West Bengal that has become a museum and popular tourist spot of the state.



LOCATION MAP OF STUDY AREA: (VICTORIA MEMORIAL)

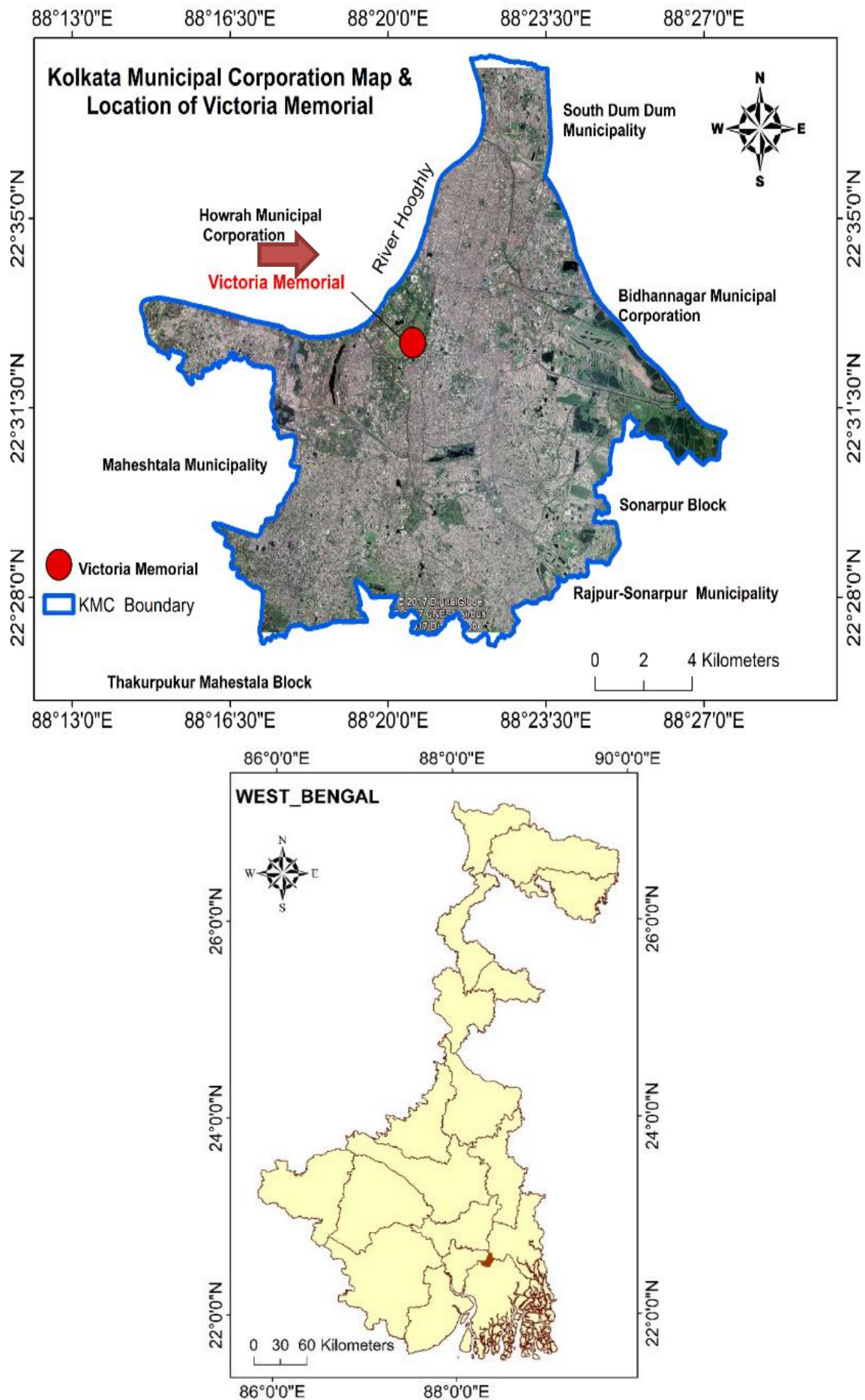




Figure-2: Location Map of Victoria Memorial

IMPORTANT FACTS ABOUT VICTORIA MEMORIAL

Latitude: 22°32'42.10"N

Longitude: 88°20'32.63"E

Total Area: 57 acres

Image source: Google earth

Map sources: National atlas of India

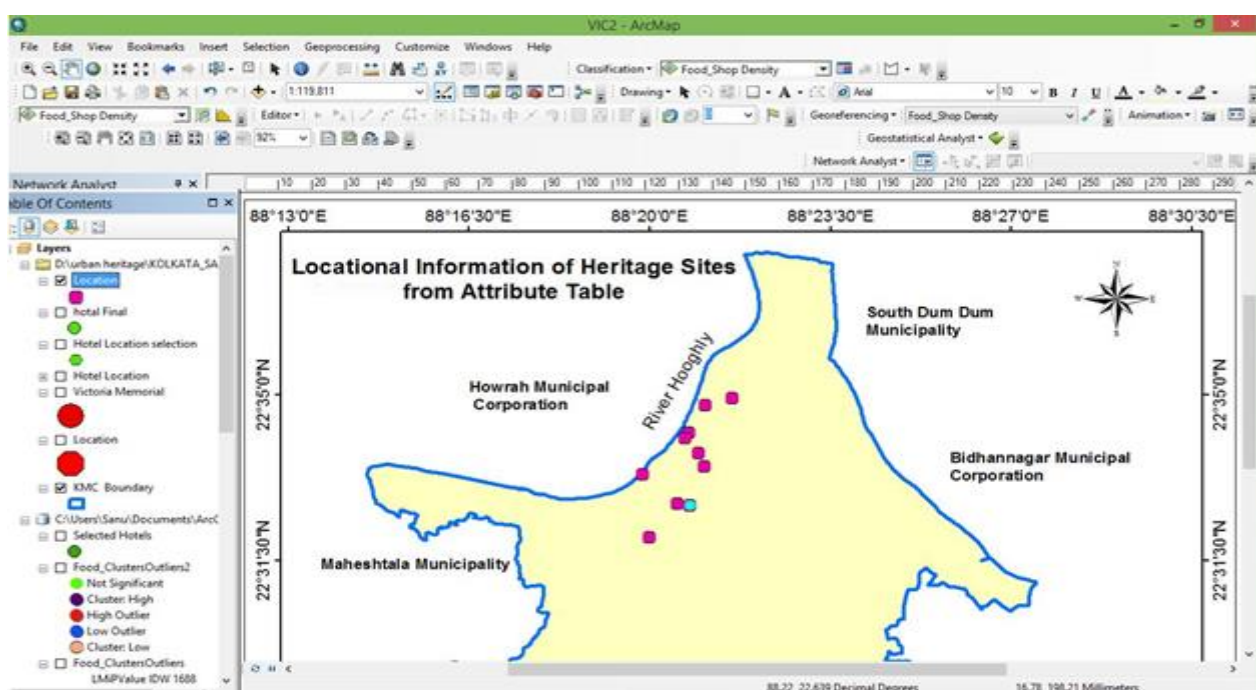


- ❖ This monument Built between 1906 to 1921, Conceptualised by George Curzon , was dedicated to the **memory of Queen Victoria (1819–1901).**
- ❖ **William Emerson**, the then president of the Royal Institute of British Architects was the chief architect of the memorial.
- ❖ This grand and exquisite memorial stands out as an excellent architectural gem in Indo-Saracenic, style, encompassed a blend of British architectural style with that of Egyptian, Venetian, Deccani, Mughal and other Islamic styles.



Creation of spatial data & attribute for thematic mapping

Serial Number	Name of the Layer	Attributes
1	Heritage Sites	ID, Sites name, Latitude & longitude Address, contact no, opening time, closing time
2	Hotel Data	Hotel ID, hotel Name, address, ph.no. Lowest Rent, Hotel categories (Five star, four star, three star)
3	Road Data	Road ID, Road Name, Road length , Road Width, Road Types (National highway, States highway, metal Road, unmetal Road)
4	Food Data	Shop name, shop address, shop number, open & closing times , Food Types (veg, non-veg), Restruents types (South Indian, Punjabi , chinses, North Indian)
5	Shopping mall	Shopping mall name , address, ph Number, opening & closing times , parking facilities



Where to go?(Location of Heritage Sites & it's attribute Table)

Figure 3: GIS database Creation for major Heritage sites of Kolkata (Example: St. Paul's Cathedral)

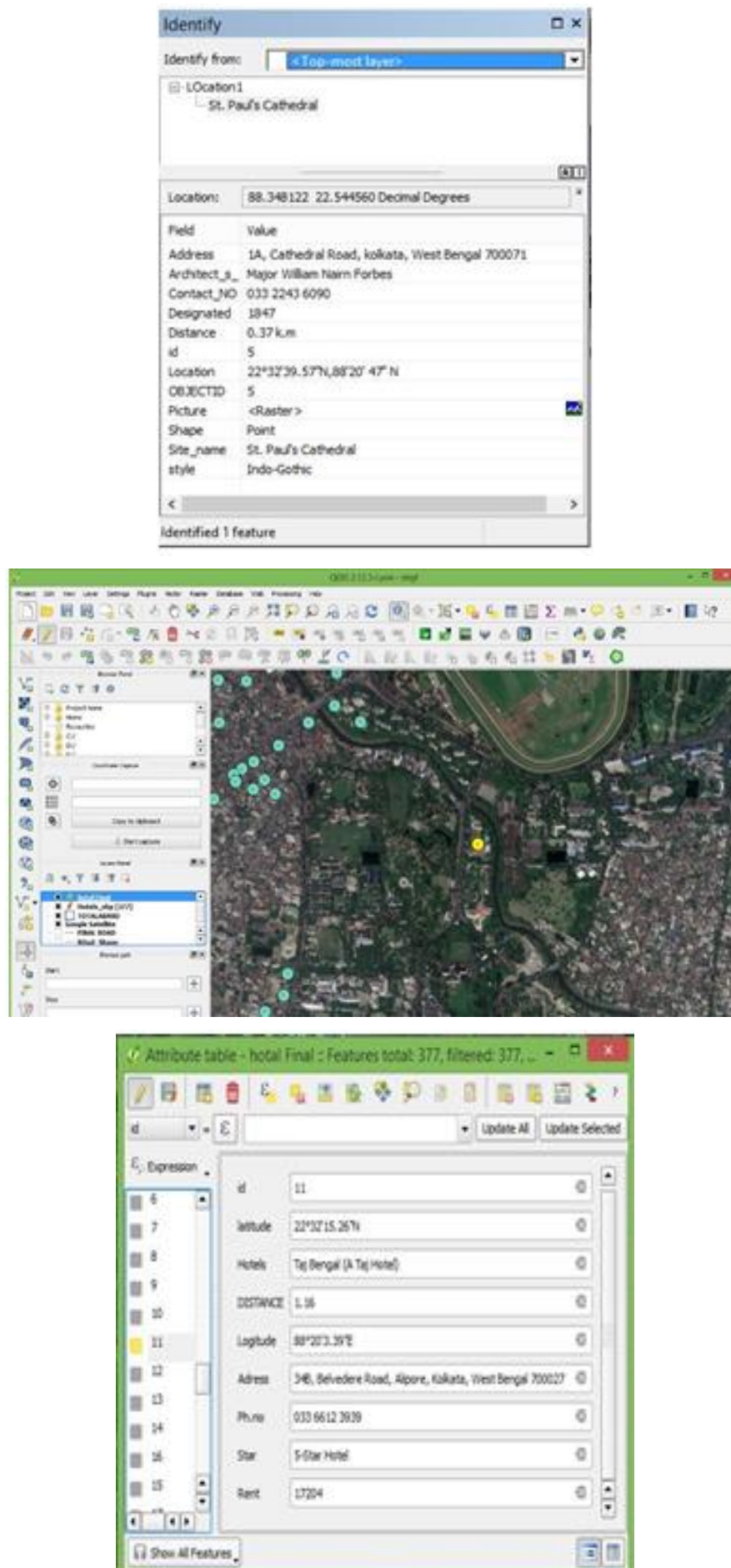


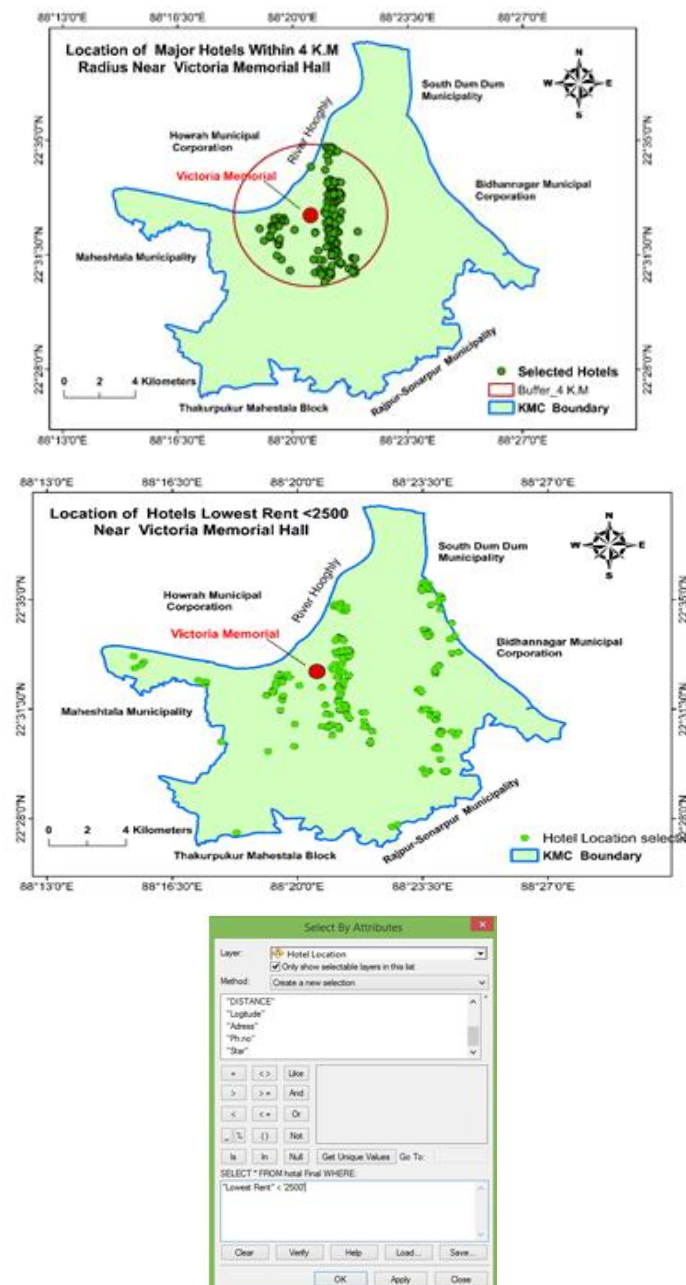
Figure-5: Creating 4 K.M Buffer to know Hotels near Victoria Memorial



Where to stay? (Hotel Information)

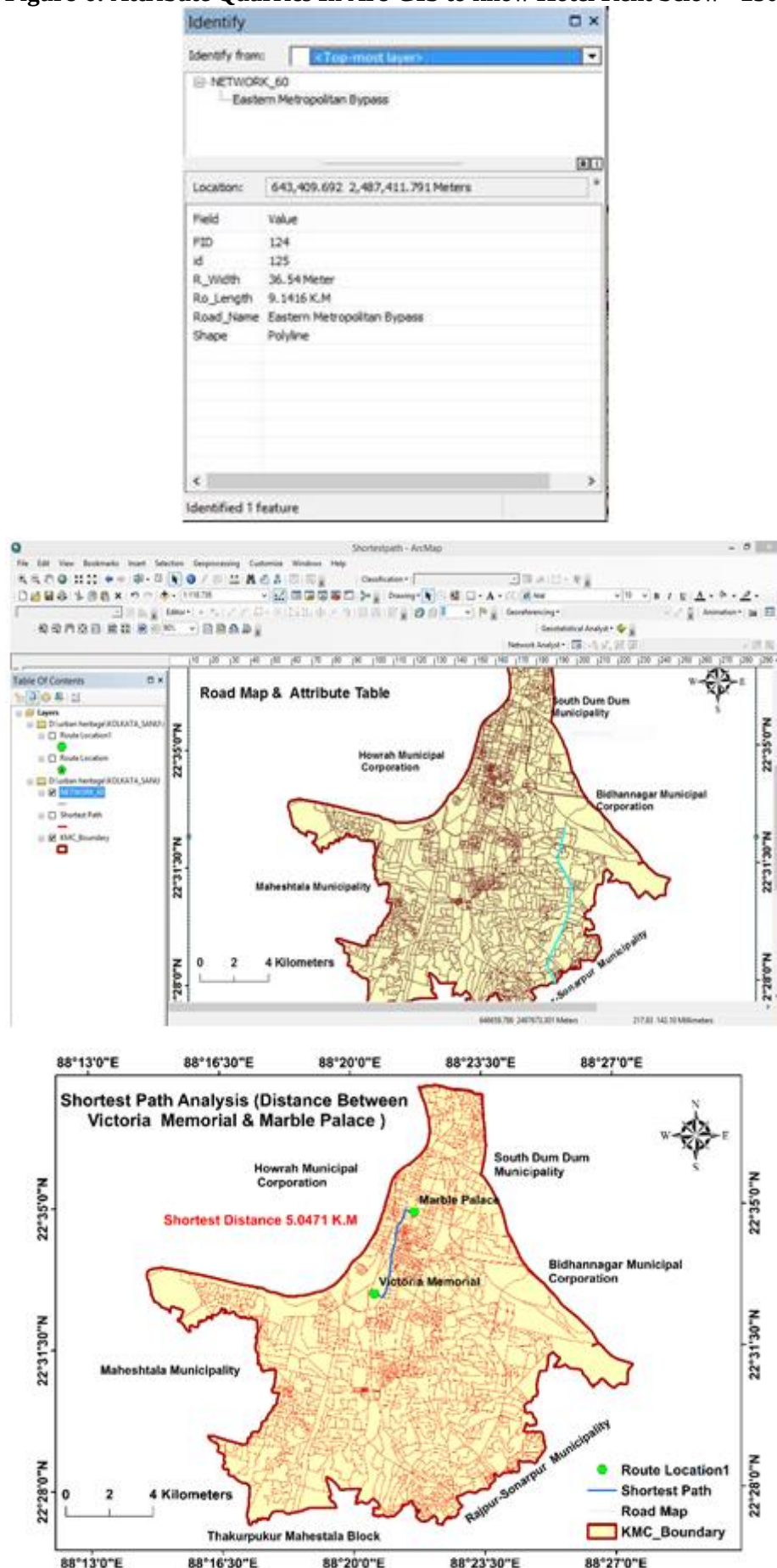
Buffer & query generation for extracting valuable information from database:

Figure-4: Attribute table for hotel Information



How to Reach? Transport Information (Taxi Rent)

Figure-6: Attribute Quarries In Arc-GIS to know Hotel Rent below <2500



Where and What to eat? (Data regarding Location of Food Shop)

Figure-10: Relationship between food shop & Road Network

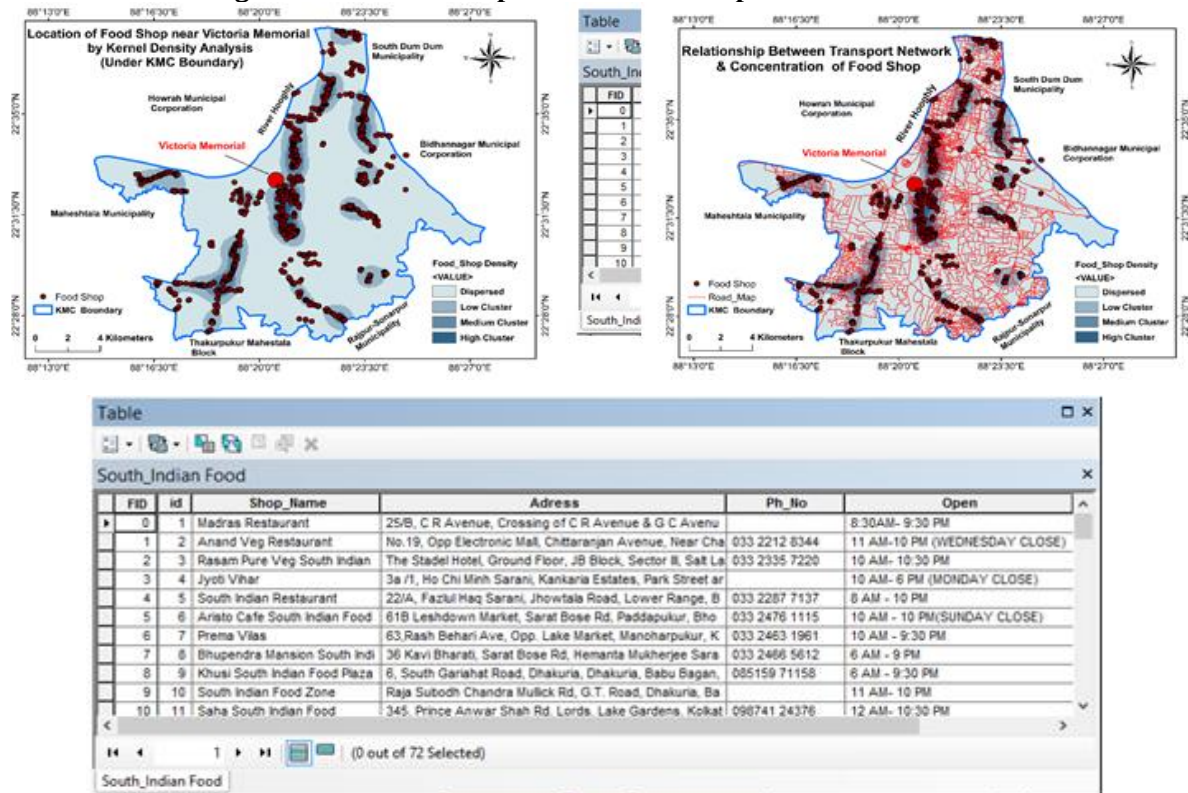


Figure-9: Concentration of Food Shop Near Victoria Memorial

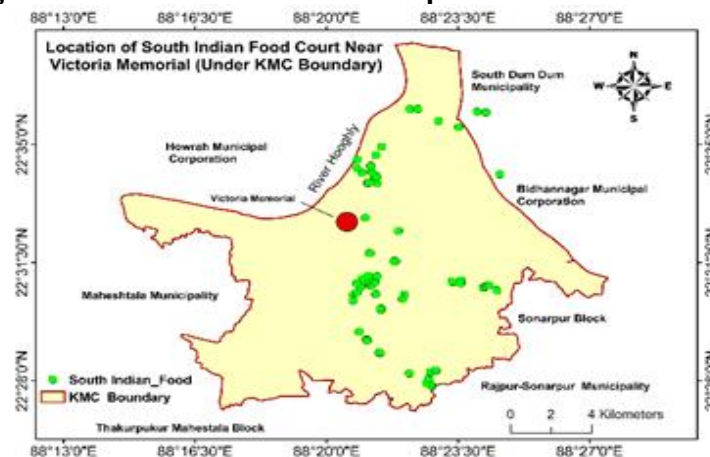
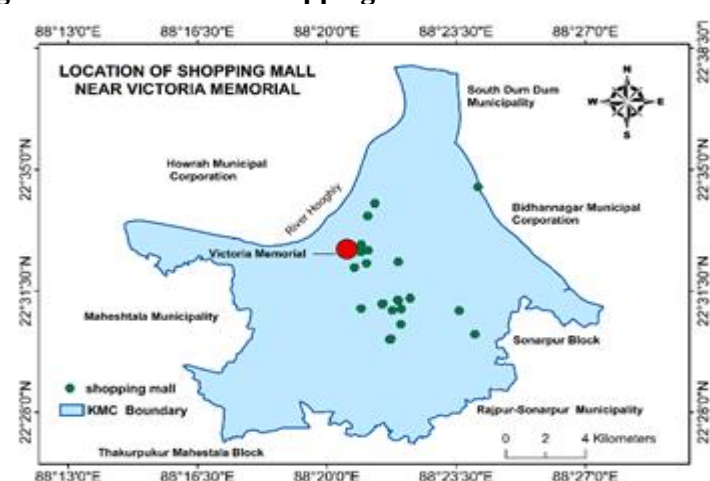


Figure 12: Location of Shopping Mall near Victoria Memorial

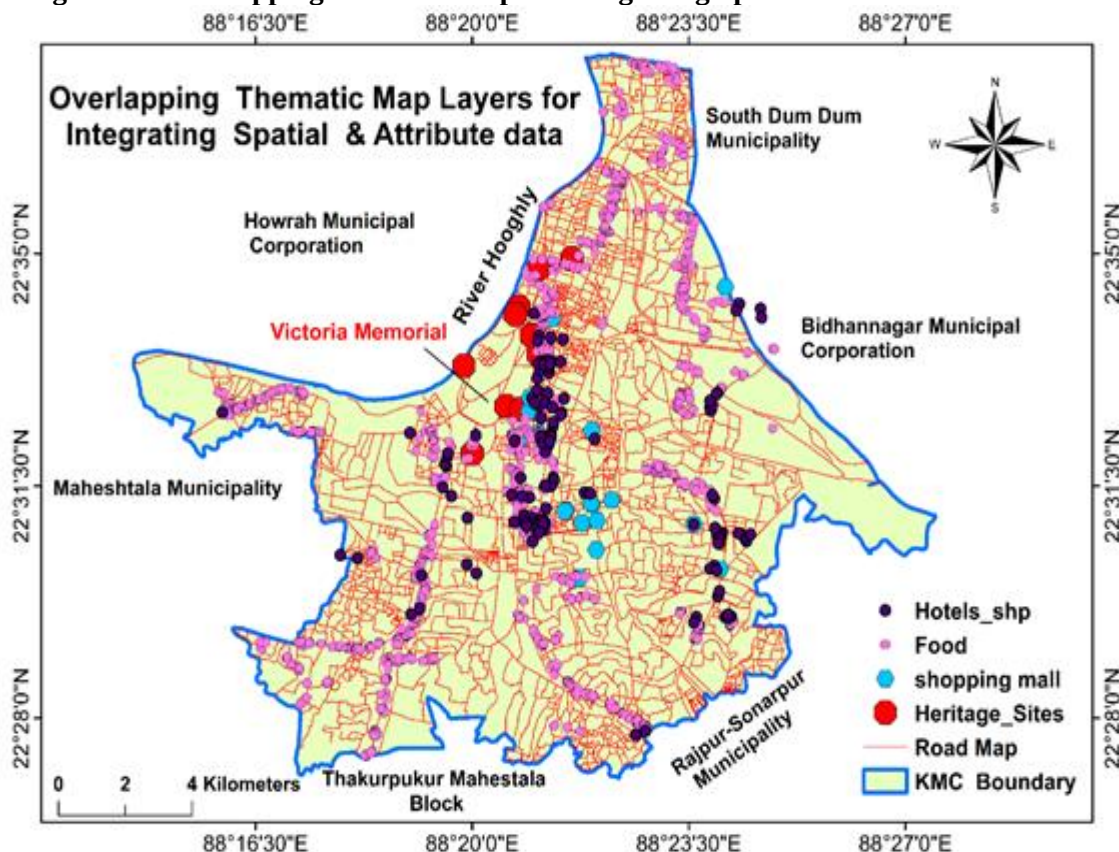


Attribute table - shopping mall : Features total: 22, filtered: 22, selected: 1

	id	Mall_Name	Address	Ph.No	Open
0	1	Emami Market	3, Lord Sriha Road, Elgin, Kolkata, West Bengal 70...	093318 25789	11AM-8:30 PM(M...
1	2	The Metro Plaza ...	No. 1, Ho Chi Minh Sarani, Next To American Consul...	033 3052 5473	11 AM-9 PM(MO...
2	3	Fort Knox	6, Camac St, Elgin, Kolkata, West Bengal 700017	033 4010 1500	10AM-9 PM(SUN...
3	4	Forum Courtyard	10/3, Elgin Road, Sreepally, Bhowanipore, Kolkata, ...	033 4023 5003	11 AM-9 PM
4	5	Merlin Homeland ...	188, Ashutosh Mukherjee Rd, Bhowanipore, Kolkata...	NELL	11 AM-8:30 PM
5	6	Quest Mal	33, Syed Amir Ali Ave, Beck Bagan, Ballygunge, Kol...	033 2281 1111	9AM-11 PM
6	7	Lake Mall	104, Rash Behari Avenue, Lake Market, Kalighat, L...	NELL	9 AM-11 PM
7	8	Gariahat Mall	7a, Bentsick Street, Calcutta Gpo, Eldala, Ballygu...	033 2461 3568	11 AM-8 PM
8	9	Dakshinapan Sho...	8/1B, Rohim Ostagar Rd, Jodhpur Park, Kolkata, W...	072784 21720	10 AM-8 PM(SUN...

Show All Features

Figure-13: Overlapping Thematic Map for Integrating Spatial data & Attribute Data



FINDINGS & CONCLUSION

From GIS we can generate and get the information about spatial and attribute data and after linking spatial and attribute data it would be helpful for us searching, editing and choice of tourist places for visiting, after creating GIS database we can use it as a tool decision support systems such as location analysis, land-use mapping and tourism development planning (*Remigiusz stras*). highlighted areas of the present study is identification of colonial heritage sites of Kolkata and application of GIS data for better understanding of tourists spot and decision making about choice of tourist spots. Major finding from this study are:

- ❖ GIS as a tool we can use it successfully for identification of **tourist spot, creating of attribute table consisting useful information about tourist place, transportation, Lodging, food, shopping & health information.**
- ❖ We can integrate **spatial data(Geographic location)** with **attribute data** for **visualizing & better interpretation** of tourist destination to avail maximum information to the tourists.
- ❖ GIS has huge potential in tourism development, **due to lack of tourism databases and inconsistencies** in data its application area are limited to some extent.

CONCLUSION

For the effective management & planning of tourism resources, in process of execution of those plan in-depth information about tourism resources is essential for the planner, policy makers, local administrator and GIS analysts for surveying, plan implementation and decision making process. It is an established fact that GIS has a huge potential for tourism development but due to lack of tourism related database and inconsistencies in data, its application areas are limited to some extents, for example very little site specific information about the source of visitor origin and destination, travel motivation, spatial pattern of recreation and tourism used, suitable sites for future development etc. Successful implementation of GIS database for promoting tourism depends on using of Web-GIS technology & internet connectivity, present days uses of Internet & web-based technology in India increasing steadily so it can be hoped that Government should enrich their tourism related website with all necessary tourism information for tourists in development of Tourism industry. It is hoped that such research efforts would help govt. officials and planners to have a better understanding of colonial heritage tourism and to formulate improved strategy and planning about cultural heritage tourism destinations.

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WEBSITE SOURCES

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15. <http://kolkatacitytours.com/prinsep-ghat-kolkata/>

**PUBLIC-PRIVATE PARTNERSHIP (PPP) AND EXPANSION OF HIGHER EDUCATION IN INDIA:
IMPLICATIONS FOR INCLUSIVE GROWTH**

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ABSTRACT

The paper critically analyses the role of public private partnership in the expansion of higher education along with its implications for the inclusive growth of higher education in India. The Public Private Partnership (PPP) in higher education is portrayed as an effective way of expanding, financing and governing higher education systems across the world. The implementation of PPP in Indian higher education sector is believed to bring so many benefits such as saving of resources and time for the public sector, improving access to higher education, ensuring quality, improving the efficiency, significant sharing of risks between the partners of PPP and promoting the autonomy of higher education institutions. Notwithstanding the perceived benefits associated with PPP, there are some major issues with private sector in general and PPP in particular which have serious implications for the inclusive growth of higher education sector in India. The paper while discussing the perceived benefits and challenges of PPP in higher education, argues that without keeping in place the proper mechanisms for checking the profit motive and commercial nature of private sector in higher education in India, the PPP in higher education might simply turn out to be an another form of privatization with commercialization character, which would only reinforce the multi-dimensional inequalities that already exist in higher education in India.

Keywords: Public Private Partnership (PPP), Higher Education, Privatization, New Economic Reforms, Commercialization, New Public Management.

1. INTRODUCTION

The role of higher education in the social, cultural and economic development of a nation is widely accepted across the spectrum. It is not a coincidence that the economically advanced countries have high Gross Enrollment Ratio (GER) in higher education. According to the World Bank global report of tertiary education, 2013, Countries with higher Gross National Income (GNI) per capita (\$20,000) have more than 50% Gross Enrollment Ratio (GER) in higher education. The converse is also true with few exceptions (World Bank, 2013). According to the report of All India Survey on Higher Education (AISHE) 2015-16, the Gross Enrolment Ratio (GER) of India in Higher education is 24.5%. Despite the massive expansion, the higher education in India has witnessed in the past three decades, the GER of India in higher education is still below the global average of 29.2%. The emergence of global knowledge economy has generated a huge demand for a highly educated workforce, especially a workforce with university degree. This has accelerated a worldwide demand for higher education.

Currently, 50% of the India's population is below 25 years old. This is likely to increase in the future, and by 2020, India would be the largest country in terms of its tertiary age population. The upsurge in the tertiary age population has been creating a huge demand for higher education in India. Various policy documents of Government of India have fixed the target of 30% Gross Enrolment Ratio (GER) to be achieved by 2020. In order to achieve this target, India would need about 800 more universities and 35,000 more colleges (GOI, 2013; Heslop, 2014). But, due to the financial constraints, the public sector has not been able to cope with the surging demand, which led to the unbridled growth of private higher education institutions for the past three decades. This scenario has created an uneven system of higher education in India. Various initiatives and strategies have been proposed in the recent years to expand the higher education with a focus on equity and excellence. Public Private Partnership (PPP) is one such initiatives in that direction. PPP is expected to play key role in the expansion of higher education in India. In this background, the paper critically examines the role of Public Private Partnership (PPP) in the expansion of higher education in India and its implications for inclusive growth.

2. EXPANSION OF HIGHER EDUCATION IN INDIA

The expansion of higher education in India, especially in the past three decades, is very remarkable. Between 1950-51 and 2015-16, the number of universities increased from 27 to 799; colleges from 578 to 35.8 thousand; teachers from 23 thousand to 1.5 million and students from around 200 thousand to 34.6 million. The expansion was the fastest in the decade of 2000s. The enrolment increased from 8.8 million in 2001-02 to 29.2 million in 2011-12. The number of universities increased from 256 to 564; colleges from 12 thousand to 32.9 thousand and teachers from 411 thousand to 898 thousand. The GER was doubled in 2011-12. The growth of Indian

higher education from 2001 to 2010 was twice as much as the growth it has made in the fifty years of independence. At present, the Indian higher education system is the largest in the world in terms of the number of institutions, and the second largest in terms of the number of students.

Notwithstanding the impressive growth the Indian higher education has made in the post-independence era, there exists a multi-dimensional inequalities in the access to higher education at different levels. The inequality in access exists across different social groups such as caste, class, gender, religion, region, locality and disability (GOI, 2013). For example, the GER for Scheduled Castes is 19.9% and it is 14.2% for Scheduled Tribes which is less than the national GER 24.5%. Further the GER for Males and Females are 25.4% and 23.5% respectively (MHRD, 2016).

Table-1: Growth of Higher Education in India

Year	Universities	Colleges	Teachers ('000s)	Enrolment (million)	Gross Enrolment Ratio (%)
1950-51	30	695	23	0.2	-
1960-61	55	1542	59	0.6	1.5
1970-71	103	3604	128	2.0	4.2
1980-81	133	4722	193	2.8	4.7
1990-91	190	7346	263	4.4	5.9
2001-02	256	12806	411	8.8	8.1
2010-11	564	32964	898	27.5	19.4
2011-12	645	35539	1247	29.2	20.8
2012-13	701	37204	1308	30.2	21.5
2013-14	748	39613	1367	32.3	23.0
2014-15	784	40760	1473	34.2	24.3
2015-16	847	41435	1518	34.6	24.5
2016-17	895	42338	1470	35.7	25.2

Source: UGC Annual Reports and All India Survey on Higher Education (AISHE) for various years.

3. PARTICIPATION OF PRIVATE SECTOR IN HIGHER EDUCATION IN INDIA

The participation of private sector in the higher education is not new. However, the role of private sector in higher education was very minimal in terms of its share in the total number of higher education institutions and in the total enrolments in higher education until 1980s. Higher education in India and in most of the countries was majorly a public funded one till the late eighties. But, for the past three decades, private higher education witnessed a rapid growth that resulted in a significant diminution in the relative size of the public sector in higher education. At present, around 37% of the universities in India are run by private sector. At the college level, around 78% of the colleges are privately managed, out of which 64% are private un-aided and 14% are private aided. The same is the case with stand-alone institutions also, where 76% of the institutions are run by private sector, of which 66% are private un-aided and 10% are private aided. The rest 24% of the institutions are run by government. While the share of private colleges in the total number of colleges is 78%, it contributes only 67% of the total enrollment (MHRD, 2016). Excessive demand and resource crunch are considered to be the main factors behind the rapid growth of private higher education institutions.

Table-2: Share of Enrollments in Government and Private Colleges

Type of Management	% Number	% Enrollment
Government	22.4	33
Private Aided	13.8	21.4
Private Un-aided	63.8	45.6

Source: Report of AISHE, 2016

Apart from the excessive demand and the limited capacity of the state, there is another important factor that is closely related with the growth of private higher education institutions. The new economic reforms popularly known as Liberalization, Privatization and Globalization (LPG) that was introduced in 1991 in India has played a significant role in the rapid growth of private higher education. Disinvestment in the public sector and deregulation of private sector were the main features of new economic reforms. Growing demand for higher education, the limited capacity of the public higher education institutions and the lack of or the decline in the public funding for the further expansion of public funded higher education institutions altogether gave a green signal to the expansion of private sector (Rani, 2010). There was almost no un-aided private higher education

institutions in the late 1980s, but now it accounts for 66% of the total number of higher education institutions in India (Tilak, 2014). At present, there are 13 states that have more than 50% private un-aided colleges. Telangana and Andhra Pradesh have more than 80% private un-aided colleges. Tamil Nadu and Uttar Pradesh have around 76% un-aided colleges.

Table-3: Share of Private Un-Aided and Aided Colleges

S. No	Name of the State	Private Un-Aided %	Private Aided %	Private (Total) %
1	Telangana	83.32	5.95	89.27
2	Andhra Pradesh	80.36	7.47	87.83
3	Tamil Nadu	75.98	10.58	86.56
4	Uttar Pradesh	75.92	10.49	86.41
5	Rajasthan	73.49	6.27	79.77
6	Haryana	67.70	12.87	80.57
7	Karnataka	67.59	12.93	80.51
8	Kerala	65.79	16.59	83.32
9	Puducherry	62.34	2.60	64.94
10	Gujarat	61.21	25.91	87.12
11	Punjab	60.94	18.44	79.38
12	Maharashtra	59.81	21.45	81.26
13	Madhya Pradesh	58.93	9.90	68.83

Source: Report of AISHE, 2016

The implementation of public private partnership in higher education in India has to be understood in relation to the rapid and unbridled growth of private higher education in India for the past three decades.

4. DEFINITION OF PUBLIC PRIVATE PARTNERSHIP (PPP)

The term Public Private Partnership (PPP) has multiple meanings in the public policy. The definition of PPP varies from country to country. Finance ministry of India in its *Approach Paper on Defining Public Private Partnership* defines Public Private Partnership (PPP) as follows:

“PPP means an arrangement between a government or statutory entity or government owned entity on one side and a private sector entity on the other, for the provision of public assets and/ or related services for public benefit, through investments being made by and/or management undertaken by the private sector entity for a specified time period, where there is a substantial risk sharing with the private sector and the private sector receives performance linked payments that conform (or are benchmarked) to specified, pre-determined and measurable performance standards” (Ministry of Finance, 2010: 6).

The term private in PPP encompasses all non-government agencies such as the corporate sector, voluntary organizations, self-help groups, individuals and community based organizations. Public-private partnership is essentially a long-term partnership between the government and the private sector. It generally involves a complex relationship between both the sectors; the monitoring and setting up of the norms related to quality are handled by the public sector, whereas the operation and management are dealt by the private sector; the risk is divided between both.

5. EMERGENCE OF PUBLIC PRIVATE PARTNERSHIP (PPP) IN THE GLOBAL EDUCATIONAL CONTEXT

Public-Private Partnership (PPP) emerged globally in the late 1980s as a specific policy response to the global economic and financial crisis that affected many developed and developing economies (Madan, 2017). At the global level, various multilateral development banks such as World Bank Group (WBG), European Investment Bank (EIB), the Asian Development Bank (ADB), the African Development Bank (AfDB) played a vital role in the promotion of PPP at the policy level through financial and technical assistance. Earlier, PPP were mostly implemented in the areas such as infrastructure, urban renewal, water supply and transportation. PPP entered into the policy arena of education somewhat lately. Though there were different forms of engagements between public and private in the education sector, those were not exclusively termed as public-private partnership. The first published reference to PPP in education can be found in the World Bank and ADB joint report titled *The new social policy agenda in Asia* that was published in 2000. During this time, World Bank Group and other international financial organizations organized various conferences, seminars and published number of reports and books that are aimed at popularizing and promoting PPP in education. PPP in education is portrayed as a

middle ground between state monopoly and extreme privatization, which has found support even among the critiques of privatization (Verger, 2012 & 2016). Different educational systems have different experiences in relation to the outcomes of PPP. While some support PPP on the grounds of limited financial resources, some support it on the grounds on the quality and efficiency. At the same time, there is no dearth of scholarship, which question the very premise of PPP in education (Srivastava, 2010; Robertson & Verger 2012).

6. PUBLIC-PRIVATE PARTNERSHIP (PPP) IN HIGHER EDUCATION IN INDIA

In the Indian context, the term Public Private Partnership (PPP) first featured in the 2002 Report of the Working Group on Public–Private Partnership that was formed under the Prime Minister’s Office. Eventually, a PPP sub-group was formed in 2003 with an objective of exploring the possibilities of PPP in social-sector development, including school education (Srivastava, 2010). Later, in order to explore the possibilities of public-private partnership in higher education, an expert committee was constituted by UGC and the committee submitted its report on March 2011. The committee recommended the following four models of PPP in higher education:

Model I – Basic Infrastructure Model: Private sector invests in infrastructure while government runs the operations and management and make annualized payments to the private investor;

Model II – Outsourcing Model: Private sector invests in infrastructure and runs the operations and management while responsibility of the government is to pay the private investor for the specified services;

Model III – Equity/Hybrid Model: Investments in infrastructure is shared between the government and private sector while operations and management vests with the Private sector;

Model IV – Reverse Outsourcing Model: Government invests in infrastructure and the private sector takes the responsibility of operations and management (Neema, 2012 & MHRD, 2011).

In the Basic Infrastructure Model, the physical infrastructure and additional services would be provided by the private sector, who could also earn third party revenues from some of the pre-determined infrastructure beyond curriculum hours from permissible activities. The desirability and the extent to which the private sector could involve in earning would be decided by the government.

Under the Outsourcing Model, the private sector would invest in infrastructure and also carry out the operation and management including the core teaching activities of the educational institution while the government would pay for specific services; such as hostel, canteen, library etc., on per student basis. The government would also set up standards for teaching and physical infrastructure and decide the location of the institution. The mechanism of this model is similar to the student vouchers, in which the government pays part or full fee of students based on some specified criteria and the students joins the institution of their choice.

Under the Hybrid Model, the private player and the government would share investment in infrastructure whereas operation and management would be carried out by the private player. The share would be pre-decided by the partnership contract and the operation and the management of the institution would be managed by a board which would be formed from amongst the different players in the partnership. Operating cost shall be recovered through user charges (tuition fee, hostel fee etc.) and third party revenue.

Under the Reverse Outsourcing Model, the government would invest in infrastructure whereas the operation and management of the institutions rests with the private sector. The cost of operation and management is to be recovered by the private player by user charges and third party revenues. This model is considered to be useful in the case of existing institutions in higher education.

While the infrastructure division of the planning commission has consensus over the first two models of PPP namely Basic Infrastructure Model and Outsourcing Model, it has reservations over the next two models namely Hybrid Model and Reverse Outsourcing Model. However, the education division of the planning commission has the positive view about all the four models and critical of excluding any of the four models. (Press Trust of India, 2013)

In the eleventh five year plan, 20 IITs and 300 Polytechnic colleges have been proposed to be established under PPP model. Establishment of 16 out of 20 IITs were approved by MHRD in the year 2013-14. Rs.14.84 crores and Rs.7.44 crores were also released in the years 2013-14 and 2014-15 respectively. Twelfth five year plan also proposed the establishment of various technical and research institutions including new IITs and IIMs under innovative models of PPP (GOI, 2013).

According to the scheme of providing financial assistance for setting up of new polytechnics under PPP mode, the fund has to be shared among the central government, the state government and the private partner. Rs.3

crore will be provided by the Ministry of Human Resource Development to the State Governments in installments on the recommendations of the AICTE. Rs.2 crore will be provided by the State Govt. and in case land is provided by the State Govt., the condition of Rs.2 crore can be waived of. A minimum of Rs.10 crores will be deposited by the private partner for construction of building, equipment and running of the polytechnic in Institute Management Committee account.

The scheme of setting up of 20 new Indian Institutes of Information Technology (IIITs) on Public Private Partnership (PPP) model stated that the capital cost of each IIIT is Rs. 128 crore which has to be shared in the ratio of 50: 35:15 by the Central Govt., the State Govt, and the industry respectively.

7. THE PERCEIVED BENEFITS OF PUBLIC PRIVATE PARTNERSHIP IN HIGHER EDUCATION IN INDIA

Public-private partnership (PPP) in education is portrayed as a cost effective policy solution to the access and quality problems that many education systems, especially in developing countries, currently face. It is argued that PPP are different from privatization, thus assuming a middle position between pure government delivery and outright privatization which does not attract as much controversy and criticism as privatization. The report of the UGC expert committee on PPP in higher education claimed that public-private partnership in higher and technical education would be effective in terms of saving resources and time; improve efficiency of the system; improve performance and promote autonomy that can guarantee high quality in higher education (MHRD, 2011).

The PPP are assumed to possess the potential to tap the private resources effectively to the development of higher education thus saving the public resources and time. PPP are capable of channeling the additional resources to the provision for education. It is claimed that the issue of resource crunch could be effectively addressed by inviting more private players to invest in the higher education infrastructure through innovative models of PPP. Given the increasing demand and scarce financial resources, it is proposed that private participation especially through various models of PPP is the only viable alternative to cater to the increasing demand for access to higher education (Neema, 2012).

The notion of risk sharing plays a key role in justifying PPP. Risk sharing is considered to be the defining feature of PPP. PPP contracts are assumed to accomplish an increased level of sharing between the government and the private sector. This risk-sharing is expected to increase efficiency in the delivery of services. Further, it is also believed that implementing PPP in higher education could promote autonomy of the higher education institutions which subsequently improve the quality and efficiency of higher education (Gupte, 2015).

8. MAJOR ISSUES WITH PUBLIC PRIVATE PARTNERSHIP (PPP) IN THE CONTEXT OF HIGHER EDUCATION IN INDIA

In spite of the claims about PPP as a viable alternative and an effective policy solution to the impending problems that the higher education sector in India currently face, there are some major with PPP which have serious implications for the inclusive growth of the higher education in India. The issues include:

1. Conflict of Interest
2. Commercialization
3. Uneven Growth

Conflict of Interest: One of the main issues of PPP is that the conflict of interests between the partners in PPP. While the objective of the government is to achieve the constitutional ideals such as social inclusion, access and quality assurance in the higher educational institution, the private sector may be participating in the higher education merely for profit making (Neema, 2012). This conflict of interests if not dealt properly might hamper the proper functioning of higher education institutions modelled on PPP.

Commercialization: As per the existing legal framework in India, education is a 'not-for profit' entity. Profit making in education is not allowed. It is mandatory for the private players to register their organization as a 'not-for profit' trust to run a school or college. But, in the past 30 years history of higher education in India, one can easily observe that private sector in higher education is making exorbitant profits by running colleges and universities.

There are various guidelines and court judgements that are aimed to prevent the profit making activity of private higher education institutions. The central government even formulated a legislation in this regard titled 'Prohibition of Unfair Practices in Technical Educational Institutions, Medical Educational Institutions and Universities Bill 2010' to curb the unfair practices of private higher education institutions. But, profit making in

higher education is still persisting (Tilak, 2014). The governments and courts are not consistent in their attempt to stop profit making in higher education. There was no proper clarity in the policy documents and court judgments about the extent of privatization that can be allowed in higher education. Tilak (2008) describes the contradictory statements of the state and judiciary as follows:

“privatization is acceptable, but not commercialization of higher education; high fees are okay, but not exorbitant fees; exorbitant fees are okay, but not if surplus is generated; surplus is okay, but not profits; profits are okay, but not exorbitant profits, etc.” (Tilak 2008: 227)

Moreover, the twelfth five-year plan proposed to re-examine the ‘not-for-profit’ tag on higher education sector for pragmatic considerations. It further suggested that private institutions should be allowed to raise funds through public offerings of bonds or shares (GOI, 2013). This document signals a paradigm shift in the higher education policy in terms of accepting higher education as a ‘for profit’ entity.

Although, the guidelines for setting up of 20 IITs and 300 polytechnics mandates the private partner in PPP to be a ‘not-for profit’ trust, it also mentions that the IITs ought to be provided complete autonomy to set fees and raise funds through various means such as donations. It is further stated that the operating expenditure of the IITs established under PPP model should be borne by the institutes within 5 years of commencement out of students fees, research grants, endowments etc. It gives free hand to the institution to use various means to raise funds. This has to be viewed in the backdrop of the decline of philanthropic oriented institution and takeover of profit oriented intuitions.

Further, the new models of PPP are based on the concept of ‘New Public Management’ which draws its theoretical basis from the ‘neo-liberal’ theory of governance that emphasize on deregulation of private sector and restructuring the state functions on the business lines to serve the market interests (Robertson & Verger 2012). In this context, with minimum state support and the freedom to set fees and raise funds through any means, there are more reasons to believe that the PPP in higher education might turn out to be an another form of privatization, with the commercialization character which would lead to the exclusion of students from the marginalized sections of the society and reinforce the multi-dimensional inequalities that already exist in Indian higher education.

Uneven Growth: Indian higher education registered a phenomenal growth in the post-independence era. But, the growth is uneven in many ways, as there are significant multi-dimensional inequalities in enrolment rates between rural and urban populations, rich and poor, minority and other communities, men and women and people with disabilities. (Heslop, 2014). A UGC report in 2012 observed that the distribution of public and private institutions in India is skewed. It further noted that the enrollment in public institutions is mostly concentrated in conventional disciplines such as arts and sciences, whereas in private institutions, more students are enrolled in market-driven disciplines such as engineering, management, etc. (UGC, 2012).

A study on the changing landscape of higher education revealed that most of the private engineering colleges in Tamil Nadu are located in the urban areas. The study further observed that the private sector is reluctant to invest in the backward regions, and invests only in the economically prosperous regions and also where the public sector has already invested and made significant progress in terms of infrastructure facilities such as roads, connectivity and airport, etc. This is a common trend which can be observed in other states also (Rani, 2010). As mentioned earlier, the phenomenal growth in higher education was characterized by the unbridled growth of private higher education institutions. The market orientation and the profit motive of the private sector along with the austerity measures of the state contributed significantly to the uneven growth of higher education. The positioning of private players in the PPP could in fact reinforce this uneven growth rather than resolving it.

9. CONCLUDING REMARKS

There is no doubt that the participation of private sector in any form is essential to the development of higher education in India. But, the unprecedented growth of private higher education institutions that constitute more than 75% of the total number of higher education institutions in India has significantly contributed to the uneven growth of higher education sector in India. In this context, without any proper mechanisms to check the profit making of private sector in higher education, PPP in higher education might turn out to be an another form of privatization with the commercialization character which would lead to the uneven development of higher education in India by further reinforcing the multi-dimensional inequalities that already exist in the higher education sector in India.

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**WEAKER SECTIONS' ENROLMENT WITH REFERENCE TO RTE ACT 2009: EVIDENCE FROM
SELECTED STATES OF INDIA**

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ABSTRACT

The present research paper analyzes the elementary education in terms of ST enrolment, SC enrolment and OBC enrolment with reference to Right to Education Act 2009 with secondary data obtained from the annual report of National University of Educational Planning and Administration (NUEPA). The time period considered for this study is span of 12 years from 2004-05 to 2015-16 and divided into 2 sub-periods with reference to Right to Education Act 2009 i.e., Before RTE Act and After RTE Act (2010-11 to 2015-16). The study considers all states and union territories of India as population and 17 states are selected as sample states. Annual Average Growth Rates, Mean and Standard Deviation are calculated for fruitful results. Three statistical tests are employed to test the statistical significance of variations in enrolment during pre and post RTE Act. The result reveals that there has been an increase in the percentage of SC enrolment in upper primary schools in majority of states, percentage of ST Enrolment in primary and upper primary schools in almost all sample states and the percentage of OBC enrolment at elementary level in all states since the enactment of RTE Act. There has been a significant improvement in OBC and SC enrolment at elementary level after the implementation of the RTE Act.

Keywords: Enrolment, Right to Education Act, ANOVA

INTRODUCTION

The importance of education for the upliftment of the individual is universally acknowledged. It is a recognized fundamental human right. Education is an important tool for empowerment envisaged under the Constitution of India (Anil, 2009). In addition, education is also necessary for the fulfillment of any other civil, political, economic or social right. Thus the Right to Education serves as a prerequisite for all other Human Rights (Claude & Weston, 2006). Furthermore, the Right to Education has been identified as an integral part of Right to Development (RTD) which includes the right to food, primary health care and Primary Education (CDHR, 2004).

After independence in 1947, the Government of India proclaimed Right to Education under Indian Constitution having made it the duty of the state to provide free and compulsory elementary education to all children of ages 6 to 14. On 26th January 1950 when Indian Constitution came into force, it had in its Article 45 a directive principle promising free and compulsory education for all children until they complete the age of 14 years. This was to be attained within 10 years (Biradar & Swadi, 2014). The original text proposed by the Constituent assembly indicated: "Every citizen is entitled as of right to free primary education and it shall be the duty of the State to provide within a period of ten years from the commencement of this Constitution for free and compulsory primary education for all children until they complete the age of fourteen years" (Tripathi, 2016).

National policy of education of 1986 and 1990 recommended including RTE as a fundamental right in Indian constitution. Based on this recommendation, National policy on Education 1992 was formulated. India also signed the UN Convention on the Rights of the Child (CRC), in 1992 and started the process of adopting legislation to make education a fundamental right of the child (Gaddipati, 2015). The UN declared Convention on Rights of Children that recognise education for all children of the world as the fundamental right of a child in 1989 but India recognised it in 2002. Several public interest litigation petitions in different High courts created tremendous pressure on the parliament for a constitutional amendment to include the right to education as a fundamental right. The Indian State adopted the 86th Amendment Act (2002) to the Constitution, thereby conferring on education the status of a fundamental right. Through 86th constitutional amendment, Article 21-a (part III) was inserted in the fundamental right section of constitution under which, "The State shall provide free and compulsory education to all children of the age of 6 to 14 years (Palanithurai, 2011).

In 2004 a revised version of this Bill, re-titled the Free and Compulsory Education for Children Bill 2004, was re-posted (NDA Government). The Free and Compulsory Education Bill, 2004 began to provide free and compulsory education to all children from the age of six to fourteen. The Government of India had re-constituted the Central Advisory Board of Education (CABE) Vide Resolution dated 6th July, 2004. After four years, the Prime Minister, Dr. Manmohan Singh presided a meeting on 14th February 2008 in which a decision

was taken to proceed with the drafting of a Central Legislation on Right to Education. With this meeting HRM constituted a Working Group under the chairpersonship of Secretary, DSE&L to review the draft (2005 version). The Working Group made available draft Right of Children to Free and Compulsory Education Bill, 2008 for submission to the Cabinet (Mondal, 2015). The Right of Children to Free and Compulsory Education Bill, 2008 was passed in the Rajya Sabha on 20th July, 2009 and in the Lok Sabha on 4th August, 2009. It can be said that nearly six years after the Amendment, the Bill was cleared by the cabinet. After several failed attempts in 2005 and 2008, finally the Right to Free and Compulsory Education Act was passed in 2009 and came into effect from 1st April, 2010. Now under the Indian constitution, article 21 reads “every child between the ages of 6-14 years has a fundamental right to education which the state shall provide in such manner as the state may by law determine” (Viswanath, 2014).

In the past, there were number of policies that could not succeed to achieve policy goals due to implementation failure (Chaudhri & Jha, 2012). No matter how well a policy is written on paper, the success of a policy depends largely on how well it is implemented (Calland, 2010). The RTE Act is a detailed and comprehensive piece of legislation which includes provisions related to schools, teachers, curriculum, evaluation, access and specific division of duties and responsibilities of different stakeholders (Hussain et al, 2014). Though, the Act introduces several positive features which, if implemented, can bring about long-pending improvements in the school education system of India. These include: upgrading of infrastructure, recruitment of additional teachers in order to comply with the prescribed pupil-teacher ratio of 30:1 at the primary level, making education free, enrolment of all out-of-school children, constitution in each school of democratically elected school management committees, and doing away with screening procedure and capitation fee for admission of children and with private tuition by teachers (RTE Forum, 2012). RTE Act fulfills the constitutional mandate for free and compulsory primary education but some of its provisions have raised debates over the years. Various challenges and issues are being faced by stakeholders in implementing this Act in the schools (Banerjee & Arora, 2013). Though, the states are paying special role on RTE implementation number of constraints and Challenges faced by RTE while implementation.

After crossing seven years of its implementation, it remains to be seen whether the Act has been implemented well enough to make a significant impact in the lives of children and whether it will truly serve to improve the quality of education. In this context it would be appropriate to conduct a study on implementation of Right to Education Act with special reference to enrolment of elementary education in weaker sections.

DATA AND METHODOLOGY

The present study is descriptive- cum- analytical in nature. Data collected from the annual report of National University of Educational Planning and Administration (NUEPA) on Elementary Education in India. The time period we consider for this study is span of 12 years from 2004-05 to 2015-16. The study period divided into 2 sub-periods with reference to Right to Education Act 2009 i.e., Before RTE Act (2004-05 to 2009-10) and After RTE Act (2010-11 to 2015-16) for the purpose of our study. All states and union territories of India considered as population and 17 states are selected as sample states for the study. Sample states are selected based on zonal council of India. From each zone one high literacy state, one moderate literacy state and one low literacy state were selected. Together all 17 states were selected from 7 zones of India. The study used Annual Average Growth Rates (AAGR), Mean, Standard Deviation (SD) and Coefficient of Variation (CV) for selected variables. The objective of the F- test, Z-test and The Kruskal-Wallis test is to find out the selected parameters differ significantly during pre and post RTE Act, 2009.

RESULTS AND DISCUSSION

The growth rates of ST students' enrolment in primary schools of all the 17 states before the RTE Act period have recorded a mixed trend that is increasing in 12 states and declining in 5 states. Only the state of Goa (12.74%) achieved relatively stronger growth per year. In addition, Kerala (5.16%), Manipur (4.68%), Odisha (3.8%) and Madhya Pradesh (2.53%) have grown at more than 3.0 percent per annum and in Maharashtra (2.4%), Tamil Nadu (1.27%) and Mizoram (1.03%) states the positive growth is recorded more than 1.0 percent. The higher CV recorded in Punjab i.e., 55.63 percent, it reveals that greater the level of dispersion around the mean and the lower CV recorded in Arunachal Pradesh i.e., 1.41 percent, it reveals that slighter the level of dispersion around the mean. After the implementation of RTE Act, the growth of ST students' enrolment in primary schools has been decreased excluding Uttar Pradesh and Odisha. In Punjab and Delhi there is no change in average annual growth rates. As observed, during this period, a negative growth of ST students' enrolment is recorded highest in Kerala (-7.39%), then by Andhra Pradesh (-5.81%), Uttar Pradesh (-3.07%), Goa (-2.63%), Manipur (-1.67%), Tamil Nadu (-1.05%) and the lowest in Mizoram (-0.18%). The CV for enrolment in primary schools ranged between 17.14 i.e., highest in Kerala and lowest in Mizoram i.e., 0.41

percent. The lower the value of the coefficient of variation in Mizoram indicate the more precise the estimate of dispersion. The results from Average Annual Growth Rate clearly indicate that the ST students' enrolment in primary schools has increased before RTE Act and after RTE Act period the ST students' enrolment in primary schools has declined in the selected states (Table – 1).

Table – 1: Percentage of ST Enrolment in Primary Schools during 2004-05 to 2015-16								
States	Before RTE Act (2004-05 to 2009-10)				After RTE Act (2010-11 to 2015-16)			
	Mean	SD	CV	AAGR	Mean	SD	CV	AAGR
Madhya Pradesh	24.97	0.95	3.82	2.53	25.95	0.41	1.57	-0.85
Uttar Pradesh	0.69	0.13	19.38	-8.76	0.77	0.05	6.15	3.21
Uttarakhand	3.63	0.38	10.37	-6.07	3.02	0.19	6.18	-3.07
Odisha	27.58	1.91	6.92	3.80	31.97	1.05	3.27	1.69
Sikkim	36.68	0.53	1.45	0.36	37.13	0.51	1.36	-0.42
Arunachal Pradesh	76.17	1.07	1.41	0.43	75.22	1.15	1.53	-0.81
Manipur	43.93	3.06	6.98	4.68	46.37	1.61	3.48	-1.67
Mizoram	101.97	7.87	7.72	1.03	98.55	0.45	0.46	-0.18
Delhi	0.41	0.07	17.39	-2.76	0.40	0.00	0.00	0.0
Punjab	0.18	0.10	55.63	-28.31	0.00	0.00	0.00	0.0
Rajasthan	15.77	0.25	1.61	-0.60	16.07	0.32	2.02	-0.6
Andhra Pradesh	10.67	0.16	1.48	0.77	9.92	1.33	13.40	-5.81
Kerala	2.33	0.21	9.07	5.16	2.15	0.37	17.14	-7.39
Tamil Nadu	1.95	0.09	4.55	1.27	1.88	0.04	1.98	-1.05
Goa	7.35	1.66	22.52	12.74	7.95	0.36	4.52	-2.63
Gujarat	19.77	1.38	6.96	0.02	18.43	0.31	1.68	-0.64
Maharashtra	12.70	1.06	8.35	2.40	12.57	0.26	2.04	-0.94
Source: Source: State Report Cards on Elementary Education in India various issues from 2004-05 to 2015-16, National University of Educational Planning and Administration, New Delhi.								

The growth rates of ST students' enrolment in upper primary schools of all the 17 states before the RTE Act period have recorded a mixed trend that is increasing in 13 states and declining in 4 states. Only the state of Goa (16.93%) achieved relatively stronger growth per year with more than 15.0 percent. In addition, Odisha (8.96%), Manipur (8.18%), Mizoram (4.12%) and Gujarat (3.91%) have grown at more than 4.0 percent and in Kerala (3.48%), Madhya Pradesh (3.45%) and Andhra Pradesh (2.32%) the growth is recorded with more than 2.0 percent. The CV ranged between 50.64 i.e., highest in Punjab and lowest in Rajasthan i.e., 1.74 percent. After the implementation of RTE Act, the growth of ST students' enrolment has recorded a distinct growth pattern and it is increasing in 6 states and declining in 10 states. In the State of Punjab, the trend is remains same. The positive growth of ST student' enrolment in upper primary schools is recorded highest in Odisha (4.35%), then by Uttar Pradesh (4.17%), Maharashtra (2.87%), Madhya Pradesh (2.77%), Rajasthan (1.18%) and the lowest in Manipur (0.45%). The higher CV recorded in Delhi i.e., 27.84 percent and reveals that greater the level of dispersion around the mean and the lower CV observed in Mizoram i.e., 0.45 per cent. The results from the Average Annual Growth Rate clearly indicate that the ST student' enrolment in upper Primary Schools has increased before RTE Act and during post RTE Act period the ST student' enrolment has declined in the selected states (Table – 2).

Table – 2: Percentage of ST Enrolment in Upper Primary Schools during 2004-05 to 2015-16								
States	Before RTE Act (2004-05 to 2009-10)				After RTE Act (2010-11 to 2015-16)			
	Mean	SD	CV	AAGR	Mean	SD	CV	AAGR
Madhya Pradesh	17.82	1.01	5.66	3.45	21.63	0.99	4.57	2.77
Uttar Pradesh	0.64	0.12	19.22	-6.08	0.70	0.06	8.25	4.17
Uttarakhand	3.77	0.26	6.97	-3.13	3.28	0.20	5.94	-3.56
Odisha	19.53	3.26	16.69	8.96	23.30	1.69	7.25	4.35
Sikkim	35.12	0.80	2.27	0.25	35.88	0.31	0.86	-0.04
Arunachal Pradesh	71.85	1.66	2.31	1.04	74.73	0.41	0.54	-0.10
Manipur	33.03	4.62	13.99	8.18	38.03	0.52	1.38	0.45
Mizoram	92.50	12.85	13.90	4.12	98.38	0.45	0.45	-0.10
Delhi	0.33	0.10	30.54	-4.82	0.38	0.11	27.84	-11.67

Punjab	0.25	0.12	50.64	-31.44	0.00	0.00	0.00	0.00
Rajasthan	12.75	0.22	1.74	0.79	13.72	0.25	1.81	1.18
Andhra Pradesh	7.43	0.30	4.01	2.32	7.37	0.88	11.98	-3.86
Kerala	1.85	0.15	8.11	3.48	2.05	0.37	17.98	-4.35
Tamil Nadu	1.67	0.19	11.31	1.20	1.45	0.05	3.45	-1.24
Goa	7.58	1.88	24.86	16.93	10.18	0.38	3.74	-0.36
Gujarat	15.15	2.09	13.80	3.91	16.33	0.33	2.05	-0.34
Maharashtra	9.22	0.31	3.34	0.13	10.57	0.53	5.03	2.87
Source: Source: State Report Cards on Elementary Education in India various issues from 2004-05 to 2015-16, National University of Educational Planning and Administration, New Delhi.								

The growth rates of SC students' enrolment in primary schools before the RTE Act period have diverged and they are increasing in 7 states and are declining in 10 states. Only one state is Mizoram (14.91%) achieved relatively stronger growth. In addition, Manipur (3.73%) and Kerala (1.59%) have grown at more than 2.0 percent and in Sikkim (0.7%), Punjab (0.59%), Maharashtra (0.29%) and Madhya Pradesh (0.13%) the growth is recorded less than 1.0 percent. The CV for SC students' enrolment ranged between 49.10 i.e., highest in Mizoram reveals that greater the level of dispersion around the mean and 0.91 i.e., lowest in Rajasthan indicate the more precise the estimate of dispersion. After the RTE Act, growth rates of SC students' enrolment in primary schools have recorded a mixed trend; positive in 7 states and negative in 10 states. Only two states Arunachal Pradesh (38.67%) and Mizoram (21.67%) achieved relatively stronger growth with the growth rate per year more than 20.0 percent. In addition, Manipur (1.89%) and Andhra Pradesh (1.51%) have grown at more than 2.0 percent and in Sikkim (0.78%), Uttar Pradesh (0.02%) and Madhya Pradesh (0.01%) the growth is recorded less than 1.0 percent. The CV after RTE was fluctuation between 37.93 percent in Arunachal Pradesh and 0.71 percent in Tamil Nadu. From the table, it can be found that a similar kind of pattern has been witnessed before and after RTE Act periods. In the majority of states, primary education in terms of SC students' enrolment shows a decreasing trend during before and after the RTE Act (Table – 3).

Table – 3: Percentage of SC enrolment in Primary Schools during 2004-05 to 2015-16

State	Before RTE Act (2004-05 to 2009-10)				After RTE Act (2010-11 to 2015-16)			
	Mean	SD	CV	AAGR	Mean	SD	CV	AAGR
Madhya Pradesh	17.38	0.27	1.57	0.13	16.98	0.13	0.79	0.01
Uttar Pradesh	27.53	0.49	1.79	-0.69	28.15	0.39	1.39	0.02
Uttarakhand	26.90	0.37	1.37	-0.28	24.70	0.83	3.36	-1.66
Odisha	20.43	0.73	3.58	-0.87	18.93	0.26	1.39	-0.83
Sikkim	7.25	0.21	2.95	0.70	7.98	0.13	1.68	0.78
Arunachal Pradesh	0.75	0.16	21.73	-6.40	0.62	0.23	37.93	38.67
Manipur	3.32	0.38	11.60	3.73	4.12	0.25	6.18	1.89
Mizoram	0.41	0.17	41.90	14.91	0.32	0.11	33.70	21.67
Delhi	11.93	1.00	8.35	-3.33	10.53	0.19	1.79	-0.56
Punjab	50.05	1.82	3.64	0.59	38.08	0.74	1.95	-0.83
Rajasthan	20.10	0.18	0.91	-0.29	20.45	0.31	1.51	-0.38
Andhra Pradesh	19.12	0.40	2.08	-1.13	19.20	0.64	3.35	1.51
Kerala	12.02	1.22	10.12	1.59	9.27	0.70	7.52	-3.97
Tamil Nadu	24.77	0.48	1.95	-1.10	24.15	0.17	0.71	-0.08
Goa	2.72	0.45	16.56	-4.70	1.52	0.20	12.86	-7.17
Gujarat	7.83	0.88	11.22	-0.69	7.17	0.30	4.24	-2.49
Maharashtra	15.25	1.39	9.10	0.29	13.55	0.48	3.53	-2.04
Source: Source: State Report Cards on Elementary Education in India various issues from 2004-05 to 2015-16, National University of Educational Planning and Administration, New Delhi.								

The growth rates of SC students, enrolment in upper primary schools before the RTE Act period have recorded an increasing trend in 11 states and a declining trend in 6 states. Only one state i.e., Mizoram (35.71%) has achieved relatively stronger growth per annum. In addition, Goa (13.18%) and Manipur (9.34%) have grown at more than 9.0 percent. In the states like Odisha (2.9%), Punjab (2.25%) and Uttarakhand (2.07%) the growth is recorded more than 2.0 percent per year and in Rajasthan (1.89%), Kerala (1.87%), Madhya Pradesh (1.27%) and Gujarat it is recorded more than 1.0 percent. The higher CV recorded in Mizoram i.e., 62.48 percent, it reveals that greater the level of dispersion around the mean and the lower CV recorded in Tamil Nadu i.e., 1.06

percent, it reveals that slighter the level of dispersion around the mean. After the implementation of the RTE Act, the growth of SC students, enrolment in upper Primary Schools has registered a diversified trend; increasing trend in 9 states and declining trend in 8 states. Only two states i.e., Mizoram (100.0%) and Arunachal Pradesh (21.95%) achieved relatively strong growth per year. In the remaining states like Sikkim, Manipur, Punjab and Andhra Pradesh the growth positive which is recorded more than 2.0 percent and in Uttar Pradesh, Rajasthan and Delhi it is recorded less than 1.0 percent. The CV for SC enrolment in upper primary schools ranged between 54.41 i.e., highest in Mizoram and lowest in Odisha i.e., 0.85 percent. The lower the value of the CV in Odisha indicate the more precise the estimate of dispersion. From the table, it can be concluded that the same pattern has been observed before and after RTE Act Periods. In the majority of states, upper primary schools in terms of SC students' enrolment have shown an increasing trend during, before and after the RTE Act (Table – 4).

Table – 4: Percentage of SC enrolment in Upper Primary Schools during 2004-05 to 2015-16

State	Before RTE Act (2004-05 to 2009-10)				After RTE Act (2010-11 to 2015-16)			
	Mean	SD	CV	AAGR	Mean	SD	CV	AAGR
Madhya Pradesh	17.42	0.38	2.18	1.27	17.93	0.23	1.27	-0.44
Uttar Pradesh	27.22	0.73	2.70	-1.60	26.53	0.64	2.40	0.64
Uttarakhand	23.67	0.94	3.97	2.07	25.00	0.48	1.92	-0.71
Odisha	20.62	2.76	13.38	2.90	19.72	0.17	0.85	-0.19
Sikkim	6.13	0.21	3.48	0.50	6.93	0.54	7.80	4.44
Arunachal Pradesh	0.76	0.27	35.00	-13.28	0.48	0.13	27.80	21.95
Manipur	3.50	0.51	14.66	9.34	4.53	0.19	4.16	1.88
Mizoram	0.38	0.24	62.48	35.71	0.42	0.23	54.41	100.00
Delhi	11.12	0.53	4.77	-2.46	9.68	0.25	2.63	0.26
Punjab	41.12	2.03	4.93	2.25	37.48	0.94	2.50	1.62
Rajasthan	17.42	0.57	3.29	1.89	19.48	0.19	0.96	0.62
Andhra Pradesh	18.72	0.35	1.89	-1.07	18.95	0.52	2.74	1.50
Kerala	10.90	0.36	3.27	1.87	9.67	0.56	5.84	-3.21
Tamil Nadu	24.83	0.26	1.06	-0.63	24.27	0.26	1.08	-0.65
Goa	2.00	0.42	20.82	13.18	1.85	0.10	5.18	-3.11
Gujarat	7.58	1.13	14.95	1.16	7.75	0.23	2.96	-1.54
Maharashtra	14.42	0.52	3.59	-1.07	14.17	0.25	1.76	-0.99

Source: Source: State Report Cards on Elementary Education in India various issues from 2004-05 to 2015-16, National University of Educational Planning and Administration, New Delhi.

The growth rates of OBC students' enrolment in primary schools of all the 17 states before the RTE Act period have recorded an increasing trend in 9 states and declining trend in 8 states. Only one state i.e., Uttarakhand (16.76%) have achieved relatively stronger growth per year with more than 15.0 percent. In addition, the states of Goa (5.8%) and Kerala (3.07%) have grown at more than 3.0 percent and in Delhi (1.65%), Uttar Pradesh (1.65%) and Manipur (1.54%) growth is recorded more than 1.0 percent. In Madhya Pradesh and Tamil Nadu the positive growth is recorded less than 1.0 percent. The CV recorded in Mizoram i.e., 45.28 percent and reveals that greater the level of dispersion around the mean and the lower CV observed in Tamil Nadu i.e., 0.72 per cent. The growth rates of OBC enrolment in Primary Schools of all the 17 states after implementation of the RTE Act have recorded separate trend the states and it is increasing in 12 states and declining in 5 states. Only two states i.e., Punjab (44.74%) and Arunachal Pradesh (43.21%) achieved relatively remarkable growth rate with more than 40.0 percent per year and in the states namely Manipur (23.72%) growth is more than 20.0 percent. In addition, Uttarakhand (3.22%), Goa (2.33%), Andhra Pradesh (1.63%) and Kerala (1.6%) have grown at more than 1.0 percent and Uttar Pradesh (0.85%), Tamil Nadu (0.51%) Maharashtra (0.46%), Madhya Pradesh (0.18%) and Sikkim (0.09%) a positive growth is recorded with less than 1.0 percent. The coefficient of variation for total expenditure ranged between 60.81 percent i.e., highest in Punjab 0.75 percent i.e., lowest in Tamil Nadu. The results from the Average Annual Growth Rate before RTE Act clearly indicate that the OBC enrolment in primary schools has increased and after RTE Act period the OBC enrolment has declined in the selected states (Table – 5).

Table – 5: Percentage of OBC enrolment in Primary Schools during 2005-06 to 2014-15

States	Before RTE Act (2004-05 to 2009-10)				After RTE Act (2010-11 to 2015-16)			
	Mean	SD	CV	AAGR	Mean	SD	CV	AAGR
Madhya Pradesh	41.90	0.49	1.16	0.79	41.92	0.33	0.79	0.18
Uttar Pradesh	49.94	1.17	2.34	1.63	50.56	0.64	1.27	0.85
Uttarakhand	28.34	9.83	34.69	16.76	27.84	1.17	4.19	3.22
Odisha	35.20	2.67	7.58	-0.70	34.66	0.43	1.23	-0.26
Sikkim	39.74	0.95	2.40	-0.36	38.84	0.51	1.32	0.09
Arunachal Pradesh	0.53	0.21	39.14	-17.11	0.66	0.34	51.25	43.21
Manipur	8.50	1.08	12.67	1.54	16.08	5.10	31.72	23.72
Mizoram	0.39	0.17	45.28	-7.34	0.34	0.16	47.79	-2.08
Delhi	9.32	1.62	17.40	1.65	6.36	0.52	8.12	-6.02
Punjab	14.92	1.54	10.29	-5.56	26.34	16.02	60.81	44.74
Rajasthan	47.98	0.47	0.97	-0.68	41.10	13.66	33.23	-17.24
Andhra Pradesh	46.62	1.76	3.77	-1.46	46.50	0.99	2.12	1.63
Kerala	65.80	7.32	11.12	3.07	63.46	2.30	3.62	1.60
Tamil Nadu	68.74	0.49	0.72	0.11	69.46	0.52	0.75	0.51
Goa	9.12	1.70	18.68	5.80	7.38	0.50	6.72	2.33
Gujarat	52.80	4.33	8.20	1.60	49.84	0.38	0.77	-0.45
Maharashtra	33.98	3.11	9.14	-0.09	33.26	0.34	1.02	0.46

Source: Source: State Report Cards on Elementary Education in India various issues from 2004-05 to 2015-16, National University of Educational Planning and Administration, New Delhi.

The growth rates of OBC students' enrolment in upper primary schools of all the 17 states before the RTE Act period have recorded a mixed trend that is an increasing trend in 10 states declining trend in 7 states. Only two states i.e., Delhi (62.87%) and Uttarakhand (39.96%) achieved relatively stronger growth and Goa (19.96%) has grown at 20.0 percent. In addition, Gujarat (7.6%), Uttar Pradesh (3.51%) and Manipur (2.1%) have grown at more than 2.0 percent and in Kerala (1.77%), Odisha (1.22%), Madhya Pradesh (0.45%) and Sikkim (0.29%). The CV for OBC students' enrolment ranged between 67.51 i.e., highest in Delhi reveals that greater the level of dispersion around the mean and 0.68 i.e., lowest in Tamil Nadu indicate the more precise the estimate of dispersion. After the RTE Act have the growth recorded diverse trend that is increasing in 13 states and declining in 4 states. Only two states Arunachal Pradesh (44.58%) and Punjab (38.61%) achieved relatively strong growth rate per year the more than 35.0 percent. In addition, Manipur (13.01%), Delhi (11.92%), Goa (5.36%) and Uttarakhand (3.80%) have grown at more than 4.0 percent and in Kerala (1.59%) and Sikkim (1.28%) a positive trend is recorded with less than 2.0 percent. In the remaining states Andhra Pradesh, Maharashtra, Tamil Nadu, Gujarat and Uttar Pradesh the growth of OBC students' enrolment is recorded less than 1.0 percent. From the table, the similar kind of pattern has been observed before and after RTE Act Periods. The CV after RTE was fluctuation between 57.50 percent in Punjab and 0.76 percent in Uttar Pradesh. In majority states upper primary schools in terms of OBC enrolment shows on increasing trend during before and after the RTE Act (Table – 6).

Table – 6: Percentage of OBC Enrolment in Upper Primary Schools during 2005-06 to 2014-15

States	Before RTE Act (2004-05 to 2009-10)				After RTE Act (2010-11 to 2015-16)			
	Mean	SD	CV	AAGR	Mean	SD	CV	AAGR
Madhya Pradesh	45.16	0.41	0.90	0.45	44.48	0.44	1.00	-0.44
Uttar Pradesh	47.58	2.21	4.64	3.51	50.82	0.39	0.76	0.21
Uttarakhand	22.80	12.40	54.37	39.96	21.48	1.11	5.15	3.80
Odisha	42.24	5.96	14.12	1.22	41.58	0.35	0.84	-0.47
Sikkim	42.14	1.28	3.03	0.29	42.10	1.05	2.49	1.28
Arunachal Pradesh	0.70	0.45	64.90	-24.57	0.56	0.24	43.15	44.58
Manipur	11.12	1.37	12.28	2.10	18.94	3.70	19.56	13.01
Mizoram	0.35	0.18	50.51	-21.99	0.36	0.12	33.33	-8.33
Delhi	4.40	2.97	67.51	62.87	2.92	0.47	16.12	11.92
Punjab	16.70	1.37	8.18	-4.54	26.70	15.35	57.50	38.61
Rajasthan	49.82	0.82	1.65	-1.20	42.20	13.85	32.83	-17.29

Andhra Pradesh	46.36	0.73	1.57	-0.88	47.50	0.58	1.23	0.90
Kerala	59.94	1.49	2.48	1.77	62.66	1.95	3.11	1.59
Tamil Nadu	68.90	0.47	0.68	-0.03	69.52	0.56	0.80	0.54
Goa	8.84	1.73	19.58	19.84	11.32	0.95	8.35	5.36
Gujarat	45.22	7.24	16.01	7.60	49.30	0.62	1.26	0.31
Maharashtra	32.36	0.79	2.43	-0.16	34.36	0.55	1.60	0.68

Source: Source: State Report Cards on Elementary Education in India various issues from 2004-05 to 2015-16, National University of Educational Planning and Administration, New Delhi.

ENROLMENT SOCIAL COMMUNITY WISE - VARIANCE ANALYSIS

The average growth of the enrolment in primary schools under OBC and SC category (5.68 and 2.62) during the post RTE Act is higher than that of the pre RTE Act (-0.02 and 0.14). As regards SC enrolment in primary schools during the pre RTE Act (-0.67) is found negative and is lower than that of the post RTE Act (-1.24). It shows that the average growth of OBS and SC enrolment during the post RTE Act is higher than that of the pre RTE Act. On the contrary, the average decline of the ST enrolment during the post RTE Act is higher than that of the pre RTE Act. The RTE Act has no impact on the growth of OBC and SC enrolment. From the Table it can be found that there are differences in the average growth of schools between pre and post RTE periods. As observed from the table, the average growth of enrolment in upper primary schools under OBC and SC categories during the post RTE Act (5.66 and 7.18) is greater than that of the pre RTE Act (5.07 and 3.06). In the case of ST enrolment in upper primary schools, the average growth during the pre RTE Act (0.55) is higher than that of the post RTE Act. The table below indicates that the average growth of enrolment under the OBC and SC categories is better in the post RTE Act period than pre RTE Act period. The implementation of the RTE Act has contributed in improvement of enrolment in upper primary schools. Further, the study finds that there are mean differences in the average growth of enrolment between pre and post RTE Act periods (Table – 7).

Table – 7: Enrolment Social Community wise -Descriptive Statistics							
Variable		Before RTE Act			After RTE Act		
		N	Mean	SD	N	Mean	SD
Primary Schools	ST Enrolment	17	-0.67	8.50	17	-1.24	2.48
	SC Enrolment	17	0.14	4.46	17	2.62	11.00
	OBC Enrolment	17	-0.02	6.69	17	5.68	16.29
Upper Primary Schools	ST Enrolment	17	0.55	9.85	17	-0.58	3.81
	SC Enrolment	17	3.06	9.98	17	7.18	24.57
	OBC Enrolment	17	5.07	20.46	17	5.66	15.13

Analysis of variance was conducted to examine the statistical significance of the above mentioned differences both before and after the RTE Act regarding the growth of enrolment with parametric and non-parametric tests. Panel-A of the Table presents the results of the t-test with the null hypothesis that the estimated average growth of OBC enrolment, SC enrolment and ST enrolment between the pre RTE Act and post RTE Act is not different. The null hypothesis is accepted in all the instances as calculated t-statistics are statistically not significant. Thus, it shows that there are no significant mean differences between the pre RTE Act and post RTE Act regarding the growth of OBC enrolment, SC enrolment and ST enrolment. Panel-B of the Table presents the results of f-test with the null hypothesis that the variance in the growth of OBC enrolment, SC enrolment and ST enrolment between pre RTE Act and post RTE Act is not different. The null hypothesis is accepted in all the cases as calculated F-statistics are statistically not significant. Hence, the study concludes that there is no significant variation between pre RTE Act and post RTE Act regarding the growth of OBC enrolment, SC enrolment and ST enrolment. Panel-C of the Table provides the results of Kruskal-Wallis Test and discloses that the distribution of the growth of OBC enrolment, SC enrolment and ST enrolment between the pre RTE Act and post RTE Act is similar (Table – 7(a) & 7(b)).

Table – 7(a): Hypothesis Testing - Primary Schools			
Variables	OBC Enrolment	SC Enrolment	ST Enrolment
Panel A: t-test			
H_0 : Mean growth of Enrolment between Pre and Post RTE is not different			
t-statistics	1.334	0.860	0.270
p-value	0.192	0.396	0.789

Inference	Accepted H_0	Accepted H_0	Accepted H_0
Panel B: ANOVA			
H_0 : Mean growth of Enrolment between Pre and Post RTE is not different			
F-statistics	1.780	0.739	0.073
p-value	0.192	0.396	0.789
Inference	Accepted H_0	Accepted H_0	Accepted H_0
Panel C: Kruskal -Wallis Test			
H_0 : The distribution of Enrolment between Pre and Post RTE is not different			
Test statistic	0.601	0.003	4.272**
p-value	0.438	0.959	0.039
Inference	Accepted H_0	Accepted H_0	Rejected H_0

Table – 7(b): Hypothesis Testing - Upper Primary Schools

Variables	OBC Enrolment	SC Enrolment	ST Enrolment
Panel A: t-test			
H_0 : Mean growth of Enrolment between Pre and Post RTE is not different			
t-statistics	0.096	0.641	0.439
p-value	0.924	0.526	0.664
Inference	Accepted H_0	Accepted H_0	Accepted H_0
Panel B: ANOVA			
H_0 : Mean growth of Enrolment between Pre and Post RTE is not different			
F-statistics	0.009	0.416	0.193
p-value	0.924	0.526	0.664
Inference	Accepted H_0	Accepted H_0	Accepted H_0
Panel C: Kruskal -Wallis Test			
H_0 : The distribution of Enrolment between Pre and Post RTE is not different			
Test statistic	0.323	0.363	2.350
p-value	0.570	0.547	0.125
Inference	Accepted H_0	Accepted H_0	Accepted H_0

CONCLUSION

There has been an increase in the percentage of SC enrolment in upper primary schools in majority of states, percentage of ST Enrolment in primary and upper primary schools in almost all sample districts and the percentage of OBC enrolment at elementary level in all states since the enactment of RTE Act. There has been a significant improvement in OBC and SC enrolment at elementary level after the implementation of the RTE Act. In the case of state level, the parametric and nonparametric statistical tests have accepted the null hypothesis in almost all instances. The results of hypothesis testing reveal that there is no significant difference in the growth of selected indicators of elementary education between pre and post RTE Act.

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STUDY OF PHASE TRANSITION IN COMPOUND MULTIPLICITY DISTRIBUTION IN SELF-AFFINE SPACE

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ABSTRACT

In the present work the phase transition and its bin dependence has been studied in two dimensional ($\cos\theta - \phi$) self affine space using the experimental data of compound hadrons and pions obtained from $\pi^- - \text{AgBr}$ interactions at 350 GeV/c. The Levy indices μ measured from the analysis fulfills the requirement of the levy stable region $0 \leq \mu \leq 2$. The Levy index $\mu > 1$ indicates that a non-thermal phase transition exists for compound hadrons in the $\pi^- - \text{AgBr}$ interactions at 350 GeV/c. But $\mu < 1$ for pions reveals thermal phase transition. Further the analysis indicates different degrees of multifractality for different bin ranges.

Keywords: Hadron-nucleus interaction; Phase transition; Levy index; Ginzburg – Landau theory; self-affine scaling

1. INTRODUCTION

In high energy interactions a new matter state –quark-gluon plasma (QGP) – may be formed. The study of the multiparticle production process may be very effective and useful for probing the formation of QGP. Up to now many possible signals about the phase transition have been proposed theoretically. However, the formation of QGP as well as the signals of such phase transition is under debate. Thus further studies about the signal are needed.

In order to detect the existence of phase transition in hadronization process the Levy stable law [1,2] has been used. This law is characterized by the Levy stability index μ . This parameter μ , characterizing the width of probability distribution in the elementary partition of random cascade, takes value in the range [0,2] according to the requirement of Levy stability [1,2]. Within the region of stability $0 \leq \mu \leq 2$, μ has a continuous spectrum. The index μ allows the estimation of the cascading rate [2]. The two bound axes of the Levy index correspond to the degree of fluctuation in the particle production. $\mu = 2$ corresponds to the minimum fluctuation from self-similar branching processes. $\mu = 0$ corresponds to the maximum fluctuation that characterizes the interacting system as monofractal [3, 4]. But phase transition cannot be indicated by monofractal behavior alone. According to [2], when $\mu < 1$, there is a thermal phase transition. On the other hand, when $\mu > 1$, there is a non-thermal phase transition during the cascading process.

The above discussion about Levy-stability index is for self-similar random cascading process when the Scaled Factorial Moments (SFM) are calculated in the self-similar way, i.e. shrinking the higher dimensional phase space isotropic ally. However, phase space in high-energy multiparticle production is anisotropic as indicated by Van Hove [5]. The fluctuation pattern is also expected to be anisotropic and the scaling behavior should also be different in different directions giving rise to self-affine scaling. In self-affine scenario when the SFMs are calculated, the phase space should be shrunk according to the inherent self-affine parameter --- Hurst exponent H . The Levy index μ obtained only in this way is meaningful to characterizing the self-affine random cascading process. A very few Levy index analysis in self-affine space have been reported so far [6, 7].

Pions (shower particles) are believed to be most informative in finding the proper dynamics of the multiparticle production process. But the medium energy (30- 400 MeV) knocked out protons, which manifest themselves as grey particles in nuclear emulsion, may also play an important role in this regard. It is generally believed that grey particles are supposed to carry relevant information about the hadronization mechanism, since the time scale of emission of these particles is of the same order as that of the produced shower particles and hence are expected to remember a part of the history of these reactions. These target protons are the low energy part of intra-nuclear cascade formed in high-energy interactions. Therefore if one combines the number of gray and shower particles per event in a collision as a new parameter, named “ compound multiplicity” ($n_c = n_g + n_s$), it could also play an important role in understanding the reaction dynamics in high energy nuclear interactions. A pioneering study of compound multiplicity has been done by Jurak et. al. [8]. But so far only limited attempts have been made to work with this parameter. In order to establish that the compound multiplicity is also an

important parameter in the study of the reaction mechanism, one has to investigate other kinds of effect with this parameter, already observed for the case of shower multiplicity.

The aim of the present paper is to perform Levy stability analysis of the produced pions in two dimensional $(\cos \theta - \phi)$ phase space under self-affine scenario imposing special emphasis on phase transition study. This paper presents an in depth study of Levy stable law by dividing full bin range into different sub-bin ranges for both compound multiplicity and shower multiplicity in $\pi^- - \text{AgBr}$ interactions at 350 GeV/c .

2. EXPERIMENTAL DETAILS

We study the hadron-nucleus interaction data of $\pi^- - \text{AgBr}$ at 350 GeV/c . A stack of G5 nuclear emulsion plate was exposed horizontally to a π^- beam at CERN with 350 GeV/c .

The nuclear emulsion covers 4π geometry and provides very good accuracy, even less than 0.1 mrad , in angle measurements due to high spatial resolution and thus is suitable as a detector for the study of fluctuations in fine resolution intervals of the phase space. The emulsion plates were area scanned with a Leitz Metalloplan Microscope fitted with a semiautomatic scanning device, having a resolution along the X and Y axes of $1 \mu\text{m}$ while that along the Z axis is $0.5 \mu\text{m}$. A sample of 569 events of $\pi^- - \text{AgBr}$ at 350 GeV/c was chosen, following the usual emulsion methodology for selection criteria of the events.

The events were chosen according to the following criteria:

- The incident beam track should not exceed 3° from the main beam direction in the pellicle. This is done to ensure that we have taken the real projectile beam.
- Events showing interactions within $20 \mu\text{m}$ from the top and bottom surface of the pellicle were rejected. This is done to reduce the loss of tracks as well as to reduce the error in angle measurement.
- The incident particle tracks, which induced interactions, were followed in the backward direction to ensure that they indeed were projectile beam starting from the beginning of the pellicle.

The emission angle (θ) and azimuthal angle (ϕ) are measured for each tracks by taking readings of the coordinates of the interaction point (x_0, y_0, z_0) , coordinates (x_i, y_i, z_i) at any point on the linear portion each secondary track and coordinate (x_1, y_1, z_1) of a point on the incident beam.

According to nuclear emulsion terminology [9], the particles emitted in high-energy interactions are classified as:

- Black particles:** They are target fragments with ionization greater than or equal to $10 I_0$, I_0 being the minimum ionization of a singly charged particle. Their ranges are less than 3 mm. Their velocity is less than $0.3c$ and their energy is less than 30 MeV, where c is the velocity of light in free space.
- Grey particles:** They are mainly fast target recoil protons with energy up to 400 MeV. The ionization power of gray particles lies between $1.4 I_0$ to $10 I_0$. Their ranges are greater than 3 mm and they have velocities between $0.3c$ to $0.7c$.
- Shower particles:** They are mainly pions with ionization $\leq 1.4 I_0$. These particles are generally not confined within the emulsion pellicle.

3. METHODOLOGY

The method of scaled factorial moment is used here to analyse the intermittent type of fluctuations of emitted particles in two-dimensional phase space. Denoting the two-phase space variables as x_1 and x_2 , factorial moment of order q may be defined as [10]

$$F_q(\delta x_1, \delta x_2) = \frac{1}{M} \sum_{m=1}^M \frac{\langle n_m(n_m-1).....(n_m-q+1) \rangle}{\langle n_m \rangle^q} \quad (1)$$

where $\delta x_1 \delta x_2$ is the size of a two-dimensional cell. The brackets $\langle \rangle$ denote the average over the whole ensemble of events. n_m is the multiplicity in the m^{th} cell. M is the number of two-dimensional cells into which the considered phase space has been divided.

One has to connect δx_1 , δx_2 and M . As the starting point to solve this problem let us fix a two-dimensional region $\Delta x_1 \Delta x_2$ and divide it in to sub cells of width $\delta x_1 = \Delta x_1 / M_1$ and $\delta x_2 = \Delta x_2 / M_2$. Here M_1 is the number of bins along x_1 direction and M_2 is the number of bins along x_2 direction. Cell size dependence of factorial moment is studied by shrinking the bin widths in both directions. There are two ways of doing it. Widths may be shrunked equally ($M_1 = M_2$) or unequally ($M_1 \neq M_2$) in the two dimensions. The shrinking ratios along x_1 and x_2 directions are characterised by a parameter $H = \ln M_1 / \ln M_2$ where $0 < H \leq 1$ is called the roughness or Hurst exponent [11, 12]. If and only if the shrinking ratios along the two directions satisfy the above relation with a particular H value, the function $F_q(\delta x_1, \delta x_2)$ will have a well-defined scaling property. $H=1$ signifies that the phase space is divided isotropically and consequently fluctuations are self-similar. When $H < 1$ it is clearly understood that the phase spaces along x_1 and x_2 directions are divided anisotropically consequently the fluctuations are self affine in nature.

As noted, the intermittent behavior of the multiplicity distribution manifests itself as a power law dependence of factorial moment on the cell size as cell size approaches zero,

$$\langle F_q \rangle \propto M^{\alpha_q} \quad (2)$$

The index α_q is obtained from a linear fit of the form

$$\ln \langle F_q \rangle = \alpha_q \ln M + a \quad (3)$$

where a is a constant.

According to the predictions of a simple scale – invariant cascade model [1], the higher order scale factorial moments are related to the second order scaled factorial moments by a modified power law

$$F_q \propto F_2^{\beta_q} \quad (4)$$

which may provide some vital information about the underlying dynamics. It has been found that the slopes of the power law between higher order and second order SFM s are independent of phase space size and phase dimension [4, 13]. In other words the values of β_q summarize the scale invariance property on the global scale.

Now we can define the quantity β_q in terms of the ratio of higher order intermittency exponent to the second order intermittency exponent (or in terms of the ratio of higher order anomalous fractal dimension to the second order anomalous fractal dimension) by the following relation

$$\beta_q = \frac{\alpha_q}{\alpha_2} = \frac{d_q}{d_2} (q-1) \quad (5)$$

β_q is related to Levy index (μ) by the equation

$$\beta_q = \frac{\alpha_q}{\alpha_2} = \frac{q^\mu - q}{2^\mu - 2} \quad (6)$$

Here, μ , known as Levy index, is considered a measure of degree of multifractality [4]. Within the region of stability $0 \leq \mu \leq 2$, μ has a continuous spectrum.

Note that if $\mu = 2$, the Levy distribution will be transformed into Gaussian one. Under this condition one expects minimum fluctuation in the self-similar branching process. On the other hand, for $\mu = 0$, $d_q = d_2$ i.e. d_q does not depend on q , corresponds to monofractality and maximum fluctuation and might, therefore be a signal of QGP second order phase transition. When $\mu > 0$, $d_q \neq d_2$ i.e. d_q depends on q , the condition for multifractality is satisfied.

4. RESULT AND DISCUSSION

In order to reduce the effect of non-flat average distribution, the cumulative variables $X_{\cos\theta}$ and X_ϕ are used instead of $\cos\theta$ and ϕ [14, 15]. The corresponding region of investigation then becomes [0-1]. The new “cumulative” variable X_z is related to the original single- particle density distribution $\rho(z)$ as,

$$X_z = \int_{z_{\min}}^z \rho(z') dz' / \int_{z_{\min}}^{z_{\max}} \rho(z') dz' \quad (7)$$

where $z_{\min}$ and $z_{\max}$ are the two extreme points of the distribution. In the $X_{\cos\theta} - X_\phi$ space we divided the region [0, 1] into $M_{\cos\theta}$ & M_ϕ bins respectively. The partitioning was taken as $M_{\cos\theta} = M_\phi^H$. We choose the partition number along ϕ direction as $M_\phi = 10, \dots, 50$. The $(X_{\cos\theta} - X_\phi)$ space is divided into $M = M_{\cos\theta} \times M_\phi$ cells and calculation is done in each bin independently. In this paper the full bin range is divided into different sub-bin ranges e.g. $10 \leq M_\phi \leq 20$, $20 \leq M_\phi \leq 30$, $30 \leq M_\phi \leq 40$, $40 \leq M_\phi \leq 50$.

To analyze the anisotropic nature of compound hadrons (pions + protons) in the $(X_{\cos\theta} - X_\phi)$ phase space factorial moment of different orders for different Hurst exponents starting from 0.3 to 0.7 in steps of 0.1 and for $H=1$ are calculated for the compound multiplicity distribution data set.. We have studied the variation of average factorial moment $\langle F_q \rangle$ against the number of the two-dimensional cells M in a log-log plot for different orders ($q = 2, 3, 4$ & 5) and for the considered H values. In order to find the partitioning condition at which the scaling behavior is

Table-1: Values of different parameters (β_q, μ) for compound hadrons

Bin range	H	q	β_q	μ
$10 \leq M_\phi \leq 20$	0.3	2	1	
		3	2.39	1.23 ± 0.04
		4	3.70	
		5	5.62	
$20 \leq M_\phi \leq 30$	0.7	2	1	
		3	2.18	1.32 ± 0.02
		4	3.76	
		5	5.75	
$30 \leq M_\phi \leq 40$	0.4	2	1	
		3	2.33	1.26 ± 0.01
		4	3.62	
		5	4.85	
$40 \leq M_\phi \leq 50$	0.6	2	1	
		3	2.61	1.29 ± 0.01
		4	3.63	
		5	4.87	

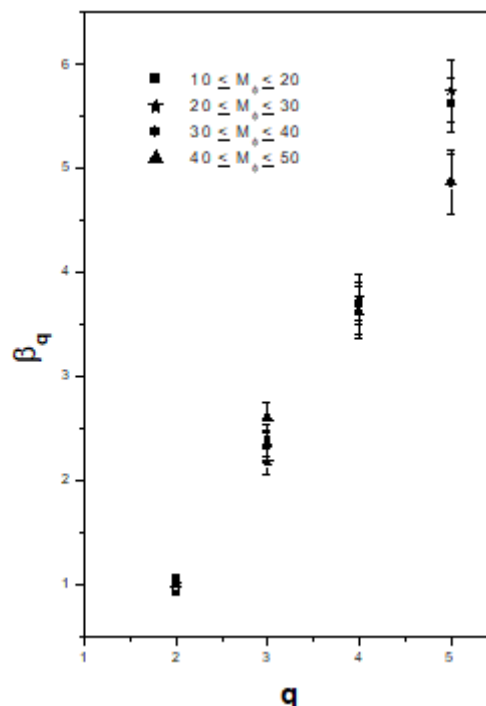
best revealed, we have performed the linear best fits. From the linear best fits intermittency exponents (α_q) are extracted. $\chi^2/\text{d.o.f.}$ values are calculated for each linear fits. We have also estimated the confidence level of fittings from the χ^2 values. The minimum value of χ^2 per degree of freedom indicates the best linear behavior. For compound multiplicity distribution the best linear fit in different bin ranges occurs at different H values which shows that the anisotropic behavior is different in different bin ranges and is best revealed at those H values.

Table-2: Values of different parameters (β_q, μ) for pions

Bin range	H	q	β_q	μ
$10 \leq M_\varphi \leq 20$	0.4	2	1	
		3	2.20	0.54 ± 0.01
		4	3.46	
		5	4.77	
$20 \leq M_\varphi \leq 30$	0.7	2	1	
		3	2.11	0.76 ± 0.01
		4	3.06	
		5	3.89	
$30 \leq M_\varphi \leq 40$	0.6	2	1	
		3	2.30	0.70 ± 0.03
		4	3.17	
		5	4.13	
$40 \leq M_\varphi \leq 50$	0.5	2	1	
		3	2.29	0.49 ± 0.03
		4	3.54	
		5	4.60	

For these H value variation of $\ln \langle F_q \rangle$ with $\ln M$ is observed for compound hadrons. To compare the self-affine behaviour with the self-similar one the variation of $\ln \langle F_q \rangle$ against $\ln M$ corresponding to $H=1$ is also observed. It is seen that χ^2 per degree of freedom values are significantly high and confidence level of fittings are very poor indicating that the scaling behaviour does not hold good at $H=1$. So the dynamical fluctuation pattern of compound hadrons in π^- - AgBr interaction at 350 GeV/c is not self-similar but self-affine in nature.

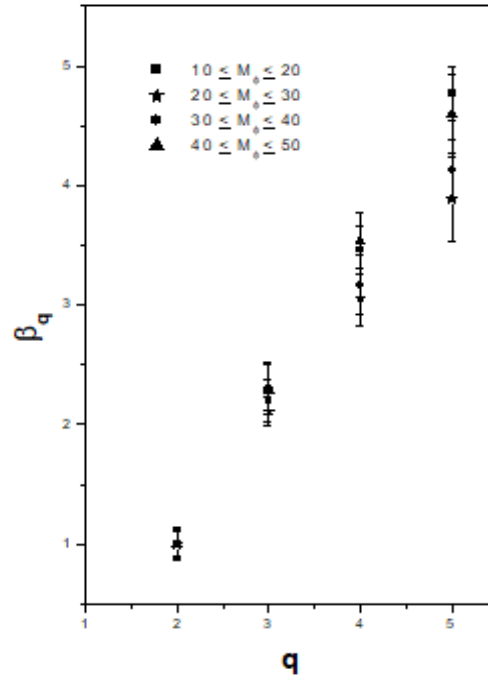
Using the values of α_q , we have calculated β_q using Eqn. (5) These values are given in Table 1. The β_q versus q graph is shown in Fig. 1. It is observed that the parameter β_q increases with increasing order of moments. This indicates the fact that compound multiplicity distribution has multifractal structure.

Figure-1: Variation of β_q with q for compound hadrons

Then Levy stability index μ is calculated using Eqn. (6) and tabulated in Table 1 which are within the permissible limit $0 \leq \mu \leq 2$. Here $\mu > 1$ would have indicated a non-thermal phase transition during the cascade process.

The whole procedure is repeated for shower multiplicity distribution also. It is seen that fluctuation pattern is self affine rather than self similar for pions also. Corresponding values are calculated and tabulated in Table 2. An evidence of thermal phase transition is obtained for self-affine fluctuations of pions.

Figure-2: Variation of β_q with q for pions



5. CONCLUSIONS

Phase transition and its bin dependence have been studied for compound hadrons and pions in self-affine $\cos \theta - \phi$ phase space. The following interesting features are revealed from the present investigation: -

1. The parameter β_q increases with increasing order of moments q , which indicates that self-similar cascading to be the mechanism responsible for multiparticle production. From our analysis we find that the particle density distribution possesses multifractal structure and the degree of multifractality is different for different bin ranges.
2. The values of the Levy stability index μ obtained in our study are consistent with the Levy stable region $0 \leq \mu \leq 2$.
3. We get $\mu > 1$ for compound hadrons for all bin ranges indicating a non-thermal phase transition in multiparticle production process. On the otherhand, for pions $\mu < 1$ is obtained revealing second order thermal phase transition and thus may serve as a possible indication of QGP being formed.

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INTERACTIVE EFFECT OF THERMAL POWERPLANT WASTEWATER, COAL FLY ASH AND DIFFERENT NITROGEN LEVELS ON GROWTH AND YIELD ATTRIBUTES OF CHICKPEA (CICER ARIETINUM L. cv. BG-256)

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ABSTRACT

The use of thermal power plant wastewater (TPPW) and coal fly ash in agriculture for irrigation need specific studies to evaluate their effect on different soils, crops and agro-climatic conditions. This study was therefore conducted to observe the suitability of wastewater for irrigation, and Cicer arietinum L.cv. BG-256 was used as a test crop. The experiment was conducted in the winter season of 2000–2001 to evaluate its effect together with the basal application of four doses of nitrogen (N_0 , N_{10} , N_{20} , N_{30} kg ha⁻¹). Fly ash (@ 10%) selected from previous study, conducted in the year 1999 was amended with soil to make the final weight 7 Kg ha⁻¹. Wastewater irrigation resulted in the increased growth and yield of the crop. Lower fertilizer dose of nitrogen @ 10 Kg ha⁻¹ together with wastewater irrigation and fly ash amended soil (FA₁₀) proved optimum, resulting in greater leaf area, plant fresh weight, dry matter (DM) and leaf NPK content, number of pods per plant, 100 seed weight and protein content relative to control which is found to be at par with higher N doses (N_{20} and N_{30}). Thus fertilizer rates could be lowered without reducing yields when using wastewater for irrigation and fly ash (FA₁₀) as an amendment to the soil.

Keywords: Thermal power plant wastewater, fly ash, yield, chickpea, nitrogen.

I. INTRODUCTION

In most parts of the developing world, fresh water supply is becoming increasingly limited due to over consumption by the fast growing population of these countries. More than 60% of the valuable water used each year is diverted for irrigating crops. For Asia, which has two third of the world's irrigated land, the figure is still higher (85%) due to unscientific irrigation. The colossal wastage of our scarce freshwater resources can be reduced by various ways, important being the reuse of wastewater in agriculture which is gaining importance nowadays because of its value as a potential irrigation source and a nutrient supplier. In addition to the manorial ingredients, it effectively augments the supply of water, the most important requirement of cultivated crops. Wastewater not only offers an alternative water irrigation source, but also the opportunity to recycle plant nutrients (1). Its application might ensure the transfer of fertilizing elements, such as nitrogen (N), phosphorous (P), potassium (K⁺), organic matter, and meso and micro-nutrients, into agricultural soil and has been reported to increase crop yield (2, 3, 4, 5, 6, 7, 8 & 9). Hence, wastewater nutrients can contribute to crop growth (10). Wastewater rich in organic materials and plant nutrients is finding agricultural use as a cheap way of disposal (11). Application of wastewater e. g. thermal power plant wastewater (TPPW) to cropland is an attractive option for disposal because it can improve physical properties and nutrient contents of soils (12). Thus, its use would help in water conservation recycling nutrients (NPK) in wastewater, reducing direct fertilizer inputs and minimizing pollution loads to receiving water bodies (13, 14 & 15).

Similarly, Disposal of high amount of fly-ash from thermal power plants absorbs huge amount of water, energy and land area by ash ponds. In order to meet the growing energy demand, various environmental, economic and social problems associated with the disposal of fly-ash would continue to increase. Every year thermal power plants in India produce more than 100 million tonnes of fly ash, which is expected to reach 175 millions in the near future (16). Disposal of this huge quantity of fly ash is posing a great problem due to its limited utilization in the manufacturing of bricks, cements, ceiling and other civil construction activities. This would further bring changes in land-use patterns and contribute to land, water and atmospheric degradation, if proper management options for handling ash are not undertaken (17, 18 & 19). Therefore, fly-ash management would remain a great concern of the century. Fly-ash has great potentiality in agriculture due to its efficacy in modification of soil health and crop performance. The high concentration of elements (K, Na, Zn, Ca, Mg and Fe) in fly-ash increases the yield of many agricultural crops. But compared to other sectors, the use of fly-ash in agriculture is limited.

While, the most important role of N in the plant is its presence in the structure of protein and nucleic acids which are the most important building and information substances of every cell. In addition, N is also found in chlorophyll that enables the plant to transfer energy from sunlight by photosynthesis. Thus, the supplies of N to

the plant will influence the amount of protein, amino acids, protoplasm and chlorophyll formed. Consequently, it influences cell size, leaf area and photosynthetic activity (20, 21, 22, 23 & 24). Therefore, adequate supply of N is necessary to achieve high yield potential in crops. In general, N deficiency causes a reduction in growth rate, general chlorosis, often accompanied by early senescence of older leaves, and reduced yield (23 & 25).

Pulses, being an integral part of vegetarian diet in the Indian sub-continent, are a known rich source of protein. However, it must be admitted that the area under their cultivation has not increased in proportion to population explosion. Consequently the per capita availability of pulses has progressively declined from 60.7g day⁻¹ in 1951 to nearly 36g in 2000 against the FAO/WHO recommendation of 80g (26). Chickpea (*Cicer arietinum* L.), an important pulse crop grown throughout the country, accounts for more than a third of the area under pulses and about 40% of their production in India, the average annual area and production being about 7-8 million hectares and about 4-5 million tonnes respectively (27).

Keeping in mind the importance of nitrogen (N), disposal problem of thermal power plant wastewater and fly ash, that can be used as nutrients for betterment of plant, and to minimize the use of chemical fertilizer, an experiment was conducted in the year 2000 at Department of Botany, Aligarh Muslim University, Aligarh on chickpea.

II. MATERIALS AND METHODS

An experiment was conducted on chickpea cultivar BG-256, to strengthen the findings of earlier experiment with inorganic fertilizer doses. Here, the comparative effect of TPPW and GW was studied. On the basis of observations made earlier, the best concentration of fly ash i.e. 10% was selected and added to the soil, making the final weight of fly ash amended soil up to 7kg ha⁻¹. Different doses of nitrogen i.e. 0, 10, 20 and 30kg ha⁻¹ were supplemented in order to work out the optimum dose for cultivar BG-256. A uniform basal dose of phosphorus and potassium at the rate of 20kg ha⁻¹ each was also applied before sowing. Healthy seeds of more or less uniform size were surface sterilized and then inoculated (28). Seeds were procured from Indian Agricultural Research Institute (IARI), New Delhi and viable *Rhizobium* culture (*Rhizobium* sp.) specific for chickpea was also obtained from IARI, New Delhi. Before irrigation the water samples were collected and analysed for physico-chemical characteristics adopting the procedures outlined in the standard methods (29). The soil/fly ash samples were collected before the start of the experiment. These samples were also analysed for standard physico-chemical properties according to some workers (30, 31, 32, 33, 34, 35 & 36). For investigating the comparative effect of TPPW, GW and fly ash under inoculated conditions, observations were carried out at vegetative, flowering, fruiting and at harvest stages. For the study of the root, the plants were uprooted carefully and washed gently to clear all the adhering particles. For assessing dry weight, three plants from each treatment were dried, after taking their fresh weight, in hot air oven at 80°C for two days and weighed. The area of leaves was measured using leaf area meter (LA 211, Systronics, India). For nodule number, whole plant was uprooted with the precaution that the roots or the nodules may not be damaged. Samples were washed gently to wipe away all the adhering foreign particles and the number was carefully counted.

NRA and chlorophyll were estimated (37 & 38). Healthy leaves were collected at different samplings stages for the estimation of N, P and K contents (39 & 40). Potassium was estimated with the help of flame photometer. Ten millilitres of aliquot was taken and K was read using the filter for potassium. A blank was also run side by side with each set of determinations. The readings were compared with a calibration curve plotted against known dilutions of standard potassium chloride solution. At harvest, yield attributes including seeds per pod, pods per plant, 100-seed weight, and seed yield per plant were noted and protein content (41) in the seeds was measured. The data for the growth and yield of each experiment were analysed statistically taking into consideration the variables (42). The 'F' test was applied to assess the significance of data at 5% level of probability ($p \leq 0.05$). The error due to replication was also determined.

Table 1. Chemical characteristics of soil and fly ash before sowing. All determinations in mg l⁻¹ in 1: 5 (soil-water extract) or as specified.

Soil		Fly ash	
Determinations		Determinations	
Texture	Sandy loam	CEC (meq 100g ⁻¹ fly ash)	7.34
CEC (meq 100g ⁻¹ soil)	2.88	pH	8.90
pH	8.30	Organic carbon (%)	2.19
Organic carbon (%)	0.789	EC (μ mhos cm ⁻¹)	1037.00
EC (μ mhos cm ⁻¹)	281.00	NO ₃ -N (g kg ⁻¹ fly ash)	—
NO ₃ -N (g kg ⁻¹ soil)	0.243	Phosphorus (g kg ⁻¹ fly ash)	2.22

Phosphorus (g kg ⁻¹ soil)	0.120	Potassium	11.00
Potassium	21.00	Calcium	19.03
Calcium	30.29	Magnesium	16.59
Magnesium	18.24	Sodium	14.27
Sodium	13.18	Carbonate	13.26
Carbonate	18.36	Bicarbonate	64.37
Bicarbonate	81.64	Sulphate	26.25
Sulphate	18.28	Chloride	19.11
Chloride	28.13		

Table-2: Chemical characteristics of ground water (GW) and thermal power plant wastewater (TPPW). All determinations in mg l⁻¹ or as specified.

Determinations	Sampling			
	I		II	
	GW	WW	GW	WW
Ph	7.3	7.9	7.5	8.0
EC (μ mhos cm ⁻¹)	710	880	700	840
TS	902	1298	947	1288
TDS	520	637	528	621
TSS	404	658	431	694
BOD	16.17	68.10	17.35	69.24
COD	38.24	124.18	37.19	129.24
Mg	17.84	26.36	18.18	28.22
Ca	26.17	41.84	24.18	38.36
K	7.52	16.67	8.24	14.39
Na	17.13	44.29	15.38	41.37
HCO ₃ ⁻	67	93	69	92
CO ₃	21	38	22	37
Cl ⁻	69.13	111.17	65.84	105.67
PO ₄	0.70	1.22	0.74	1.34
NO ₃ -N	0.74	1.19	0.76	1.13
NH ₃ -N	2.19	5.31	2.10	5.12
SO ₄	46	65	47	64

III. RESULTS AND DISCUSSION

In this factorial randomized pot experiment, the comparative effect of two irrigation water sources and three basal levels of nitrogen, supplemented with phosphorus and potassium at the rate of 20kg ha⁻¹ each applied uniformly before sowing, was studied on chickpea (*Cicer arietinum* L.) cv. BG-256. The growth characteristics and physiological parameters were recorded at three stages. Yield attributes including seed yield and seed protein content were recorded at harvest.

TPPW proved efficacious for all the growth parameters studied, while GW gave significantly lowest value at vegetative, flowering and fruiting stages respectively. Among various nitrogen treatments (N₀, N₁₀, N₂₀ and N₃₀), N₁₀ proved optimum for all growth parameters studied, being at par with N₂₀; followed by higher dose of nitrogen i.e. N₃₀ which gave at par values at all the sampling stages. Nitrogen treatment of 10kg ha⁻¹ proved optimum when interacted with TPPW as well as GW. TPPW-nitrogen combination gave better results than GW-nitrogen combinations, whereas lowest values were recorded by GW×N₀. The wastewater was enriched with considerable amount of nutrients which are considered essential for maintaining soil fertility and enhancing plant growth and productivity. Among them, nitrogen (N) is the most important element limiting plant growth. It is invariably required in large quantities and in wastewater it was present in both ionic forms (Table 2) and thus deserves special consideration. As vegetative growth includes formation of new leaves, stem and roots, the involvement of N through protein metabolism controls them. This was also clearly evident from the enhanced growth under the wastewater irrigation (Fig. 1, 2 and 3). Suitability of ammonium (NH₄⁺-N and NO₃⁻-N) ions for the growth and development of plants depends upon many factors (43). However, normally the highest growth rate and plant yield (Fig. 7b) are obtained by a combined supply of both; therefore, in the present study, the enhancement in growth could be due to cumulative effect of ammonium as well as nitrate ions together (44). It is noteworthy that applied ammonium nitrogen (NH₄⁺-N) is toxic for some higher plants (45).

However, in the presence of nitrate-nitrogen ($\text{NO}_3\text{-N}$), it has been reported to benefit wheat (*Triticum aestivum*) (46) and chickpea (47). Thus the observed nutritional superiority of wastewater for growth of chickpea was not exceptional and possibly explains better performance of crop growth under wastewater irrigation (Fig. 1, 2 and 3). A substantial increase in dry matter of test plants was also observed (Fig. 1, 3 and 4) because of the increased leaf area and expansion (Fig. 2) which might have influenced the light absorption within plant causing stimulation of PN, thereby optimizing the CO_2 assimilation and photosynthetic production (48). The increase in leaf area brought about by the N supply causing expansion of individual leaves has also been reported by Taylor et al. (49) and Gastal and Lemaire (50). The possible reason for this may be through its effect on cell division and cell expansion (51). Another essential nutrient, P when it is supplied in limited amounts to sugar beet (*Beta vulgaris*); it has much greater impact on growth than on photosynthesis (52 & 53). During the present study better growth of plants was observed receiving wastewater having phosphorus (Table 2) in addition to other nutrients, and it was also comparatively richer than ground water. The observation of improved performance of the crop receiving wastewater was therefore understandable. But, a regular supply of the enriched wastewater up to harvest ensured availability of P and thus improved the growth and which ultimately led to higher seed productivity. Next to N and P, K is the third most important macronutrient required in the largest amounts by the plant. It is known to play a significant role in stomatal opening and closing (54) and under light conditions the guard cells produce abundant adenosine triphosphate (ATP) in photosynthetic phosphorylation, thus supporting active K^+ uptake with sufficient energy (55), and the resulting high-turgor pressure thus causes the opening of the stomata. The diffusion of carbon dioxide (CO_2) into the stomata is followed by its transport into the chloroplasts where it is reduced by ribulose-1, 5-biphosphate carboxylase/oxygenase (RuBPCO). It is this supply of CO_2 which catalyzes reversible dehydration of bicarbonate (HCO_3^-) to CO_2 in close proximity to the CO_2 -fixing enzyme (48). It is also well known that N is fully utilized for crop production only when K^+ is adequate (56) and the presence of K^+ in wastewater was nearly double the amount present in groundwater (Table 2). Therefore, the crop under study was benefitted not only due its own physiological role (57) but also by enhancing the effect of N. This was also strengthened by the presence of higher N, P and K contents in the leaves of the plants receiving the wastewater (Fig. 6). In addition to these three major macronutrients explained above, the presence of other essential nutrients like sulphur (S) could have also played a vital role in plant metabolism (58). It may be pointed out that the application of N in the form of urea is ineffective unless S is applied simultaneously, and its deficiency reduces the leaf area (59) besides decreasing the chlorophyll contents (60). Moreover, in S-deficient plants not only does the protein content decrease but also the S content in proteins, indicating that proteins with lower proportions of methionine and cysteine but higher proportions of other amino acids such as arginine and aspartate are synthesized (48). This decrease in the S-rich proteins is not confined to wheat grains but can also be found in other cereals and legumes (61), and the lower S content of the proteins influences the nutritional quality considerably (62). In the present study the total protein was significantly enhanced in the wastewater-fed plants (Fig. 7c). Similarly, the presence of calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions (Table 2) could have further added benefits, as Ca^{2+} , being an essential component of the cell wall, is involved in cell division (63) while Mg^{2+} is a central atom of chlorophyll and is required for structural integrity of the chloroplast (64) on which the rate of photosynthesis is directly dependent. It may be pointed out that the chlorophyll content was enhanced in plants grown under wastewater (Fig. 5 and Table 2) indicating the possible involvement of Mg^{2+} in addition to other nutrients. The observed enhanced growth ultimately led to increase in 100-seed weight (Fig. 7a). Ensured supply and availability of the above mentioned nutrients might have played a cumulative role in enhancing the metabolic activities and finally the seed yield and protein (Fig. 7b&c).

Fly ash (FA_{10}) when applied with nitrogen (N_{10}) gave better results being at par with $\text{FA}_{10}\text{N}_{20}$ and $\text{FA}_{10}\text{N}_{30}$ as compared to FA_{10}N_0 for all growth, physiological and yield parameters. FA amendment increases the porosity and water-holding capacity, due to the fine-textured nature of fly ash, which helps in improving the physical health of the soil for supplying all essential nutrients in significant quantities for plant growth. The addition of fly ash into soil increased the organic carbon content which helps in binding soil particles in aggregates and improving the water-holding capacity of soil. Such improvement in agronomic properties of soil by constituents of fly ash has also been reported elsewhere as well at Aligarh (65, 66, 67 & 68).

Plant growth is the expression of interplay between meristematic activities and metabolic processes leading to an increase in biomass (64). In addition to the role of N in cell division and expansion (69), it is also essential for a number of biologically important molecules. Therefore, the requirement of N (and the other essential nutrients) during the vegetative growth of a plant is determined primarily by the rate of CO_2 assimilation and if it is high, the required nutrients must be correspondingly at optimum levels in order to convert the photosynthates efficiently into other metabolites.

Thus, growth and yield parameters were noted to be significantly affected by N application (N_{10} proving optimum) as a result of the cumulative enhancement of growth and yield parameters, including seed yield (Figs. 1-7). This dose was also found to be optimum for leaf area, NRA and chlorophyll content (Figs. 2&5) which finally led to more pods and the heavier seeds (Fig. 7b). By contrast application of excess N (N_{30}) resulted in decreased grain yield and proved deleterious. Toxicity due to N, when applied as urea is known to appear at two stages of plant growth. The first at seedling stage may be due to accumulation of NH_4^+ (after hydrolysis of urea) which becomes toxic at pH 8 and above. The second is due to accumulation of NO_2^- under certain conditions damages young plants (70). Contrary to above findings, higher optimum doses up to 30 kg N ha^{-1} were reported for chickpea by Sharma *et al.* (71) and Krishna *et al.* (72). It was not surprising that in our study comparatively lower dose (N_{10}) proved effective as the applied wastewater had sufficient N in the form of NH_4^+ and NO_3^- ions. In case of legumes due to rhizobial activities, host plants grow well in soil even with low N doses and no benefit from this association may occur if high levels of fertilizer N are given (73). This was in conformity with the present observations. Since N_{10} and N_{20} were at par in their effect therefore it may be concluded that N_{20} led to luxury consumption, thereby proving wasteful, while N_{30} affected adversely thereby proved toxic when wastewater was the source of irrigation, which proved economically as well as environmentally viable.

When nodulation was considered similar observations were made. The beneficial effect of lower dose (N_{10}) was noted to increased root formation (Fig. 3). This provided more surface area for bacterial infection. However, application of N beyond a certain level is known to delay and even suppress nodulation (74, 75, 76, 77 & 78). On the other hand, the crop grown without nitrogen (N_0) expectedly gave significant lowest values as some starter dose of N is always needed even by the leguminous plants to grow normally. Nitrate reductase levels have been shown to fluctuate in response to changes in environmental conditions, including availability of N (79 & 80). Enzymes are sensitive to nutrient levels as is indicated in the present study where NRA was found to decrease with comparatively higher N dose (Fig. 5a). Similar observation has been made in trifoliate leaves in *Phaseolus lunatus* at different canopy positions by Wallace (81) and Andrews *et al.* (82). The induction of NRA requires very low concentration of nitrate suggesting that nitrate is actually sensed more as a hormone than as a nutrient (83). Nitrogen also increased the leaf chlorophyll and NPK contents as it increased the availability of substrate for protein synthesis allowing the development of more and larger chloroplasts with extensive thylakoid system and larger stomal volume (84). The increase in leaf NPK (Fig. 6) was due to the synergistic interplay of the three nutrients, which are known to accelerate root proliferation, thus, extracting more nutrients present in the root zone leading to development of larger canopies (Fig. 2) and greater dry matter accumulation (Figs. 1&2). Similar positive interactions between N and P were also noted by Russell (85) and between N and K by Murphy (86). N as an essential macronutrient has the distinction of being absorbed both as cation as well as an anion. This puts N in a unique relationship of both an anion-cation as well as cation-cation interaction.

Expectedly the application of N enhanced seed protein contents (Fig. 7c) as it chief constituents of proteins. Its adequate supply can increase the amino acid levels through the conversion of organic acids produced from carbohydrates during respiration. As pointed out by Pretty (87), some quality factors in a few grasses were related to the effective utilization of N and the conversion of N-compounds into true proteins. Improvement in seed protein content was also boosted due to the addition of K, applied uniformly as the starter dose alongwith N, as K influences the level of some non-protein N components and positive role in converting these proteins. The N effect on seed protein was also dependent upon the type of crop, its cultivars and other environmental factors including water. Smika and Greb (88) observed the relationship of soil NO_3^- -N and soil water for the protein in wheat. The former was positively correlated with grain protein where opposite relationship was noted due to available soil water. In their opinion adequate soil moisture in addition to N was the important factors for this parameter. Since, the present work was carried but in pots and water was given regularly, therefore, possible protein in the present study was increased.

Finally it was concluded that Plants irrigated with TPPW performed better when supplemented with low fertilizer N level, N_{10} , thus proving the utility of wastewater in saving some amount of costly nitrogenous fertilizers which simultaneously solving the problem of its disposal partially. N_{30} proved deleterious, while N_{20} showed luxury consumption when given with wastewater. Nodulation and seed protein content were also increased by the application of N_{10} , while N_{30} decreased nodulation.

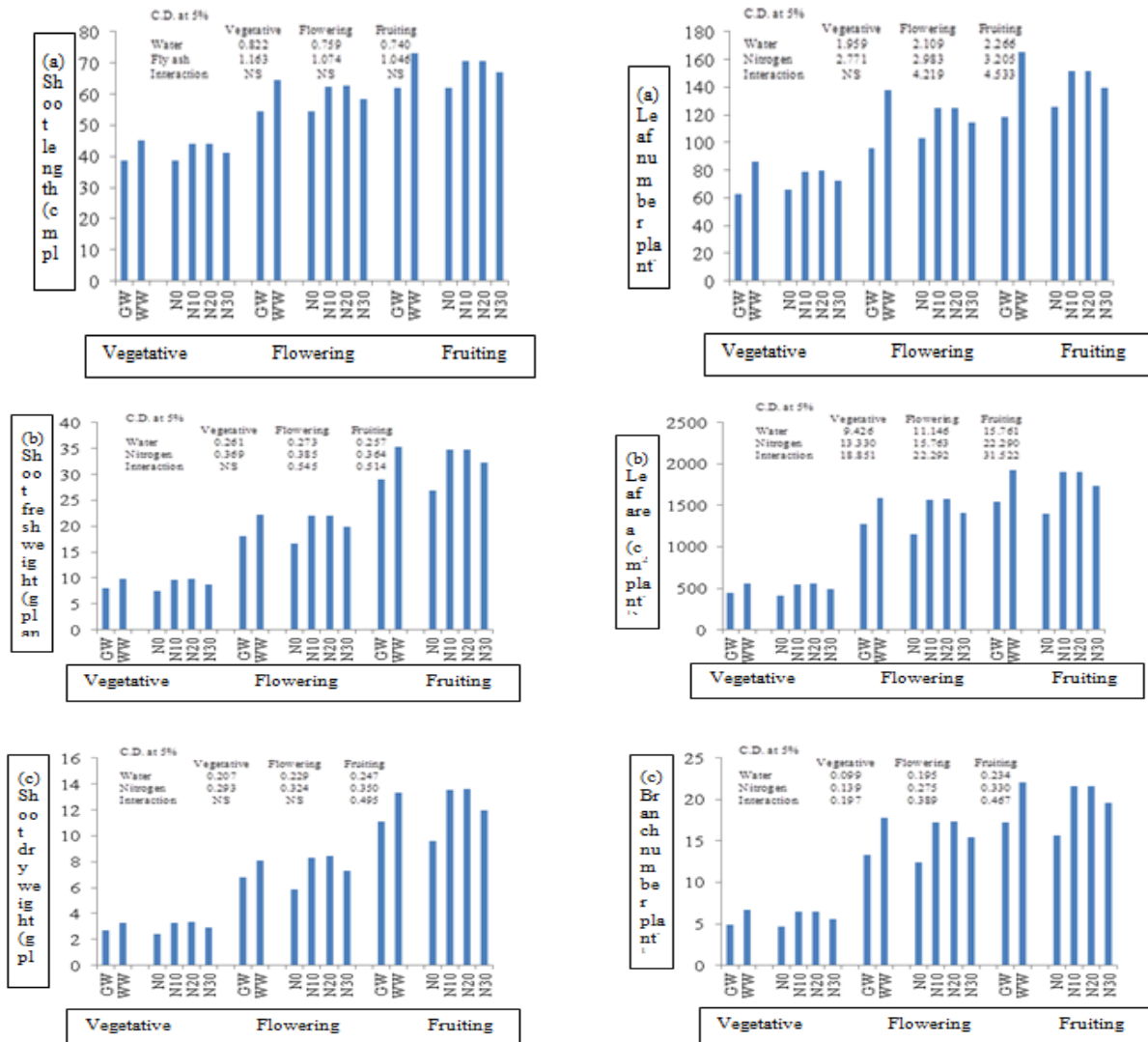
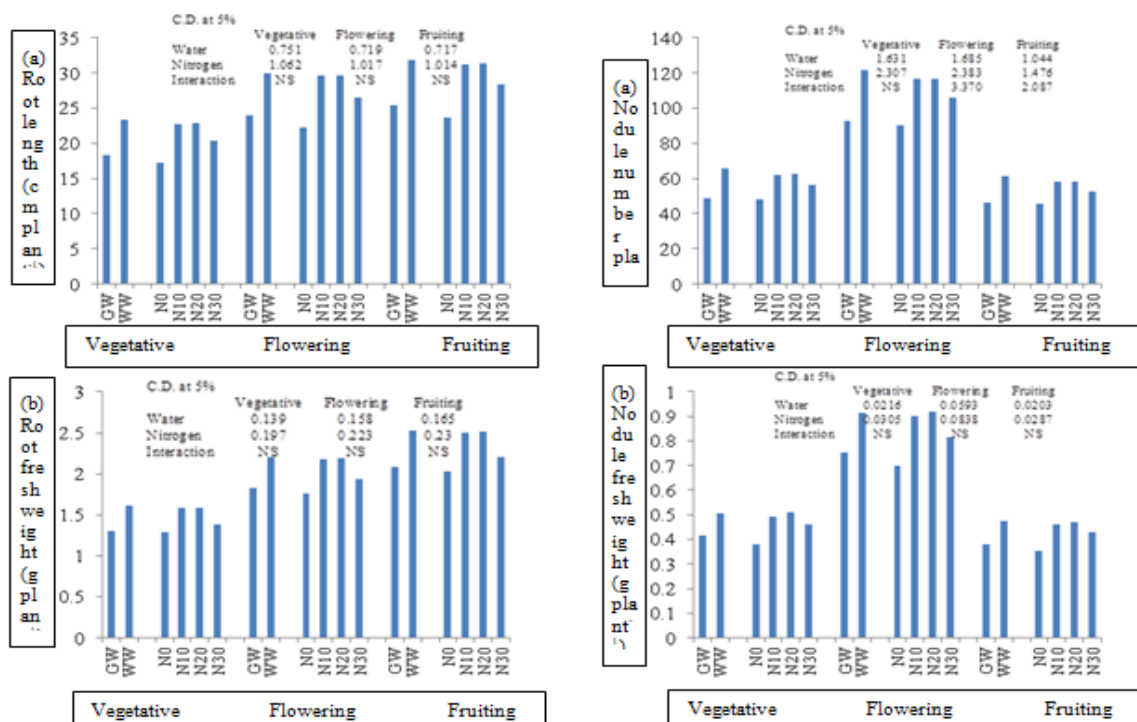


Fig-1: Effect of wastewater and nitrogen on chickpea cv. BG-256

Fig. 2. Effect of wastewater and nitrogen on chickpea cv. BG-256



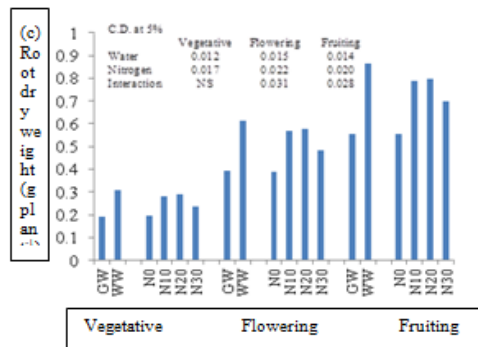


Fig-3: Effect of wastewater and nitrogen on chickpea cv. BG-256

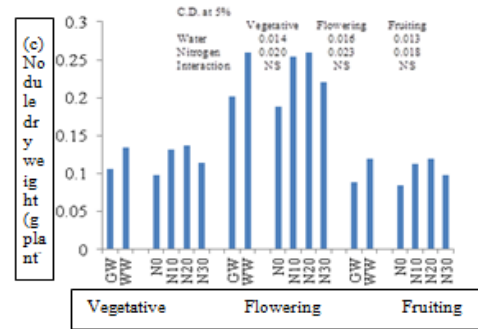


Fig. 4. Effect of wastewater and nitrogen on chickpea cv. BG-256

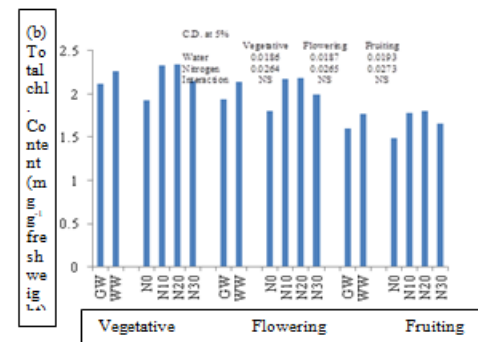
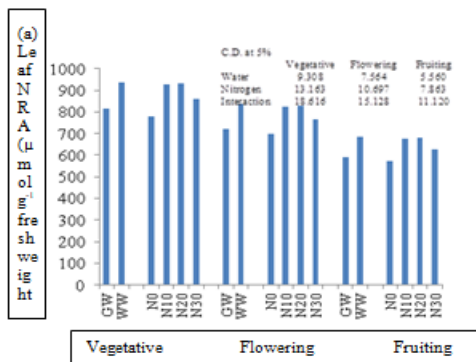


Fig. 5. Effect of wastewater and nitrogen on chickpea cv. BG-256

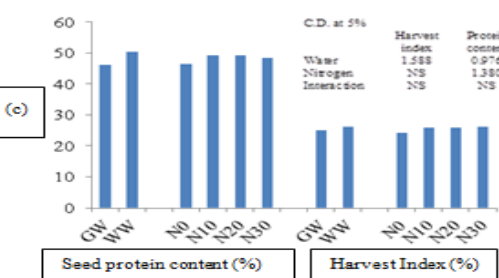
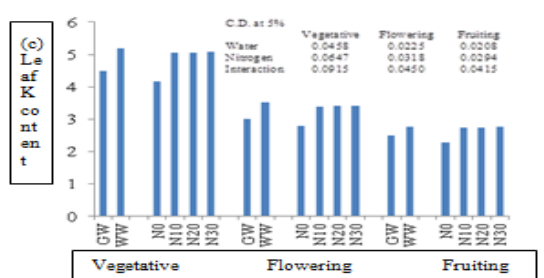
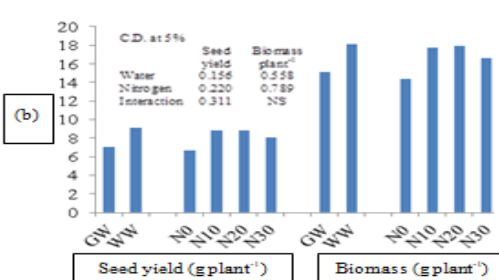
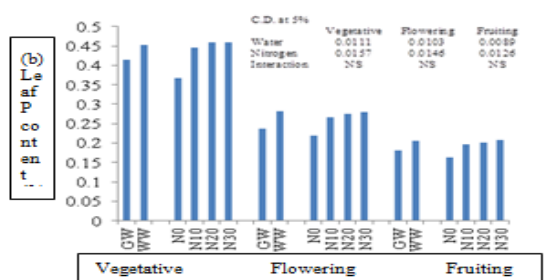
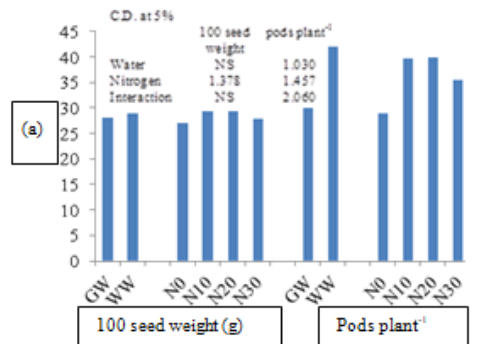
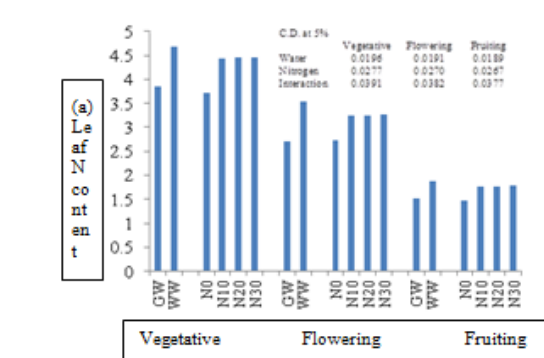


Fig. 6. Effect of wastewater and nitrogen on chickpea cv. BG-256

Fig. 7. Effect of wastewater and nitrogen on chickpea cv. BG-256

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ASSESSMENT OF THE DEVASTATING EFFECTS OF FLOOD DISASTER ON HUMAN LIVES AND PROPERTY OF DHOBI MOHALLA, HAZRATBAL, KASHMIR (INDIA)

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ABSTRACT

A survey was conducted by using standard questionnaire method to gain information about the impacts caused by the disaster. During the survey though no loss of life was found, but about 83.33% of the houses were found partially damaged and 16.67% houses were fully damaged. Almost all the families in the study area were suffering from infections due to prevailing unhygienic conditions and lack of sanitary facilities. Most affected were children 68% followed by women (18%) and men (14%). Besides this per capita expenditure increased from 6000 Indian rupees to 7000 Indian rupees per month. The affected people were found residing in damaged houses, temporary sheds and tents (58% and 25% and 2% respectively) in cold season which aggravated their miseries. In nutshell people were not ready to withstand such a natural calamity and lack of early warning, rescue and rehabilitation was the main cause of post disaster problems.

Keywords: Dhobi Mohalla, Disaster, Flood, Impacts, Loss,

INTRODUCTION

A flood is a natural disaster or man-made event which leads to inundation of extensive land area with water for several days in continuation. In comparison to this a flash flood is, in short, a sudden local flood of great volume and short duration which follows within a few (usually less than six) hours of heavy or excessive rainfall. From the hydrological point of view, factors that have a decisive influence on the occurrence of flash floods - apart from the intensity and duration of the rainfall - are topography, soil conditions, and coverage of the terrain. A river that overflows its banks erodes roads, spoils pavements, covers the fields and meadows with sand and silt and easily washes away huts and earthen houses. In houses remaining intact it inundates the basements and lower floors which stay damp long after the flood has subsided. The phenomenon of the flash flood is one of the most difficult natural hazards to predict in terms of time and place of occurrence. As a result, it is challenging for the concerned authorities and communities to respond appropriately and devise mitigation plans to reduce the damage.

FLOOD GENESIS IN KASHMIR VALLEY

The dominating regimes of western disturbances experienced during the winter to spring months and monsoons controlling the summer and early autumn precipitation are the governing factors controlling the climate and weather of kashmir valley. The high rainfall in the southern area of Kashmir valley and along the Pir panjal mountain range gives credibility to the power of the monsoons in the experiential extreme rainfall event in the 2014 Kashmir floods. With the developed and mismanaged floodplains of river Jhelum lending thrust, the condition attained disturbing proportions owing to the extended severe rainfall proceedings observed during the first week of the September over the entire Kashmir. The data from 18 weather stations located in different areas of kashmir valley was observed and it was understood that the primary cause of the 2014 flood event was a high spell 18 inch of rainfall falling over the entire catchment of river jhelum in 30 hours. Huge and rapid runoff was generated in the catchments of various tributaries located in the south kashmir which the main channel river jhelum could not hold. The main lifeline of kashmir valley i.e river jhelum flowing from south to north of kashmir valley has a carrying capacity of 35,000 cusecs and the supplementary flood channel to parrypora via rambagh has a capacity of only 15,000 cusecs. The total discharge of river jhelum was 135000 cusecs as on 6th september at sangam, this figure clearly indicates the enormity of the extreme flood event of september 2014. The inundation showed a high peak on 8th september in the south of the kashmir valley and after that sheet of flood event receded and it began to start inundation of down stream areas mainly the srinagar city. This extreme flood event inundated approximately 557 Sq Kms of valley of kashmir and affected 22 lakh people. Of the total inundated area, 444 sq kms comprised of agriculture and 67 sq kms of residential and commercial area.

STUDY AREA

Dhobi Mohalla is situated about 12kms from Srinagar city. It is just adjacent to the Hazratbal Shrine and on periphery of Dal Lake. The Mohalla comprises of about 250 houses, the population of the area is about 12000. The livelihood of majority of the people depends upon Dal Lake. The area is mostly occupied by shopkeepers, boatmen, fishermen and labourers.

METHODOLOGY

A survey was conducted by asking a number of questions to the residents of Dhobi mohalla by using standard questionnaire method (Table 1) in order to gain information regarding various damages or losses which have occurred in the area.

Table-1: Questionnaire used for survey

S.No.	Property Type	Damage Cost	Damage Type
01	House		
02	House Hold		
03	Vehicles		
04	Domestic Animals		
05	Crop Damage		
06	Any Other (if any-specify)		

Loss to health and property

The September floods proved very disastrous for the area. When the lock gate got damaged at Dal Gate on 7th September where water from river Jhelum entered into the Lake. The normal water level of Dal is nine feet while the danger level is 12 feet. After Jhelum waters entered Dal its level rose up to record 21 feet submerging localities in and around it. Most residents of the locality whose houses were damaged had shifted to their relative's homes for shelter. However, some of the residents of the area were found in the partially damaged houses and the rest of the residents were residing in the temporary built shelters, others were engaged in reconstruction of their damaged walls around their houses. The September floods proved very disastrous for the area. When the lock gate got damaged at Dal Gate on 7th September where water from river Jhelum entered into the Lake. The normal water level of Dal is nine feet while the danger level is 12 feet. After Jhelum waters

entered Dal its level rose up to record 21 feet submerging localities in and around it. The whole areas around Dal Lake got submerged, about one and half storey of every house remained under water for 11 days. Around ten houses were fully collapsed in the area and the walls of around 48 houses went down and the rest developed cracks.

RESULTS

The results revealed during survey are presented below and summarised in Table 2.

Table-2: Data collected during survey

Fully damaged houses	10
Partially damaged houses	50
No. of deaths	0
Health related problems	All infected
Compensation (fully damaged houses)	Rs 75,000/house
Compensation (partially damaged houses)	Rs 3,600/house
Water level	12 feet

Loss of houses

Affected Households were 60 in number with 10 fully destructed houses (worth Rupees 20 to 30 lacs). Partially destructed houses were 50 (worth 1.5 to 5 lacs). The dwellers in the area are mainly labourers, shikara and motor boat owners earning a little amount of livelihood. During the survey, about 83.33% of the houses were found partially damaged and 16.67% houses were fully damaged (Fig. 1)

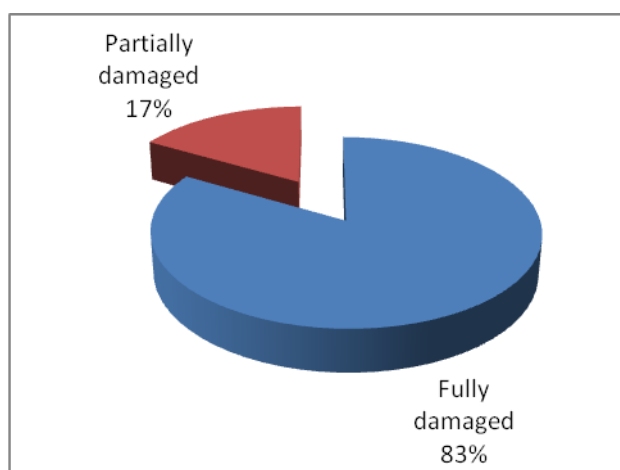


Fig-1: Houses damaged

Health Conditions

Almost all the families in the study area were suffering from infections due to unhygienic conditions which prevailed after the floods. Most affected were children 68% followed by women (18%) and men (14%) shown in Fig. 2.

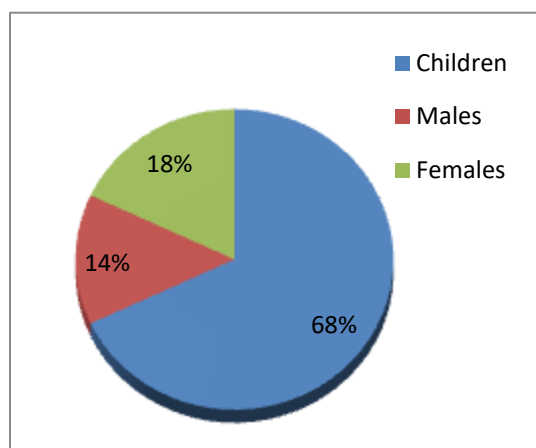


Fig-2: Health status of affected people

Increase in per capita expenditure of affected people

Expenditures of each family had got increased after floods due to cleaning, health issues and rehabilitation from 6000 Indian rupees to 7000 Indian rupees per month (Fig. 3). Majority of the affected people were found residing in tents in cold season which aggravated their miseries. Besides the market price has also gone up after the floods which made the affected people more worried due to increase in expenditures.

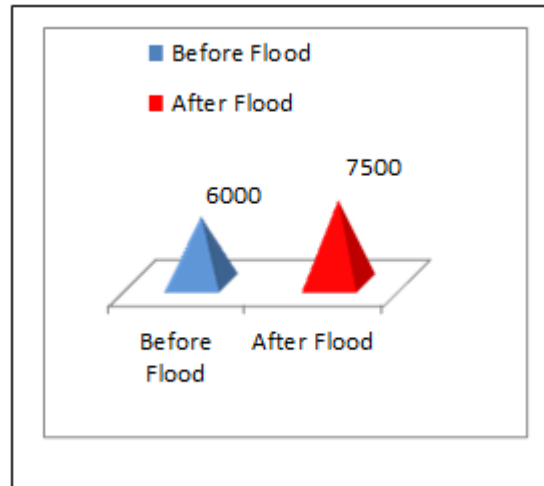


Fig-3: Increased monthly Expenditures.

Relief provided to affected people

The immediate relief distribution in the area has almost completed with a little more to handle. The compensation of 75000 INR has been provided to those having their houses gutted completely while 1200-3800 INR has been given to affected as per the damage caused to them. 13% households claimed of no compensation, 48% affected households were provided full compensation and partial compensation was provided to 39% households (Fig.4).

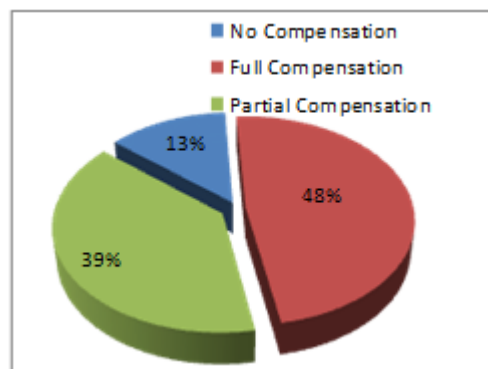


Fig.4: Relief percentage provided to people.

Shelter status and environmental conditions found in study area

Affected people whose homes were completely damaged were living in the temporary Sheds made of the iron sheets in cold autumn. Majority of people were living in the damaged houses (58%), and were facing severe cold going on at that time of the season which was their biggest cause of psychological problems and health issues (Fig. 5).

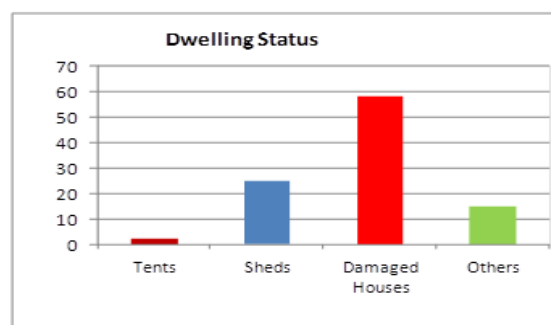


Fig-5: Shelter Status of affected people

CONCLUSION AND SUGGESTED MEASURES

Major floods cannot be stopped but can be managed with proper strategy to minimize the loss of life and property the various measures that can help in minimizing the loss of life and property are as:

To prevent more floods in future, there's an urgent need to manage and restore our water bodies which act as important flood reservoirs

- We have to put a stop to the indiscriminate deforestation, encroachment of flood basins, tributaries and provide maximum corridors to rivulets, streams and tributaries
- Massive catchment area treatment and creation of water reservoirs where possible in the catchment.
- Remodeling of flood channel for a discharge of 30000 cusecs.
- Dredging and removal of encroachments in wular lake
- Dredging of Jhelum river
- There is a need to improve the flood forecasting techniques in Kashmir valley, plagued by lack of instrumentation, by using simulation models and satellite based observations.
- Immediate de-siltation of lakes, revival of flood basin of Khushalsar, Gilsar, Anchar, Hokharsar, Shalabugh, Haigam, preparing a flood zonation map,
- Construction of an alternate flood channel from Sangam/Kandizal to Wular and regular dredging of rivers to meet the possible future scenarios.
- Strengthening of the bunds and embankments at places raising them so that the low lying areas around them are safe.

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MAHATMA GANDHIJI VISION ON SANITATION AND CLEANLINESS IN INDIA

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ABSTRACT

On 2nd October, 2014, the Indian Prime Minister, Narendra Modi, launched a nation-wide cleanliness campaign on the occasion of Mahatma Gandhi's birth anniversary. The concept of Swachh Bharat is to provide sanitation facilities to every family, including toilets, solid and liquid waste disposal systems, village cleanliness, and safe and adequate drinking water supply. We have to achieve this by 2019 as a befitting tribute to the Father of the Nation, Mahatma Gandhi, on his 150th birth anniversary. As a searcher of Truth, Gandhiji maintained meticulous life style and accorded highest importance to cleanliness. As father of the nation, he realized indispensable place of sanitation in nation building and stated 'Cleanliness is only next to Godliness' He made cleanliness and sanitation an integral part of the Gandhian way of living. His dream was total sanitation for all. Cleanliness is most important for physical well-being and a healthy environment. It has bearing on public and personal hygiene. It is essential for everyone to learn about cleanliness, hygiene, sanitation and the various diseases that are caused due to poor hygienic conditions. According to World Bank study, lack of toilets and other proper sanitation facilities costs India nearly \$54 billion a year through hygiene-related illness, lost productivity and other factors stemming from poor sanitation. Census of India collected data on access to water and sanitation shows that only 31 per cent rural households were having any toilet facility in their households. According to Census 2011, at national level only 32.7% HHs have toilet facilities. Poor performance of sanitary facilities continues to be serious concern for the country. In fact, Even after more than 68 years of Independence from British rule, over 60 per cent of Indians including women still use open air and unhygienic facilities for answering the call of nature. Thus, Gandhiji's vision of Clean India to not fulfill after 68 years of Independence. Modi also delivered a short speech highlighting the need of cleanliness to fulfill Gandhiji's vision of Clean India. Through this paper I would like to discuss the importance of sanitation and cleanliness, rural sanitation scenario, sanitation campaigns and its performance with factors attributed to poor performance and also to suggest strategies to improve the impact of sanitation.

Keywords: Mahatma Gandhi, Sanitation, Hygiene, Harijan, Campaigns, Cleanliness

INTRODUCTION

On 2nd October, 2014, the Indian Prime Minister, Narendra Modi, launched a nation-wide cleanliness campaign on the occasion of Mahatma Gandhi's birth anniversary. The concept of Swachh Bharat is to provide sanitation facilities to every family, including toilets, solid and liquid waste disposal systems, village cleanliness, and safe and adequate drinking water supply. We have to achieve this by 2019 as a befitting tribute to the Father of the Nation, Mahatma Gandhi, on his 150th birth anniversary. As a searcher of Truth, Gandhiji maintained meticulous life style and accorded highest importance to cleanliness. As father of the nation, he realized indispensable place of sanitation in nation building and stated 'Cleanliness is only next to Godliness' He made cleanliness and sanitation an integral part of the Gandhian way of living. His dream was total sanitation for all. Cleanliness is most important for physical well-being and a healthy environment. It has bearing on public and personal hygiene. It is essential for everyone to learn about cleanliness, hygiene, sanitation and the various diseases that are caused due to poor hygienic conditions. According to World Bank study, lack of toilets and other proper sanitation facilities costs India nearly \$54 billion a year through hygiene-related illness, lost productivity and other factors stemming from poor sanitation. Census of India collected data on access to water and sanitation shows that only 31 per cent rural households were having any toilet facility in their households.

According to Census 2011, at national level only 32.7% HHs have toilet facilities. Modi also referred to a WHO report that says every average Indian has to spend Rs 6500 every year due to poor sanitation. If there are hygienic conditions in the country, substantial money can be saved every year. Poor Sanitation and lack of toilets cost of India nearly three lakh crore rupees because of hygiene related illness resulting in poor productivity. The Problem is not only economic but of human dignity also. The practice of manual scavenging still exists very much in our country which is the worst violation of an individual's right to life with dignity. Poor performance of sanitary facilities continues to be serious concern for the country. There are several problems existing in the whole sanitation campaign. In fact, Even after more than 68 years of Independence from British rule, over 60 per cent of Indians including women still use open air and unhygienic facilities for answering the call of nature. Thus, Gandhiji's dream of Clean India to not fulfill after 68 years of Independence.

Modi also delivered a short speech highlighting the need of cleanliness to fulfil Gandhiji's dream of Clean India. Through this paper I would like to discuss the importance of sanitation and cleanliness, rural sanitation scenario, sanitation campaigns and its performance with factors attributed to poor performance and also to suggest strategies to improve the impact of sanitation.

RELEVANCE OF SANITATION AND CLEANLINESS

India has progressed at many fronts over the decades since independence in 1947 but on other hand, India has the largest numbers of with people malnourishment in the world. That malnourishment is not only due to scarcity of food but also due to scarcity of safe drinking water and sanitation. Many water borne diseases like diarrhea, dysentery, typhoid are related to huge morbidity burden and loss of working days. Access to safe water and sanitation has been considered one of the most important social determinants of health. Water related illness constitutes one- third morbidities among adults and two-thirds among children. In India, cleanliness should consider as important as praying to god. By tradition, the Indian society and culture value personal hygiene, but give little importance to clean and healthy community environment. Sanitation is an integral component of public hygiene and health care. Sanitation contributes to clean and improved environment, social development and generates significant economic benefits. Sanitation has, however, been seen as a matter of individual understanding and initiative rather than a collective responsibility of the community. Investment to promote environmental sanitation in this fast changing socio-cultural background is accorded the low priority. A sanitation facility is the important indicators of health system. Proper sanitation is very much essential for improving the quality of life of the rural people and to provide privacy and dignity to women. Affordable sanitation undoubtedly remains a challenge.

GANDHI'S VIEWS ON SANITATION & CLEANLINESS

Indians gained freedom under the leadership of Gandhiji, but his dream of a clean India is still unfulfilled. Mahatma Gandhi said "Sanitation is more important than independence". He made cleanliness and sanitation an integral part of the Gandhian way of living. His dream was total sanitation for all. Cleanliness is most important for physical well-being and a healthy environment. It has bearing on public and personal hygiene. It is essential for everyone to learn about cleanliness, hygiene, sanitation and the various diseases that are caused due to poor hygienic conditions. The habits learnt at a young age get embedded into one's personality. Even if we inculcate certain habits like washing hands before meals, regular brushing of teeth, and bathing from a young age, we are not bothered about cleanliness of public places. Mahatma Gandhi said, "I will not let anyone walk through my mind with their dirty feet."

Gandhiji dwelt on cleanliness and good habits and pointed out its close relationship to good health. No one should spit or clean his nose on the streets. In some cases the sputum is so harmful that the germs infect others. In some countries spitting on the road is a criminal offence. Those who spit after chewing betel leaves and tobacco have no consideration for the feelings of others. Spittle, mucus from the nose, etc, should also be covered with earth. (*Navajivan* dated 2 November, 1919).

IMPORTANT ELEMENTS IN RURAL SANITATION

In accordance with the studies and various findings, there are a few most important elements involved in rural sanitation. If these elements are handled properly, many public health problems can be solved. So far, majority of the diseases are spreading due to lack of proper sanitation and availability of protected drinking water sources. Even though the protected drinking water source is available, if there is no proper sanitation or water handling and better sanitation practices, the problem will be the same. Keeping this in view, the most important elements have been identified to address rural sanitation issues in a focused manner. Later these were identified as better sanitation hygiene practices. They are: i) Safe handling of drinking water, ii) Disposal of waste water, iii) Safe disposal of human excreta, since human excreta is associated with more than 50 per cent of diseases, iv) Safe solid waste disposal, v) Home sanitation and food hygiene, vi) Personal hygiene, particularly, washing one's hand with soap, and vii) Sanitation in the community. The above-mentioned best hygiene practices are unavoidable aspects in the process of rural sanitation. So far, due to lack of awareness, rural communities are generally not familiar with the hygiene practices. Many studies have shown the importance of washing one's hands with soap as it reduces diarrheal disease by 43 percent. Respiratory problems, such as sniffles and coughs cases were brought down by 45 per cent when hands were washed five times a day. Safe sanitation practices should be a compulsory part of school curricula and of all programmes where women are trained in community, economic and health issues affecting the household. After many studies, surveys and consultations, the government of India decided to tackle rural sanitation issues through a strong communication strategy. From then, the government started a pilot programme as part of the sector reforms in water and sanitation. (Tenth Five Year Plan (2002-2007) on Water and Sanitation (2008).

RURAL SANITATION SCENARIO IN INDIA

The 69th round of the national Sample Survey Office (NSSO) in its nationwide survey on “Drinking water, sanitation, hygiene and housing in India” has sketched a shaky picture on these basic requirements of civil life. The survey was conducted from July to December, 2012, covering 4,475 villages and 3,522 urban blocks. The survey reveals that nearly 60 per cent of rural households in India do not have latrine facilities as late as 2012. According to Census 2011, at national level only 32.7% HHs have toilet facilities. The States with HHs more than national average include Kerala [94.40%], Goa [72.06%], Panjab [71.09%], Himachal [67.05%], Haryana [57.07%], Maharashtra [44%], Andhra [34.09%], and Gujarat [34.02%] whereas the states with HHs below National average include Jharkhand [8.3%], Madhya Pradesh [13.06%], Odisha [15.3%], Bihar [18%], Uttar Pradesh [22.9%] and Tamil Nadu [26.7%]. Dismally the number of HHs with toilet rose only 16.5% between 2001 to 2011. Increase is, however, just 4.8 in Bihar, followed by 6.12 [UP], 6.3% [MP], 8.3% [Odisha] and 8.4% [Rajasthan]. (Kavita Kalkoti: 2003:5).

It's surprising that state reported HHs with toilets, on website of the TSC run by the union Ministry of Rural Development, are significantly higher than that under census 2011, viz. national average [68.15%], Kerala [100%], Himachal [100%], Haryana [96.04%], Uttar Pradesh [81.76%], Gujarat [81.6%], Tamil Nadu [78.11%], Andhra [77.07%], Goa [76.24%], Madhya Pradesh [76.37%], Maharashtra [71%], Odisha [53.89%], Jharkhand [42.37%] and Bihar [32%]. This invariably needs to be corrected since States in their enthusiasm to complete among them have reported significantly high achievement. It is also questioned whether toilet are really being used. People may agree to use toilet. But it is a challenging task to change to new habit when for generations they have been used to open defecation. It is necessary to sustain behavioral change.

SANITATION CAMPAIGNS

The total sanitation campaign is now operation in 572 districts with an outlay of Rs 11,375 crores. Most of the money comes from the Central government with smaller contributions from states and some community efforts. The programme, launched in the year 2003, has built 31 million household toilets, 9997 community sanitary latrines, 357 school toilets in Anganwadis. The TSC is implemented as a community-led and people-centric approach to generate effective demand for sanitation facilities through creating awareness among village communities, educating them and providing all required information that can help them to avail Government's subsidy and technical services under the TSC program. The Nirmal gram Puraskar incentive scheme has been launched to attain a 100% open defecation-free environment. Under the scheme a total of 25,145 gram Panchayats, 166 intermediate Panchayats and district panchayats have received the award in the last six years. Sikkim has become the first state to receive the award. Within a decade all 2.5 lakh Gram Panchayats are proposed to be converted into Nirmal Gram Panchayats. The thrust is not just to construct toilets, but to ensure their continued use keeping clean and maintaining properly which of, of course, calls for behavioral change. From June 1, 2011 to motivate the community towards creating sustainable sanitation facilities and their continued usage, the financial incentive in the form of subsidy for individual household latrines for BPL families has been raised from Rs.2200 to Rs.3200 and for hilly and difficult areas from Rs.2700 to Rs. 3700. The Progress under the TSC has been significant, with some surveys estimating that at an average 2.8 million individual household latrines (IHLs) have been constructed annually over the 2001-2005 period. A significant achievement has been the construction of 0.4 million-school toilets, 0.15 million-child care center toilets, and 8,000 rural sanitary marts. (Government of India: 2006 & 2011)

Though efforts are being made in the right direction, there are several problems existing in the whole approach to sanitation. While reluctance to use a major impediment, the other problems includes: (i) lack of cleanliness and unhygienic conditions; (ii) scarcity of water in certain places to clean toilet at regular intervals; (iii) inadequate toilet in schools and separate toilet for girls in rural areas; (iv) lack of fresh air in toilets which motivate people to defecate in open spaces; and (v) Superstitious attitude regarding use a toilets.

PERFORMANCE OF SANITATION FACILITIES

Poor performance of sanitary facilities continues to be serious concern for the country. Factors attributed to this include, inter alia [i] cultural and traditional reasons and practice [ii] most of SCs, STs, BPL families and lower income group generally are not aware of the importance of sanitation for better health and clean environment. Sanitation is not a “felt need” for them and therefore, they do not participate in sanitation programs [iii] low sanitation coverage due to inadequate and lack of concerted efforts to create awareness among rural households, motivate them to have toilet facilities, lack of affordable sanitation technology and trained implementing agencies and [iv] non-availability of choice of toilet designs and area specific technologies, inadequate supporting delivery systems and absence of trained masons, skilled workers and technical manpower are reasons for low coverage.

ROLE OF WOMEN IN PROMOTING RURAL SANITATION

- Women always play the decisive role in promotion and proper management of household-level sanitation in a family.
- In absence of a toilet at home, women and young girls suffer the most, which also make them vulnerable to different diseases.
- Compared to men, women pay more attention towards basic sanitation and hygiene principles, which we apply in our daily life.
- Children from female-headed families were found much more conscious and concern about personal hygiene norms than that of male-headed families.
- Strategies of Total Sanitation Campaign (TSC) would have been much more effective to ensure full-sanitation coverage in rural areas, if the gender component had been given much more priority.

ENSURING A HEALTHY RURAL ENVIRONMENT THROUGH PROPER SANITATION:

- Encouraging more and more fundamental research in the sphere of rural sanitation with a special focus on different issue of environmental sanitation of rural India.
- Encouraging the development of indigenous, affordable, eco- friendly and culturally acceptable sanitation technologies in rural India
- Generating awareness and creating demand at community level for safe access to water and sanitation through community participation
- Integration of poverty reduction and environmental regeneration through participatory watershed management
- Promoting behavioral change towards adoption of environment- friendly practices among the rural mass
- Creating provision for livelihood security to resource- poor household through sustainable access to basic needs such as food, fodder, fuel and water

AWARENESS CAMPAIGN

It is necessary to design and implement a location-specific Information, Education and Communication Strategy throughout the country create a massive awareness among individual households, communities and institution on the importance of sanitation on the health of individuals, public and environment and bring custom, cultural and attitudinal change in individual households. Need of the hour is to launch a social movement against caste prejudice and manual scavenging. While the NGOs, Civil society, Community-based-organizations and women Self-Help- Groups will have to play significant role in mobilizing individuals and communities and in working with poor to assist them in finding affordable community- managed solutions to day-to-day problems, electronic and print media will have added responsibility to make the awareness campaigns result- oriented.

ELECTED REPRESENTATIVES

Experiences suggest that top-down, supply-driven programmes have not worked and will not work. Learning from the experience of a community-led and demand-driven Total Sanitation Campaign, India does not just need toilet technology and a budget, but the involvement of elected officials, effective monitoring, transparency to eliminate corruption and accountability to achieve targeted outcomes. While elected representatives of the panchayat should be primarily responsible to identify, initiate, plan and provide urban sanitation seeking user's participation as an integral part of Swachh Bharat Mission, the Member of the Legislative Assemblies and Members of the parliament and Rajya Sabha will have added role and responsibility in achieving the targeted outcomes under the program through quarterly monitoring the implementation process and resolving the identified issues inhibiting the progress.

TRAINING OF CLEANLINESS

During Gandhiji's second trip to India from South Africa, he attended the Congress session in Calcutta to plead the cause of the ill-treated Indians in South Africa. The sanitary condition of the Congress camp was horrible. Some delegates used the veranda in front of their room as latrines, others did not object to it. Gandhi reacted immediately. When he spoke to the volunteers, they said; "This is not our job, this is a sweeper's job." Gandhi asked for a broom and cleaned the filth. He was then dressed in western clothes. The volunteers were astonished but none came forward to assist him. Years later, when Gandhi became the guiding star of the Indian National Congress; volunteers formed a *bhangi* (sweeper) squad in the Congress camps where for once the Brahmins

worked as *bhangis*. Two thousand teachers and students were specially trained for doing the scavenging at the Haripura Congress. Gandhi could not think of having a set of people labeled untouchables for cleaning filth and dirt. He wanted to abolish untouchability from India. Whenever Gandhi got an opportunity to do a little bit of cleaning work, he felt happy. (Speech at a prayer meeting on 3 September 1946 in NewDelhi)

USE OF MEDIA TO CREATE AWARENESS ON CLEANLINESS

In South Africa the whites despised the Indians for their slovenly habits. Gandhii specked their quarters and asked them to keep their homes and surroundings clean. He spoke about it at public meetings and wrote in newspapers. Gandhi's house in Durban was built in western fashion. The bathroom had no outlet for water. Commodes and chamber-pot used by his clerks residing with him had to be cleaned. He compelled his wife Kasturba to do the same. He also taught his young sons this work. Kasturba once expressed her disgust when asked to carry the chamber-pot used by his caste clerks. Gandhi rebuked her and told her to leave the house if she wanted to observe caste bias. He was once socially boycotted by his own sympathizers for admitting an untouchable couple to the Sabarmati Ashram. (Harijan,18/08/1940 and Harijan,05/12/1936:64,105)

RESPONSIBILITY OF PEOPLE TOWARDS CLEANLINESS

Gandhijisaid, "So long as you do not take the broom and the bucket in your hands, youcannot make your towns and cities clean."When he inspected a model school, he told the teachers: "You will make yourinstitution ideal, if besides giving the students literary education, you havemade cooks and sweepers of them."To the students his advice was, "If you become your own scavengers, you willmake your surroundings clean. It needs no les courage to become an expertscavenger than to win a Victoria Cross." Allscavenging work in his ashram was done by the inmates. Gandhi guided them.People of different races, religions and colours lived there.No dirt could be found anywhere on the ashram ground. All rubbish was buried in pits Peelings of vegetables and left-over food was dumped in a separate manurepit. The night-soil, too, was buried and later used as manure. Waste water wasused for gardening. The farm was free from flies and stink though there was no *puckk* drainage system. (Hairjan, 8 February, 1935)

CONCLUSION

The hard fact would be a sustained camping for educating people to use the facilities through attitudinal change. It has been the experience that most rural people are comfortable with open spaces as this has been their practice for long.A distressing feature, however, is the fact that in many rural areas of the country public toilets have been abandoned either because of the reluctance of the people not to use them as a lack of motivation or because of no proper planning to clean them at regular intervals. India, as an emerging economy, must introspect as to why it cannot emulate and deal with the issues of Rural Sanitation as have been dealt with by developed countries since decades. The Stark reality is that India urgently needs commitment of the experienced, seasoned and trained administrators to navigate our way out of this predicament. In today's India ,the youth will have to place the demand of neat and clean India on their elected representatives who are policy, Makers and administrators who have to implement programs totally involving youths and the users. The government has to rely on the grass root organizations that are capable of carrying the work faster and with efficiency and simultaneously motivate the people to use sanitary latrines to protect their health. The government, civil society and community should work together to achieve the vision of Swachchh Bharat by Mahatma Gandhi.

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PREPARING TEACHERS FOR THE GLOBAL DIGITAL LEARNING ENVIRONMENT

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ABSTRACT

The objective of this paper is to prepare teachers for contemporary digital learning environment of the present era by sensitizing and making them aware about the use of latest technologies. Teaching in the present changing world has become more complex where knowledge is changing speedily. Technology has become one of the basic building blocks of today's education system. Digital environment is making every one conscious for digital learning. Digital learning is the learning facilitated by the use of technology which gives students some elements of control over time, path and pace. Global Digital learning environment is created by availing facilities like Virtual laboratories, e-learning resources from National Programme on Technology Enhance Learning (NPTEL), Go lab, Uni School labs, Mobile Education, Video Conferences, Audio Conferences. NPTEL is a joint initiative of the IITs (Indian Institute of Technology) and IISc (Indian Institute of Science) NPTEL provides e-learning through online web and video courses. National Mission on Education through Information and Communication Technology (NMEICT) is a project undertaken by the Ministry of Human Resource Development (MHRD), Government of India with a plan to focus on the utilization of available education satellite, training and empowerment of teachers to effectively use the new method of teaching learning. Digital world calls for change mindsets about schooling, teaching, learning and assessment. Teacher's involvement in digital world helps learners in quality learning and develops student's higher order thinking, ability to apply knowledge and skills to analyze problems, grasp concepts, new ideas and find solutions. Teachers who have skills and knowledge about technological advancements have edge in providing quality education to their students. Therefore, it is very essential to prepare teachers who are skilled and technologically competent and are able to survive in today's digital world.

Keywords: Digital learning, virtual laboratories, Go-lab, Mobile learning.

INTRODUCTION

Teaching profession is a challenging and demanding profession as the boundaries of knowledge are expanding day by day. A teacher is a person who imparts knowledge to the learners and sharpens their critical thinking and is considered to be a leader in the teaching learning process. Teaching profession is considered as very pious profession among all professions. Teachers need to be technology expert. A teacher instructs, and also inspires the students and this task can be facilitated with the help of technology in very effective manner. Technology has become very common in every walk of life. The use of technology in education makes education more student-centered and helps learners to develop curiosity, generate interest, make topic easy and understandable. The world is moving rapidly into digital world. Learning environment are changing and becoming more digital. Technology has become an essential part of teaching-learning process in the 21st century. Every aspect of education is affected by Information and Communication Technology (Yusuf, 2005). Three conditions according to Zhao & Czikowski (2001) are necessary for teachers to introduce ICT into their classrooms. (i) teachers should believe in the effectiveness of technology (ii) they should believe that the use of technology will not cause any disturbances (iii) they shall have a control over technology. Technology is seen to be the means to support student learning and preparing teachers, via electronic media.

The Internet has given students the ability to learn anywhere and anytime thereby eliminating many difficulties in the way of learning. Interactive and adaptive software allows learners to learn in their own style, making learning personal and engaging. It allows students to learn at their own pace, spending time accordingly on lessons or subjects to achieve the level of learning. Teacher educators in education system should prepare teachers to use the available technologies and facilities. ICTs allow the creation of digital resources like digital libraries where the students, teachers and experts can access material for research and course material from any place at any time.

OBJECTIVE

- To explore the digital learning environment that improve teacher's abilities and to help teachers in developing the quality of learning among learners.
- To explore the challenges of teachers in the global digital learning environment.
- To explore the need and significance of Virtual Laboratories, like Go-Lab, Uni School Labs, and T10kT in the global digital learning environment.

- To explore the importance of Mobile Education, Video conferencing, Audio conferencing in the global digital learning environment.

Technology has become one of the basic building blocks of today's education system. It has very prominent role in changing educational system and teaching-learning process. Let us discuss about digital learning that is helpful for teaching- learning process. We should prepare teachers for digital learning which help learners in quality learning. Let us see what digital learning is.

DIGITAL LEARNING

The term digital learning means any instructional practice that effectively uses technology to support and strengthen the students learning experience. It refers to the process of learning with the help of digital content. Digital content is academic material which is delivered with the help of technology. Digital Learning is facilitated by technology that gives students some control over their learning making them more confident. It needs a combination of technology, digital content and instruction. Teachers should be able to prepare themselves for digital learning to help the learners in quality learning. Therefore it is very much necessary to prepare teacher of tomorrow to use today's best technology in the classroom, so that they can handle the digital environment. To be good teacher in our education system a person should be able to use the available technologies for effective teaching-learning process. Let us see what digital learning environment is.

DIGITAL LEARNING ENVIRONMENT

Digital Learning Environment (DLE) is one of the learning venues. It improves learning, sustains continuous improvement in individuals and minimizes the time between knowledge development and implementation and changes virtually everything regarding learning system and affects the every aspect of education system. This environment is created by availing facilities like virtual laboratories; e-learning resources from National program me on Technology Enhance Learning (NPTEL) and National Mission on Education through information and communication technology (NMEICT) and mobile education/m-learning. Digital learning environment improves teacher's abilities and the teachers help in developing the quality learning among learners. Following are the ways with the help of which digital learning environment may be created.

VIRTUAL LABORATORIES

Virtual laboratories are digital tools. In fact, many schools are furnished with computer classes, tablets and high-speed internet connection while using a huge variety of web-based learning applications. Barker and Gossman (2013) found that virtual labs could "maximize student reflection and encourage progressive thought, and independent thinking." Virtual labs can be very useful especially in the teaching of science. Therefore, we should prepare teachers for virtual labs that would be helpful for teachers in imparting quality teaching learning becomes more comfortable. Examples of virtual laboratories are.

➤ Go-Lab

Go laboratories offers a set of remote laboratories, virtual experiments, and data-sets together referred to as "online labs." The Go-Lab environment allows teachers to create specific learning spaces, provide access to resources supporting the development of realistic and engaging classroom activities, facilitates networking and exchanging these activities through an online community. Teachers are prepared for labs that help teachers to develop quality teaching learning. Go-Lab aims to promote the use of new technologies in order to foster teacher competences and skills to live and work in today's knowledge society and global world and increase the attractiveness of scientific knowledge and knowledge about scientific society.

➤ Uni School Labs

The Uni School Labs project provides schools with an on line toolkit for accessing university science laboratories and creates inquiry-based learning activities for learners. The project aims at improving the quality of science education. Uni School Labs fosters collaboration between universities and schools through an online platform that allows teachers an easy access to remote university laboratories through a common web browser and aims to promote the use of new technologies and ICT based services in order to foster teachers and student's competence and skills to live and work in globalised world. This way Uni School labs are very are helpful for teachers to prepare themselves for quality learning among learners.

The National Programme on Technology Enhanced Learning:-NPTEL is a joint venture of Indian Institutes of Technology is self-governing higher education located in India. They are governed by the Institute of Technology Act 1961 which has stated them as institutions of national importance along with National Institutes of technology (IITs) and Indian Institute of Science (IISc) for research and higher education in engineering, science, design and management. It is located in Bangalore city funded by the Ministry of Human Resources Development India (MHRD). NPTEL focuses on providing students learning materials by acting as a

curriculum building exercise. Also the study material provided has its syllabi set straight in accordance with the All India Council for Technical Education (AICTE). Its basic aim is to impart information through web and video more so the content and the syllabi for the courses are altered accordingly. The National Program on Technology Enhanced Learning (NPTEL) provides e-learning through online web and video courses in Engineering, Sciences, Technology, Management and Humanities. In addition the course materials both web and video are freely accessible by anyone irrespective of their geographic location. These courses can be used by professionals for updating their academic background. NPTEL is an important initiative that is helpful for teaching learning process. Course contents that are available through NPTEL are helpful for preparing teachers and improving the standard of teaching in the teaching learning environment.

National Mission on Education through Information and Communication Technology (NMEICT):- National Mission on Education through Information and communication technology seeks to bridge the digital divide i.e., the gap in the skills to use computing devices for the purpose of teaching- learning among urban and rural teachers/learners in higher education domain and to empower those who are unaware of the digital revolution and have not been able to join the mainstream of the knowledge society. It plans to focus on appropriate pedagogy for e-learning, providing facility of performing experiments through virtual laboratories, on-line testing and certification, on-line availability of teachers to guide and monitor learners, utilization of available education satellite and direct to home platforms, training and empowerment of teachers to effectively use the new method of teaching learning etc. Here we will discuss about the T10kT

T10kT: “Train 1000 Teachers” program me initiated by IIT Bombay in 2009 under the project Empowerment of Students/Teachers, sponsored by the National Mission on Education through ICT (MHRD, Government of India). The main focus of this program me is to work with engineering colleges in the country to enhance the teaching skills of faculty in core engineering and science subjects. This project attempted to address a critical subset of important issues, and adopts an approach to address these utilizing modern technologies. In 2013, this program me was scaled further to train up to 10,000 teachers at a time using 338 established Remote Centers across India. IIT Kharagpur is partner Institution in the second phase. Together they 1,50,000 teachers over the next three years. “Train 10,000 Teachers” (T10kT) uses the A-VIEW(Amrita Virtual Interactive e learning World) framework developed by Amrita University(Amrita Vishwa Vidya-peetham, Amritanagar Tamil Nadu), which provided an interactive social environment through the internet for e-learning, communicating and interacting with people at different places. It is used to deliver and transmit live lectures given by faculty at IIT, to all RCS (Regional Centers). T10kT is helpful for teachers training and improving the quality of teaching learning process.

Mobile Education: Mobile education is a sort of learning that happens when the learner takes advantage of the mobile. Mobile learning or M-Education offers modern way to support learning process through mobile devices, such as smart mobile phones. Teachers can use this technology anywhere to enable communication with students, experts and peers. We should train our teachers for mobile learning as it will be helpful in better connecting with students.

Video conferencing: is electronically and digitally possible to create a virtual classroom situation where the remote participants can hear and see each other in real-time interaction. In this virtual or electronic classroom many of the possibilities of face-to-face teaching and learning are created electronically. Tiffin & Rajasingham 1995, Keegan 1996, Videoconferencing gives new chances for real-time, synchronous interaction, which takes place regardless of distances. In videoconferencing, it is possible to create a virtual classroom in which the participants, regardless of geographical distances, can act almost as if they are in a face-to-face situation. We should train our teachers for videoconferencing as it will be helpful in learning process.

Audio conferencing: is inexpensive, accessible and flexible. Students who learn at a distance can engage in real-time discourse with teachers and fellow students. Audio conferencing builds learning communities, even where the community is physically dispersed and made up of students from a wide range of backgrounds. The use of an audio medium adds variety to course presentation, and accordingly helps support a broader range of learning styles and preferences. Audiotapes and broadcasts also bring a human element to course presentation for the distance education learner; for some teachers and students, it is easier to convey emotion and personality via the spoken word rather than the written word. Countries like Australia, New Zealand, Canada and India where populations are widely dispersed have successfully used this technology in education as well. Teachers should be prepared to use Audio conferences that become helpful for their students in their better learning.

CONCLUSION

Teaching in the present changing world has become more complex as the knowledge is changing day by day. Digital world calls for changed mindsets about teaching- learning. Teachers involvement in digital world help learners in quality learning and develop students, their ability to apply knowledge and skills to analyze challenging problems, grasp broader concepts, new ideas and solutions. We should prepare teachers who have skills and knowledge about digital advancement. Technology has very prominent role in changing educational system and teaching learning process. World is moving rapidly in digital learning environment, the role of technology in education is becoming more and more important and will continue to grow and develop. Digital learning environment created by availing facilities like Virtual laboratories, Go Lab, Uni School Labs, T10kt programme, Video conferencing, Audio conferencing, e-learning and Mobile learning. We should be preparing them to use these available technologies and facilities to help students to learn. We should prepare teachers to teach in online environments. The adaption and use of digital learning in education have a positive impact on teaching learning, and research. Technology in education is becoming more and more important and therefore it is very essential to prepare teachers who are skilled, technically competent having awareness about the latest technology and digital world, so that they can work in the digital environment.

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UNRAVELING DIVERSITY IN SHAPES OF SOMATIC EMBRYOS OF *HARDWICKIA BINATA*: A UNIQUE CASE STUDY OF HIGH FREQUENCY SECONDARY SOMATIC EMBRYOGENESIS

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ABSTRACT

Somatic embryogenesis in *Hardwickia binata* was obtained by culturing cotyledons from immature seeds in MS medium supplemented with low concentrations of 2,4-D. Secondary embryogenesis was then initiated when explants were subsequently cultured on MS medium fortified with Absciscic acid (ABA) plant growth hormones. The embryogenic lines remained productive for eleven cycles and repetitive induction of somatic embryos (SE) was obtained which resulted in inexhaustible production of embryos. Including globular, torpedo, heart, and cotyledonary shapes many other novel shapes obtained during secondary embryogenesis under the influence of Absciscic acid are presented here for the first time in tissue culture studies.

Keywords: *H. binata*, woody plant, somatic embryogenesis, conservation, in vitro propagation

INTRODUCTION

Somatic embryogenesis is a well-known phenomenon in tissue culture and is the most desirable pathway for *in vitro* plant regeneration. Since 1958 (Steward 1958a,b) numerous studies have been performed in diverse plant species with variations in growth regulators, concentrations and combinations, genotypes, culture conditions, embryonic stages and altered requirement for different stages like somatic embryo induction, maturation and development etc. Somatic embryogenesis plays a critical role in having its practical application in *in vitro* regeneration of woody plants, especially for those tree species which are problematic to propagate by conventional methods (Isah 2016). However, various recalcitrant forest tree species of economic value are still difficult to establish *in vitro* mainly due to reduced or lack of morphogenetic ability, increased level of contamination and insubstantial rooting of the regenerated shoots (Bonga 2010). Under tissue culture approach the plant spp. belonging to the family Leguminosae is in general considered to be recalcitrant to *in vitro* regeneration. *Hardwickia binata* Roxb. (family Fabaceae) commonly known as Anjan, is one such economically useful tree species found in Eastern Asia which has now become vulnerable, owing to heavy biotic pressure as the wood is used as timber. The wood of the tree is among hardest and most dense of trees growing in India. The bark yields a fiber which is used for making ropes. The leaves are used as fodder and green manure. Oleo-resin extracted from the heart wood is used in manufacture of varnishes. The natural propagation of this tree sp. greatly suffers due to poor seed setting and low seed germination percentage (Mandora et al. 2014). Very few *in vitro* regeneration studies have been reported for propagation of this economically useful timber yielding species where, *in vitro* propagation from callus cultures by Das et al. (1995), from mesocotyls, shoot tips and axillary buds by Anuradha et al. (2000) somatic embryogenesis from semi mature zygotic embryos by Chand and Singh (2001) and Das P. (2011) and recently *in vitro* propagation from axillary bud of the seedling nodal segments was perfected by Mandora et al (2014). However, complete plants from somatic embryos could not be obtained and still raise possibilities for a successful protocol to be worked out. Under these efforts, we subjected *Hardwickia binata* to tissue culture technique for effective somatic embryogenesis from immature cotyledons leading to development of avenues for mass production and development of elite genotype.

MATERIALS AND METHODS**Explant collection and Surface Sterilization**

Fresh and immature pods of *H. binata* were collected from trees growing in the forest of Rajpura valley, located 20 km from Indore (M.P.), India. The pods were surface sterilized by washing under running tap water for 20 min followed by washing with T-20 sol. (1ml/100ml) for 10 min and subsequently washed with distilled water. The pods were then subjected to savlon antiseptic solution treatment (0.6ml/100ml) for 15 min and rinsed by distilled water for 15 min Further sterilization was done under Laminar Air Flow, where pods were disinfected with 0.1% freshly prepared aqueous mercuric chloride (HgCl₂) for 10 min followed by washing with sterile distilled water. Finally the pods were treated with 70% ethanol for 60 s and again washed 3 times with sterile distilled water to remove all the traces of the disinfectants.

Culture conditions

The seeds were taken out and seed coat was removed carefully. After removing seed coat small segments of cotyledons were aseptically cut and cultured into test tubes containing MS medium having 3% sucrose and

0.6% agar supplemented with various concentrations of 2,4-D (0.25- 2.0 mg.l⁻¹). The pH of the medium was adjusted to 6.8 before sterilization. The medium was steam sterilized at 121°C under 1.06 kg/cm² pressure for 15 min. Based on preliminary studies, the cultures were maintained in dark for two weeks and then transferred to light conditions. In light condition, the cultures were provided with 16/8 h. of photoperiod and were maintained at 35±2°C. The cultures were transferred to fresh medium after an interval of every four weeks. Once somatic embryogenesis was achieved, the embryos were transferred to MS medium supplemented with ABA (0.25 - 2.0 mg.l⁻¹) for three weeks and then the mature embryos were transferred to MS medium fortified with BAP (0.5-2.0 mg.l⁻¹) and IAA (0.25-1.0 mg.l⁻¹) (Table 1).

Table-1: Growth regulators used during various stages of somatic embryogenesis

Basal Media	SE Induction	SE Maturation	SE Germination	
	2,4-D (mg.l ⁻¹)	ABA (mg.l ⁻¹)	BAP (mg.l ⁻¹)	IAA (mg.l ⁻¹)
MS	0.25	0.25	0.5	0.25
	0.5	0.5		0.5
	1.0	1.0		1.0
	2.0	2.0	1.0	0.25
	-	-		0.5
	-	-		1.0
	-	-	1.5	0.25
	-	-		0.5
	-	-		1.0
	-	-	2.0	0.25
	-	-		0.5
	-	-		1.0

RESULTS AND DISCUSSION

During the first week of culture the cotyledons showed expansion with swollen cut ends and after another week the whole surface got swollen and fully expanded. When transferred to light, the cotyledons exhibited small globular protuberances pale whitish in color, directly from the surface (fig.1a) after two weeks of culture period.

The primary somatic embryos further grew and started acquiring heart and torpedo shapes (fig. 1b). These embryos grew further (fig. 1c) and acquired cotyledonary shape within two weeks growth period. Best embryogenic response was obtained in cultures growing in MS medium supplemented with 2,4-D (0.5 mg.l⁻¹) where from each explant 30-35 embryos were obtained. Use of 2,4-D to initiate somatic embryogenesis has been reported in various plant species; like Norway spruce (Hakman et al. 1985), Loblolly pine (Becwar et al. 1990), *Alnus glutinosa* (Corredoira et al. 2013) and on elite trees (Peeris and Senarath 2015). Even the use of immature and mature zygotic embryos has been reported in various plant species by many researchers (Yuan Guan et al., 2016)

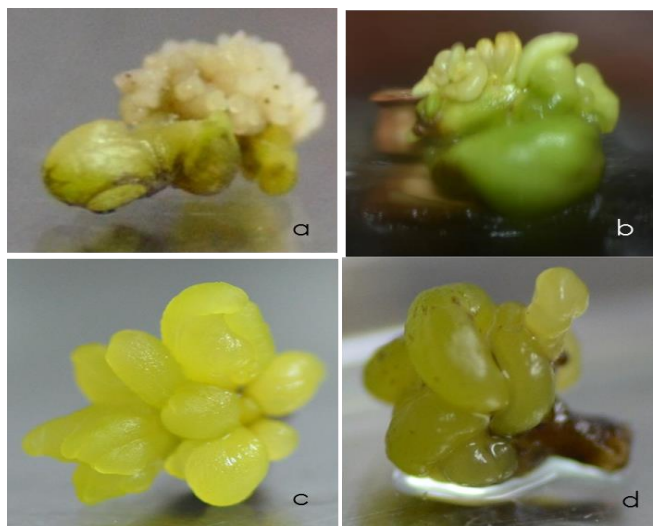


Fig. 1a: Globular somatic embryo induction; b: Heart and torpedo shaped somatic embryos; c: Somatic embryos acquiring growth; d: Cotyledonary shaped somatic embryos.

SECONDARY SOMATIC EMBRYOGENESIS

The mature embryos were transferred to ABA ($0.25 - 3.0 \text{ mg.l}^{-1}$) supplemented medium for maturation, but the embryos proliferated further and the mature embryos started forming new embryos from their surface (Fig. 2a). This phenomenon where new somatic embryos are formed from the existing ones is very well known as secondary somatic embryogenesis (Raemakers et al. 1995). The secondary somatic embryogenesis was highly repetitive which started along the axes (fig. 2a), and gradually covered whole surface (fig. 2b). During this period, while few embryos grew in size, the others kept on giving rise to new embryos further (fig. 2c). Secondary somatic embryo induction was so vigorous that huge number of new embryos was obtained from all the primary embryos. These new embryos again acquired torpedo and cotyledonary shapes during their maturation, but after that they turned black and went under dormant phase of 10-12 days.

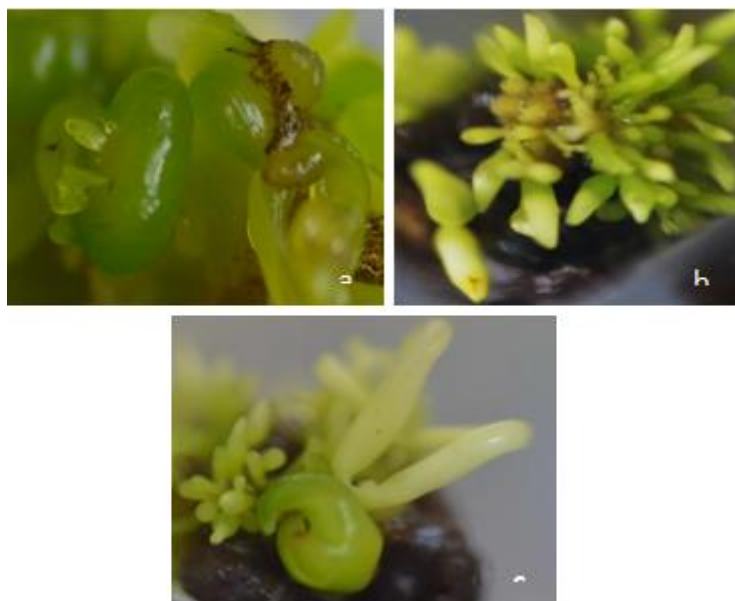


Fig. 2a: Induction of secondary somatic embryos; 2b: Whole surface covered by secondary somatic embryos; 2c: Maturation of secondary somatic embryos.

Soon, this dormant phase was broken and new embryos again emerged from all over the surface of the old embryos. They multiplied and acquired maturity (fig. 3a-b). During this phase the embryos accumulated of pigmentation, green (fig. 3c) and red (fig. 3d). Very soon pigmentation was lost, the embryos re-entered dormancy and initiated the cycle all over again. Similar process continued for eleven more cycles and innumerable embryos multiplied exhibiting immense embryogenic proliferation potential. The concentration of abscisic acid played a very crucial role. On raising the concentration from 0.25 to 0.5 mg.l^{-1} , the embryos enlarged in size and new interesting shapes mostly like florets and curled whorls (fig 4a-d) were observed.

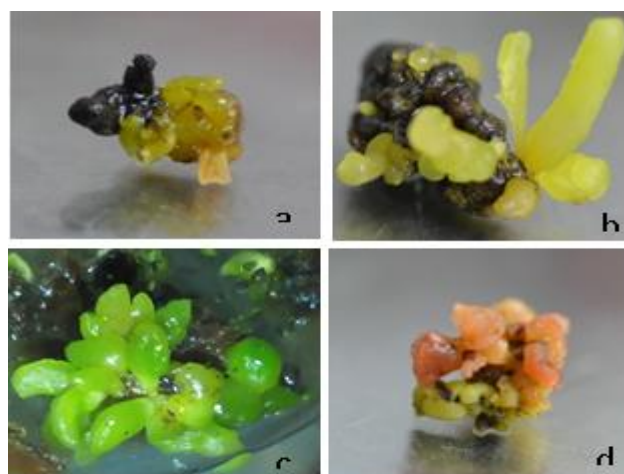


Fig-3a-b: Multiplication and maturation of secondary somatic embryos; 3c-d: Embryos accumulating green and red pigmentation.

Fig. 4a-d: Secondary somatic embryos exhibiting curled whorls and florets under the influence of raised ABA concentration (0.5 mg.l^{-1}).

Further increment in the concentration of ABA (1.0 mg.l^{-1}) led to more compact and fused morphology (fig. 5a-b). The accessory embryos did not show distinct identity instead aberrant shape morphology was observed. Advancement in concentration of hormone, further led to enlarged size and compact cotyledon shaped structures (fig.5c-d) were observed. All these embryos however continued proliferating new embryos; which seemed to be a never ending process. In woody plants however, secondary somatic embryogenesis is reported to maintain the embryogenic competence of cultures for many years and thus embryos prove to be a useful research material (Martinelli et al. 2001; Martinez et al. 2015). The stimulus triggered by the growth regulator was so intense that the somatic embryo proliferation was unstoppable even after complete removal of ABA from the medium. ABA is found to stimulate embryo development to the precotyledonary stage on media (Becwar et al. 1990) and is considered to trigger cell fate transition under stress conditions (Karami and Saidi (2010); Ikeuchi et al. 2015).

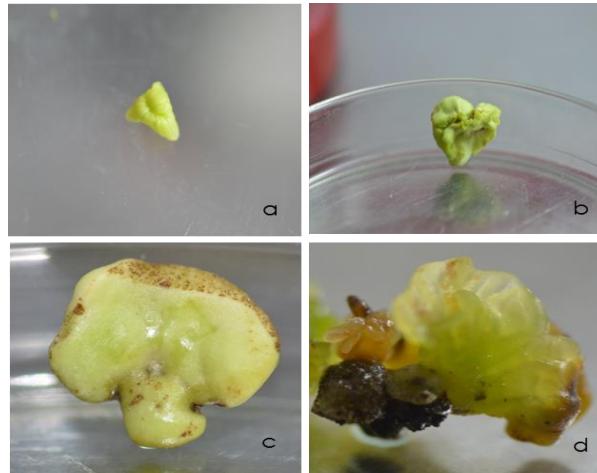


Fig-5a-b: Embryos exhibiting compact and fused morphology; c-d: Embryos exhibiting expanded cotyledon shapes.

GERMINATION OF SOMATIC EMBRYOS

The somatic embryos were transferred to germination medium containing BAP ($0.5\text{-}2.0 \text{ mg.l}^{-1}$) and IAA ($0.25\text{-}1.0 \text{ mg.l}^{-1}$). After one week of growth period, the embryos gained pigmentation and exhibited radicular end with hypocotyl formation. The shooty end however continued exhibiting fused morphology under the influence of elevated concentrations of BAP and IAA, leading to merged cotyledonary structures (fig.6a), anisocotyledonary (fig.6b), multi cotyledonary (fig.6c), funnel shaped (fig.6d), trumpet shaped (fig.6e), cone head shaped (fig.6f), bulged head (fig.6g), fan head (fig.6h), bean head (fig. 6i) etc. Few embryos under the influence of lower concentrations of BAP (1.0 mg.l^{-1}) and IAA (0.2 mg.l^{-1}) converted to plantlets exhibiting root shoot morphology (fig. 7a-b); however efficient conversion to whole plantlets needs further research. Vahdati et al. (2008) found low efficiency of embryo maturation, germination and conversion to plantlets, a major problem which affects efficacious completion of somatic embryogenesis.



Fig.6. Morphology acquired by somatic embryos during germination under the influence of BAP and IAA. Merged cotyledonary shape (fig.6a), anisocotyledonary (fig.6b), multi cotyledonary (fig.6c), funnel shaped (fig.6d), trumpet shaped (fig.6e), cone head shaped (fig.6f), bulged head (fig.6g), fan head (fig.6h), bean head (fig. 6i)

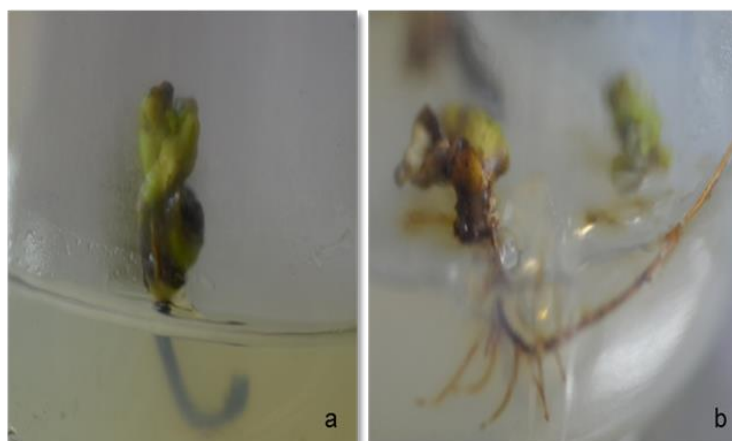


Fig-7: Conversion of embryos into plantlets exhibiting bipolar morphology

CONCLUSION

The somatic embryos emerge out as bipolar propagules from the undifferentiated mass of cells having potential to give rise to new plantlets. Our study unravels various shapes of somatic embryos displaying the morphological and developmental disparity with the natural zygotic embryos. A high frequency rapid somatic embryogenesis obtained in our study provides a way to new research on developmental biology of plants. The protocol set forth, raises great promises synthetic seed production of such woody plant species of commercial value.

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EFFECT OF WORKING HOURS ON OBESITY IN WORKING AGE POPULATION

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ABSTRACT

Background: Working time has a profound effect on the health of the working population. Long working hours are said to alter health behaviors by giving less time for recovery and self-care. Obesity is said to be a major risk factor for developing chronic diseases and is affected by adverse working conditions including long working hours. Aim: The research aims to study the comparative consequences of working hours on obesity with respect to age and gender in the working age population engaged in work for less than equal to 48 hours per week (normal work hours) and those working more than 48 hours per week (long work hours). Method: This is a cross-sectional study including working population (n=640). The study participants were divided according to age (30-45 years and 46-60 years), gender (males and females) and working hours (those engaged in work for ≤ 48 hours/week (normal hours) and > 48 hours/week (long hours). General and work-related information were collected using a questionnaire while Body Mass Index and Waist Circumference were used as a measure of obesity. Comparison according to age, gender and working hours was made using student t-test while the association between working hours and obesity was studied using Pearson's Chi-Square test. Results: The results indicate a significantly higher Body Mass Index ($p=0.000$) for women in the age group of 30-45 years who were working long hours. Waist circumference was found to be higher in both males ($p=0.012$) and females ($p=0.001$) in the age group of 46-60 years. Also, work hours were found to significantly associate with both the measures of obesity with a higher number of individuals falling into overweight, obese and at-risk categories. Conclusions: Adverse working conditions like long working hours are a significant risk factor for the development of obesity and thus individuals working long hours may be more prone to develop chronic health conditions in the long run.

Keywords: Obesity, BMI, Waist Circumference, Working hours, working-age population, Gender, Age

I. INTRODUCTION

An individual working regular full-time job roughly spends one-third of his life at work. Workplaces now days are an ideal setting for overweight and obesity to develop. Work pressure, sedentary mode of work and working hours affect employees eating habits, activity and behavior, which may lead to obesity ([1], [2], [3]). According to the International Labor Organization (ILO), individuals working more than 48 hours are said to be working long hours. India is one of the founder members of ILO and ratifies its conventions on work and environment laws [4]. With a booming 62 % working age population, occupational health is a major concern for India [5].

Long work hours can facilitate weight gain through stress, fatigue, and changing habits. Firstly, stress could impact behaviors such as diet, alcohol consumption and physical activity, which in turn are related to the development of obesity. Also, stressful events may affect the secretion of glucocorticoids which in turn may affect lipolysis and muscle anabolism [6]. Secondly, the biological strain could lead to the modification of endocrine activity which causes an increase in the levels of adrenaline and insulin secretion while decreasing sex and growth hormones. An increase in weight gain has been seen following a decrease in the levels of sex and growth hormones. Also, the release of excess corticoids has been found to have an effect on central obesity and fat distribution. Thirdly, long work hours have been associated with fatigue and have been found instrumental in inhibiting behaviors that prevent weight gain and abdominal fat accumulation ([7], [8]). A recent study by Bombelli et al., [9] assessed the impact of body weight and central adiposity on risk of developing chronic diseases and found that with every 1kg/m² and 1cm increase in waist circumference can significantly increase the risk of developing new-onset diabetes mellitus, impaired fasting glucose and risk of developing cardiovascular diseases. Gender and age differences have been observed in the development of morbidity related to obesity in the literature ([10], [11])

With changing work organization, working hours are increasing in India ([12], [13], [14]). Growing competition, social expectations, a will to exceed above all and personal choices are some of the reasons quoted in literature as a reason to work long hour ([15], [16]). Especially in developing cities; growing service sector, increasing workload and technological innovations have changed the nature of jobs and have altered the work-life structure [17]. Keeping the above scenario in mind, the research aims to study the comparative consequences of working hours on obesity in the working age population working normal and long hours per week.

II. METHODS

A. Study population and tools

In this cross-sectional study, a sample of 640 working age individuals including both males and females, in the age range of 30-60 years were selected according to the set inclusion and exclusion criteria from public and private offices in Jaipur city of Rajasthan. The selected sample consisted of full time workers, who had a sedentary desk job and was employed for at least 5 years at the time of the interview. Those engaged in shift jobs, night shifts or touring jobs were excluded. The sample was initially divided into 2 age groups; 30-45 years and 46-60 years. Further, the study participants were equally divided into two work hour slots. Those working ≤ 48 hours/week were referred to as working “normal hours” and those working >48 hours/week were referred to as working “long hours”. Accordingly, after dividing the working hours into two work hours’ groups, each group was again divided according to the gender into equal number of males and female participants. General and work related information was collected using a questionnaire. Anthropometric data including height, weight and waist circumference (WC) were collected using standardized procedures [18]. Height and weight of the participants was used to calculate Body Mass Index (kg/m²) (BMI) which was further classified according to World Health Organization’s classification for Asians population [19]. Likewise, the waist circumference was classified according to the WHO Expert Committee on Obesity in Asian and Pacific populations [18]. BMI and WC have been widely recommended for use as reliable and easily employable methods to assess weight related health risks in adult population [20]

B. Sample Size

The sample size for single population proportion was tested with 95% confidence interval and 4% absolute precision. The initial sample was calculated to be 576. Assuming 10% non-response error total 634 samples were included which were rounded off to 640 for the ease of bifurcation.

C. Statistical Analysis

The data was analyzed using SPSS-PASW-18.0 trial version. The difference between the mean values for BMI and WC age to age and gender in the group working normal hours (≤ 48 hours/week) and those working long hours (>48 hours/week) was tested for a difference in significance using independent t-test. P value of less than 0.05 was considered to be statistically significant.

D. Ethical Approval

Ethical clearance was taken for the study from the ethics committee of Department of Home Science, University of Rajasthan.

III. RESULTS

A total of 640 employees consented to be part of the study. The sample was divided according to age groups. The age group 30-45 years and 46-60 years had 320 individuals each. Under each age group, the participants were further bifurcated according to the work hours. There were 160 subjects each in the group working long and normal hours in the age group of 30-45 years. Likewise, in the age group of 46-60 years, the subjects were again divided into normal (n=160) and long (n=160) working hours. Each work-hour category was finally divided into an equal number of males (n=80) and females (n=80) participants.

Body Mass Index (BMI) and Waist circumference (WC) were used to assess obesity. In each work hour slot the mean values for BMI and WC were computed and comparison was made using an independent t- test.

The mean values for WC and BMI according to gender, age and working hours are given in table 1. In males, the results indicate a significant difference in the means for WC and BMI with higher mean values in the group working long hours per week in the age group of 46-60 years, and BMI for the younger age group (30-45 years). In females, in the age group 30-45 years, significant difference was observed in BMI between both work hour categories with a significantly higher value in the group working long hours ($p= 0.000$), while in the age group 46-60 years, significant difference was found in the values for WC in the group working long hours ($p=0.001$).

TABLE 1: MEAN WAIST CIRCUMFERENCE AND BODY MASS INDEX OF SUBJECTS ACCORDING TO GENDER, AGE, AND WORK HOURS

Variables	Gender	Work hour category	30-45 years				46-60 years			
			Mean	SD	t value	p value	Mean	SD	t value	p value
WC in cm	Males	≤ 48 hours	92.44	8.29	1.739	0.08	94.81	10.46	2.533	0.01*
		> 48	94.74	8.43			98.95	10.19		

	Females	hours ≤ 48 hours	84.81	8.03	0.763	0.447	85.46	5.49	3.420	0.001*
		> 48 hours	85.65	5.65			89.92	10.29		
BMI in kg/m ²	Males	≤ 48 hours	26.37	4.26	1.967	0.05*	25.72	3.48	1.973	0.05*
		> 48 hours	27.52	3.01			26.85	3.79		
	Females	≤ 48 hours	26.44	4.29	3.925	0.000*	28.62	3.75	0.758	0.449
		> 48 hours	29.11	4.29			29.10	4.20		

*Statistically significant values

Table-2: Comparison of WC and bmi according to age, gender and work hours

	Age		Gender		Work hours	
	t-value	p-value	t-value	p-value	t-value	p-value
WC in cm	3.721	0.000*	12.594	0.000*	3.796	0.000*
BMI m ²	0.649	0.517	5.402	0.000*	4.258	0.000*

*Statistically significant values

It is evident from Table 2 that the waist circumference was statistically different in the two age groups. There was a significant difference in waist circumference and BMI as per gender. Also, the waist circumference and BMI was significantly different as per working hours.

1) Association between work hours and measures of Obesity

2) BMI and Work Hours: In the age group of 30-45years, the p-value for the test of significance between BMI and working hours was found to be below 0.05 for both males and females (p=0.001 and p= 0.000) showing a significant positive association between the body mass index of the participants and the working hours. The distribution of subjects as per the body mass index showed that according to the classification, in the group of subjects working long hours, a higher percentage were categorized as obese I (34.4 and 30.6) and Obese II (8.8 and 13.8) in both genders as compared to those working normal hours. In the age group of 46-60 years, significant association between work hours and BMI was found only for males with 27.5 % and 6.9 % individuals being categorized as Obese grade I and II (Table 3).

Table 3: Subject distribution as per bmi classification and its association with work hours

Age group	Gender	Work hour	Normal	Overweight	Obese I	Obese II	p value
30-45 years	Male	≤ 48	13 (8.1)	21 (13.1)	33(20.6)	13 (8.1)	.001*
		> 48	3 (1.9)	8 (5.0)	55 (34.4)	14 (8.8)	
	Female	≤ 48	15 (9.4)	23 (14.4)	28 (17.5)	14 (8.8)	0.000*
		> 48	3 (1.9)	6 (3.8)	49 (30.6)	22 (13.8)	
46-60 years	Male	≤ 48	16 (10.0)	25 (15.6)	28 (17.5)	11(6.9)	0.048*
		> 48	12 (7.5)	13(8.1)	44 (27.5)	11 (6.9)	
	Female	≤ 48	3 (1.9)	7 (4.4)	44 (27.5)	26 (16.3)	0.966
		> 48	3 (1.9)	7 (4.4)	41 (25.6)	29 (18.1)	

*Statistically significant values

TABLE 4: SUBJECT DISTRIBUTION AS PER WAIST CIRCUMFERENCE CLASSIFICATION AND ITS ASSOCIATION WITH WORK HOURS

Age group	Gender	Work hour	Normal	At Risk	p value
30-45	Male	≤ 48 hours/week	33 (20.6)	47 (29.4)	.017*
		> 48 hours/week	18 (11.3)	62 (38.8)	
	Female	≤ 48 hours/week	26 (12.5)	60 (37.5)	0.021*

		> 48 hours/week	8 (5.0)	72 (45.0)	
46-60 years	Male	≤ 48 hours/week	22(13.8)	58 (36.3)	0.125
		> 48 hours/week	13 (8.1)	67(41.9)	
	Female	≤ 48 hours/week	16 (10.0)	64 (40.0)	0.682
		> 48 hours/week	13 (8.1)	67 (41.9)	

*Statistically significant values

IV. WAIST CIRCUMFERENCE (WC) AND WORK HOURS

As per Table 4, WC was found to be significantly associated with working hours in males and females in the age range of 30-45 years with 38.8 % males and 45 % females in the at risk category.

V. DISCUSSION

The present study found a significant difference in mean BMI level as per work hour categories among women aged 30-45 years. Significantly higher mean values were found for women who were engaged in work for more than 48 hours/week. Obesity is usually represented as a result of chronic energy imbalance, due to increased energy intake and decreased energy expenditure. BMI is a recommended tool for measuring obesity and is an easy and reliable screener for large population studies to assess individuals who are at a greater risk for developing health problems due to excess weight for their respected height [21]. The results of our study are in accordance with the recent studies by Kim et al., [22] and Au, Hauck, and Hollingsworth [23] who found a significant increase in obesity in women who were working long hours.

One of the reasons, as cited in the literature, for weight gain due to poor working condition through stress is long working hours [24]. The said effect is caused due to behavioral and hormonal reasons. Behavioral reasons include changes in diet and physical activity due to the time crunch. Poor lifestyle has also been implicated in the reduction of leptin, which increases appetite and fat storage ([25], [26]). Also, in the case of women, long working hours in addition to dual household responsibilities reduces the time available for self-care and recovery, leading to stress ([27], [24]). In response to stress, glucocorticoids are released through the Hypothalamic-Pituitary Axis (HPA) which in turn inhibit lipolysis and muscle anabolism [6]. Comparatively, in women (46-60 years), no significant difference was found in mean values for BMI level between two work hour group although the average BMI levels were found to be higher than the normal values in those working long hours. One plausible reason for no significant difference might be comparatively lower stress level as with increasing years of experience comes role contentment and career satisfaction [28]. The acquired knowledge also brings refinement and hence the existing challenges at work seem less stressful [29].

Gender wise comparison of BMI levels in the age range of 30-45 years, revealed a significant difference in mean values in the group working long hours. While in the age range of 46-60 years, a significant gender difference in BMI level was prevalent across work hour categories. The study by Dugvinead et al., [30] also found age to be positively associated with the increase in overweight and obesity. Also, in each category, females were found to have significantly higher BMI as compared to men. The results are in accordance with the studies related to increase in total fat in women due to difference in body fat distribution, and changes in hormones (menopause and estrogen withdrawal) as cited in literature ([31], [32]). Another possible reason might be that due to the dual burden of responsibilities, women find far less time than men which may lead to increase in BMI by reducing exercise, replacing home cooked meals with fast foods or processed foods and disruption of sleep over work [33].

Studies indicate that the location of body fat is a better indicator, especially to assess the risk of chronic illnesses for e.g. diabetes [34]. Waist circumference measures abdominal adiposity. The results of the study found that in males and females, in the age group of 46-60 years, significant difference in mean WC exists for group working long hours. The results are in accordance with the existing literature which suggests a direct relationship between WC and long working hours ([35], [36]). In the present study, the group working longer hours had higher average values for WC as compared to those working normal hours across the age groups, though not significant. In our study the average values for waist circumference were higher for the age group 46-60 years across work hour category. The waist circumference is age dependent [11] and hence the visceral fat is found to increase with age [37].

Our study found a significant association of working hours with obesity. Similar results were obtained by Abramowitz [38], who found that in individuals engaged in non strenuous jobs working additional hours were associated with BMI in both men and women. Also, Ko et al., [39] found an association of obesity (High BMI and Waist circumference) with long working hours in population in relation to sleep hours.

VI. CONCLUSION

Our study found that females in the age range of 30-45 years who were working longer hours were at increased risk of developing chronic diseases in relation to overall obesity owing to higher BMI levels. While males and females, in the age range of 46-60 years were more at risk of developing chronic diseases specific to higher abdominal fat for e.g. diabetes. Thus, it may be suggested that adverse working conditions like long working hours are a significant risk factor for the development of obesity and thus individuals working long hours may be more prone to develop chronic health conditions in the long run. Further research is needed to assess the various behavioral factors associated in implicating obesity in people working long hours.

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EXPERIENCE OF RURAL CUSTOMERS ON ICT-BASED BANK PRODUCTS: SOME EMPIRICAL EVIDENCE FROM KANNUR DISTRICT IN KERALA

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ABSTRACT

Rapid advances in the field of Information and Communication Technology (ICT) are fast penetrating into all facets of industry and business. Commercial banking is no exception in this regard. ICT-based bank products have become an imperative for commercial banks for their survival and growth, because modern customers are highly discerning. In rural banking landscape too ICT-based products are making fast inroads because such products can offer some unmatched benefits to the customers. Considering the rural customers of two major banks in Kannur district viz. Kerala Gramin Bank (KGB) and Kannur District Co-operative Bank (KDCB) this paper looks into the types of bank ICT-based bank products and services like ATMs, Credit & Debit Cards, Mobile Banking, Internet banking etc., their acceptance among the customers, their advantages as well as problems and challenges, etc. Based on the findings of the study, strategies are suggested for more effective use of ICT-based products and services for enhanced efficiency and productivity of the banks under study.

Keywords: ICT, Customer Service, Customer Satisfaction, CRM, e-CRM, Rural Banking.

I.INTRODUCTION

As globalization pressures are sweeping across the world including India, there is fierce competition in Indian banking industry and the competition is growing day by day. Competition among the commercial banks in India so as to attain a greater slice of the total market is steadily on the rise. As the rapid advances in Information and Communication Technology (ICT) are fast penetrating into all facets of business and industry, including commercial banking, adoption of ICT has become an imperative rather than a choice for the survival and growth of any business or industry. This is because of the fact that ICT can ensure unmatched customer service, excellent productivity and cost effectiveness, and hence very high operational efficiency. As modern customers are growingly discerning, ICT adoption has become particularly relevant in the banking industry in order to meet the ever-growing customer expectations. Concept of Customer Relationship Management (CRM) has assumed great significance. Moreover, with the integration of ICT on the traditional CRM, Electronic CRM (or, e-CRM) has become more relevant today. In e-CRM, the immense potential of ICT gets added up with the use of CRM as an effective tool for withstanding competition, and for attracting and retaining customers. Banks growingly adopt ICT for providing enhanced customer service and for operational efficiency, and also the benefit of 'anytime, anywhere, any communication medium'. In the rural banking arena too, ICT advances are making fast advances because even rural customers often use modern ICT-based services, particularly the ATMs.

II.RELEVANCE AND SIGNIFICANCE OF THE STUDY

Customer satisfaction is vitally significant in today's banking and so also their sustained patronage. ICT can ensure competitiveness in banking services apart from cost-effectiveness and the resultant operational efficiency on an ongoing basis. Today, customer-centricity forms the basis of all banking strategies and ICT plays the role of an enabler of superior customer service, as is the case with e-CRM. Besides, even in the rural banking arena too, modern ICT-based services like ATMs, mobile banking are fast getting acceptance. Rural banking is often considered as a strategic business model rather than a statutory or regulatory compulsion in the ongoing reforms era when concepts like social banking is less significant. ICT adoption decides the level of customer service and hence customer satisfaction even among rural customers. In this situation, this paper makes a systematic study of customer attitude towards ICT-based bank products and services, the advantages and challenges of such products and services, etc. The area of study is Kannur district of Kerala. Two banks with good presence in rural banking viz. Kerala Gramin Bank (KGB) and Kannur District Co-operative Bank (KDCB) are chosen for this study.

III.LITERATURE REVIEW AND RESEARCH GAP

A macro level analysis of the prospects of retail banking in India by Manoj P. K. (2003) [5] "Retail Banking: Strategies for Success in the Emerging Scenario" in *IBA Bulletin*, the author pointed out the potential of retail loans, particularly housing loans in rapid economic development of the nation in times of recession. Linkage effect and its positive effect in increasing economic activities, the need for promotion of retail loans particularly in recession times etc, were discussed. Ten strategies for the successful promotion of retail banking products,

including the need to ensure 'Human Factor' (human touch) in the service delivery were suggested. ICT adoption is one main strategy suggested by the author. A research article on bank marketing by Manoj P. K. (2006) [6], 'Success Strategies for Marketing of Bank Products' pointed out the need for aggressive marketing of bank products for the survival and growth of banks in the reforms era in India. Strategies for effective bank marketing in the Indian context were suggested. In a research paper by Manoj P. K. (2010) [7], "Impact of Technology on the Efficiency and Risk Management of Old Private Sector Banks in India: Evidence from Banks Based in Kerala" in *European Journal Social Sciences*, studied the impact of ICT on net interest margin (NIM) and non-interest margin (NOM) of Kerala-based Old Private sector Banks (OPBs) and observed that higher ICT adoption leads to reduced NIM and enhanced NOM. Neeraja James and Manoj P. K. (2014) [12] in their paper 'Relevance of E-Banking in the Rural Area – An Empirical Investigation' analyzed the significance of E-banking services with reference to a typical rural area in Kerala and suggested measures for better reach of banking services in rural areas. William George A. J and Manoj P. K. (2013) [16] in their study "Customer Relationship Management in Banks: A Comparative Study of Public and Private Sector Banks in Kerala" noted the vital significance of CRM for the banks based in Kerala in the context of the ever increasing competition. The authors noted that private sector banks in Kerala were much ahead of their public sector counterparts in the CRM front.

In another empirical study on e-CRM by Manoj P. K., Jacob Joju & Vasantha (2014) [8] "Impact of E-CRM on Commercial Banking: An Empirical Investigation with Reference to Private Sector Banks in Kerala" in *International Journal of Applied Financial Services & Marketing Perspectives* the authors observed that majority of the customers of private sector used CRM and other ICT-based services. Also, vast majority of the bank customers and bank staff preferred e-CRM and other ICT-based services, and they preferred bank marketing efforts too. In an empirical study on e-CRM by Jacob Joju, Vasantha S., & Manoj P. K. (2015) [3], "E-CRM: A Perspective of Urban and Rural Banks in Kerala" in *International Journal of Recent Advances in Multidisciplinary Research*, the authors compared the acceptance level of e-CRM among the urban and rural customers. It was noted that e-CRM was more accepted among the urban customers, and that rural customers had more inclination towards 'human factor' in banking services than their urban counterparts. In paper by Shih, C. (2016) [15], "Customer Relationship Automation is the New CRM" in *Harvard Business Review*, the author observed the future of CRM lied in automation and digitization, since it saved the time required for manual data entry, refining data etc. A study on bank marketing by Manoj P. K. (2016) [9], "Bank Marketing in India in the Current ICT Era: Strategies for Effective Promotion of Bank Products" in *International Journal of Advance Research in Computer Science and Management Studies* the need for adoption of ICT for effective delivery of bank products was highlighted. Six key strategies were suggested for marketing of bank products and the sixth strategy was about the effective use of e-CRM. In a recent paper by Manoj P. K. (2018) [10], "CRM in Old Private Sector Banks and New Generation Private Sector Banks in Kerala: A Comparison" in *Journal of Advanced Research in Dynamical and Control Systems*, the author noted that CRM in New Generation Private Sector Banks was much elaborate and advanced than those in their Old Generation counterparts.

Though there are many studies on ICT adoption or e-CRM in banks including a few such studies done in the Kerala context, studies that assess the acceptance of such products and services among the rural customers are very scarce. Hence, this paper seeks to bridge this research gap and makes an empirical study of the acceptance level and attitude of rural customers towards ICT-based products and services. For the above purpose, two banks functioning in Kannur district of Kerala viz. Kerala Gramin Bank (KGB) and Kannur District Co-operative Bank (KDCB) are selected.

IV. OBJECTIVES OF THE STUDY

- (i) To study the attitude and satisfaction level of rural customers towards major ICT-based bank products and services, including their perceived advantages, problems and challenges;
- (ii) To study the extent of use of major bank products and services by the rural customers; and
- (iii) To suggest strategies for effective use of ICT-based products and services by rural customers.

V. MATERIALS AND METHODS

The study was designed as descriptive-analytical, based on data drawn from both primary and secondary sources. Primary data were collected from the customers of the branches in the Kannur district in respect of the two banks under study viz. Kerala Gramin Bank (KGB) and Kannur District Co-operative Bank (KDCB). A multi-stage sampling procedure was adopted. So, Kannur district was divided into three different Taluks (i.e. Kannur, Thalasserry, and Taliparamba). Of the 86 branches of KGB in the district 60 branches (i.e. about two-

third of the total) were chosen on a pro-rata basis from the three respective Taluks. Likewise, from the 59 branches of KDCB, 40 branches (i.e. about two-third of the total) were selected on a pro-rata basis from the three respective Taluks. Totally there were 100 branches (60 of KGB and 40 of KDCB) in the sample and 5 customers each were chosen from each of these 100 branches. So, totally there were 500 customers (i.e. 300 of KGB and 200 of KDCB) from whom feedback was collected using a carefully drafted pre-tested Questionnaire using random (lottery) sampling technique. The sample members represented diverse socio-economic status, occupational and educational profile etc. and they fell under different age groups also. Customers' views on the nature and extent of their use of ICT-based bank products and services were obtained. Using a five-point scale (Table I) scores were assigned to their feedback. Secondary data were collected from authentic sources like the reports of the Reserve Bank of India (RBI), the publications of the Governments of India and Kerala, Official websites of KGB, KDCB, NABARD, etc. Popular statistical tools were used for data analysis and interpretation. Primary data are also collected from the principal officers of the banks (i.e. KGB and KDCB) using an interview schedule.

Table I: Five-point Likert Scale and Scores

Points of Scale	Score
Very Satisfied	5
Satisfied	4
Neutral	3
Dissatisfied	2
Very dissatisfied	1

VI. RESULTS AND DISCUSSIONS

Types of ICT-Based Banking Services Used

The ICT-based bank products and services of KGB and KDCB included e-channels like ATM, Credit cards and debit cards, Tele-banking services, Mobile banking services, Internet (Online) banking services, Smart cards, Online Bill payments, Downloading of bank forms etc. Use of ATMs for deposit or withdrawal of cash, paying utility bills, transferring funds, checking balance etc. are the most popular services. The mobile banking uses are mainly balance enquiry, requesting for cheque book, knowing the last few transactions, making payment of bills, etc. The major internet banking services were knowing more about new bank products, checking the balance, transfer of funds, purchase of bank products, ordering of cheque book, changing one's password and downloading of bank forms.

Figure I depicts the major services availed by the 500 sample customers. It is noted that 98 per cent of the customers avail ATM services, 31 per cent use Debit cards, 19 percent use Credit cards, 21 per cent use Mobile banking services, 22 per cent use Internet (Online) banking services, 6 per cent make Online Bill payments, and 26 per cent use the facility of Online Downloading of various forms required for availing banking services. (Figure I).

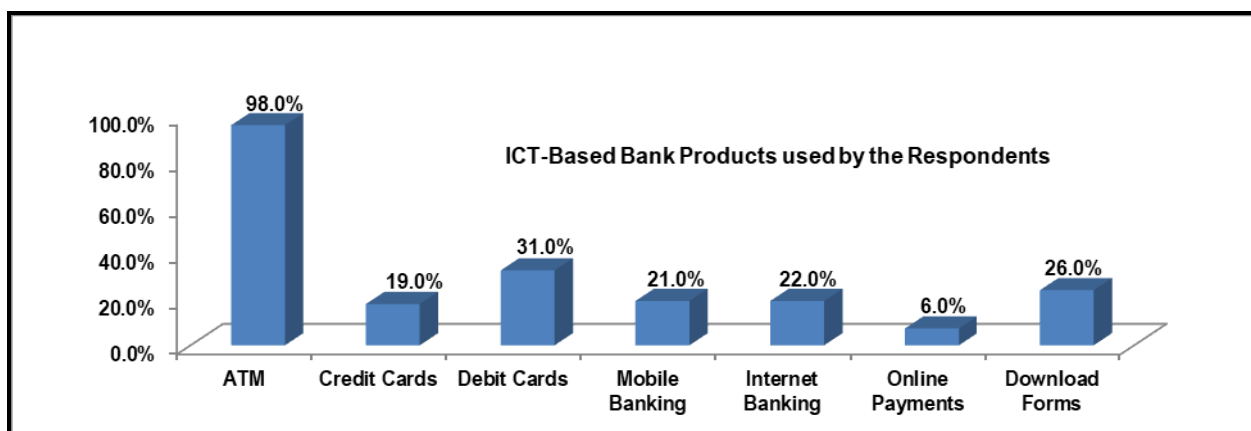


Figure-I: Different ICT-based Bank Products used by the Respondents

Attitude of People towards ICT-based Bank Products and Services

The attitude of the 500 sample bank customers towards the various ICT-based bank products and services is depicted in Figure II. It is observed that 20 per cent of them have felt that such products and services are vital, as high as 36 per cent could treat them as essential while 32 per cent could consider them only as desirable, and the rest 12 per cent have a neutral stance in this regard. In short, majority of the sample customers have a positive attitude towards ICT-based bank products and services. (Figure II).

Attitude of Customers towards ICT-based Banking Products and Services

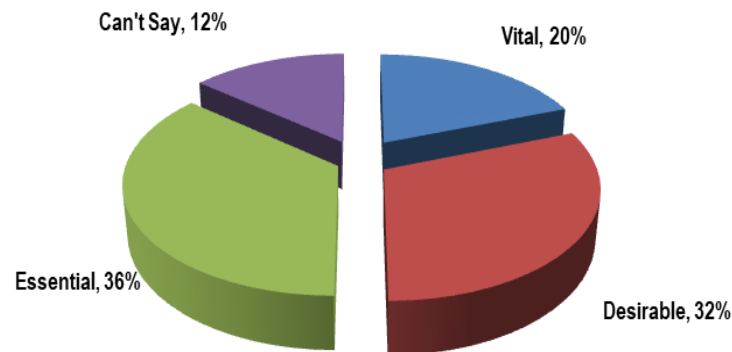


Figure-II: Attitude of Customers towards various ICT-based Bank Products and Services

Automatic Teller Machine (ATM)

One of the initial and main products of modern banking is ATM cards. Many bankers have introduced ATM to assist their customers to withdraw and deposit cash without any waiting time round the clock. ATM cards require three personal identification number entered to avail services. ATM provides fast services in terms of accessibility to cash 24 hours a day even on holidays. We can avail new notes from ATMs. The services of ATM are available at convenient locations. They provide privacy in transactions. They help the banks in reducing crowd at bankers account. Under this system banks issue ATM cards to the customers for transacting on the network. This card would contain important data such as name of the card holder, bank name, branch code and PIN. The main ATM services are depositing cash, withdrawing cash, request and stop cheque books, pay utility bills, transfer of funds, check balance of account etc. The feedbacks from the sample customers regarding the ATM services are discussed hereunder.

Figure III shows that customers use ATM facility mainly for cash withdrawals (94 per cent). Then next option is check balance (27 per cent) and is followed by Transfer of funds (19 per cent). The fourth major use of ATM facility is for payment of utility (17 per cent) and fifthly comes the request of check books through ATM (6 per cent). The sixth and the least preferred use of ATMs is that of depositing cash (5 per cent). (Figure III). Based on the personal discussion with the principal officers of the two banks under study viz. KGB and KDCB, it is learnt that people often use the ATM facility because of its ease of use, and that it is relatively less expensive. Besides, the bankers have opined that among the various services, ATM service can be easily provided to the clients and that most of the customers today, in fact, demand the ATM facility.

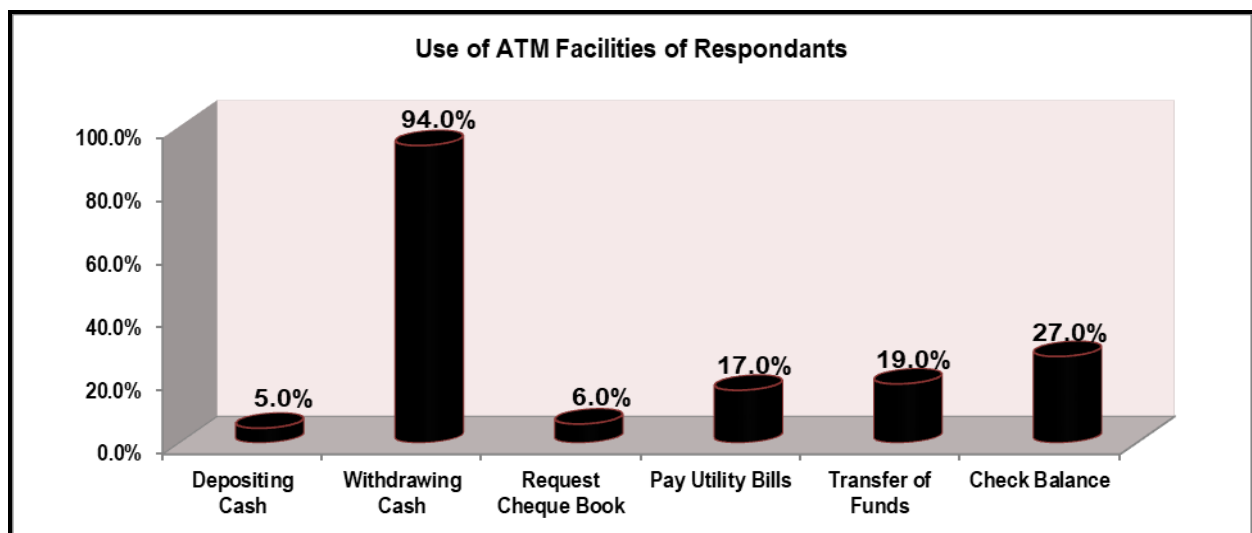


Figure-III: Use of ATM Facilities by the Sample Customers

Credit Cards and Debit Cards

Credit card is plastic money which acts as an instrument of credit. It replaces the paper currencies. The credit card holder need not carry cash in their pockets. They are used in places of making cash payments for goods and services in establishment which have agreed to accept. The credit card organizer makes payment to establishments. The credit card holders can also withdraw cash from ATM. The customers have to pay certain charges to the bank along with interest on outstanding balances. Credit card is convenient and fast transaction

for travel merchants. It has 24 hours high quality customer service. Instant SMS, interest free customer payment, guarantee full security and privacy are other specialties of a good credit card. Debit cards are more advanced than ATM cards and credit cards. It can be used in different shops. It function both has ATM and credit cards. At the retail shop, it does not require personal identification number. Just like credit cards, the debit card holder can present the card to the merchant sign sales slip. The money transacted is immediately transferred from the (transferor) card holder's account electronically to the transferee's account instantaneously.

In Indian scenario, the popularity of the debit is rather limited as the merchant concerned is charged for each transaction. So, the debit card is most often used for ATM transactions. Most of the banks issue Visa debit cards, while some issue Maestro cards (eg. SBI, Citibank India). The debit card transactions are routed through the Visa or Master card networks and not directly via the issuing bank. The National Payments Corporations of India has formally decided the name and logo of new international payment gateway. The new name is RUPAY. However in rural areas both debit and credit card have only limited usage. The reasons for this are not aware of the uses of these services and illiteracy. As a result people in rural area still prefer paper currency for shopping and other transactions.

Mobile Banking Services

Mobile banking can overcome some of the limitations of internet banking. In internet banking, a customer requires a personal computer with internet connection. But in mobile banking, the transactions take place through a mobile phone. Thus, mobile banking enables anywhere banking. Customers do not require a computer to access their bank accounts. They can use bank when they waiting for the bus, during travelling, or when in a hotel etc. Today, in rural areas also majority of customers have mobile phones.

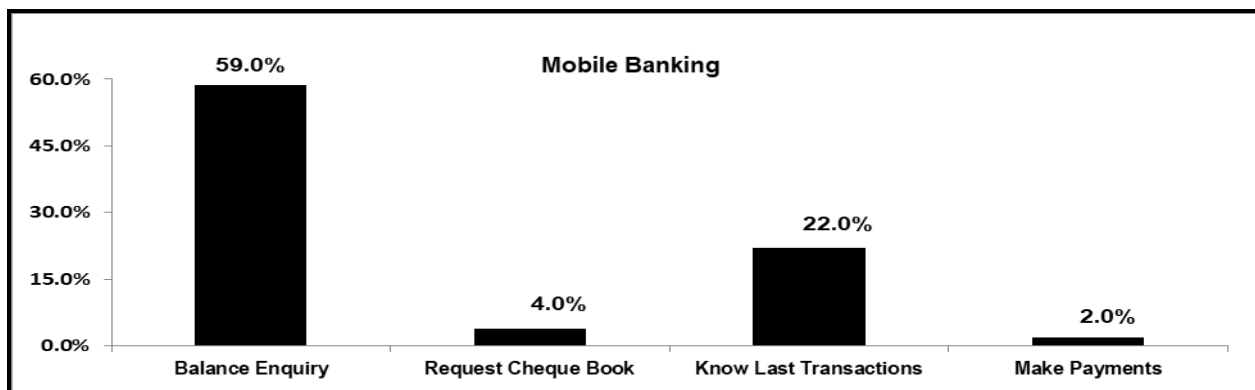


Figure-IV: Use of Mobile Banking Services by the Sample Customers

The main use of mobile banking is for balance enquiry (59 per cent). The second priority goes to that of knowing one's last few transactions (22 per cent). Requesting for a cheque book through mobile banking is done in 4 per cent cases and making payments through mobile banking happens only in 2 per cent cases. It is noted from the interaction with the customers that 77 per cent of them receive SMS alerts.

Internet Banking Services

The latest wave in the field of ICT advances in banking is that of internet banking. It is sure that internet has unleashed a revolution that affects every sphere of human life. Being an interconnection of numerous computer communication networks across the whole globe and crossing all geographical boundaries, the internet can change everything; from the way to conduct business to the way distribute information. As an interactive, two-way medium that passes through innumerable websites, the internet can enable the individuals' participation to visit shopping malls, book stores, entertainment sites and so on. (Figure V).

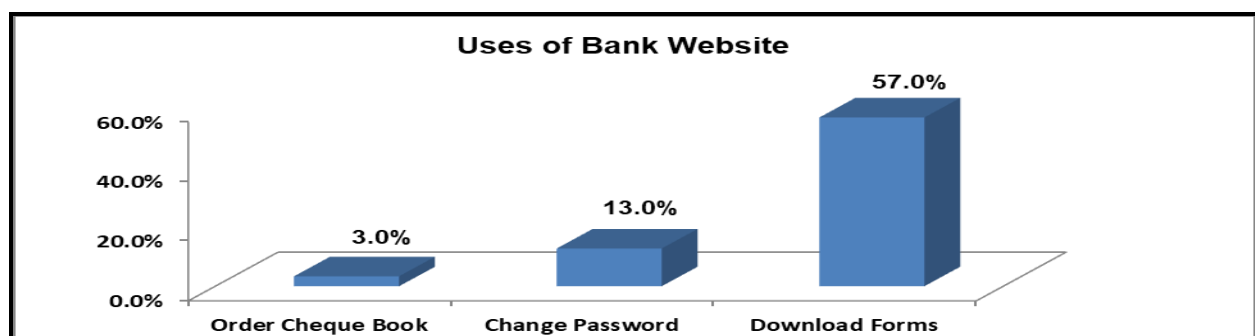


Figure-V: Use of Internet Banking Services by the Sample Customers

There are a lot of uses for Internet banking, like, knowing about new bank products, checking bank balance, transfer of funds, purchase of bank products, ordering cheque book, changing password, downloading bank forms etc. But, only 3 functions are mainly being used by the sample customers viz. Downloading forms (57 per cent), Changing password (13 per cent) and ordering cheque books (3 per cent). Other functions are not being used by the sample of rural customers in this study. (Figure V).

Information of New Bank Products

In every day new facilities and products are available in banking sector. Even in rural areas almost all the services are available. The problem is that many customers are not aware of them. The table II shows as to how the customers know about new bank products or such other banking services offered by the banks. Because of fewer banks in rural areas, the clients have direct contact with the bank staff and managers. So, as high as 38 per cent of them know about such products through the bank staff and managers. Next, by way of advertisements 19.20 per cent come to know about such products. Other major sources of information are Customers (Word of mouth) (15.20 per cent), Mobile phones (12.40 per cent), E-mails (08.80 per cent) and Websites (06.40 per cent). (Table II).

Table II: Major Sources of Information on New Bank Products

Know about products	Frequency	Percentage
Advertisements	96	19.20 per cent
Manager / Staff	190	38.00 per cent
Mobile Phones	62	12.40 per cent
E-mails	44	08.80 per cent
Customers (Word of mouth)	76	15.20 per cent
Websites	32	06.40 per cent

Source: Field Survey

Advantages of E- Banking Services

The ICT-based bank products and services have many advantages, like, relevant and detailed information in seconds, convenient way to manage services and finance, less risk and greater security, bring down the cost of banking, faster mode of banking transactions, quick movement of funds, faster internet access speed, improved service, reduced wasting cost, increased flexibility, anywhere any time banking, easy to transact from office, house, or while travelling, and so on. In any case, it is easier than the old banking system and is also more prestigious than queuing at the bank halls.

Table III: Perceived Advantages of ICT-based Bank Products and Services

Advantages of E – Banking	Frequency	Percentage
Relevant and detailed information in seconds	105	21.00 per cent
Convenient way to manage services and finance	85	17.00 per cent
Less risk and greater security	24	04.80 per cent
Bring down the cost of banking	18	03.60 per cent
Faster mode of banking transaction	22	04.40 per cent
Quick movement of funds	26	05.20 per cent
Faster internet access speed	9	01.80 per cent
Improved service, reduced wasting cost, increased flexibility	18	03.60 per cent
Anywhere, anytime banking	28	05.60 per cent
Easy to transact from office, house or while travelling	20	04.00 per cent
More easier than old banking systems	95	19.00 per cent
More prestigious than queuing at the bank halls	50	10.00 per cent

Source: Field Survey

From Table III, it is noted that the first and foremost advantage of ICT-based bank products and services is that it provides relevant and detailed information in seconds (21 per cent). Their next most important benefit is that their use is easier than the old banking systems (19 per cent). The third most important advantage is that they represent a convenient way to manage services and finance. The least important benefit of such products and services is noted to be faster internet access speed (1.8 per cent). Rural clients often do not prefer internet banking because in rural areas the access to internet is low and it is slow also. As internet banking is not very effective they don't consider it as an advantage. (Table III).

Problems of ICT-based Products and Services as Perceived by Customers

There are many problems with ICT-based banking products and services, like, ATMs not working properly, banks not attending phone calls, delays in service delivery, overcrowding etc. The main problems as perceived by the 500 sample customers are depicted in Table IV.

Table-IV: Problems Associated with ICT-based Bank Products and Services

Problems	Frequency	Percentage
ATM not working properly	110	22.0 per cent
Not attending phone calls promptly	75	15.0 per cent
Over crowding	60	12.0 per cent

Source: Field Survey

The worst problem of ICT-based services is that ATMs are not working properly (22 per cent). The second worst problem is that of not attending phone calls (15 per cent) and the third chronic problem is that of overcrowding (12 per cent). ATM is an important ICT device that is easy to install. But, if ATMs do not work properly, it is a crucial problem. Today, in most of the banks there is lesser than the required number of staff; and KGB and KDCB are no exception. They might not be in a position to attend the phone calls promptly. Overcrowding problem arises because of lesser number of rural branches.

Factors Contributing to ICT Adoption and Challenges Faced in ICT adoption: Bankers' Perception

From the feedback from the bankers (i.e. principal officers of the two banks under study, viz. KGB and KDCB), it is noted that many factors contributed towards the mass adoption of ICT-based bank products and services. Such motivating factors include, ease of use, reduction in work time, security and privacy, reduction of risk, rationalization of regular job, reduced interaction with the customers, and so on. Of these, the vital factors that are agreed by all the bankers interviewed are: (i) ease of use, (ii) reduction in work time, (iii) security and privacy and (iv) reduced interaction with customers. Bankers believe that a job loss is not a major factor, because in the technical area there are a lot of job opportunities. Banks encourage their customers to use various ICT-based bank products and services. Banks make such products and services cheaper by reducing the charges and fees, and providing incentives to the users of such products and services, and contacting every customer personally. Banks adopt many methods to improve their ICT-based products and services, and offer allied services (eg. employee education, gearing up grievances, simplification of rules, and reducing complexity of software) to improve their business. But, there are many challenges in the adoption of ICT-based products and services. These are as follows:

- Cost is very high, particularly the initial investment. (eg. investment in ATMs).
- Traditional banking still remains as the best mode for rural clients, especially for the older clients.
- Many such services are very expensive, given the high initial investment and recurring costs.
- There are vast differences in the profitability across various ICT-based products and services.
- Technological illiteracy or low technological readiness (TR) of the rural clients is a deterrent.
- Fear of various risks associated with ICT-based products and services (eg. Cyber security).
- Many rural customers are not even aware of the various ICT-based products and services.
- Many rural customers still prefer the face to face banking (or, Brick and mortar banking).
- Concerns over security, privacy, etc. are very discouraging, and are constantly growing too.
- Such products and services do not often ensure the privacy of rural customers.
- Some such products and services are not yet adopted by banks though demanded by customers.

Based on the feedback from the bankers there are many problems associated with offering such services. The worst problem is that most rural customers are unaware about such products and services. At present, there is no programme or scheme for creating awareness among the customers. Once customers become aware of such products and services, then banks can provide them very meaningfully and can also improve such services in rural areas. Bankers perceive that age is also a factor that influences the use of such products and services; because most of the old aged or middle age clients prefer the face to face mode of service delivery. On the other hand, such products and services are mainly used by the youth, business men, and professionals. The opinion of bankers about the future prospects of such products and services is very positive, because younger generations

growingly prefer them in this busy world. But today there is difficulty in implementation of ICT-based bank products and services as huge investment is involved initially. But, within 5 to 10 years, the entire banking system will radically change.

VIII. SUMMARY OF FINDINGS AND SUGGESTIONS

Summary of Major Findings

- ❖ The two banks under study (viz. KGB and KDCB) have made available almost all the ICT-based bank products and services to their customers – mostly of rural background; and these include: ATMs, Credit and Debit cards, Mobile banking, Internet banking, and so on.
- ❖ The key factors that have contributed to the adoption of such products and services are their ease of use, reduction in work time, reduced interaction with the customers, and security and privacy.
- ❖ Majority of the old-aged and middle-aged rural customers still prefer the face to face mode of banking (or, traditional banking or ‘brick and mortar’ banking) whereas the younger generation customers and professionals do have a definite preference to modern ICT-based services.
- ❖ The banks under study have adopted such products and services as part of their own policy, and also because of competition from other banks and demand from clients, particularly the young generation clients and professionals who are techno-savvy and prefer ICT-based services.
- ❖ Both the banks under study offer employee education and staff training and give greater thrust on simplification of rules and reduction in complexity of software. They take their own staff into confidence and solicit their views while adopting modern ICT-based initiatives.
- ❖ From the perspective of the bankers, the reasons for customers not interested in ICT-based products and services are primarily: security concerns, lack of awareness among most of the clients and their preference to traditional banking, higher fees for some ICT-based services, etc.
- ❖ Preference to ATM shown by the respondents is primarily because of its ease of use. From the bankers’ perspective, it is easy to provide the ATM service to their clients, and there is high demand for ATMs from their customers, and further other banks offered this facility. This situation prompted the banks under study (viz. KGB and KDCB) also to install many ATMs.
- ❖ To enhance the use of ICT-based bank products and services, the banks reduced their charges and fees, and further provided incentives to the users of such services. Besides, the banks started contacting their customers personally also, so as to garner more business.
- ❖ Since the respondents are all from rural areas, at least one member in every household is a member of poverty alleviation projects like ‘Kudumbashree’ mission of Government of Kerala. Developmental activities are done through such governmental schemes, and the funds are given to the members through commercial banks. Hence, every member in a family invariably starts an account so as to enable her to withdraw the funds, often through the ATMs. In short, in rural areas also, ATMs become the preferred mode of banking transactions, like, withdrawal of funds. ATMs are being used for diverse purposes, like, depositing cash, withdrawal of cash, requesting cheque books, paying utility bills, transferring funds, checking bank balance, etc. Vast majority of the rural people, however, use ATMs mainly for withdrawal of cash; and other uses are very less.
- ❖ Some of the worst problems associated with the ICT-based bank products and services are as follows: (i) ATMs often do not work properly, (ii) there is overcrowding in front bank counters or ATMs because less number of staff or ATMs, (iii) not attending phone calls promptly etc.
- ❖ Mobile banking can be used for balance enquiry, requesting cheque books, knowing last few transactions, payment of bills etc. But, the rural customers under study use it mainly for balance enquiry (59 per cent) and then for downloading forms (22 per cent); other uses are very less.
- ❖ Websites of the banks under study are used for knowing about new bank products, checking balance, transferring funds, purchasing of bank products, ordering cheque books, changing password, and downloading of various forms. In respect of the rural customers under study, the main uses are downloading forms (57 per cent), changing password (13 per cent), and ordering cheque books (3 per cent); other uses have been found to be virtually nil.
- ❖ Because of less number of banks in rural areas, the managers and staff of the two banks (KGB and KDCB) have had close relationship with most of the customers under study. So the managers and staff themselves

intimate the customers regarding the new bank products. The clients use this mode more than other modes, like, advertisement, website, e-mail, word of mouth, mobile, etc.

- ❖ There do exist many advantages for ICT-based bank products and services, and these include: relevant and detailed information in seconds, ease of use than traditional banking system, etc. The least preferred benefit for rural clients is that of faster internet access, as rural clients often have less access to internet and the speed is very slow. So they mostly do not consider it as a benefit.
- ❖ The banks in rural areas provides almost all the services, but people prefer personal contacts for registering their complaints instead of using website or the facility of mobile banking. In fact, only a small number of customers prefer the mobile (telephone) banking facility as a medium.
- ❖ Based on the feedback from the bankers the key challenges of ICT-based banking services is that (i) most customers are unaware of such services, and (ii) technological illiteracy of most clients. Other challenges are traditional banking still remain the best option for many rural customers, fear of various risks associated with ICT-based products, customers prefer face to face mode of interactions, higher charges and fees, lack of privacy, and some preferred services are not offered.
- ❖ Regarding the opinions of bankers about the future prospects of ICT interventions in banking, difficulty is reported in raising the huge initial investment. But, once implemented properly, they are confident that the system will change radically and positively within 5 to 10 years' period. So, great scope is anticipated for ICT-based services; but, right guidance to the customers is essential.

SUGGESTIONS

Based on the findings of the study as above, following are the suggestions for improving the performance of ICT-based bank products and services and for meaningfully launching more such services in the future:

- In view of the growing popularity of various electronic channels (e-channels) it is quite meaningful to offer large number of such channels. Such a step will attract the young generation in particular, and also professionals, businessmen etc. This is because of the fact that convenience is accorded high priority by the new generation customers, professionals etc.; as per the feedback.
- Banks should make the availability of ATMs and the accessibility of other services convenient for the customers. The channels should be secured from the fear of loss of information, and the number of ATMs be increased. Besides, efforts should be made to launch Mobile ATMs because such ATMs are time-saving and are more popular today. (eg. Mobile ATMs at pilgrim spots etc.).
- It is noted that ATMs, Cards (credit and debit), and internet banking are highly preferred by the customers because of time and cost considerations, efficiency in service delivery etc. wherein other channels are not very effective. Hence, banks should make efforts to show the demo fares or provide information at the counters so as to make e-channels popular and easier to the customers.
- Disclosure of full information regarding the service charges, service tax, penalty, terms and conditions etc. should be done so as to win the customer confidence. As the customers are mainly rural customers, information be preferably disclosed in the vernacular language, viz. Malayalam.
- The bank branches should provide sufficient and proper vehicle parking facilities, sitting arrangements, water and sanitary facilities etc. in the branch premises. Besides, posters showing the details of existing schemes be displayed in the branch premises at prominent places so as to attract the attention of customers. Posters in vernacular (i.e. Malayalam) language are preferred.
- All the employees of banks should be imparted suitable training periodically, depending on the level of their assignment, department concerned etc. Such periodical trainings are required to match their skill levels with the requirements of the fast changing environment. They should be made aware of the services on offer, and camps be conducted to promote such services among the customers, both existing and prospective, and also the public at large.
- Bank officials (managers and other staff) should maintain good social rapport with the customers so as to create an environment conducive for promotion of products and services, dissemination of information on new products, and easier implementation of changes in the existing systems, etc.
- Last, but not the least, concerted efforts are required to launch mass awareness programmes and training courses to make the rural customers aware of the various ICT-based products and services and also to train them as to how to use such services effectively.

From this study, it is noted that vast majority of the rural customers of the two banks under study are using ICT-based services, like ATMs, and they are generally satisfied with such ICT initiatives also. It is noted that even the rural customers have started to opt for various e-channels while making banking transactions, the primary considerations being time and cost savings, and efficiency in service delivery. However, not all customers are fully aware of the various ICT-based initiatives and banking services, particularly the operational part of various channels, their transactional facilities, etc. Based on the field study, it is revealed that the future of such ICT-based services is quite bright. Such products and services will definitely pave the way to radical transformation in the banking industry with some clear positive outcomes in the rural areas. This digital transformation will be helpful to formulate innovative economic and financial policies for the banks concerned. In short, ICT does play a vital role in creating radical and revolutionary changes in the rural banking landscape in Kerala; probably this may be true in other parts of the country or the world also. But, ICT adoption alone cannot bring in the positive results, like, improving the performance of the banks and creating a competitive edge for them. Rather, banks have to ensure that skilled and training workforce (staff) are available to effectively use such ICT-based equipments and devices. Besides, the customers (mostly from rural settings) should also be properly trained so as to effectively avail the various ICT-based innovative services meaningfully. Though some extra efforts are required initially, such efforts will certainly bring in rich dividends to the respective banks in the future.

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A STUDY OF PRODUCTIVITY IN PUBLIC SECTOR BANKS OF INDIA

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ABSTRACT

Productivity in banking sector plays a major role in financial system for growth of economy. After 1991, banking sector reforms were introduced by liberalization and globalization in India. And private and foreign players came in the financial system and brought important changes in the operating environment for banks working in India. This leads to competitive environment for public sector banks. To survive, PSBs must have to inspect their performance in all aspects. The performance of bank is highly depended on profit making capacity. Productivity is also major element of bank's performance, as it is directly linked to the profit of the bank. Productivity is one of the factors to measure the effectiveness of invested resource and it can be better measured by analysis of different productivity ratio. Ratio analysis is benchmark technique applied by policy planner, industry analysts and management to examine banking performance. An observation of changes of various ratios over time shows changes in bank policies and strategies and/or in its business environment. The researcher tried to do study of productivity ratio of selected public sector banks (Viz. SBI, SBM, SBT, SBBJ, BOB, BOI, Canara Bank and PNB). In case of productivity BOB is doing excellent, where as SBI and BOI performing at par in terms of productivity. Then after Canara Bank and SBBJ performing equally in terms of productivity. SBM, SBT and PNB have to improve their performance in productivity ratio.

Keywords: Productivity, Public Sector Banks in India, Ratio Analysis

INTRODUCTION

Productivity in banking sector plays a major role in financial system for growth of economy. After 1991, banking sector reforms were introduced by liberalization and globalization in India. And private and foreign players came in the financial system and brought important changes in the operating environment for banks working in India. This leads to competitive environment for public sector banks. The public sector faced challenges in the form of competitive pressures and customer demands. The competition among Banks has been escalating and this is not limited to the Public Sector V/s Private Sector, but it is also among public sector Banks. So it is required to make a study of Public Sector Banks. To survive, PSBs must have to inspect their performance in all aspects. The performance of bank is highly depended on profit making capacity. Productivity is also major element of bank's performance, as it is directly linked to the profit of the bank. Productivity is one of the factors to measure the effectiveness of invested resource and it can be better measured by analysis of different productivity ratio. The aim of study is to evaluate the performance of Public Sector Banks functioning in India based of their Productivity. With the help of this study stakeholders connected with PSBs like Shareholder, Government, policy planner, Customers and Employees can know about the efficiency of the public Sector banks.

LITERATURE REVIEW

(Dr. D. Mahila Vasanthi Thangam and Ms. Thoushifa. T, 2016) pointing out that number of branches and number of employees of are extremely influenced the Productivity of banks. The large banks with high number of branches have the weak Productivity and vice versa.

(K.V.N. Prasad, 2012) compared the performance of public and private sector banks by applying CAMEL model and result of study reveals that there is no significant difference among performance of public and private sector banks.

(Makkar and Singh, 2012) pointing out after applying ratio analysis that there is significant difference in productivity performance of the private and public sector bank in India.

(Uppal, 2011) throws light on the productivity and efficiency of Indian Banking sector in E-Age technology. The research work contains ratio analysis for comparison of pre reform era and post reform period. Efficiency and Productivity has been calculated to find results and concluded that e-age affects banking industry in India where private sector banks are leading and public sector banks are lagging behind in adopting technological advancements.

(Karam and Puja, 2008) analyze the productivity of public, private and foreign banks adopting ACGR and regression and conclude that public sector banks are rising with steady pace and intra group variations are also less than other sector.

RESEARCH GAP

Review of literature in depth shows that a small number of studies have been conducted from the period 2011-12 to 2015-16 in context of the cited objective.

RESEARCH METHODOLOGY

The prime objective is to analyze the Productivity of selected Public Sector Banks in India.

UNIVERSE OF THE STUDY

It consists of all Public Sector Banks (25) operating in India during the study period.

SELECTION OF BANKS

The researcher has measured selected eight public sector banks. State Bank of India, State bank of Bikaner & Jaipur, State Bank of Travancore, State Bank of Mysore, Bank of Baroda, Bank of India, Punjab National Bank and Canara Bank are the sample Banks of the study. The selected banks have an average market capitalization of 5 billion rupees or more during the last six months (prior to FY: 2011-12).

RESEARCH TECHNIQUE

The researcher has applied Productivity Ratios to justify the objectives of the study. The Productivity ratios adopted in the study are Per Employee Business, Per Employee-Net Profit, Net Total Income per Employee, Business per Branch and Net Profit per Branch. With the help of these ratios researcher tried to justify the performance of productivity of selected PSBs for the period of 2011-12 to 2015-16. The average value of ratio and SD is also considered for study. Here, study is reliant on the secondary data, which is collected from annual reports of sample banks.

DATA ANALYSIS AND INTERPRETATION

The below mentioned tables shows the percentage of selected productivity ratios of sample banks with an average and S.D. for the study period from 2011-12 to 2015-16.

1. Productivity Analysis of State Bank of India**Table-1: SBI**

State Bank of India	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D
Business per Employee (%)	8.87	9.85	11.73	13.49	15.38	11.86	2.65
Net Profit per Employee (%)	0.054	0.062	0.049	0.061	0.05	0.05	0.01
Net Total Income per Employee (%)	0.560	0.594	0.697	0.821	0.923	0.72	0.15
Business per Branch (%)	133.93	149.87	162.2	176.1	190.3	162.48	22
Net Profit per Branch (%)	0.820	0.940	0.678	0.802	0.592	0.77	0.13

Inference

The maximum value of Business per Employee ratio is 15.38 % for the year 2015-16 and a minimum value is 8.87 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.062 % for the year 2012-13 and a minimum value is 0.049 % for the year 2015-16. The maximum value of Net Total Income per Employee ratio is 0.923 % for the year 2015-16 and a minimum value is 0.56 % for the year 2011-12. The maximum value of Business per Branch ratio is 190.32 % for the year 2015-16 and a minimum value is 133.93 % for the year 2011-12. The maximum value of Net Profit per Branch ratio is 0.94 % for the year 2012-13 and a minimum value is 0.592 % for the year 2015-16.

2. Productivity Analysis of State Bank of Bikaner & Jaipur**Table-2: SBBJ**

State Bank of Bikaner & Jaipur	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D.
Business per Employee (%)	8.61	10.10	10.33	11.62	12.34	10.6	1.44
Net Profit per Employee (%)	0.050	0.056	0.054	0.058	0.062	0.06	0
Net Total Income per Employee (%)	0.535	0.641	0.677	0.750	0.787	0.68	0.1
Business per Branch (%)	116.65	125.02	120.25	121.96	126.85	122.15	4.01
Net Profit per Branch (%)	0.686	0.704	0.637	0.616	0.646	0.66	0.04

Inference

The maximum value of Business per Employee ratio is 12.34 % for the year 2015-16 and a minimum value is 8.61 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.062 % for the year

2015-16 and a minimum value is 0.05 % for the year 2011-12. The maximum value of Net Total Income per Employee ratio is 0.787 % for the year 2015-16 and a minimum value is 0.535 % for the year 2011-12. The maximum value of Business per Branch ratio is 126.85 % for the year 2015-16 and a minimum value is 116.65 % for the year 2011-12. The maximum value of Net Profit per Branch ratio is 0.704 % for the year 2012-13 and a minimum value is 0.616 % for the year 2014-15.

3. Productivity Analysis of State Bank of Travancore

Table-3: SBT

State Bank of Travancore	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D.
Business per Employee (%)	10.07	12.52	10.95	11.60	11.19	11.27	0.9
Net Profit per Employee (%)	0.040	0.050	0.021	0.024	0.022	0.03	0.01
Net Total Income per Employee (%)	0.593	0.764	0.728	0.768	0.722	0.72	0.07
Business per Branch (%)	144.3	150.16	142.11	138.11	141.53	143.24	4.46
Net Profit per Branch (%)	0.581	0.607	0.272	0.289	0.286	0.41	0.17

Inference

The maximum value of Business per Employee ratio is 12.52 % for the year 2012-13 and a minimum value is 10.07 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.05 % for the year 2012-13 and a minimum value is 0.021 % for the year 2013-14. The maximum value of Net Total Income per Employee ratio is 0.768 % for the year 2014-15 and a minimum value is 0.593 % for the year 2011-12. The maximum value of Business per Branch ratio is 150.16 % for the year 2012-13 and a minimum value is 138.11 % for the year 2014-15. The maximum value of Net Profit per Branch ratio is 0.607 % for the year 2012-13 and a minimum value is 0.272 % for the year 2013-14.

4. Productivity Analysis of State Bank of Mysore

Table-4: SBM

State Bank of Mysore	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D.
Business per Employee (%)	8.78	9.45	10.24	11.59	11.69	10.35	1.29
Net Profit per Employee (%)	0.036	0.038	0.025	0.040	0.033	0.03	0.01
Net Total Income per Employee (%)	0.545	0.608	0.635	0.756	0.745	0.66	0.09
Business per Branch (%)	122.1	130.64	117.63	116.34	120.07	121.37	5.65
Net Profit per Branch (%)	0.501	0.533	0.291	0.402	0.345	0.41	0.1

Inference

The maximum value of Business per Employee ratio is 11.69 % for the year 2015-16 and a minimum value is 8.78 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.04 % for the year 2014-15 and a minimum value is 0.025 % for the year 2013-14. The maximum value of Net Total Income per Employee ratio is 0.756 % for the year 2014-15 and a minimum value is 0.545 % for the year 2011-12. The maximum value of Business per Branch ratio is 130.64 % for the year 2012-13 and a minimum value is 116.34 % for the year 2014-15.

The maximum value of Net Profit per Branch ratio is 0.533 % for the year 2012-13 and a minimum value is 0.291 % for the year 2013-14.

5. Productivity Analysis of Punjab National Bank

Table-5: PNB

Punjab National Bank	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D.
Business per Employee (%)	10.84	11.06	12.22	12.91	13.64	12.13	1.19
Net Profit per Employee (%)	0.078	0.075	0.050	0.044	-0.056	0.04	0.05
Net Total Income per Employee (%)	0.653	0.728	0.729	0.764	0.766	0.73	0.05
Business per Branch (%)	118.65	119.22	129.12	134.44	142.81	128.85	10.28
Net Profit per Branch (%)	0.861	0.808	0.539	0.466	-0.587	0.42	0.59

Inference

The maximum value of Business per Employee ratio is 13.64 % for the year 2015-16 and a minimum value is 10.84 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.078 % for the year

2011-12 and a minimum value is -0.056 % for the year 2015-16. The maximum value of Net Total Income per Employee ratio is 0.766 % for the year 2015-16 and a minimum value is 0.653 % for the year 2011-12. The maximum value of Business per Branch ratio 142.81 % for the year 2015-16 and a minimum value is 118.65 % for the year 2011-12. The maximum value of Net Profit per Branch ratio is 0.861 % for the year 2011-12 and a minimum value is -0.587 % for the year 2015-16.

6. Productivity Analysis of Bank of Baroda

Table-6: BOB

Bank of Baroda	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D.
Business per Employee (%)	15.94	18.61	21.99	21.18	18.41	19.23	2.41
Net Profit per Employee (%)	0.118	0.103	0.098	0.068	-0.103	0.06	0.09
Net Total Income per Employee (%)	0.784	0.900	0.943	0.959	0.943	0.91	0.07
Business per Branch (%)	169.8	184.97	195.76	197.5	176.19	184.8	12.05
Net Profit per Branch (%)	1.264	1.033	0.920	0.641	-0.992	0.57	0.9

Inference

The maximum value of Business per Employee ratio is 21.99 % for the year 2013-14 and a minimum value is 15.94 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.118 % for the year 2011-12 and a minimum value is -0.103 % for the year 2015-16. The maximum value of Net Total Income per Employee ratio is 0.959 % for the year 2014-15 and a minimum value is 0.784 % for the year 2011-12. The maximum value of Business per Branch ratio is 197.51 % for the year 2014-15 and a minimum value is 169.8 % for the year 2011-12. The maximum value of Net Profit per Branch ratio is 1.264 % for the year 2011-12 and a minimum value is -0.992 % for the year 2015-16.

7. Productivity Analysis of Bank of India

Table-7: BOI

Bank of India	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D.
Business per Employee (%)	12.76	15.93	19.63	20.69	17.96	17.39	3.15
Net Profit per Employee (%)	0.060	0.064	0.063	0.037	-0.122	0.02	0.08
Net Total Income per Employee (%)	0.715	0.846	0.978	1.052	0.935	0.91	0.13
Business per Branch (%)	141.76	156.38	182.30	190.91	171.79	168.63	19.78
Net Profit per Branch (%)	0.669	0.641	0.586	0.349	-1.199	0.21	0.8

Inference

The maximum value of Business per Employee ratio is 20.69 % for the year 2014-15 and a minimum value is 12.76 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.064 % for the year 2012-13 and a minimum value is -0.122 % for the year 2015-16. The maximum value of Net Total Income per Employee ratio is 1.052 % for the year 2014-15 and a minimum value is 0.715 % for the year 2011-12. The maximum value of Business per Branch ratio is 190.91 % for the year 2014-15 and a minimum value is 141.76 % for the year 2011-12. The maximum value of Net Profit per Branch ratio is 0.669 % for the year 2011-12 and a minimum value is -1.199 % for the year 2015-16.

8. Productivity Analysis of Canara Bank

Table-8: CANB

Canara Bank	2011-12	2012-13	2013-14	2014-15	2015-16	Mean	S.D.
Business per Employee (%)	13.24	14.00	14.79	14.89	14.90	14.36	0.73
Net Profit per Employee (%)	0.077	0.067	0.049	0.050	-0.052	0.04	0.05
Net Total Income per Employee (%)	0.799	0.872	0.891	0.894	0.905	0.87	0.04
Business per Branch (%)	155.43	160.41	151.79	141.48	137.55	149.33	9.57
Net Profit per Branch (%)	0.911	0.771	0.512	0.475	-0.481	0.44	0.54

Inference

The maximum value of Business per Employee ratio is 14.9 % for the year 2015-16 and a minimum value is 13.24 % for the year 2011-12. The maximum value of Net Profit per Employee ratio is 0.077 % for the year 2011-12 and a minimum value is -0.052 % for the year 2015-16. The maximum value of Net Total Income per

Employee ratio is 0.905 % for the year 2015-16 and a minimum value is 0.799 % for the year 2011-12. The maximum value of Business per Branch ratio is 160.41 % for the year 2012-13 and a minimum value is 137.55 % for the year 2015-16. The maximum value of Net Profit per Branch ratio is 0.911 % for the year 2011-12 and a minimum value is -0.481 % for the year 2015-16.

CONCLUSION

Bank of Baroda is very good with an average of 19.23 % in business per employee, whereas State Bank of Mysore has to improve in this particular ratio. Again Bank of Baroda has performed excellent with an average of 0.06 % in net profit per employee, whereas Bank of India has to improve the efficiency of their employee. Bank of Baroda's employees are very efficient to maintain their net income with an average of 0.91 %, whereas, State Bank of Mysore has to improve the efficiency in net income per employee ratio. Bank of Baroda is very good at productivity with an average of 184.8 % in case of business per branch whereas, State Bank of Mysore has to improve productivity. State Bank of India is performing well in Branch productivity in matter of profit with an average of 0.77 % whereas, Bank of India has to improve their Branch performance to improve net profit. To face threat of competition from the foreign and private sector banks, the Public Sector Bank has to incorporate a number of measures to improve the working efficiency and reduction of operating costs to meet customer expectations. And high productive performance leads to high profitability which adds value in each stakeholder's wealth.

In case of Profitability ratio, the SBI performed very well followed by SBBJ, SBT, PNB, BOB, SBM and BOI in order. Wherein, CANB performed weak during the study period. The SBI is one of the best performing bank and SBM is having weakest performance from the SBI group banks. Similarly in case of other public sector bank the PNB is one of the best performing bank and CANB is having weakest performance.

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**CHANGING PARADIGMS OF WOMEN INVOLVEMENT IN FAMILY BUSINESS
MANAGEMENT: AN EMPIRICAL STUDY**

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ABSTRACT

In the dynamic changing economic environment, trade & commerce are the crucial parameters for the growth and development of the nation. It is in this scenario women play an important role and become the driving force for the growth. Today, women in advanced countries own more than 20% of all businesses and women-owned businesses in Africa, Asia, Eastern Europe, and Latin America are growing at fast pace. These changes have taken place due to gender imbalances which existed in the society which have led to creating more productive atmosphere post liberalization in the country. As the countries become more democratic, gender inequalities lessen offering a more conducive business environment for both sexes, thus it has been observed women are becoming job creators, entrepreneurs, innovators and providers of economic security for the nation. Women entrepreneurs are owners of small and medium-sized enterprises (SMEs) across the globe who create jobs and in turn help the economy to grow.

Keywords: Women entrepreneurs, gender imbalances, working partners, extended families, multiple generations,

INTRODUCTION

The family business offers two separate but connected systems of family and business with uncertain boundaries, different rules, and differing roles. Family businesses may include numerous combinations, including husbands and wives, parents and children, extended families, and multiple generations in roles of stockholders, board members, working partners, advisors, and employees. To encourage the next generation of women to be valuable members of the business, potential female successors should be nurtured by assimilation into the family firm, mentoring, sharing of important tacit knowledge and having positive role models within the business. Women family members are one category of stakeholders with a vested interest in the viability of the business, next to owners and employees (Davis and Tagiuri, 1991)¹ and they can have an important impact on the business. While women tend to enhance their presence as female entrepreneurs, research on women in family businesses has suggested that the majority of women continued to remain in the background, staying 'invisible' (Cole, 1997; Fitzgerald and Muske, 2002)², contradicting the level of feminism.

In India the most women business owners were either housewives or fresh graduates with no previous experience of running a business. These women business owners were in traditionally women-oriented business like garments, beauty care and fashion designing, which either do not require any formalized training or are developed from a hobby or an interest into a business.

In France the phenomenon of female entrepreneurialism is such that it has now been given the name of "mumpreneur", a term coined to define young mothers who are starting up their own businesses. A profile of entrepreneurs that includes women of between 25 and 40 years, mothers, with higher education qualifications and most with previous experience in middle management positions.

Authors (Dumas, 1998; Lyman et al., 1985)³ occupying a subdued role has provided them with a unique vantage point allowing a rich understanding of the prevailing issues and relationship dynamics where they might make a highly valuable input to the efficient conduct of the business and the management of relationships among family members. Sharma (2004)⁴ even says that, if used astutely, wives' observations, intuition and emotional capital can make a difference between the success or failure of a family firm

¹ Vадnjal V, Zupan Blaz, "Role of Women in Family Business", Economic and Business Review, Vol.11, No.2, 2009, 159-177.

² Vадnjal V, Zupan Blaz, "Role of Women in Family Business", Economic and Business Review, Vol.11, No.2, 2009, 159-177.

³ Vадnjal V, Zupan Blaz, "Role of Women in Family Business", Economic and Business Review, Vol.11, No.2, 2009, 159-177.

⁴ Vадnjal V, Zupan Blaz, "Role of Women in Family Business", Economic and Business Review, Vol.11, No.2, 2009, 159-177.

The classic example will be of herbal queen Lady Shehnaz Husain who started her herbal-based treatment from a relatively small scale. Infact she started literally from her kitchen domain to a chain of beauty parlours spread out across the nation and world. Shehnaz started her business as a hobby on a relatively small budget and made an herbal empire to be inherited by her family.

Mrs. Rajni Bector first women entrepreneurs in Ludhiana, an arts graduate, founder of the MRS. BECTOR'S CREMICA started her new career from a housewife to an entrepreneur with a meager investment of Rs. 20000/- for the manufacturing of Ice Creams & Bakery items from the backyard of her residence.

She was just a housewife before she started selling her kitchen-made ice creams at Diwali Melas in the late 1970s. Now, Cremica group does sales of Rs.200 crore (Rs.2 billion) and is an important link in the supply chain to the fast food industry with an inventory of buns, breads, sauces, ketchups and ice creams toppings to the likes of McDonalds and syrups and mayonnaise to Barista..

WOMEN ENTREPRENEUR

Women Entrepreneurs are the group of women who initiate, organize and operate a business enterprise. The government of India notes women entrepreneurs as *"an enterprise owned and controlled by women saving a minimum financial interest of 51 per cent of the capital and giving at least 51 per cent of the employment generated in the enterprise to women"*.

According to Kamala Singh¹, "A women entrepreneur is a confident, innovative and creative woman capable of achieving economic independence individually or in collaboration generates employment opportunities for others through initiating establishing and running an enterprise by keeping pace with her personal, family and social life.

According to **Medha Dubhanshi Vinze²,** "a women entrepreneur is a person who is an enterprising individual with an eye for opportunities and an uncanny vision, Commercial acumen, with tremendous perseverance and above all a person who is willing to take risk with the unknown because of the adventures spirit she possesses."

In Canada, 95.9% of females starting businesses in 1985 entered either the service or retail industries.

In UK, it is an estimated 6.4 per cent of the country's working population is engaged in activities directed toward starting a new business (Kelley et al., 2011)³. A growing number of men and women around the world are opting out of the corporate rat race to start their own business, with the popular press regularly detailing these successful new businesses (e.g. Bloomberg Business Week, 2010; Maitland, 2006)⁴.

In 2008 among the veteran Jewish population in Israel, there were 4.4 percent male entrepreneurs versus 2.2 percent female entrepreneurs. Among immigrants from the Former Soviet Union (FSU) 1.7 percent of all men and

1.4 percent of all women were entrepreneurs, whereas among the Arab population only 2.1 percent of the men and 0.6 percent of the women engaged in entrepreneurial undertakings (Menipaz et al., 2009). Thus, in 2008, Arab women comprise the group with the lowest rate of entrepreneurship in Israel. As to the ratio between men and women entrepreneurs, the gap is widest among the Arab population. Whereas the ratios for the Jewish veteran population and immigrants from the FSU are 0.50 and 0.82 (52 and 82 women per 100 men entrepreneurs), respectively, the ratio for the Arab population is 0.28 (Menipaz et al., 2009)⁵.

REASON FOR WOMEN ENTRANCE INTO ENTREPRENEURSHIP

The reason for women's entrance into entrepreneurship has still not been fully determined: while studies suggest that women have been largely drawn into entrepreneurship by the promise of rewards, work life

¹ Indian Women: Natural Potential to be an Entrepreneur [Online], <http://www.articlesbase.com/entrepreneurship-articles/indian-women-natural-potential-to-be-an-entrepreneur-3316789.html>

² Indian Women: Natural Potential to be an Entrepreneur [Online], <http://www.articlesbase.com/entrepreneurship-articles/indian-women-natural-potential-to-be-an-entrepreneur-3316789.html>

³ Terjesen Siri, Sullivan Sherry E., The role of developmental relationships in the transition to entrepreneurship Career Development International, Vol. 16 No. 5, 2011, pp. 482-506

⁴ Terjesen Siri, Sullivan Sherry E., The role of developmental relationships in the transition to entrepreneurship Career Development International, Vol. 16 No. 5, 2011, pp. 482-506

⁵ Hanifa Itani, Yusuf M. Sidani and Imad Baalbaki Equality Diversity and Inclusion: An International Journal, Vol. 30 No. 5, pp. 409-424, 2011.

balance, independence and flexibility (i.e., through opportunity-driven circumstances), others argue that women have been pushed into it by restructuring and downsizing, which have eroded the availability of once secure jobs in the labour market (i.e., necessity-driven circumstances).

D. P. Moore and E. H. Buttner (1997)¹ suggest that women started their own businesses from a desire for self-determination and for career challenge, and that they expect the corresponding respect, recognition, and self esteem that both self-determination and challenge provide. Primarily, entrepreneurship is a survival instinct that motivates women to start a business. Around the world, miserable economic conditions, high unemployment rates, and divorce catapult women into entrepreneurial activities. Desperate to put food on the table for their children, women are defying societal norms. Women who own and operate a business are not a homogeneous group.

OBJECTIVE

- To study and analyze the role of women entrepreneur in family own business

LITERATURE REVIEW

According to Gangte (2011), “ In Manipuri society, women can be categorized into three groups – 1) educated and employed; 2) educated and unemployed; 3) uneducated. The last groups are mostly the ones which set up small enterprises to sustain themselves and their families. Although, becoming an entrepreneur did arouse a little dilemma in many Manipuri women who have the potentialities for becoming one. However, to earn quick money was the basic reason for women to start entrepreneurship. They has a deep-seated need for a sense of independence along with a desire to do something meaningful with their time and to have their own identity instead of remaining closeted behind their husband’s nameplate. Women of Manipur with high education view at entrepreneurship as a challenge, while for women with no education background find entrepreneur merely a means for earning money.

Women entrepreneurship is a relatively new phenomenon in Nepal. Although certain ethnic communities in the country, especially the Newars and Tibeto-Burman Highland Groups such as the Sherpas, Curungs, Thakalis are known to have a long tradition of women being involved in small business enterprises (CEDA, 1981), it is only within the last ten years that the concept of women entrepreneurship has progressively gained some acceptance in the overall dominant majority within the Nepalese society. With the growing recognition that women have unique talents which could be harnessed for development and for creating employment opportunities for others who are not suited to an entrepreneurial career, developing women as entrepreneurs has become an important part of national development planning and strategies

International Labour Organization (ILO) funded a project to help poor women living in selected slum clusters in Bangalore and Delhi to acquire decent employment. From 2001 till 2004 a total of 1,600 women had been trained, 300 women in Bangalore and 780 women in Delhi, and 456 were under training. Many organizations in Delhi and Bangalore volunteered to help these women. In Bangalore, Parinati was working with tribal and nontribal in Bandipur. Karnataka Kolageri Nivasigala Samyukta Sangatane (KKNSS) raises awareness and mobilizes slum dwellers, especially women. In Delhi, Disha operates in both rural and urban areas, and assists in setting up Self Help Groups (SHGs); Jan Shikshan Sansthan Prayas is working with slum communities in Jahangirpuri; Bhartiya Parivardhan Sansthan works in East Delhi and their activities include family planning, counseling, awareness on HIV/AIDS and health and legal awareness; and Prerna has designed programmes for growth and development of the marginalized sections of society.

In an earlier study, Stoner, Hartman, and Arora (1990) as cited in Maysami et. al. (1999) found that the work home conflict – the tension caused by the dual responsibility of managing a business and maintaining a family to be the main stumbling block for female business owners.

Poza and Messer (2001) described six different types of roles adopted by spouses of successful family firms: jealous spouse; chief trust officer; partner or copreneur; vice-president; senior advisor; and free agent.

Curimbaba (2002) reported that Brazilian women occupied either a professional, invisible or anchor role in their firms. Due to the small convenience samples these studies mainly provide an indication of the varying types of women’s roles. However, it is mostly expected that women occupy the second rank or head up one of the business functions, traditionally finance and accounting or sales.

¹ Moore, D. P. & Buttner, E. H. (1997), *Women entrepreneurs: Moving beyond the glass ceiling*. Thousand Oaks, Sage Publication.

In a study by Barwa (2003) on women entrepreneurs in Vietnam, the author found that women face additional handicaps due to the prevailing social and cultural gender-based inequalities and biases.

In Uganda (UNIDO Document, 2003), women entrepreneurs in rural areas suffer from a lack of training and advisory services that would allow them to upgrade their managerial and technical skills and solve immediate production problems, thus improving productivity and increasing profitability. In Uganda, where more than 70 percent of enterprises employ less than 20 people, micro- and small enterprises play an important role in the economic and social life of the majority of citizens. However, the growth and the competitiveness of this sector are hampered by a lack of managerial and technical skills, weak infrastructure, difficulties in accessing loans, and complicated company registration processes.

Danes and Olson (2003) found 42% of wives as major decision- makers even in family firms owned and managed by men. Fourth, spouses and other female family members are often just paid employees in family firms: Danes and Olson (2003) found 57% of working spouses even in family firms owned by their husbands, with 47% being paid, which may suggest a certain level of discrimination at this point.

In Africa, according to Richardson et. al. (2004), society's views are largely negative about women entrepreneurs who associate and network with others in business.

A study by Richardson, Howarth and Finnegan (2004) on women entrepreneurs in Africa reveals that many women entrepreneurs in Africa feel they lack abilities, skills and expertise in certain business matters. Many of the issues mentioned appear to relate to women's relative lack of exposure to the world of business. In addition to this lack of exposure, women's business networks are poorly developed as social assets. This in turn impacts on a range of factors that adversely affect the women entrepreneurs at all levels.

Lee et al. (2006) note when married women in business-owning families experience tensions over resource constraints between family and business systems, they report lower levels of well-being.

In a recent 2007 study, Coleman examines human capital as well as financial capital variables to explain differences in business profitability between male- and female-owned businesses. Coleman's (2007) findings indicate that human capital variables such as education and experience are more likely to contribute to the profitability of female-owned businesses and that financial capital has a greater impact on the success and profitability of male-owned businesses

Kirkwood (2009), in studying spousal roles among entrepreneurs in New Zealand, finds that women are more likely to seek unambiguous support of their business endeavors, while men are likely to assume spousal support exists without seeking explicit statement of it.

Recent surveys. Conducted in several countries by the National Foundation of Women Business Owners (NFWBO) indicate that women-owned firms involved in the global marketplace have greater revenues, are more optimistic about their business prospects and are more focused on business expansion than women-owned firms that are domestically oriented.

Expected outcomes

Women at the moment are more enthusiastic to take up activities that were once considered the preserve of men, and have proved that they are second to no one with respect to contribution to the growth of the economy. The role of Women entrepreneur in economic development is also being acknowledged and steps are being taken to promote women entrepreneurship. Women entrepreneurship must be molded properly with entrepreneurial traits and skills to meet the changes in trends, challenges worldwide markets and also be competent enough to sustain and strive for excellence in the entrepreneurial arena. As the Indian Woman today is at a threshold where she is confronting not only herself and her own inner feelings, but also managing interfaces in the outside world both at home and work place. As recent role-models demonstrate, women tentatively are crossing this threshold, challenging themselves and blistering a new path for future generations. The new Millennium may well shepherd in an era, where not only women but the entire human race can more easily achieve self-actualization and total fulfillment both professionally and personally. The leaders of tomorrow would be such that they would not be identified by their gender, but by their potential and ability.

The outcomes of this research will help us to identify the role of women in family own run business. As the Women today are more willing to take up activities that were once considered the preserve of men, and have proved that they are second to no one with respect to contribution to the growth of the economy. This study also help us what role they are playing in a male dominant society and especially to rural women also who are contributing in small-scale and cottage industries.

In spite of many hurdles, Women's are excelling in business with flying colors.

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DESIGN AND COMPARATIVE ANALYSIS OF WELLBORE CENTRALIZERS FOR CASING PIPE APPLICATIONS

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ABSTRACT

A centralizer is a mechanical device protected around the casing at different locations to keep the casing from touching the wellbore walls. Its outcome of covering centralization, a continuous annular go-ahead everywhere the casing allow cement to completely seal the casing to the borehole wall. It results in less friction between centralizer and hole pipe as the bows of welded type centralizer are curved by the dies and bows are not straightly in contact with whole pipe so there is no touching between bows and hole pipe. High resistance power is attained in the Welded semi rigid type centralizers by curving the bows which improves bow strength to hold the weight of hole pipe or outer pipe. The survey of Different Models is done in order to examine the Centralizer, Stop Collar and Float Equipment. As they are used in oil Field Industry so the motive of Testing of Centralizer is to analyze the Starting, Running and Restoring Force of Centralizer and Float Equipment for Ductility and high Pressure and High Temperature Test. For upgrading the Design of Centralizer, Stop Collar and Float Equipment, the Resulting Data from these Tests are intended to review the Quality and base.

Keywords: centralizer, design, bows, wellbore, casing

1. INTRODUCTION

A centralizer is a mechanical device protected around the casing at different locations to keep the casing from touching the wellbore walls. Its outcome of covering centralization, a continuous annular go-ahead everywhere the casing allow cement to completely seal the casing to the borehole wall. Casing centralization device assures the worth of a cementing work by dodging mud channeling and poor zonal separation. Centralizers can also influence in the movement of the casing and the avoidance of difference spike. Its method is extensive. It is expectable that 10 million centralizers are bulk-produced and used every year globally. Centralizer producers possibly desire to increase the demand for centralizers. To ensure keep casing from contacting the bore wall Casing centralizer is used. For following reasons Tool centralization is needed.

- a) To prevent tool from hanging up on obstructions or blockage on wellbore wall.
- b) To pass fluid efficiently and prevent excessive standoff.

There are four various kinds of centralizers.

- a) Bow spring design
- b) Semi rigid design
- c) Rigid blade design
- d) Mold on design

The separation of casing from the wall of the hole is called Stand-off or the level to which pipe is centered is known as Stand-off. If the casing is exactly centered than the stand-off is 100% and the 0% stand-off means the pipe is in contact with wellbore. The stand-off should be more than 67% throughout the casing string with respect to the API standards. $\text{Stand-off} = C / (A-B)$. For learning the deflection of casing we must study the force balance for pipe section. Two types of forces on casing:

- a) Axial tension force at the ending, pushing casing upwards.
- b) Gravitational force on the pipe body, pulling casing downwards.

The direction (upward or downward) of the net side force depends on the weight and tension of casing.

To set the position of the centralizer at an efficient place, three methods are used.

- a) Specify spacing- 40 feet is the standard spacing between the two centralizers (1 centralizer per joint). The standoff at the central point is forever lower than on centralizer because of bow spring centralizer used here. The standoff at central point between centralizers is summation of casing sag among the centralizer and at bow spring compression at centralizers.

- b) Specify standoff- Stand-off is called the parting of casing from the wall of hole. The stand-off will be setup on the mid span between centralizer. The Specify standoff mode ensures minimum standoff will be setup. The "specify standoff" mode ensures minimum standoff of casing between centralizer. According to API the minimum 67% standoff will be required as per requirement.
- c) Optimum spacing- Both approaches must have specifying standoff 70% with 20ft incremental space requirement to get the optimum position of the centralizer on pipe.

2. RESEARCH METHODOLOGY

Introduction of 5S

5S is the name of place of work involvement method that uses an inventory of five Japanese words: seiri, seiton, seiso, seiketsu, and shitsuke. 5S engage community through the exercise of 'Standards' and 'Discipline'. It is not just about maintenance, but focused to maintain the values & guideline to administer the group - all achieved by continuation & viewing respect for the office every day.

The 5 Steps are as follows:

- a) Sort: reform & split the one which is desirable & not needed in the area.
- b) Straighten: place items that are desirable so that they are complete & simple to use. Undoubtedly recognize locations for all items so that anybody can locate them & return them once the job is finished.
- c) Shine: Clean the place of work & tools on a usual base in order to preserve values & spot the defects.
- d) Standardize: re-examine the first three of the 5S on a common root and verify the state of the workplace using normal actions.
- e) Sustain: maintain to the rules to preserve the standards & go on to improve every day.

Introduction of Seven QC Tools

The Seven Basic Tools of Quality is a description given to a predetermined set of graphical technique recognized as being most supportive in resolving issues allied to quality. They are called basic because they are appropriate for community with minor proper training in figures and because they can be used to resolve the vast mass of quality-related issues.

1. Cause-and-effect diagram (also known as the "fishbone" or Ishikawa diagram)
2. Check sheet
3. Control chart
4. Histogram
5. Pareto chart
6. Scatter diagram
7. Stratification (alternately, flow chart or run chart)

The Seven necessary Tools rest in distinction to other highly developed numerical methods such as survey sampling, acceptance sampling, statistical hypothesis testing, design of experiments, multivariate analysis, and various methods developed in the field of operations research.

Introduction of Kaizen

Kaizen is the practice of continuous improvement. Kaizen was originally introduced to the West by Masaaki Imai in his book Kaizen: The Key to Japan's Competitive Success in 1986. Today Kaizen is recognized worldwide as an important pillar of an organization's long-term competitive strategy. Kaizen is Continuous Improvement that is based on certain guiding principles:

1. Good processes bring good results
2. Go see for yourself to grasp the current situation
3. Speak with data, manage by facts
4. Take action to contain and correct root causes of problems
5. Work as a team
6. Kaizen is everybody's business
7. And Much more

3. PROPOSED WORK

Welded bow type centralizer are made up of cast iron and available in various size and made by different types of materials. These centralizers have high resistance power and long lasting. In the welded type centralizer bows are made under high temperature conditions with correct grade electrodes. In this type bows are not directly in contact with hole pipe so no contact between bows and hole pipe. So this results the less friction between centralizer and hole pipe. The bows are of high quality alloy steel and change into required shape by use of dies and then heat treatment will be done under temp/time cycles for required spring characteristics. These centralizers are used where stress points are few.

Table-1: Parameters of Welded Type Centralizer

Size	6" x 24"
Weight	5.400 Kg
Height	24 inches
Thickness	5 mm



Fig-1: Welded type Centralizer

Welded semi rigid bow spring centralizer

The semi rigid bow spring centralizer are good robust design, reliable and are of high performance. These are made up of cast iron and available in various size. The highly treated bows are welded on end collar of centralizer. The bows are first bent as per requirement with the help of dies then we do heat treatment of bows at temp/time cycle under requirements. The small area that bent are in contact with hole pipe which increases friction between centralizer and hole pipe. These type of centralizers are used where stress points are large or where stress is too high.



Fig-2: Welded semi rigid type centralizer

Table-2: Parameters of Welded semi rigid type centralizer

Size	6" x 24"
Weight	4.500 Kg
Height	24 inches
Thickness	5 mm

4. Results and Analysis Starting Force Test

The starting force indicates the detailed force required to put the inner pipe into the outer pipe (after make up for the weightiness of the inner pipe and additions).

- First step to test starting force of centralizer mount the centralizer in fully assembled condition. We must ensure that centralizer assembled in same manner as used in actual service.

- b) The test should be performed at an angle of 5 degree of vertical position.
- c) The contacting area of centralizer to the outer pipe must lubricate with petroleum based grease so that centralizer must move easily.
- d) Apply the load by universal testing machine (UTM) on the inner pipe to insert centralizer into outer pipe.
- e) Then take the readings at various load/time conditions. Check the maximum force that is required to fully insert the centralizer inside the outer pipe.
- f) Check whether the centralizer was pulled or pushed into the outer pipe
- g) Check the holding device used to conduct the starting force test.

Running Force

The running force signifies the extreme force needed to move the inner pipe inside the outer pipe when the force reading has become fixed (after reimbursing for the heaviness of the inner pipe and additions

- a) Install First step to test starting force of centralizer mount the centralizer in fully assembled condition. We must ensure that centralizer assembled in same manner as used in actual service.
- b) The final outcome of this test is not compulsory to note the maximum value. This test should be performed and final outcome will be recorded.
- c) This test can be done when the starting force test going on or do this test separately.
- d) Take different readings of force at different period of time when centralizer is moving inside the outer pipe until the inner pipe is fully placed.
- e) Write down the maximum force as the running force after reparation as in 1.

Restoring Force

The restoring test can be used to test the bows strength that how much force absorbed by the bows of centralizer.

- a) The restoring test can be done by setting up the pipe at an angle of 5 degree horizontal.
- b) The force applied to the bows up to 12 times to check strength ability of bows.
- c) Put the load by universal testing machine to the outer pipe so that load will be transported to the inner pipe vertically over the point of contact of the centralizer with the outer pipe
- d) Put on load and read load-deflection analyses at least possible of 1, 6 mm (1/16 in) rises until three times (□5 %) the smallest restoring force has been attained. The travel distance to obtain 67 % standoff shall be discover out for each test position.
- e) Repeat the process, testing the centralizer until each spring and each set of springs has been tested in situations 1 and 2 as shown in Figure.
- f) Determine the total load at each deflection by recompensing for the mass of the move pipe and attachments.
- g) Make the final load-deflection curve using the calculation average of the force readings at corresponding deflections. Restoring force shall be find out from this curve at 67 % standoff ratio.

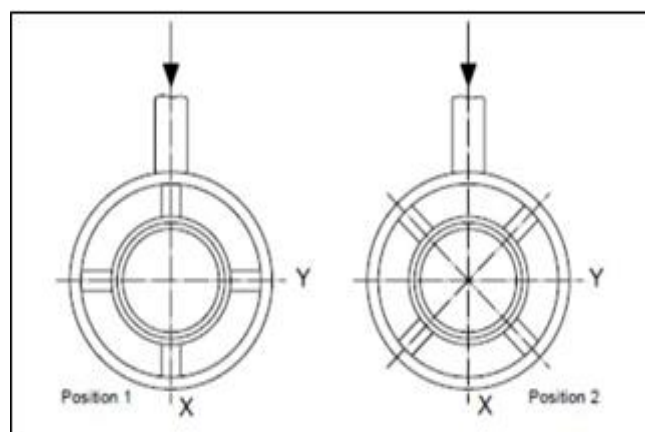
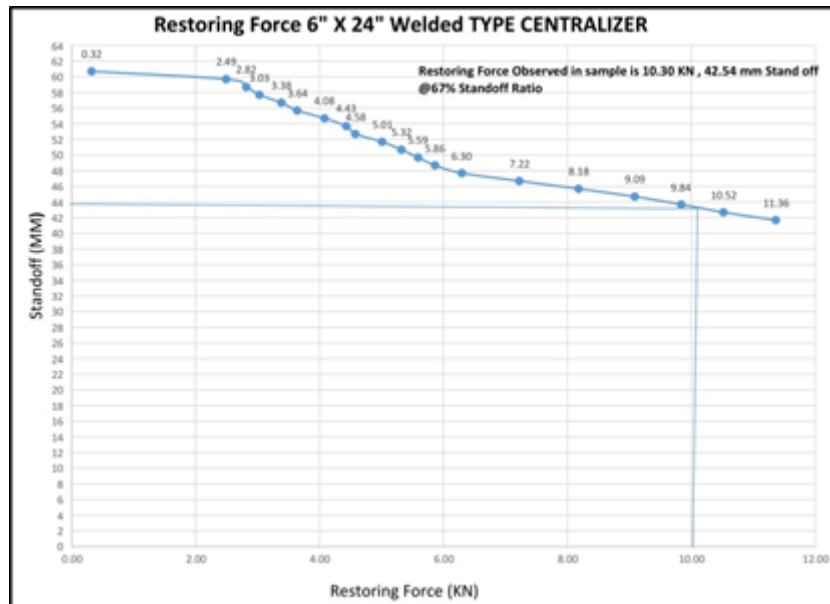
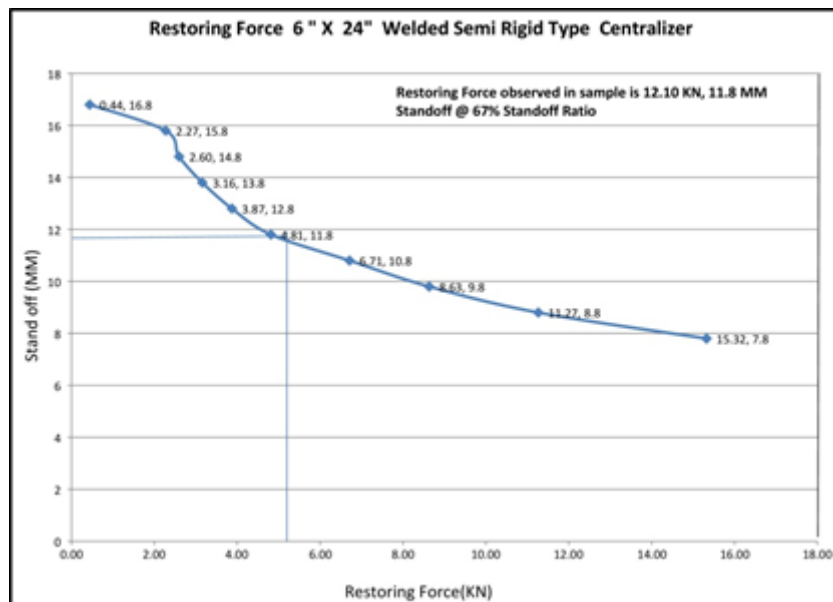


Fig-3: Example of Casing Centralizer for Restoring Force Equipment



Graph-4.1: Welded Type Centralizer



Graph-4.2: Welded Semi Rigid Type Centralizer

Compression Test of Sledge Chakra

Compressive strength is the ability of a material or assembly to endure loads inclining to decline size, as opposite to tensile strength, which persists loads tending to extend. In other words, compressive strength repels compression (being pushed together), whereas tensile strength struggles tension (being pulled apart). In the study of strength of materials, tensile strength, compressive strength, and shear strength can be analyzed independently. Compressive strength can be measured by plot graph between applied forces compared to deformation on a universal testing machine.

Table-3: Results of Compression Strength

TEST	RESULT
Load At Peak	140.740KN
Elongation at Peak	10.130MM
Compression Strength	15.667N/MM ²

5. CONCLUSION AND FUTURE SCOPE

A Welded semi rigid bow spring centralizer for wellbore applications is proposed. This type of centralizer is flexible and can operate in various wellbore applications. Introducing bending of bows improve bow strength to hold the weight of outer pipe or hole pipe. A Welded semi rigid bow spring centralizer provides larger Starting

force, running force. These types of centralizers also have more absorption energy than welded type centralizer. The nut bolt attached to both sides of centralizer which removes the usage of stop collar. The main highlights of this thesis are the welded semi rigid bow spring centralizer of proposed structure with given dimensions promise the large restoring force and larger starting and running force than welded type centralizer. Future scope of these centralizers are functions as centralization and mud removal. It is one of the most important factors in obtaining a good cement job. Effective centralization assists in mud removal and helps ensure an even cement coat around the casing. Certain running procedures, such as pipe reciprocation and rotation, improve the mud displacement process. Centralizers for horizontal wells have to fulfill two requirements: They should have a high restoring capability and a low moving force, and they should allow pipe rotation and reciprocation. Conventional bow-type centralizers have been used effectively in some horizontal wells. But as the horizontal section length increases, special centralizers, such as low-moving-force, bow-type centralizers and rigid centralizers, may be essential. The welded semi rigid type these centralizer with stop collar is designed for future wellbore applications with API Specifications.

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ORGANIZATIONAL CULTURE AND JOB SATISFACTION AMONG EMPLOYEES IN BANKING SECTOR

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ABSTRACT

The determination for this research was to explore the impact of organizational culture and to measure the job satisfaction as applied to employees of banking sector. This study featured some key highlights which empowered the key managers to probe out some of the important aspects for the decreasing satisfaction level in the employees and to upgrade a portion of its culture blocks to increase the job satisfaction of the employees. The outcome appears as social components – steadiness, compensate framework, similarity, security, and protection, leadership style, subordinate disposition and correspondence structure have a huge effect on employment fulfillment. It must be required for all associations to give accentuation on remuneration framework since it is compelling route for expanding representative's fulfillment level. It must be needed for all organizations to give emphasis on reward system because it is very effective way for increasing employee's satisfaction level.

Keywords: Banks, Job Satisfaction, Organization Culture, correlation, Employees

INTRODUCTION

Organization culture is a system of shared meaning held by member's that distinguishes the organization from other organizations. This is a set of characteristics that the organization values. The most important factor contributing in the success of any organization is the work force of the organization which provides an inimitable source of competitive advantage. Culture has a direct impact on the job satisfaction of the employees and it has been observed through literature the more the organization is flexible, follows the participative management style with a strong communication and acknowledge with the rewards and benefits unbiased distribution higher will be the satisfaction level of the employees followed by organization moving on the track of success (McKinnon *et al.* 2003).

REVIEW OF LITERATURE

Bureaucratic, innovative and supportive cultures influenced the employee's job satisfaction (Khan and Parveen, 2014). Job satisfaction of operational staff is determined through organizational climate, occupational stress, age and gender (Khan and Parveen, 2014). Seven factors have significant influences on job satisfaction are fairness, working conditions, job security, performance, salary and other benefits, comfortable working environment, training and demographic factors (Grover, Himani, Juneja, and Waheel, 2013). Ahmed (2005) investigated the relationship between the two variables and revealed that three organizational climate are positively related to the job satisfaction whereas equity and empowerment are negatively related to the job satisfaction.

STATEMENT OF THE PROBLEM

Banking division is one of those areas in which the work weight has dependably been high. As of the world, has acquired the enormous changes the working of banks and financial institutions in general managers of banks, mainly depends on organizational culture such as supportiveness, reward, security and privacy, administration style, subordinate frame of mind, correspondence structure and so on. Another reason for this study was to decide if impressions of various respondents are diverse about hierarchical culture and occupation fulfillment or not. Since the association culture have the effect to expand the productivity of the financial areas, and this benefit earned through the workers. If the employees are satisfied with the organizational culture of their concerned institute then the institutions earn huge profit with their performance. Thus, there have the immediate connection between organizational culture and employee's job satisfaction.

OBJECTIVES OF THE STUDY

- To study the determinants of organizational culture and climate as related to job satisfaction in banking sector in Uttar Pradesh.
- To study the impact of demographic factor on organizational culture and climate as a one of the important determinants of job satisfaction.

HYPOTHESIS OF THE STUDY**Null Hypothesis**

H₀: There is no significant difference in job satisfaction among different cadres of employees with different age group, gender groups, marital status, educational qualification, experience, and type of branches.

Alternative Hypothesis

H₁: There is significant difference in job satisfaction among different cadres of employees with different age group, gender groups, marital status, educational qualification, experience, and type of branches.

RESEARCH METHODOLOGY

The present study is an empirical study based on the survey conducted through census method among the employees working in the Banks in Uttar Pradesh. The primary data related to the employees working in the Banks in Uttar Pradesh have been collected through a pre-structured questionnaire, prepared by the researcher. The questionnaire contains questions pertaining to personal data, socio economic data, employment details and satisfaction in work. Before finalizing the questionnaire, discussions were held with a selected number of bank employees working in the study area. Based on the discussion, the questionnaire was modified. In the study all banks of U.P. have been chosen for data collection. The census design has been decided with reference to the personal records of employees maintained Banks in Uttar Pradesh. The researcher took 284 employees working Banks in Uttar Pradesh including 63 officers in number, 142 clerical staff in number and sub staff accounted for 79. Finally, 275 respondents are considered for study.

FINDINGS OF THE STUDY

Among the officers 57 percent had medium dimension regarding job satisfaction and 15 percent had higher level. In the view of clerical staff 31 percent had lower dimension of job satisfaction and 61 percent had medium dimension of job satisfaction. However, among sub-staff 68 percent had lower dimension of job satisfaction which is higher than that of the officers and clerical staff. Clerical and sub-staff had about a similar dimension of job satisfaction, that is, 8 percent had more elevated amount of job satisfaction.

22.19 percent of the respondents working in Banks in Uttar Pradesh had the job satisfaction score 50 to 100. It is additionally clarified that just 59.64 percent of the bank employees had the job satisfaction.

Age is the metabolic marker of physical development of a person. Job satisfaction differs with age. Least age limit for an individual to get work into a bank is 18. The retirement age of a similar respondent is 60. The mental goals of people increment with the expanding age. It is trusted that more youthful individuals have fewer goals than the more seasoned one. Since the earnings are low at a lower age there is higher satisfaction for more youthful ones than the more seasoned individuals in work. As the age expands the satisfaction one lands in the position diminishes. A respondent is profoundly happy with the basic employment which he/she gets at a prior age. A similar worker does not get a similar dimension of satisfaction as he/she increments in age. Thus, there is a relationship among factors, the age and employment satisfaction. So as to look at the connection between these two factors a two path table with age and employment satisfaction is built. Likewise, workers have been assembled into four classes based on their age. It has been distinguished that there is a connection between the factors that is, age and job satisfaction, among the workers in Banks in Uttar Pradesh. Out of the 60 managers, 57 percent have medium dimension of job satisfaction, 15 percent officers are at an abnormal state of employment satisfaction and 29 percent, officers have a low dimension of employment satisfaction. It shows that the vast majority of the officers are modestly fulfilled in their activity. Age-wise investigation of job satisfaction uncovers that 85 percent of the officers in the age gathering of 40 to 50 are at a medium dimension of employment satisfaction. Since officers in the age gathering of 40 to 50 are more dynamic than the officers in other age gathering.

Subsequently they effectively accomplish their objective in their activity and land position satisfaction. The activity satisfaction among the officers matured over 50 has declined to certain degree. Likewise, since the officers beneath age 40 are fledglings to the activity, they discover hard to accomplish their objective in their activity. Subsequently their activity satisfaction is similarly moderate. On account of clerical staff 61 percent workers have medium dimension of job satisfaction, 19 percent respondents have abnormal state of job satisfaction and 31 percent respondents have low dimension of employment satisfaction. Age-wise result of clerical staff uncovers that the majority of the workers in the age gathering of 50 to 60 are at a medium dimension of employment satisfaction. It is seen from the investigation that clerical staff in the wake of picking up an adequate involvement in the underlying ages performs better in their activity and land higher position satisfaction up to the age underneath 50. However, when they achieve the age 50 they are baffled with their activity. Henceforth, their activity satisfaction decays at the age over 50. Result of job satisfaction among sub

staff uncovers that out of sub staff 22 percent have medium dimension of employment satisfaction and 4 percent have abnormal state of job satisfaction and 68 percent have low dimension of job satisfaction. On account of confinements in business, there is no sub staff in the age gathering of 20 to 40. Further it is obvious from the table that 28 percent of the sub staff who are in the age bunch over 40 are at a medium dimension of satisfaction because of ordinary and routine work nature of the sub staff. The previous talk on job satisfaction among various workers of various units in particular officers, clerical staff and sub staff demonstrates that there is a noteworthy relationship among the factors - age, framework of business and employment satisfaction. So as to think about the noteworthy relationship among three factors, factual testing through ANOVA is endeavored. The test of ANOVA is continued with the invalid speculation that, "There is no critical contrast in job satisfaction among various units of respondents with various age aggregate in Banks in Uttar Pradesh".

Job satisfaction among various genders of bank representatives in various units in Banks in Uttar Pradesh. The dimension of job satisfaction among various gender orientation groups of representatives having a place with various units. Obviously there is no critical distinction seen in the job satisfaction of officers based on gender orientation: 89 percent of the all out male workers are fulfilled up to medium dimension. Just 11 percent of the representatives have the more elevated amount of occupation satisfaction. Essentially on account of female representatives 32 percent of the ladies workers alone are at an abnormal state of employment satisfaction. By and large investigation of job satisfaction of people authorities in banks demonstrates that 18 percent of the complete officers alone are exceedingly fulfilled in their activity. With respect to staff, practically comparable inclination as saw among officers is seen in job satisfaction among people. It is discovered that just 9 percent of the men and 8 percent of the ladies administrative staff alone have scarcely accomplished an abnormal state of employment satisfaction. The others have either accomplished a lower level or medium dimension of employment satisfaction. Be that as it may, among the sub-staff in State Bank of India 25 percent of the ladies representatives have the higher activity satisfaction. However, 3 percent of the male workers have accomplished a larger amount of employment satisfaction, which is an unimportant number. Every one of these elements may have extensively affected ladies in their business status. As the result, numerous ladies in the District have gone for occupation in the early ages and obtained an equivalent status as like men. A significant number of the ladies representatives are not the original workers. Thus, such ladies representatives did not land position satisfaction either on finding a new line of work in a bank or even in the wake of getting advancement to a higher evaluation. As the result, people working are nearly at a comparable dimension of employment satisfaction. So as to contemplate the noteworthy relationship saw among the three factors to be specific gender orientation, unit and employment satisfaction measurable testing through ANOVA is endeavored. The test of ANOVA is endeavored with the invalid speculation that, "There is no critical distinction in job satisfaction among various frameworks of representatives having a place with various gender bunches in Banks in Uttar Pradesh".

Job satisfaction among wedded and unmarried workers in Banks in Uttar Pradesh. It is clear that hitched authorities are at a larger amount of job satisfaction than the unmarried staff. Among the wedded representatives in the official classification 87 percent of the staff has either accomplished the lower dimension of job satisfaction or a medium dimension of job satisfaction however among the unmarried workers just 72 percent of the officers have achieved either a medium dimension or lower dimension of employment satisfaction. However, it isn't so the situation with administrative staff. Among the wedded administrative representatives 98 percent have achieved work satisfaction up to medium dimension. The equivalent isn't the situation with unmarried workers where 60 percent of the representatives have the job satisfaction up to medium dimension. On account of sub staff, such a sort of examination of job satisfaction among various classifications of workers based on conjugal status of the representatives couldn't be endeavored in light of the fact that there is no unmarried sub staff in Banks in Uttar Pradesh. Since the administrative staff are practically comparative in age and specifically huge numbers of them are youthful, in the compensation bundle there is no distinction among hitched and unmarried administrative staff. Be that as it may, when they are advanced as authorities they get a higher compensation. In any case, the unmarried ones, who are legitimately designated as officers, don't get a higher compensation as the advanced officers. Subsequently, among authorities the wedded ranking staff gets a higher pay and higher satisfaction than the new unmarried contestants to the officer grade. It demonstrates that there is a relationship among various units of representative with various conjugal statuses with their activity satisfaction. So as to examine the critical relationship among occupation satisfaction, framework of business and conjugal status, ANOVA test is endeavored with the invalid speculation that, "There is no huge distinction in job satisfaction among various units of representatives with various conjugal status in Banks in Uttar Pradesh".

Job satisfaction among officers having a place with Forward Caste is moderate. It is additionally recognized that 88 per cent of the authorities having a place with Forward Caste have either the lower or medium dimension of employment satisfaction. Practically comparative pattern wins among workers have a place with Backward Caste and Scheduled Caste/Scheduled Tribe people group. Anyway 30 percent of the workers having a place with Scheduled Caste/Scheduled Tribe have a higher activity satisfaction. On account of administrative staff 91 percent of the representatives having a place with Forward Caste have the job satisfaction up-to medium dimension. Thus 95 percent of the Backward Class representatives and 83 percent of the Scheduled Caste/Scheduled Tribes workers have the job satisfaction up-to medium dimension. The purpose behind the above pattern might be the advancement of social equity and socialist development in the District in the early century which has finished in the training and up-liftment of the Backward Caste and Scheduled Caste/Scheduled Tribes. This has significantly improved the status of the workers having a place with these networks. On account of sub-staff representatives having a place with Forward Caste, Backward Caste and Scheduled Caste/Scheduled Tribes people group, they are embarrassed about functioning as sub-staff. Consequently, they are not happy with their activity. Be that as it may, as a result of the monetary impulses they are compelled to function as sub-staff. Subsequently, number of workers alone has accomplished a larger amount of employment satisfaction. So as to inspect the job satisfaction among various units of representatives having a place with various social classes the accompanying speculation has been confined and the equivalent is tried through ANOVA. "There is no noteworthy distinction in job satisfaction among various units of workers having a place with various social classes in Banks in Uttar Pradesh".

Job satisfaction is either low or medium with eighty one per cent of Hindus as against ninety five per cent of the Christians. the identical is that the case with clerical and sub-staff. Among the clerical workers sixty four per cent of the workers belong to Hinduism are either at medium level or high level of satisfaction as against eighty two per cent of the Christians and forty per cent of the Muslims. analysis of the amount of job satisfaction of the sub-staff shows that Christians and Hindus are virtually equally happy either at a medium or high level. It indicates that among officers and clerical staffs Christians and Muslims are additional happy than the Hindus. however among the sub-staff such a distinction couldn't be detected. so as to look at the link between the variables job satisfaction, cadres of workers and faith ANOVA take a look at is applied. For applying ANOVA take a look at the subsequent null hypothesis is mounted, "There is not any important distinction in job satisfaction among totally different cadres of workers happiness to different religions in Banks in Uttar Pradesh". It shows that the interactive result of religions and also the cadre of employees have relationship with job satisfaction of the workers in Banks in province.

Level of job satisfaction among totally different cadres of workers with different academic qualifications in Banks in province. Relationship between totally different cadres of workers with different academic qualifications and also the job satisfaction. Among the officers with higher qualification that's graduation and post graduation - seventy nine per cent and ninety one per cent severally have the duty satisfaction up to medium level. however officers with lower qualification below Higher Secondary / Pre University Course none has had a better job satisfaction. Among the clerical workers in banking company of India ninety nine per cent of the graduate and eighty three per cent of postgraduates have the job satisfaction up to medium level. within the case of sub staffs since all of them are with qualification below S.S.L.C., the variation in job satisfaction with relation to their qualification couldn't be analyzed. With reference to the analysis of job satisfaction among totally different workers with different academic qualifications, it should be finished that because the education rises the duty satisfaction doesn't increase. Hence, it will be finished that qualification doesn't have an on the spot relationship with the duty satisfaction. so as to look at the link statistically, the take a look at of ANOVA is tried with null hypothesis that, "There is not any important distinction in job satisfaction among totally different cadres of workers having different academic qualification in Banks in Uttar Pradesh". . during this case the interactive result shows that there's no important relationship among cadre and qualification of workers with job satisfaction in Banks in province.

Analysis of job satisfaction of the workers with totally different years of expertise in Banks in province shows that within the official class fifty seven per cent of the employees are with medium level of job satisfaction. Experience-wise analysis of job satisfaction among officers reveals that seventy two per cent of the workers within the expertise cluster of fifteen to twenty years had the medium level of job satisfaction. it's important to notice that among the officers fifteen per cent of the workers with over 5 years expertise had the upper level of job satisfaction. Job satisfaction among the clerical workers reveals sixty one per cent of the staff happiness to totally different years of expertise had a medium level of job satisfaction. Similarly, nine per cent of the clerical workers with totally different years of expertise had a better level of job satisfaction. The table additional reveals that sixty eight per cent of the sub workers is at a lower level of job satisfaction. No worker had earned a

better level of job satisfaction within the expertise cluster with but five years service. it's found that solely four.5 per cent of the overall sub workers with totally different years of expertise is at a better level of job satisfaction. It indicates that almost all of the workers (official, clerical, sub-staff) are the native residents and reside within the same town / city / village wherever the bank is found the expertise makes them bored. Hence, the long years of expertise within the native District provides discontentment to them in the job. So as to look at the link among job satisfaction of various cadres of workers with expertise and to statistically study the relationship the ANOVA take a look at is applied. For applying ANOVA a null hypothesis is mounted as, "There is not any important distinction in job satisfaction among difference cadres of worker with expertise in Banks in Uttar Pradesh". It shows that the experiences and cadre of employment of the worker doesn't have important relationship with the duty satisfaction in Banks in Uttar Pradesh.

SUGGESTIONS AND CONCLUSION

Creating a positive work environment in the organization one should first provide the job satisfaction to their employees. Motivates people is the most important factor in the process. Praise, an individual note from a friend or a manager does ponder. Individuals are increasingly dedicated and drawn in when there is a procedure for them to contribute their ideas and suggestions. This gives them a feeling of proprietorship and pride in their work. This study featured some key highlights which empowered the key managers to probe out some of the important aspects for the decreasing satisfaction level in the employees and to upgrade a portion of its culture blocks to increase the job satisfaction of the employees. The outcome appears as social components – steadiness, compensate framework, similarity, security, and protection, leadership style, subordinate disposition and correspondence structure have a huge effect on employment fulfillment. It must be required for all associations to give accentuation on remuneration framework since it is compelling route for expanding representative's fulfillment level.

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PARAMETRIC STUDY OF PERFORMANCE AND EMISSION CHARACTERISTICS FOR 4S SI ENGINE USING CURCUMA LONGA L LEAVES BASED BIOFUEL

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ABSTRACT

This paper describes an experimental study concerning the feasibility of using bio-oil namely turmeric leaves-based oil obtained from the resin of turmeric plants. The emission and performance characteristics of a 4-stroke spark ignited engine were studied by using gasoline and turmeric leaves oil. The performance and emission parameters of both the fuels were evaluated and compared. The performance parameters investigated were torque, brake mean effective pressure (BMEP), brake power, specific fuel consumption (SFC), and thermal efficiency. Carbon monoxide (CO), carbon dioxide (CO₂), hydrocarbons (HC) and oxides of nitrogen (NOX) exhaust emissions levels are also presented. The results showed that torque and BMEP were slightly lower when the turmeric leaves bio-fuel was used as fuel as compare to gasoline on all engine speeds.

Keywords: *Curcuma longa* leaves oil, biofuel, 4S SI Engine, emission and performance analysis.

I. INTRODUCTION

The world energy demand has for the last two decades, witnessed uncertainties in two dimensions. Firstly, the price of conventional fossil fuel is too high and has added burden on the economy of the importing nations. Secondly, combustion of fossil fuels is the main culprit in increasing the global carbon dioxide (CO₂) level, a consequence of global warming. The scarcity and depletion of conventional sources are also cases of concern and have prompted research world-wide into alternative energy sources for internal combustion engines. Biofuels appear to be a potential alternative “greener” energy substitute for fossil fuels¹.

Petroleum resources are finite and therefore search for alternative is continuing all over the world. Development of bio-fuels as an alternative and renewable source of energy for transportation has become critical in the national effort towards maximum self-reliance- the corner stone of our energy security strategy.

The production of the biofuels from the various food sources results in many problems such as, increasing food prizes and worldwide food crisis. These problems forced the researchers to look for the new sources of alternative fuels and these new alternatives are known as Second generations biofuels. This project work is all about to give a better second generation biofuel.

Turmeric (*Curcuma longa*) (Family: *Zingiberaceae*) is used as condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. The rhizomes of turmeric are used in many ways but the leaves of the turmeric are having no use so far. However, in this work we are proposing to extract the oil from the turmeric leaves and used the oil as fuel for the petrol engine².

II. COMPOSITION OF TURMERIC LEAVES OIL

The turmeric leaves oil is extracted from the agricultural waste of the turmeric corp. by using the leaves we are producing a volatile oil by the hydro-distillation process. Leaf samples of *C. longa* and *C. aromatic* on hydro distillation yielded 1.32 and 1.00% essential oil respectively, containing *a*-phellandrene (38.24%), C8- aldehyde (20.58%), 1,8-cineole (8.64%), *a*-pinene (2.88%) and *b*-pinene (2.36%) in *C. longa*, and 1,8-cineole (28.01%), linalool (7.67%), *a*-pinene (4.74%), *b*- pinene (3.70%) and C8-aldehyde (2.62%) in *C. aromatica*, as confirmed by GLC analysis. The major compounds of *C. longa* leaf oil samples were *a*- phellandrene and C8-aldehyde. Such predominance of C8-aldehyde is novel. In *C. aromatica*, the major compounds are 1, 8-cineole (28.01%) and linalool (7.67%). The aroma of turmeric is due to its volatile oil, while the phenolic compounds and its analogues account for its bright yellow colour. Due to its lower commercial importance, the chemistry of turmeric oil has not received much attention earlier. Kelkar and Sanjeev Rao (1933) reported that steam distilled volatile oil is predominantly a mixture of sesquiterpene ketones and alcohols. Malingre (1975) reported p-cymene, b-sesquiphellandrene, turmerone, arturmerone and sesquiterpene alcohols from *C. longa*. The turmeric oil mainly consist of the phenols which are some kinds of alcohols³.

III. CHEMICAL AND PHYSICAL PROPERTIES OF FUEL

PROPERTIES	GASOLINE	TURMERIC LEAVES OIL	ETHANOL	METHANOL
Typical formula	$C_{6.97}H_{14}$	$C_{21}H_{20}O_6$	C_2H_5OH	CH_3OH
Molecular weight	106.22	368.3799	46.07	32.04
Density (kg/m ³)	750	925 at 20° c	785	792
Research octane number	95.8	Not determined	107	106
Motor octane number	85	Not determined	89.7	88.6
Kinematic viscosity (mm ² /s)	0.494 at 40°c	0.782 at 25° c	1.221 40°c	0.596 40°c
Heating value (kJ/kg)	42,600	43671.13	26,700	19,850
Flash point (°C)	95-100	102		
Fire Point (°C)				
Pour point (C)	<=-30	<=-20	<=-25	<=-20

Table-1: Comparison of properties of Turmeric leaves oil with Gasoline and other alternative

The chemical characteristics play a very important role in case of fuel all the properties are explained in the above section along with their importance in combustion. In this section we will compare the properties of the turmeric leaves oil with the gasoline and other alternate oils. The table shows the various properties of all the turmeric leaves oil, gasoline and other alcohol-based fuel.

The turmeric leaves oil has a higher Calorific value as compare to the gasoline and alcohol-based oils. The density of the turmeric oil is slightly higher but it can be compensated as it reduces as the temperature increases and also it can be reduced by adding some additives. The turmeric leaves oil has equivalent properties with the gasoline and also it is having superior quality as compare to the other alternative oils and hence this fuel will be better alternative for Gasoline⁴.

IV. EXPERIMENTAL SET-UP

The figure shows the details of the experimental test rig. These test rigs is used for the evaluation of the performance and emission characteristics of turmeric oil and are compared with the gasoline. The emission coming out from the engine is analyzed with using AVL 4 gas analyzer.

Experiments were carried out on a single cylinder 150cc engine. The engine is four-stroke, single cylinder, spark ignition and naturally aspirated. Bore and stroke are 76mm and 60mm respectively the engine works at a compression ratio of 8:1. Maximum power is 14bhp at 5500 RPM and maximum torque 1.42 kg-m at 6000 RPM. Intake valve opening at 10° BTDC and closing at 49° ABDC and exhaust valve opening and closing takes place at 55° BBDC to 12° ATDC respectively.

Engine type	single cylinder, 2 Valve, SOHC
Bore X stroke (mm)	76mm X 60mm
Displacement volume (cc)	150cc
Compression ratio	8:1
Maximum torque (kg-m/rpm)	1.42 kg-m 6000 RPM
Maximum power (kW/rpm)	14bhp at 5500 RPM
Maximum speed (rpm)	7000 RPM
Cooling system	naturally aspirated

Table-2: Engine Specifications

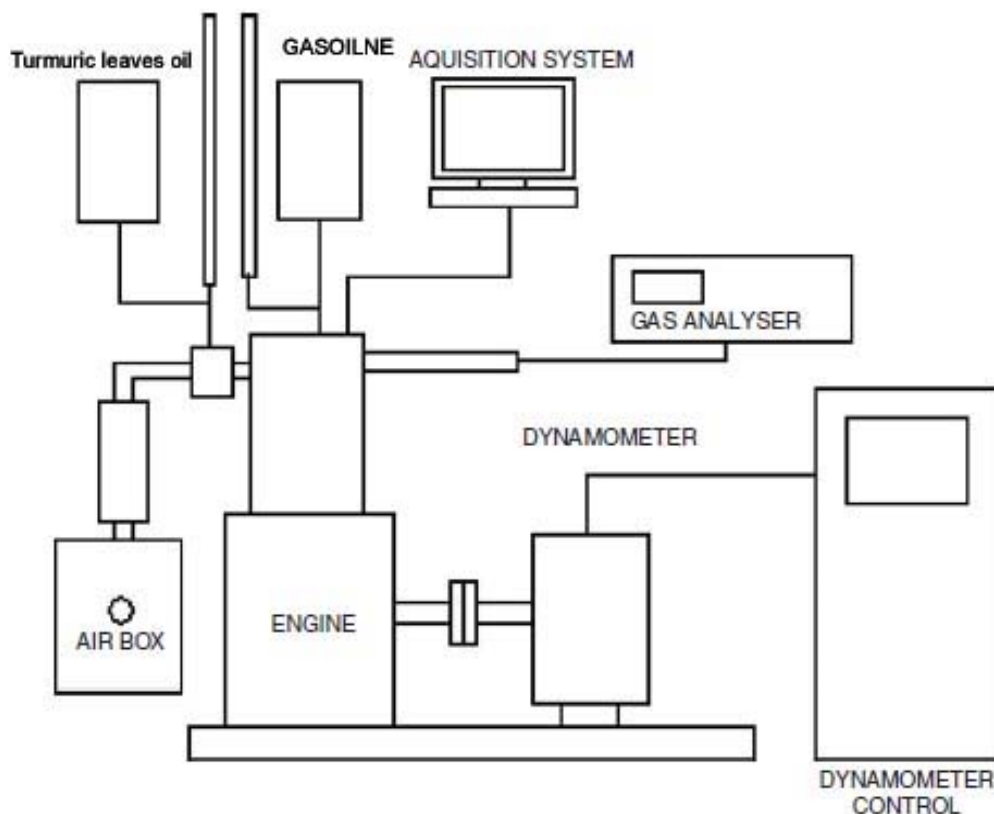
The test engine was coupled to an eddy-current dynamometer for measuring engine speed & load.

Mass of air intake is measured by air box method with U-tube water manometer and exhaust gas mass flow rate measured by exhaust gas calorimeter.

The two separate fuel tanks were used for gasoline and turmeric leaf oil. Two separate fuel-metering systems were provided to meter both primary fuel and pilot fuel. Fuel consumption of an engine was measured manually by a graduated burette.

An orifice meter attached with an anti pulsating drum measures air consumption of an engine with the help of U tube manometer.

Data were collected simultaneously from sensors and sent to data acquisition system. Also, data from engine torque and exhaust gases were recorded which included, the concentration of NO_x, unburned Hydrocarbon (UBHC), CO₂, CO and O₂ in exhaust emission.



V. EXPERIMENTAL METHOD

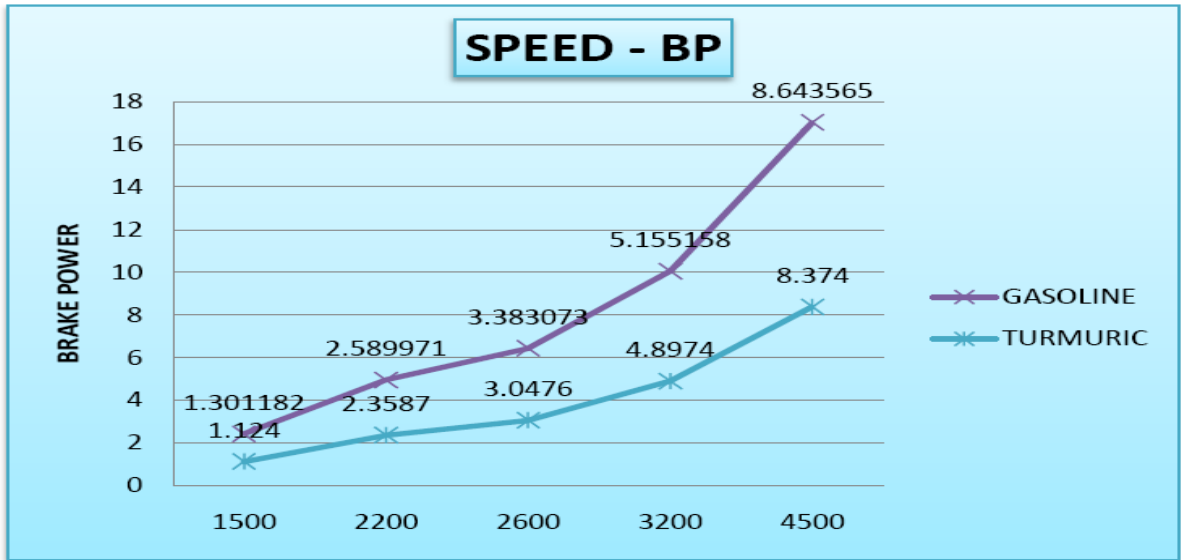
1. The whole test was conducted for the standard engine pressure and intake timing.
2. There are two separate fuel tanks are used for gasoline and Turmeric leaves oil.
3. There were two separate fuel-metering systems provided with test rig to measure primary and pilot fuel consumption, respectively.
4. The first test was conducted using unleaded gasoline emission, for determining fuel consumption and performance.
5. First 25% load was applied; consequently, speed of the engine decreases.
6. Then the second fuel i.e. turmeric leaves oil is used and fuel consumption and performance are determined.
7. Before taking the results, the engine is kept running for some time on the turmeric leaves oil so as to remove any presence of gasoline in the fuel systems.
8. Fuel consumption and cylinder pressure were measured at each load.
9. Emission is measured on all loads by using AVL 4 gas analyzer.
10. 50%, 75% and 100% loads were applied one by one and steps 8 and 9 were repeated for each load and each fuel.

VI. EXPERIMENTAL RESULTS

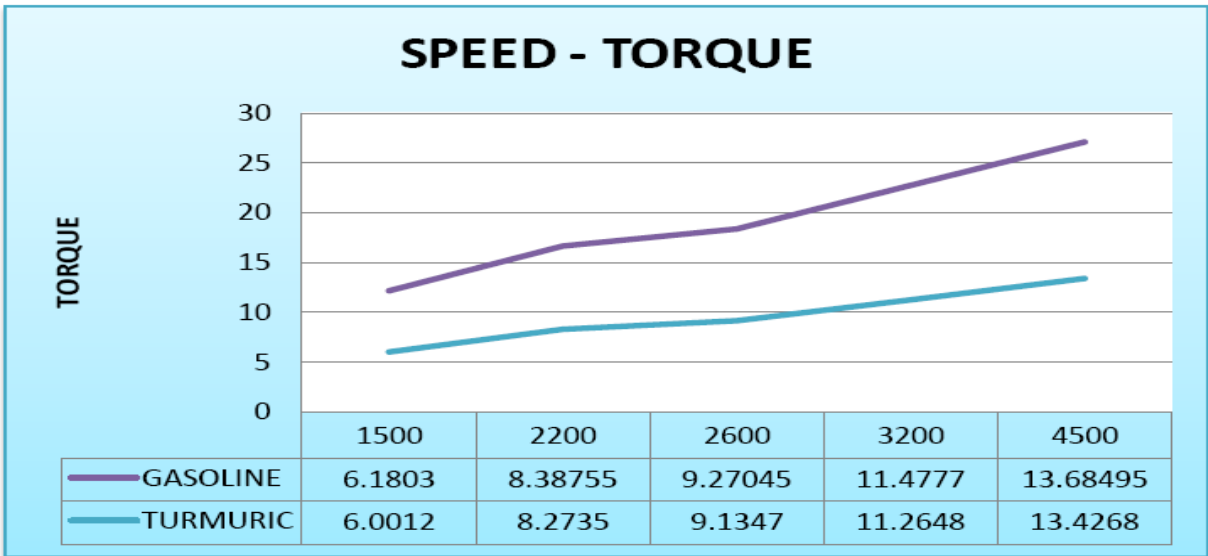
A. Engine power

When the turmeric leaves oil used the engine power slightly decreased for all engine speeds. The loss of power can be attributed to the low calorific value, which is slightly lower as compare to gasoline. the density & volumetric efficiencies is more and are also responsible for engine power. The brake engine power for gasoline and turmeric leaf oil at engine speed of 2200 RPM is 2.00 kw & 1.938 kw respectively.

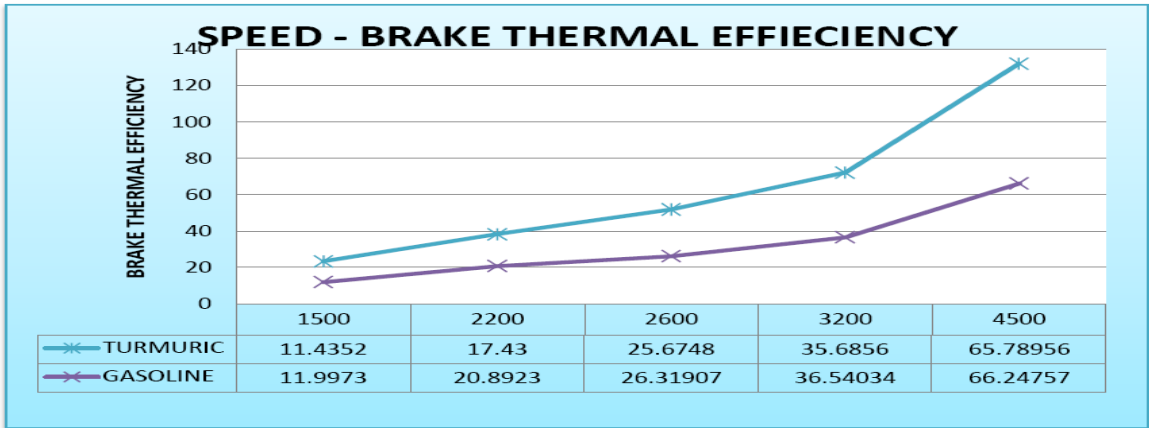
Figure-1: Experimental Set-Up



B. Torque output
The torque output of engine with turmeric leaf oil is 8.39 N-m turmeric leaves oil produces slightly rich mixture that produces more power the rich mixture allows a more advanced timings that results in high combustion pressure and thus higher torque.

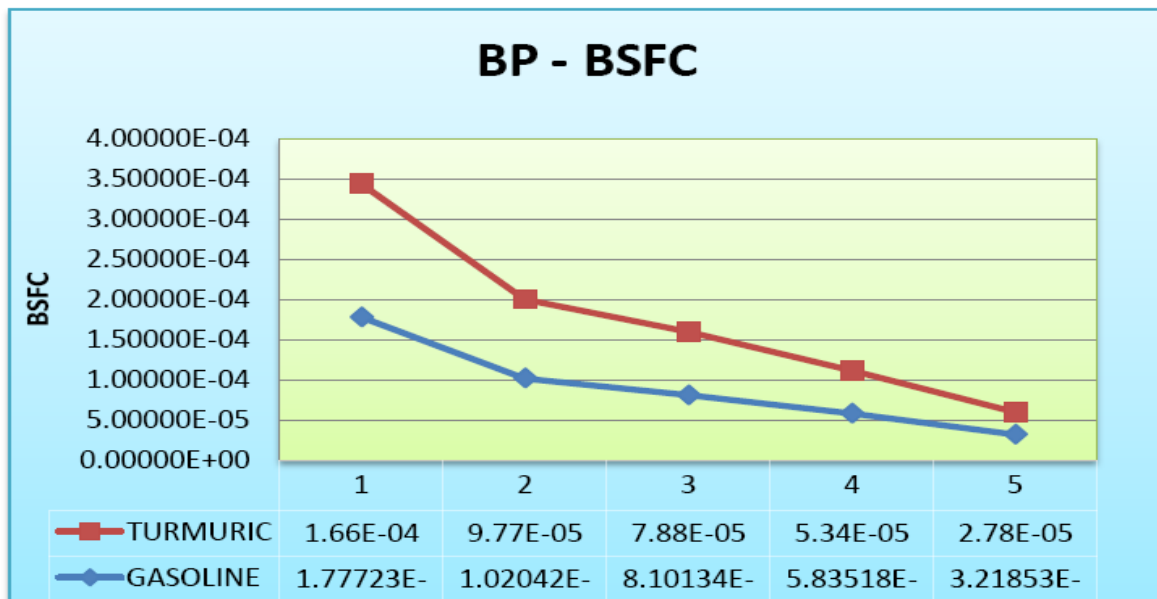


C. Brake thermal efficiency
A brake thermal efficiency of engine with, turmeric leaves oil is 14.92% which is slightly less as compare to gasoline which is 17.1.14% as the engine increase the brake thermal efficiency increases and it is maximum at 4500rpm for both gasoline & turmeric oil.



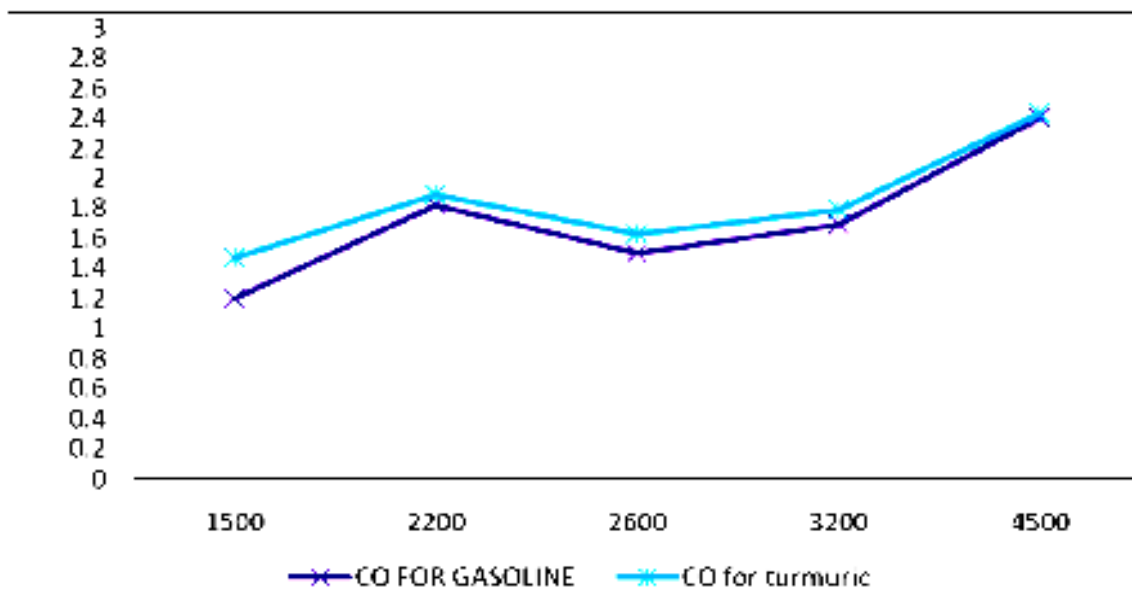
D. Brake specific fuel consumption (BSFC)

The BSFC for lower engine speed is more, then it start decreasing and, it is minimum at engine speed of 3500rpm, and then its starts increasing the BSFC for the turmeric leaf oil is 0.5517kg/kw-hr and for petrol it is, 0.4757.1 kg/kw-hr. This is due to the increased in brake thermal efficiency.



Engine emission studies

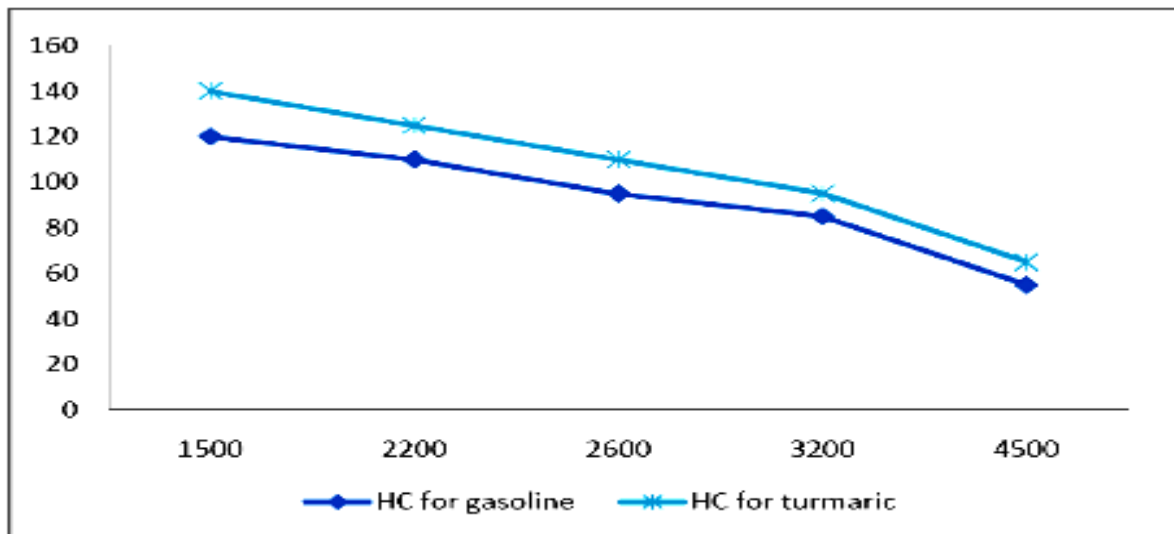
CO emission



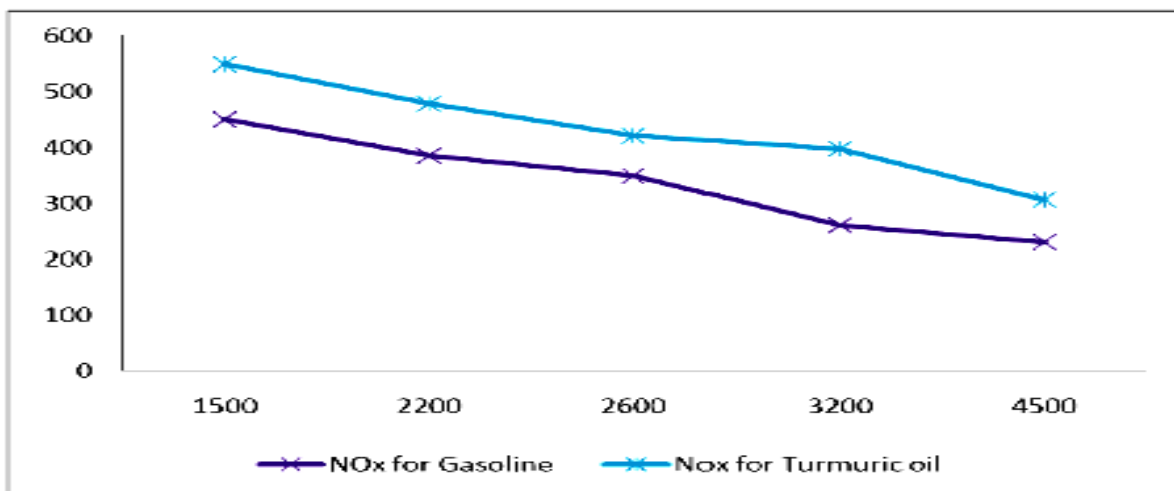
The concentrations of CO emission for different engine speeds are evaluated by AVL gas analyzer. The CO concentration in the exhaust gas emission at 3000 rpm for gasoline fuel was 4.69 (%V), while the CO concentration of turmeric leaves oil at 3000 rpm was 4.05 (%V). The CO concentrations at 3000 rpm using turmeric leaves oil was decreased by 13.7%, in comparison to gasoline. The significant reason of this reduction is that the oxygen content in the blended fuels increases the oxygen-to-fuel ratio in the fuel-rich regions. The most significant parameter affecting CO concentration is the relative air-fuel ratio (k).

E. CO₂ emission

CO₂ emission depends on relative air-fuel ratio and CO emission concentration. The CO₂ concentration in the exhaust gas emission at 3000 rpm for gasoline fuel was 12.4 (%V), while the CO₂ concentration of turmeric leaves oil at 3000 rpm was 12.9. The CO₂ concentrations at 3000 rpm using turmeric leaves oil was increased by 3.87 in comparison to gasoline.

F. HC emission

The HC concentration in the exhaust gas emission at 3000 rpm for gasoline fuel was 183 ppm, while the HC concentration of turmeric leaves oil at 3000 rpm was 152. The HC concentration at 3000 rpm using turmeric leaves oil was decreased by 16.94% at 3000 rpm, in comparison to gasoline. This result indicates that turmeric leaves oil can significantly reduce HC emissions. The concentration of HC emission decreases with the increase of the relative air–fuel ratio, the reason for the decrease of HC concentration is similar to that of CO concentration described above.

G. NOx emission

Considering the NOx emission, it is found that the NOx concentration is higher when turmeric leaves oil is used. The NOx concentration in the exhaust gas emission at 3000 rpm for gasoline fuel was 876 ppm, while the NOx concentration of turmeric leaves oil at 3000 rpm was 1002. The NOx concentrations at 3000 rpm using turmeric leaves oil was increased by 12.57% in comparison to gasoline. When the combustion process is closer to stoichiometric, flame temperature increases, therefore, the NOx emission is increased, particularly by the increase of thermal NO.

VII. CONCLUSION

In this project we look for the development of the new source of the Alternative fuel. We used the agricultural waste of the turmeric crop and we evaluated the fuel on the single cylinder spark ignited engine and compared it with the gasoline.

When the turmeric leaves oil used the engine power slightly decreased for all engine speeds. The loss of power can be attributed to the low calorific value, which is slightly lower as compare to gasoline. A brake thermal efficiency of engine with, turmeric leaves oil is 14.92% which is slightly less as compare to gasoline which is 17.14%. The BSFC for lower engine speed is more, then it start decreasing and, it is minimum at engine speed of 3500rpm, and then its starts increasing the BSFC for the turmeric leaf oil is 0.5517kg/kw-hr and for petrol it is, 0.4757.1 kg/kw-hr. This is due to the increased in brake thermal efficiency.

The CO concentrations at 3000 rpm using turmeric leaves oil was decreased by 13.7%, in comparison to gasoline. The CO₂ concentrations at 3000 rpm using turmeric leaves oil was increased by 3.87 in comparison to gasoline. The HC concentration at 3000 rpm using turmeric leaves oil was decreased by 16.94% at 3000 rpm, in comparison to gasoline. The NO_x concentrations at 3000 rpm using turmeric leaves oil was increased by 12.57% in comparison to gasoline.

we can concluded that the turmeric leaves oil can be a good alternative fuel for the spark ignited engines. We have found this fuel eco-friendly and economical as compare to the other alternative fuels such as ethanol, methanol etc. we found that the performance of the engine is reduces slightly when turmeric leaves oil is used as fuel. The turmeric leaves oil gives a lower emission which is under the Emission norms.

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ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN TOURISM MARKETING: EVIDENCE FROM THENMALA ECOTOURISM DESTINATION IN KERALA

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ABSTRACT

The vast development potential of tourism widely recognised in the literature. Hence, systematic promotion of tourism is relevant for fast economic development of nations, particularly for developing nations like India. Equally important is the immense potential of Information and Communication Technology (ICT) for bringing about improvement in customer service as well as operational efficiency. In the above context, the critical role that ICT adoption can play in tourism marketing is sought to be empirically studied in this paper with reference to Thenmala ecotourism destination in Kerala which is the first planned ecotourism destination in the whole of India. Based on the findings of the study, suggestions are made for proper design and positioning of products by effective use of ICT.

Keyterms: Ecotourism, Sustainable Development, ICT, Customer Satisfaction.

INTRODUCTION

It is widely recognised in the literature that tourism is an industry with immense potential for employment generation, development of the local community, attracting foreign exchange earnings, and hence development of the whole national economy. So, tourism is being promoted aggressively by nations, particularly the developing nations like India, for bringing about faster economic development. Globally, tourism is ranked second highest in terms of income generation, and is second only to the oil industry. Tourism is one of the largest and the most rapidly growing industries in the whole world. Increased level of leisure time coupled with enhanced higher purchasing power could enable more people to take up tours. As per the latest tourism statistics of United Nation World Tourism Organisation (UNWTO) international tourist arrivals have reached the level 1.4 Billion in 2018 itself, that is 2 years ahead of UNWTO's long term tourism forecasts issued in 2010. It has also been reported that the international tourist arrivals have increased by 6 per cent in 2018 which is higher than UNWTO's growth forecast of 4 to 5 per cent for 2018; and the growth rate 6 per cent is also higher than the actual growth rates registered every year since 2010 (UNWTO, 2019) [30]. Of late, tourism industry is receiving keen attention as a foreign exchange earner and in most parts of the globe tourism is promoted basically for the purpose of earning more foreign exchange. The disbursal of tourist expenditure on accommodation, food, transport, recreation and so on has a linkage effect leading to the overall development of a nation.

The percentage of receipts from international tourists in relation to gross national product (GDP) is widely accepted as an indicator of the importance of the nation in the tourism front. Every nation has got a unique and decisive role to play in tourism, and the tourism industry is projected as very valuable for the development of global transport and communication. Moreover, in view of the immense potential of Information and Communication Technology (ICT) for bringing about improvement in customer service as well as operational efficiency, embracing ICT makes sense in faster tourism development, particularly through attracting foreign tourists from the developed nations. ICT-based tools for tourism promotion such as Internet marketing offers many advantages, viz. (i) round the clock service creating utmost convenience, (ii) excellent reach covering the whole world, (iii) lower costs of online marketing, (iv) enabling personalisation of offers, (v) building constant relationship with customers, (vi) growing importance of social media prompts ICT adoption.

RELEVANCE AND SIGNIFICANCE OF THE STUDY

In view of the vast development potential of tourism and also the critical role that ICT plays in tourism marketing it is relevant to make an empirical study of the role of ICT in tourism marketing. So, this paper makes such a critical study with reference to Thenmala ecotourism destination in Kerala which is the first planned ecotourism destination in the whole of India.

LITERATURE REVIEW AND RESEARCH GAP

World Economic Forum (WEF) (2015) [28] in its report '*The Travel and Tourism Competitiveness Report*' made a detailed study of the competitiveness of various countries of the world, in the area of travel and tourism. This report contains the competitiveness of nations at the regional and global levels using a few well-defined

parameters; the global competitiveness of Indian tourism is 52 as against 17 of China, showing a huge performance gap between these two comparable developing nations. At the regional (Asia Pacific region) level too, there is a huge gap in the competitiveness, with in the 12th position whereas China is in the 6th position. WTTC (2015) [31] in its report, *Economic Impact of Travel & Tourism 2015 – Annual Update* has made a study of the relative performance of various nations of the world in the area of tourism, including region-wise performance and also future projections. WTTC has pointed out that South Asia, led by India and the Middle East, are globally the fastest growing regions in terms of the total contribution of Travel and Tourism to GDP. India is one among the bigger, fast growth markets along with China, Indonesia, South Korea and Turkey. Besides, it is reported that South Asia will be the fastest growing sub-region for total Travel & Tourism GDP long-run growth to 2025 (7.0 percent) as India outpaces China.

Empirical studies on the impact of ICT on tourism marketing are rare in the Indian context, and are virtually nil in the context of Kerala state in India. Some studies in the allied areas are briefly discussed here. Kumar, Yathish (2007) [11] has noted that the aim of tourism is to improve the quality of life of people, provide good experience to the tourists, and maintain the environmental quality which is vital for both the tourists and the local populace. A macro level study done in the Kerala context by Manoj P K (2008) [14], 'Sustainable Tourism in India: A Study from a Global Perspective with Focus on Tourism Prospects of Kerala' points out the vast growth prospects of sustainable tourism in Kerala from a global perspective. The author has suggested some strategies for the faster growth of sustainable tourism with special reference to the Kerala state in India. Notably, the macro level study by Manoj P K (2009) [15], 'Environment Friendly Tourism for Sustainable Economic Development in India', for instance, underscores the vital significance of tourism in India for its fast economic development; and at the same time points out the need for making tourism environment-friendly for ensuring its long term sustainability.

In his book, *Ecotourism Development Management*, Singh, Sarvjeet (2009) [25] has stated that ecotourism is entirely a new approach in tourism and it provides opportunities for visitors to experience powerful displays of nature and culture and to learn about the importance of biodiversity, conservation and local cultures. It focuses on volunteering, personal growth and finding innovative means to live on the earth. It involves travels towards locations wherein flora, fauna, cultural heritage etc. are the main attractions. It encourages the active participation by the local population in the conservation and education dimensions of tourism development process. In a research article by Manoj P K (2010) [16], 'Tourism in Kerala: A Study of the Imperatives and Impediments with Focus on Ecotourism', the tourism sector in Kerala state in India is analysed in detail using the SWOT model. Based on his findings, strategies are suggested for rapid and sustainable tourism development in Kerala. Sudheer, B (2015) [26] in his report on the UGC-sponsored research project, '*Economic and Cultural Impact of Responsible Tourism Initiative in Kerala – A Case Study of Kumarakom Panchayath*' has noted the need for alternative and innovative practices like Responsible Tourism (RT) to mitigate the negative effects of tourism on the environment and to make tourism sustainable in the long run. On the RT at Kumarakom, its positive effects (like, employment to the local community), empowerment of women through RT-related activities (like, providing vegetables, fish, meat etc. which are all procured locally), positive linkage effects on the locality (eg. earnings from the purchases made by tourists) etc. are noted.

A field-based study on ecotourism in Kerala done by Manoj P. K (2015) (a) [18], 'Prospects of Ecotourism in Kerala: Evidence from Kumarakam in Kottayam District' discusses the prospects of ecotourism, and based on his findings suggestions are made for sustainable development of ecotourism in Kerala. Another empirical study by Manoj P. K (2015) (b) [19], 'Employment Generation from Rural Tourism: A Field Study of the Local Community at Kumbalangi, Kerala' is based on the feedback obtained from the local community about their perceptions on the employment prospects of rural tourism, their expectations about the required Governmental interventions etc. The high prospects of employment generation and economic development on the one hand, and the need for enhanced tourism infrastructure, primarily through Government initiatives on the other hand are noted. Another study by the same author, Manoj P K (2016) [20], "Impact of Rural Tourism on the Environment and Society: Evidence from Kumbalangi in Kerala, India" in *International Journal of Advance Research in Computer Science and Management Studies (IJARCSMS)* noted the obvious positive effects of rural tourism but has warned about the utmost need to preserve the environmental purity by checking the unbridled inflow of tourists, controlling the use of non-degradable wastes like plastics, exerting more thrust on environmental cleanliness etc. Another research paper by Manoj P K (2017) [21], "Segmentation Strategy for Promotion of Ecotourism Products: Evidence from Thenmala Ecotourism" in *South Asian Journal of Socio-Political Studies (SAJOSPS)*, the author has studied as to whether the socio-economic factors have influenced the decisions of the tourists and has accordingly suggested the segmentation strategy for the tourists visiting Thenmala.

Another paper by Manoj P K (2018) [22], “Prospects of Responsible Tourism in Kerala and Strategies for Its Sustained Growth: Firm Level Evidence from Kumarakom in Kottayam” in *South Asian Journal of Socio-Political Studies (SAJOSPS)*, has sought to critically study the prospects of Responsible Tourism (RT) at the reputed Kumarakom destination in Kottayam district of Kerala. The positive impact of RT at Kumarakom on the local community has been pointed out and strategies for the long term sustainability of this RT initiative are suggested.

Though there are many studies on ecotourism (and its variants) done in the Indian context, including a few studies in the Kerala scenario, studies on the role of ICT on effective marketing of tourism are virtually nil, in spite of its growing importance. So, this study seeks to bridge the above research gap and it analyses the role of ICT on tourism marketing with reference to Thenmala Ecotourism project in Kollam district of Kerala which is the first planned ecotourism destination in the whole of India.

OBJECTIVES

- (i) To study the demographic and socio-economic profile of the tourists, both domestic and foreign, who have visited Thenmala ecotourism destination in Kollam district, Kerala; and also to study the profile of the local residents at the above ecotourism destination;
- (ii) To study the role of Information and Communication Technology (ICT) in the design of tourism products, based on the attitude of tourists towards ICT-based tools and services in the delivery of tourism products at Thenmala ecotourism destination in Kerala;
- (iii) To suggest strategies for the effective use of ICT and ICT-based tools and services in the delivery of tourism products at the study area, based on the findings of this study.

HYPOTHESES OF THE STUDY

Ho: There is no significant difference between the domestic tourists and foreign tourists in their preference towards ICT-Based tools and services. (Null Hypothesis).

Ha: There is significant difference between the domestic tourists and foreign tourists in their preference towards ICT-Based tools and services. (Alternate Hypothesis).

METHODOLOGY OF THE STUDY

This study is descriptive-analytical and exploratory in nature. Both primary and secondary data are used for this study. Primary data are collected using a sample survey with help of an Interview Schedule from Thenmala from four groups of respondent's viz. 120 domestic tourists, 120 foreign tourists, 60 local residents and 23 tourism officials. Secondary data are collected from the publications of United Nations World Tourism Organization (UNWTO), World Travel and Tourism Council (WTTC), World Economic Forum (WEF), Kerala Tourism Development Corporation (KTDC), Kerala State Planning Board, the tourism statistics (reports) of the Government of Kerala and Government of India, industry reports published by reputed agencies like FICCI, IBEF etc. Popular statistical tools are used for data analysis. The four groups of respondents are shown in Table I.

Table-I: Profile of Respondents

Group I	Officials in Thenmala Ecotourism Project	23
Group II	Local Residents in Thenmala	60
Group III	Domestic Tourists Arrived in Thenmala	120
Group IV	Foreign Tourists Arrived in Thenmala	120

Source: Based on the Sampling frame set for the study

Information was collected through a structured interview schedule from four categories of respondents (Table I). The respondents were selected purely on random sampling technique. Questions asked to Group I and Group II were relating to ecotourism administration, management, planning, impacts-social, economic, environmental & ecological, problems and prospects of ecotourism in Thenmala ecotourism project, ICT-based interventions at the destination and its progress over the years. Questions asked to Group III and Group IV were concerned with hospitality services, travel problems, attractions and personal experiences, their preferences towards ICT-based tools and services relating to marketing of tourism products at Thenmala destination. (Responses from all the three Groups viz. II, III and IV are relevant for the purpose of first objective of this paper whereas responses from the Groups III and IV alone are relevant for the purpose of second objective).

ANALYSIS AND DISCUSSION

Regarding the Age-Sex classification of the respondents under Group II, 63 per cent of them are female residents while the rest 37 per cent are male residents. Under Group III, the percentage share of female domestic

tourists is 48 per cent while it is 52 per cent for the male domestic tourists. Out of 120 domestic tourists 38 are in the age group 25–40, the lowest share i.e. 21 are in the age group of 56 & above. In Group IV, the percentage share of male foreign tourists is 51 per cent and that of female foreign tourists is 49 per cent. Out of 120 foreign tourists 34 are in the age group 41-55, the lowest share i.e. 23 are in the age group below 25. Thus, among the total 300 respondents, 145 (48 per cent) are male tourists and the rest 155 (52 per cent) are female tourists. Among the total 300 respondents 90 are from the age group 41-55 and the least share is 58 are from the age group 56 & above. (Table II).

Table-II: Age-Sex Classification

Group Age Group	Group II		Group III		Group IV		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Total
Below 25	5	9	13	14	11	12	29	35	64
Between 25-40	6	11	22	16	17	16	45	43	88
Between 41-55	7	15	19	15	18	16	44	46	90
56 & above	4	3	8	13	15	15	27	31	58
Total	22 (37)	38 (63)	62 (52)	58 (48)	61 (51)	59 (49)	145 (48)	155 (52)	300 (100)

Source: Field Survey

In fact, educational background of the local people, domestic tourists and foreign tourists is a major factor that influences the economic development of an area, especially with regard to ecotourism-related activities. Since people from different countries and from different states with different languages are involved in ecotourism, the educational status of the domestic and foreign tourists arriving at Thenmala and that of local residents in Thenmala is a significant factor. Table III shows that in Group II, out of the total 60 (100 per cent) respondents 6 (10 per cent) have primary education, 21 (35 per cent) have higher secondary background, 24 (40 per cent) are graduates (or equivalent Professional Diplomas), 9 (15 per cent) are post graduates or those having equivalent Professional degrees (like, Technical degree etc.) In Group III, primary, higher secondary, graduate, post graduate or professional degrees is in the ratio of 8: 40: 48: 24 or 6.67 per cent 33.33 per cent, 40 per cent, 20 per cent respectively. Group IV is in the ratio of 16: 18: 42: 44 or 13.33 per cent, 15 per cent, 35 per cent, 36.67 per cent respectively. Thus, among the 300 total respondents – belonging to the three groups viz. Group II, Group III and Group IV – the largest share is 114(38 per cent) with graduation, the lowest share is 30(10 per cent) has only primary education. (Table III).

Table-III: Educational Status

Group Level of Education	Group II		Group III		Group IV		Total	
	No	Percent	No	Percent	No	Percent	No	Percent
Primary	06	10.00	08	06.67	16	13.33	30	10.00
Higher Secondary	21	35.00	40	33.33	18	15.00	79	26.33
Graduate or equivalent	24	40.00	48	40.00	42	35.00	114	38.00
P.G or equivalent	09	15.00	24	20.00	44	36.67	77	25.67
Total	60	100.00	120	100.00	120	100.00	300	100.00

Source: Field Survey

Table IV shows the average monthly income of male and female in Group II, Group III and Group IV. In Group II, out of the 60 respondents 26 are in the middle income group i.e. 15000-30000 whereas only 3 are in the income class of 30000-50000. In Group III, out of the 120 respondents, 44 are in the income class of 30000-50000 whereas only 12 are in the class of 'Below 15000'. In Group IV, out of the 120 respondents 46 are in the income class of 'Above 50000' whereas nobody has been there in the income class of 'Below 15000'. Thus out of the total 300 respondents in the three broad groups viz. Group II, Group III and Group IV, as high as 96 respondents are in the middle income group of 15000-30000 whereas there are only 23 respondents who were in the income class 'Below 15000'.

Table IV: Monthly Income

Group Income	Group II			Group III			Group IV			Total		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total
Below 15000	3	8	11	5	7	12	0	0	0	8	15	23

15000-30000	16	10	26	21	16	37	16	17	33	45	51	96
30000-50000	0	3	3	28	16	44	29	12	41	54	34	88
Above 50000	3	17	20	8	19	27	16	30	46	28	65	93
Total	22	38	60	62	58	120	61	59	120	135	165	300

Source: Field Survey

Table V gives the details of the preferences of tourists towards ICT-based tools in the promotion as well as delivery of tourism products at the destination. It is noted from the Table II that while less than half (46.67 per cent) of the domestic tourists have strongly preferred the use of ICT-based tools in tourism services, vast majority of the foreign tourists (viz. as high as 70.83 per cent) have strongly preferred ICT-based services. While one-fourth (25 per cent) of the domestic tourists have preference towards, it is 15 per cent for the foreign tourists. While one-fifth (20 per cent) of the domestic tourists have a neutral stance towards the use of ICT in tourism services, only 9.17 per cent of the foreign tourists have such a preference pattern. While a small share of 8.33 per cent of domestic tourists do not require ICT-based interventions or services, a still lower share of 5 per cent of the foreign tourists also have such an attitude or preference level. (Table V).

Table-V: Preference of Tourists towards ICT-Based Tools in Tourism Services

Nature of Tour	Domestic Tourists (Gr. III)		Foreign Tourists (Gr. IV)	
	No. of tourists	Percentage	No. of tourists	Percentage
Strongly preferred	56	46.67	85	70.83
Preferred	30	25.00	18	15.00
Neutral	24	20.00	11	09.17
Not required	10	08.33	06	05.00
Total	120	100.00	120	100.00

Source: Field Survey

In short, it may be noted that foreign tourists have a definitely higher preference towards ICT-based tools and services in the delivery of tourism products. (Table II). This in turn suggests that more investment in ICT would definitely attract more foreign tourists.

TESTING OF HYPOTHESES

The Chi-square test is used to test the significance of the association between the socio-economic status of the tourists and their opinions and preferences. Chi-Square is calculated as:

$$X^2 = \frac{\sum(O_{ij} - E_{ij})^2}{E_{ij}}$$

$$E = (\text{Row Total} \times \text{Column Total}) \div \text{Grand Total}$$

X^2 = Chi-square

O = Observed Frequency

E = Expected Frequency

Table V shows that majority of the domestic tourists at Thenmala, in general, have preferred the use of ICT-based tools and services in marketing of tourism and in the delivery of tourism products and services to them. This ICT-orientation is more pronounced in respect of foreign tourists than domestic tourists. Now, let us test whether there is any significant difference between domestic tourists and domestic tourists in respect of their preference towards ICT and ICT-based tools or other applications. Here, the data in Table V are used for the testing of hypothesis. The relevant hypotheses (Null and Alternate) are as follows:

H₀: There is no significant difference between the domestic tourists and foreign tourists in their preference towards ICT-Based tools and services. (Null Hypothesis).

H_a: There is significant difference between the domestic tourists and foreign tourists in their preference towards ICT-Based tools and services. (Alternate Hypothesis).

Using the figures in Table V, the Computed value of Chi-square (X^2) is higher than the respective Table (Critical) value of at 5 per cent level of significance (LOS), and the p-value is at the level of 0.0222 (i.e. 2.22 per cent). So the Null hypothesis is not accepted and the Alternate hypothesis is accepted. It is statistically proved that foreign tourists have significantly higher level of preference to ICT and ICT-based tools and applications than the domestic tourists. This in turn suggests that while designing tourism products and services,

use of ICT and ICT-based tools applications should be given special attention. Here, special thrust is required in respect of attracting the foreign tourists and tourism products earmarked for them must have in-built ICT applications, eg. online reservations, specialised applications (Apps, in short) for tourism based services (for booking, alterations, cancellations etc.)

MAJOR FINDINGS AND SUGGESTIONS

Major findings of the study are interpreted hereunder. Besides, a few strategies are suggested for effective design and positioning of tourism products

- There is a marked trend in favour of ICT and ICT-based tools applications in the delivery of tourism products and services. Hence added thrust is required to harness ICT in all aspects of tourism administration and management.
- The preference of foreign tourists towards ICT and ICT-based tools and applications. Hence, special 'ICT-thrust' is preferred in respect of tourism products and services earmarked for foreign tourists. Specialised ICT-based applications (Apps, in short), freely downloadable E-books showcasing the salient features of tourism products etc. are essential today to attract the high end foreign tourists. Design considerations of tourism products for foreign tourists should have the above 'ICT-centricity'.
- Marketing of tourism products and services – of all types and at all levels – should invariably integrate the immense potentialities of ICT. All promotional activities in this regard should also be based on the use ICT-based tools and applications.
- Government agencies, like, Kerala Tourism and KTDC of the Government of Kerala or India Tourism (Incredible India) of the Government of India should offer specialised packages to foreign tourists. Besides, collaborating with other Governmental agencies (like, Indian Railways) would make such tour packages more attractive to all the stakeholders involved. The travel services of Indian tourism, for instance, would act as complementary to any tourism package. Needless to mention, special care is required to incorporate ICT-based tools and applications to the maximum possible.
- For ensuring the long-term sustainability of ecotourism, the number of tourists should be restricted in ecotourism destinations, since allowing too many tourists would result in irrecoverable harm to the ecotourism sites like Thenmala, as rightly pointed out by Manoj P K (2017) [22]. This fact points to the need for focusing on specific customer segments (e.g. foreign tourists), while promoting tourism products and services.
- Last, but not the least in importance is the need to train human resources (manpower), particularly in the delivery of tourism products and services using ICT-based tools and services, effective utilization of ICT infrastructure available for the satisfaction of tourists, especially the foreign tourists.

9. CONCLUDING REMARKS

In view of the foregoing discussions, it may be stated that promotion of tourism in Kerala, especially ecotourism would certainly fetch rich dividends to the state in the future, given the huge untapped tourism potential of the state. However, to meet the above end, careful and meticulous planning is required in the design of tourism products and services, considering the growing preference towards ICT and ICT-based tools and applications. Hence, the design considerations as well as the positioning strategy of all tourism products and services should reflect the imminent need for 'ICT-centricity'.

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TO ANALYZE THE BEHAVIOUR OF R134a AND POE-TiO₂ NANO-LUBRICANT AND DIFFERENT CAPILLARY TUBE SHAPE ON THE PERFORMANCE OF VAPOUR COMPRESSION REFRIGERATION SYSTEM

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ABSTRACT

Nano-lubricants are special type of nano-fluids that are synthesized by mixing nano-particles in the base oil. It is engineered fluids which contains nano sized (10^{-9} m) solid particles and have broad range of application in refrigeration and air conditioning. Evaporative heat transfer plays an important role in refrigeration and air conditioning system. R134a is a broadly used alternative refrigerant in refrigeration system such as domestic refrigerators and air conditioners. This research has been focused on COP of the vapour compression refrigeration system. It has been observed that lubricant, capillary tube shape and evaporative load significantly affect the COP of the vapour compression refrigeration system. In this experimentation, new type of nano-lubricant, based on nano-particles TiO₂ mixed in POE oil and R134a refrigerant, different shapes of capillary tube i.e. circular and serpentine at evaporative loads 25°C, 35°C and 45°C has been investigated. Result from current study reveals that circular capillary tube shape gives better COP than serpentine tube shape with R134a and POE oil as well as R134a and POE-TiO₂ nano-lubricant. It has been found that the COP of the vapour compression refrigeration system enhances as the concentration of TiO₂ nano-particles increases up to 1.5gm. But the rate of increment is increasing up to certain limit after that decreases with all capillary tube shape combination. It also shows that the enhancement in COP is more as evaporative load increases from 25°C to 35°C after that it decreases monotonically. Hence, it depicts that with increase in evaporative loads and nano-particles concentration, the COP of the vapour compression refrigeration system increases up to certain limit after that it decreases.

Keywords: Capillary tube shape, COP, Evaporative load, POE-TiO₂ nano-lubricant, Refrigerant R134a, TiO₂ nano-particle

INTRODUCTION

In developing countries, the generation of power is falling back the power demand. To increase the power generation in conventional methods lead to more expenses in context to negative environmental impact this is serious problem to our human society. Some impacts are Ozone depletion, Atmospheric pollution, Melting glaciers, Health issues, etc. This is the age of science and technology which leads rapid industrialization, unprecedented growth, development and technological advancement across the globe. Refrigeration and air-conditioning is one of the most important inventions which are used for many domestic as well as industrial applications. **Haider ali hussen [2014]** investigated the effect of dispersing a low concentration of TiO₂ nano-particles in the mineral oil based lubricant, as well as on the overall performance of a window type Air-Conditioner system using R22 as the working fluid. The average compressor work was reduced by 13.3%, which ultimately resulted in an increase of COP by 11.99%. The refrigeration systems are being used by the mankind from the very early age of the human civilization, the forms of the system were very elementary but the principle involved were somewhat similar as of modern refrigeration system. **Bandgar et al. [2016]** did experimental study on 'An experimental investigation of VCR system using R134a / POE oil / MO/ nano SiO₂ as a working fluid. It has been observed that the compressor using mixture of mineral oil and 0.5% of silica consumes 13.89% less energy than POE oil.

Thermo physical properties of matter play an important role in cooling as well as heating applications. It has been seen that performance of any system depends upon different thermo physical properties like viscosity, thermal conductivity, density, specific heat etc of the fluid which is used in the system. **M.S.Bandgar et al. [2016]** did experimental study on 'An experimental investigation of VCR System using R600 / POE Oil / MO / nano SiO₂ as a working fluid. It has been observed that the compressor using mixture of mineral oil and 0.5% of silica consumes 12.06% less energy than POE oil. **Reji Kumar et al. [2013]** conducted an experimental study on the performance of a domestic refrigerator using R600- TiO₂ nano-refrigerant as a working fluid. They found that the refrigeration system with nano-refrigerant works normally and frizzling capacity is higher. It is found that the power consumption reduces by 11.5% and COP increases by 19.6%. **Elansezhian et al. [2012]** did experimental on 'Experimental study on R134a-Al₂O₃ nano-refrigerant in refrigeration system'. He uses Al₂O₃-PAG oil was used as nano-lubricant in R134a vapour compression refrigeration system. The result shows that

the refrigeration system performance was better than pure lubricant with R134a working fluid with 10.32% less energy used with 0.2% volume of the concentration used. There are many efforts to enhance the heat transfer either to increase the area of the evaporator or to add additives in the base fluid. One of the passive techniques is the addition of ultrafine particles (called nano-particles) to the common heat transfer fluids so that the thermal transport properties of the prepared nano-fluid will be enhanced as compare to the base fluid. The rapid advancement in nano technology has led to emerging of new generation heat transfer using nano-refrigerant instead of basic refrigerant and nano-lubricant instead of basic compressor oil. **Yusof et al. [2015]** did experimental study on 'Experimental study of a domestic refrigerator with POE-Al₂O₃ nano-lubricant'. The addition of Al₂O₃ nano-particle to the base fluid (POE) gave reduction of power consumption and better performance. **T. Coumaressin et al. [2014]** mentioned the drawback of R134a and its high global warming potential and informed that addition of nano-particles to the refrigerant will increase the Performance characteristics of the system that will directly lead us to safe environment as well. **D. Sendil Kumar et al. [2012]** designed and manufactured an experimental setup in his laboratory for the vapour compression refrigeration system. In his work, he investigated the refrigeration system with the nano-refrigerant of aluminium oxide and PAG oil combination. He found that addition of nano Al₂O₃ to the refrigerant shows improvement in the COP of the refrigeration system and the usage of nano-refrigerant reduces the length of capillary tube and is cost effective. **Senthilkumar et al. (2015)** did study on the performance analysis of domestic refrigeration using CuO-R600 nano-refrigerant as a working fluid. They did the experimental analysis of the reliability and performance of nano-refrigerant as a working fluid of the system and cooling capacity, energy efficiency ratio were determined. The results found that the mixture of R600a with CuO nano-particles works normally in the domestic refrigerator and cooling capacity increased by 10-20%. **Hadi et al. (2011)** did experimental study on the evaporative heat transfer coefficient of vapour compression refrigeration system by using CuO-R134a nano-refrigerant. The test section had a horizontal tube in tube heat exchanger made up of copper. The CuO-R134a nano-refrigerant was evaporated inside an inner copper tube and the heat load was provided from hot water passing in an annulus surrounding the inner tube. Measurement were performed for heat flux ranged from 10 to 40 kW/m², using nano Copper Oxide concentrations ranged from 0.05% to 1% and particle size from 15 to 70 nm. The measurements revealed that the evaporating heat transfer coefficient increased with increasing nano CuO concentrations up to certain value the decreased. **Nilesh S. Desai et al. [2015]** reviewed the performance of refrigeration system using nano-fluids and given importance to the pressure drop and pumping power of the refrigeration system with nano-refrigerants. He concluded that adding of nano-particle in lubricating oil increases the load carrying capacity in comparison to plain oil. Nano-refrigerant and nano-lubricant enhance thermo-physical properties of refrigerant as well as lubricant and hence enhances the heat transfer capacity of the fluid (lubricant and refrigerant). Nano-fluid is proposed when the nano-sized particles are suspended in the base fluid. The nano-sized particles may be metallic or non-metallic. The mixtures of metallic (TiO₂, CuO, Al₂O₃, etc.) or non-metallic (carbon nano-tubes etc.) nano-particles to the basic fluid are known as nano-fluid. Due to this, transport properties, thermal conductivity, heat transfer characteristics etc. are enhanced.

- This nano-particle enhances the transport properties, thermal conductivity, heat transfer characteristic, etc.
- High specific surface area and due to this more heat transfer surface between particles and fluid.
- Pumping power is reduced as compared to base liquid to achieve equivalent heat transfer.
- High dispersion stability with predominant Brownian motion of the particle.

Now a days the most widely used cycle in Refrigeration and air-conditioning is vapour compression refrigeration cycle which is used at various places like industries, office, transportation, house hold applications, etc.

The vapour compression refrigeration system nowadays is used all over the world for all purpose of refrigeration. In this system the vapour refrigerant alternately undergoes a change of phase from vapour to liquid and liquid to vapour during the completion of a cycle. The latent heat of vaporization is utilized for carrying heat from refrigerator. There are four process occurring in the vapour compression refrigeration system that is isentropic compression, condensation, expansion and evaporation process. These all process occurs in a different device which are compressor, condenser, capillary tube and evaporator. All these components are shown in the figure 1.

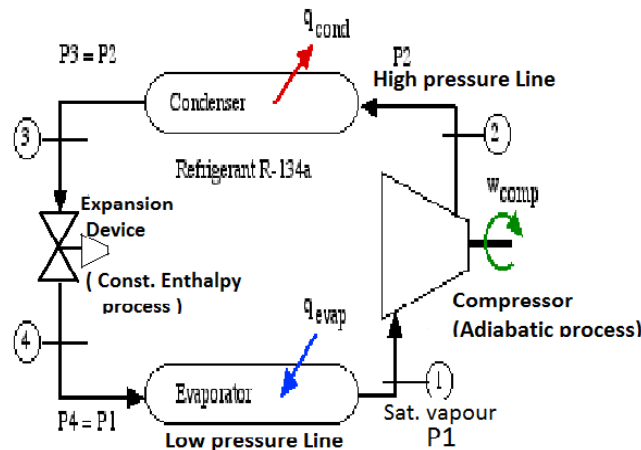


Figure-1: Vapour Compressor Refrigeration System ('Refrigeration' n.d.)

EXPERIMENTAL SETUP

To conduct the experimental analysis by using refrigerant R134a and POE-TiO₂ nano-lubricant, a refrigeration test rig was designed and installed in laboratory. The systematic diagram of experimental setup is shown below figure 2. It consists of a compressor, air-cooled condenser, expansion devices, and an evaporator. The hermetically sealed compressor is used which is reciprocating type. The evaporator is made up of copper coil spiral shape and completely dipped in water. The capillary tube is attached with the test rig as expansion device. There are two capillary tube shapes i.e. circular and serpentine attached with the setup. The heat flux is supplied to evaporator by means of heating rod (2000 W). In order to maintain homogeneous temperature conditions within the evaporator, the water is continuously agitated. Furthermore, voltmeter and ammeter are also used in the setup to measure its power consumption. Pressure gauges and digital thermocouples are installed at all salient points of the setup to measure pressure and temperature of flowing refrigerant inside the refrigeration system.



Figure-2: Experimental setup of vapour compression refrigeration system

Capillary tube is a smaller inner diameter and long tube which flows refrigerant due to this pressure of the refrigerant is decreased. It is a simple device that can be manufactured easily and it is not very costly. When the vapour compression system stops, the pressure across the capillary tube becomes same and also along the whole cycle. Due to this reason, inlet and outlet pressure of the compressor are same. Therefore, when restarted the system there is not much load on the compressor. So it is beneficial to reduce overall cost of the refrigeration system. There are two capillary tube shapes i.e. circular and serpentine are selected for the analysis of its effect on the COP of the vapour compression system which is shown figure no 3.

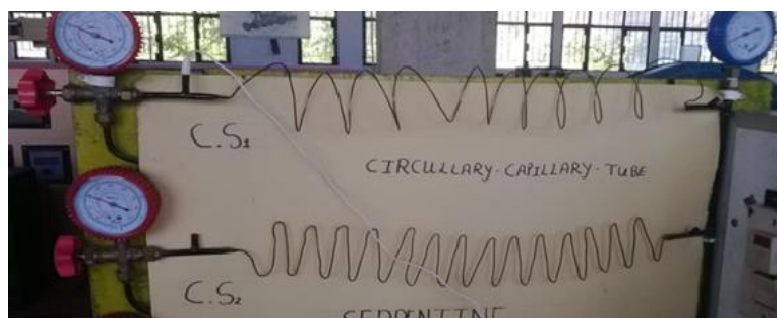


Figure-3: different shapes of capillary tube

REFRIGERATION SYSTEM EVACUATION AND CHARGING

A gas charging system is used to evacuate the vapour compression system before charging the refrigerant in order to remove the moisture and impurities. The refrigeration system is flushed with nitrogen at a pressure of 5 to 7 bar and this pressure is maintained for 45 minutes to ensure the leakage of the system. This process is carried out for all the trials. After that, refrigerant is charged carefully through the service port. The quantity of refrigerant is one kg which is measured by electronic balance. This quantity of refrigerant is charged in to the system and every time system is allowed to stabilize for 15 minutes.

PREPARATION OF NANO-LUBRICANT

Two-step method is a versatile method which is used to prepare the nano-lubricant. TiO_2 nano particle is commercially available and manufactured by Reinste Nano Venture Pvt. Ltd. New Delhi. In this method, firstly add the nano-particle TiO_2 , which has a size between 35-45 nm diameters in dry powder form by physical method in the base oil. The quantities of nano-particles are weighted by electronic balance in specific proportion i.e. 0.5 gm., 1.0 gm. and 1.5 gm. and add this quantity in one liter of POE oil respectively. The nano-particles suspended oil is placed on a magnetic stirrer and stirs it for 30 minutes. Further, make the suspension take ultrasonic vibration for 2 hours to get the nano-lubricant. During the experiment, there are appeared many bubbles on the surface of the nano-particles in the base oil and after magnetic stirring these bubbles adhere to the wall of the beaker.

PERFORMANCE ANALYSIS

From the below figure 4,

Process 1-2 - compression process in the compressor,

Process 2-3 - condensation process in the condenser,

Process 3-4 - expansion process in the expansion device

Process 4-1- evaporation process in the evaporator.

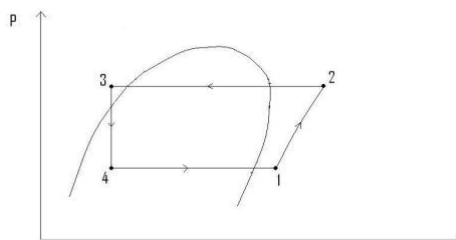


Figure:4: Pressure-enthalpy diagram of vapour compression refrigeration system

1. The work done during isentropic compression per kg of refrigerant is given by

$$\text{Work Transfer (} {}_1W_2) = h_2 - h_1$$

2. The refrigeration effect during the process by the evaporator is given by

$$\text{Refrigerating effect (RE)} = h_1 - h_4$$

3. The COP of the vapour compression refrigeration system is given by

$$\text{COP} = \frac{\text{Refrigerating effect}}{\text{Work done}}$$

$$= (h_1 - h_4) / (h_2 - h_1)$$

$$4. \text{ Rate of increment of COP (\%)} = \frac{\text{Maximum COP} - \text{Minimum COP}}{\text{Minimum COP}} \times 100$$

Where,

h_1 = Enthalpy of vapour refrigerant (kJ/kg) at temperature T_1 i.e. at suction of the compressor,

h_2 = Enthalpy of vapour refrigerant (kJ/kg) at temperature T_2 i.e. at discharge of the compressor,

h_3 = enthalpy of the vapour refrigerant (kJ/kg) at the exit of the condenser.

h_4 = enthalpy of the vapour refrigerant (kJ/kg) at the inlet of the evaporator.

RESULTS AND DISCUSSION

COP of the vapour compression refrigeration system has been calculated on the basis of shape of the capillary tube. There are two types of shape on which experimental work executed. These shapes are circular capillary tube and serpentine capillary tube of copper material.

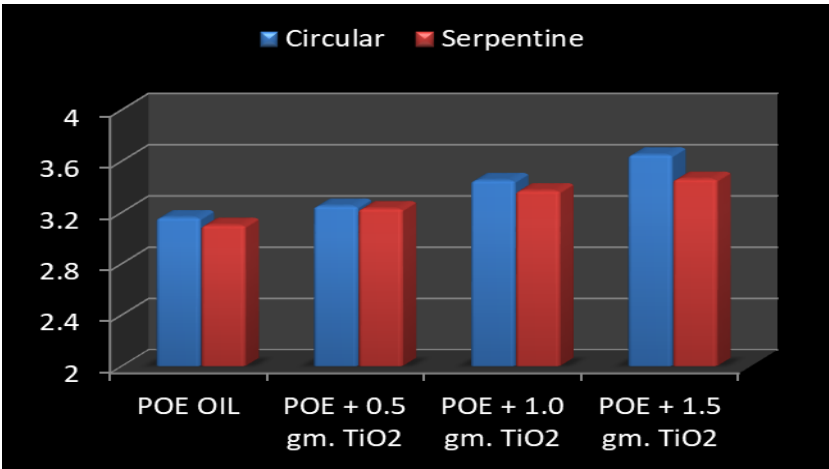


Figure-5: COP comparison for capillary shape at evaporative load 25°C

As shown in the above plot, the COP of the VCR system is decreased on the basis of shape of the capillary tube. The result shows that COP is enhanced in circular capillary tube shape in comparison to serpentine capillary shape. It also shows that when the concentration of nano-particle is increased, COP of the refrigeration system increases monotonically.

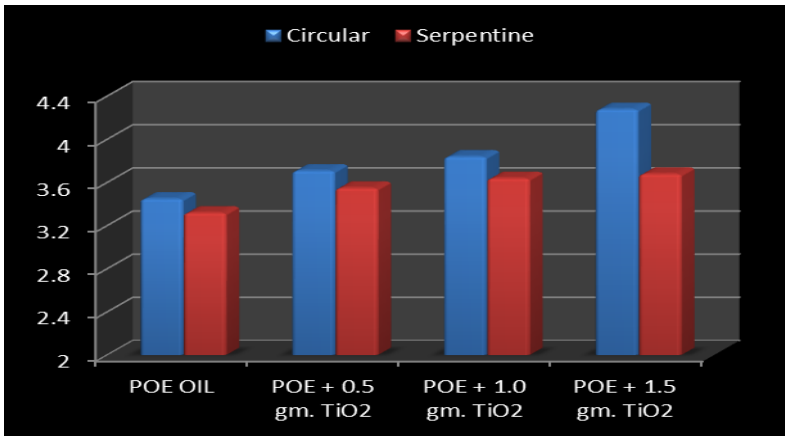


Figure-6: COP comparison for capillary shape at evaporative load 35°C

From the above plot, it has been shown that when the evaporative temperature is at 35°C, the COP of the refrigeration system is increased more efficiently in comparison to when the evaporative temperature is at 25°C.

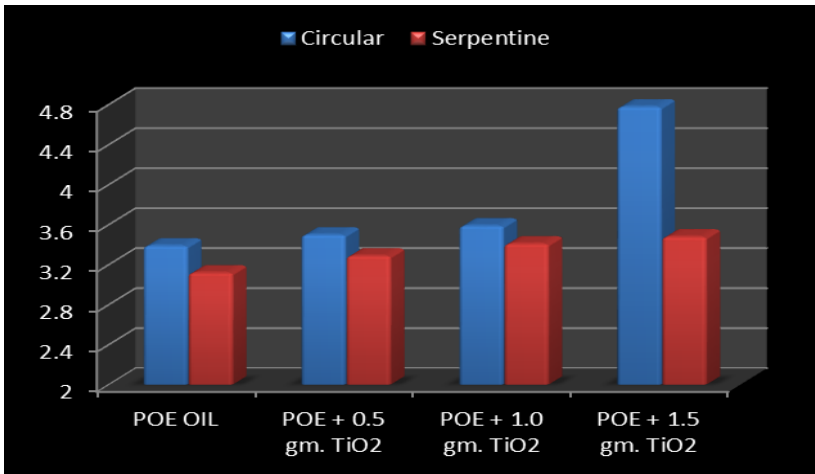


Figure-7: COP comparison for capillary shape at evaporative load 45°C

The above plot reveals that, the COP of the vapour compression refrigeration system increases also when evaporative load is at 45°C but increment is less in respect to other evaporative temperature load.

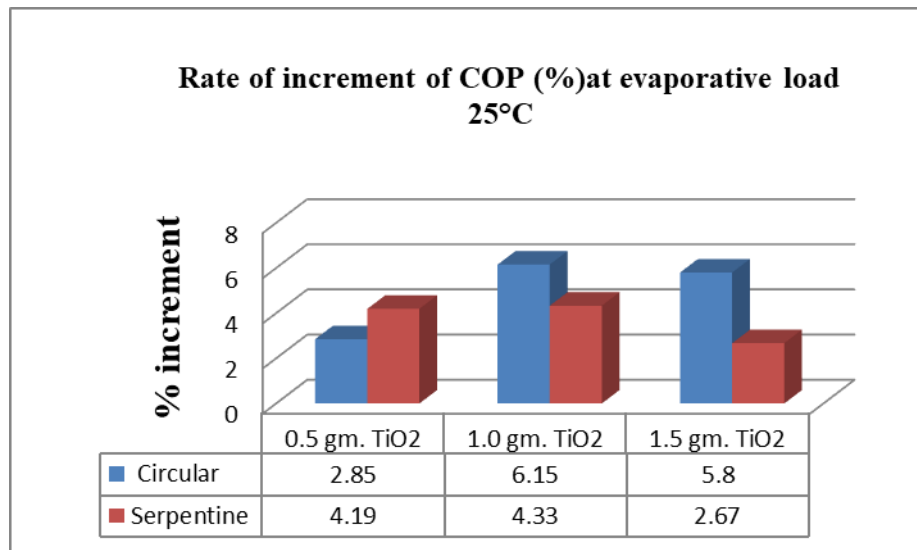


Figure-8: Rate of increment of COP (%) at evaporative load 25°C

The above figure shows percentage increment of COP when concentration of nano-particle is added in the basic POE oil. The discussion has been shown below:

- When 0.5 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 2.85 and 4.19 in the case of circular and serpentine shape respectively at evaporative load 25°C.
- When 1.0 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 6.15 and 4.33 in the case of circular and serpentine shape respectively at evaporative load 25°C.
- When 1.5 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 5.8 and 2.67 in the case of circular and serpentine shape respectively at evaporative load 45°C.

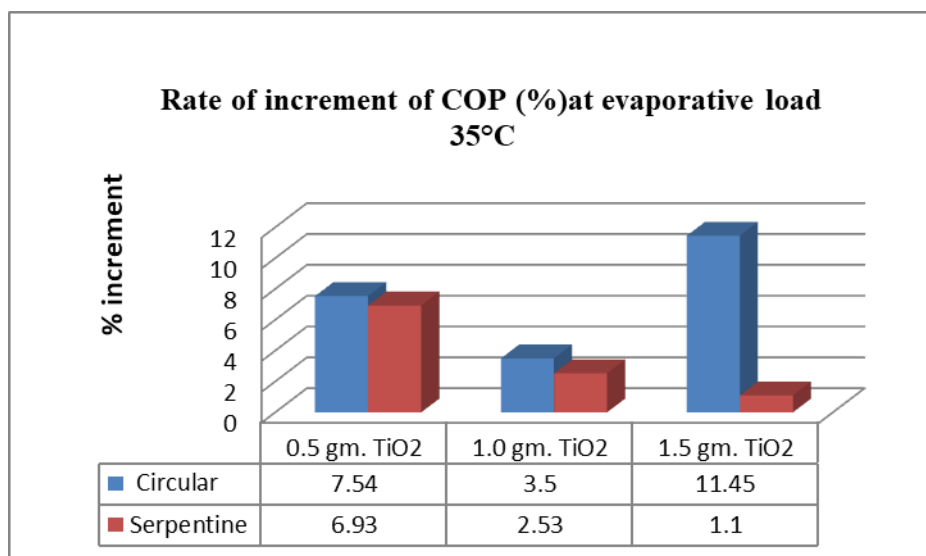


Figure-9: Rate of increment of COP (%) at evaporative load 35°C

The above graph shows percentage increment of COP when concentration of TiO₂ nano-particle is added in the basic POE oil. The discussion has been shown below:

- When 0.5 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 7.54 and 6.93 in the case of circular and serpentine shape respectively at evaporative load 35°C.
- When 1.0 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 3.5 and 2.53 in the case of circular and serpentine shape respectively at evaporative load 35°C.
- When 1.5 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 11.45 and 1.1 in the case of circular and serpentine shape respectively at evaporative load 45°C.

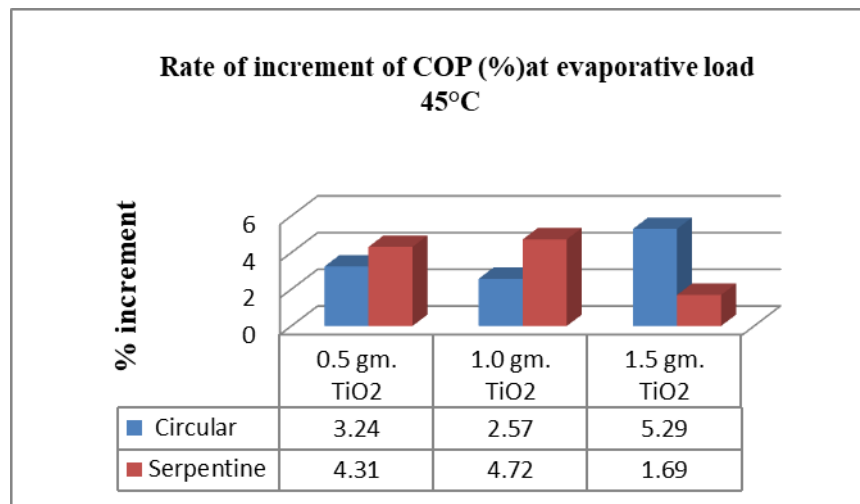


Figure-10: Rate of increment of COP (%) at evaporative load 45°C

The above figure shows percentage increment of COP when concentration of nano-particle is added in the basic POE oil. The discussion has been shown below:

- When 0.5 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 3.24 and 4.31 in the case of circular and serpentine shape respectively at evaporative load 45°C.
- When 1.0 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 2.57 and 4.72 in the case of circular and serpentine shape respectively at evaporative load 45°C.
- When 1.5 gm. TiO₂ nano-particle is added in the basic POE oil, the rate of increment is 5.29 and 1.69 in the case of circular and serpentine shape respectively at evaporative load 45°C.

CONCLUSION

Nano-lubricant is a superior fluid containing nano-sized particle. It is used to enhance the system performance in vapour compression refrigeration system. TiO₂ nano-particles with basic POE oil can be used as an excellent lubricant to improve the heat transfer characteristics in a refrigeration system. In present experimental investigation R134a refrigerant and POE-TiO₂ nano-lubricant with varying concentration of TiO₂ nano-particle i.e. 0.5 gm., 1.0 gm. and 1.5 gm. per liter of POE oil have been taken for analysis. Others parameters i.e. copper capillary tube shape- Circular and Serpentine shapes and evaporative loads- 25°C, 35°C and 45°C have been taken for the analysis of COP of the vapour compression refrigeration system. On the basis of experimental results, it can be concluded as:

- The R-134a refrigerant and nano-lubricant POE oil with TiO₂ nano powder worked smoothly and efficiently in refrigeration system.
- It is found that circular capillary tube shape gives better COP in respect to serpentine capillary shape in both R134a with basic POE oil and R134a with POE-TiO₂ nano-lubricant.
- It is also found that as the evaporative load increases, the COP of the system increases simultaneously. While the rate of increment is different for different load. In this study, the rate of COP increment is more as evaporative load increases from 25°C to 35°C than 35°C to 45°C. In circular and serpentine capillary tube shape, the rate of COP of the refrigeration system increases as evaporative load increase from 25°C to 35°C and after that it decreases to 45°C in all cases.
- As the concentration of TiO₂ nano-particles increases in the basic POE oil, the COP of refrigeration system increases continuously at different rate in circular and serpentine capillary tube shape at all load conditions.

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UV-VIS SPECTROSCOPIC ANALYSIS OF CDS NANOPARTICLE-CHLOROPHYLL INTERACTION

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ABSTRACT

Nanoparticles, due to their unique size dependent chemical and physical properties have led to many applications in biology and medicine. Cadmium sulphide (CdS) Nanoparticles (NPs) is among the most widely produced and can display novel optical, electronic, magnetic, chemical and structural properties that might find many important technological applications.

In the present research work, the interaction of CdS nanoparticles with the chlorophyll pigment molecules was studied. Nanoparticles having particle size ~ 5 nm were synthesized by using chemical route and characterized using Uv-Vis spectroscopy and X-Ray Diffraction techniques. Chlorophyll pigments were extracted from fresh spinach leaves by using standard technique. Interaction of synthesized nanoparticles with chlorophyll pigment molecules was studied by using UV-Vis spectroscopic technique. The results obtained showed shift in first peak of chlorophyll absorption spectra towards lower wavelengths and second peak towards higher wavelengths. The present work would help to understand the interaction of nanoparticles with chlorophyll pigment molecules and may offer attractive potential application route in photovoltaics.

INTRODUCTION

Semiconductor nanoparticles have attracted much interest in fundamental research and industrial development during the past decade due to their unique and important size dependent chemical and physical properties [1]. The use of nanomaterials in biophysics or biotechnology merges the fields of material science and biology. In photosynthesis process, light induced charge separation takes place and light energy is converted into chemical energy by plants. The major component in this transduction of energy is chlorophyll (Chl) pigment. The essential role of Chl is to capture solar energy, transfer the excitation energy to special locations called, the reaction centers, and bring about the charge separation for the subsequent electron-transfer processes. The photochemical and photophysical properties of Chl have been widely investigated in various laboratories around the world [2-4].

It has been shown that NPs with dimensions < 100 nm can modify the physicochemical properties (such as conductivity, reactivity and optical sensitivity) of a material [5]. Studies involving NPs and plants have shown that NPs can inhibit the germination and growth of plants [6,7]. However, to widen the applications, it would be interesting to study the interactions of nanoparticles with biomolecules. In the present work, studies were carried out to investigate the interaction of CdS nanoparticles with chlorophyll pigment molecules extracted from fresh spinach leaves.

MATERIALS AND METHODS

Synthesis of CdS Nanoparticles

CdS nanoparticles were synthesized by using standard chemical method. Cadmium chloride (CdCl_2) and sodium sulphide (Na_2S) were used as precursors. Cadmium chloride (2mM, 100 ml D/W) (0.04026 gm) was stirred with the help of magnetic stirrer for 10 minutes. Thioglycerol 18 mM was added and solution was stirred for another 10 minutes drop by drop. Sodium sulphide (30 mM, 100 ml) (0.23412 gm) of was added and continued stirred for another 20 minutes. Finally precipitate can be obtained precipitating agent like methanol (50 ml). The chemical reaction is given below:



The UV-Vis absorption spectra of CdS nanoparticle solution was obtained and band gap was calculated. Further, nanoparticles solution was dried at 60°C to obtain powder and XRD was recorded.

Extraction of Chlorophyll Pigments

For the extraction of chlorophyll pigments, 80% acetone method described by Porra et al. was used [8]. Spinach leaves were taken and their midribs were removed. Total 1gm spinach leaves were crushed with the help of mortar pestle in 80% acetone solution (20 % distilled water). The solution was then filtered with WhatmanTM filter paper (125 mm). Filtered solution was kept at 4°C for overnight. After 24 hours, UV-Visible absorptionspectra was recorded for wavelength ranging from 250 nm to 750 nm. By using this data, Chlorophyll-a, Chlorophyll-b and total Chlorophyll were estimated by using Arnon's method given below:

Arnon's Formulae:-

$$C_a = 0.0127 A_{663} - 0.00269 A_{645}$$

$$C_b = 0.0229 A_{645} - 0.00468 A_{663}$$

$$\text{And } C_{\text{total}} = C_a + C_b = 0.0202 A_{645} + 0.00802 A_{663}$$

Where,

C_a and C_b are chlorophyll a and b, respectively

And A is absorbance value at the respective wavelengths.

Interaction of CdS Nanoparticles and Chlorophyll

For the interaction of chlorophyll with CdS nanoparticles, equal volume of CdS nanoparticle solution and Chlorophyll solution was taken. Total 3 ml chlorophyll pigment solution was mixed homogeneously with 3 ml of CdS nanoparticle solution. UV-Vis spectra of extracted chlorophyll pigment solution, CdS NPs and CdS+Chlorophyll mixture solution were recorded separately between the wavelengths range 250 nm – 750 nm.

RESULTS

1.CdS Nanoparticless

a.UV-Vis Spectra

The UV-visible absorption spectroscopy has been used to focus the optical properties of quantum-sized particles. The uv-visible absorption spectrum of the nanoparticles of CdS is shown in Fig. 1. It shows a strong absorption band at 349 nm, which indicates the narrow distribution of the CdS nanoparticles. It is well known that the diameter of the particles is related to the absorption edge [9,10]. The energy bandgap of these synthesized nanoparticles was estimated using the relation $E_g = \frac{hc}{\lambda}$.

Where,

h – Planck's Constant

c – Velocity of light

λ - Wavelength

The band gap energy will be,

$$E_g = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{349.2377 \times 10^{-9} \times 1.6 \times 10^{-19}}$$

$$E_g = 3.5592 \text{ eV}$$

From this, the band gap was calculated and it is 3.5592 eV.

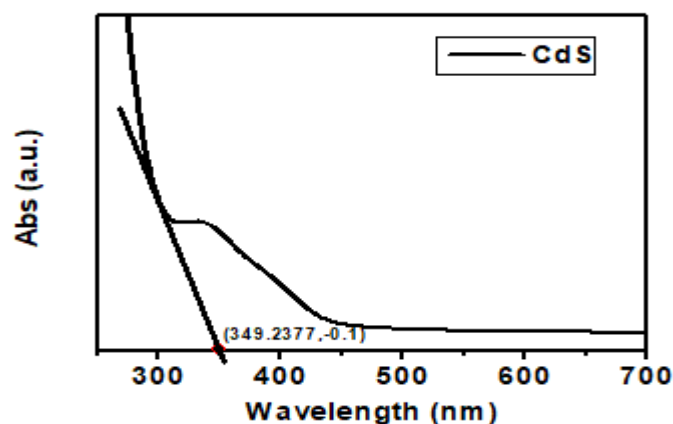


Figure-1: UV-Vis spectra of CdS Nanoparticle solution

b. X-ray Diffraction (XRD)

The XRD pattern of CdS nanoparticles is shown in Fig. 2. The XRD peaks are found to be broad which indicate the fine sized grain. The XRD pattern exhibits the prominent broad peaks at values of 26.80, 43.90 and 52.20. The particle size of CdS nanoparticles obtained from XRD is approximately 4.5764 nm and the lattice constant is 5.7681 Å.

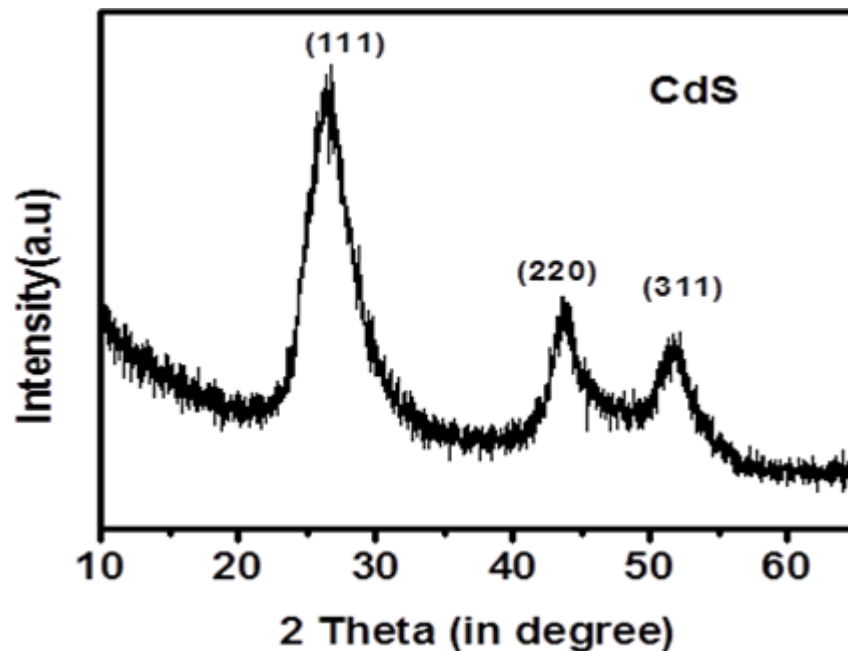


Figure-2: XRD pattern of CdS nanoparticles

2.Chlorophyll and Interaction of CdS Nanoparticles and Chlorophyll

Fig. 3 shows the absorption spectrum of the chlorophyll pigment solution, CdS NP's and CdS + Chlorophyll mixture. The result indicates two distinct regions of absorption. The first was located between 400 and 500 nm; in addition to chlorophyll a and b absorptions, other pigments such as carotenoids also absorb light radiation in this range, and an overlap of the absorption bands of the chlorophylls and carotenoids occurs [11]. The second region was in the 600– 700 nm range, where only chlorophyll a and b absorb radiation. Results of the present study show that chlorophyll behavior is changed in the presence of CdS nanoparticles. Further analysis of UV-Vis spectra shows shift of 1st peak towards lower wavelengths and shift of 2nd peak towards higher wavelengths due to the interaction with CdS nanoparticles (table 1).

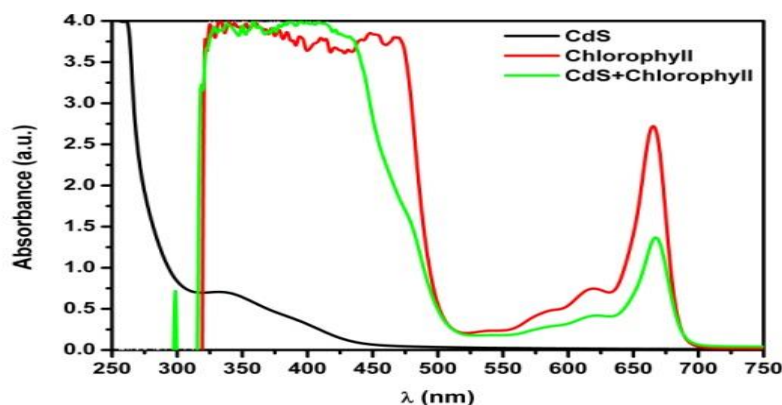


Figure-3: The absorption spectrum of the CdS NP's, Chlorophyll extract and CdS + Chlorophyll mixture

Samples	1 st Peak (nm)	2 nd Peak (nm)
Chlorophyll	451	662
CdS + Chl	436	667

Table-1: The absorption peaks of CdS NP's, Chlorophyll and CdS + Chl obtained from UV-Vis Spectra.

CONCLUSION

Results of the present study showed change in the behaviour of chlorophyll in the presence of CdS nanoparticles having particle size ~ 4.5764 nm. Analysis of UV-Vis spectra showed shift of 1st peak towards lower wavelengths and shift of 2nd peak towards higher wavelengths which could be due to the interaction of CdS with Chl pigments. Chlorophyll concentration was found to be lowered probably due to formation of complex with Cd^{2+} at the centre of the chlorophyll polar crown formed by N (Nitrogen) atoms. However, more studies have to be carried out to understand the interaction of chlorophyll molecules with different nanoparticles with different particle sizes and concentrations.

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E-GOVERNANCE: EVOLUTION AND ANALYSIS

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ABSTRACT

*With the evolutionary process, each and every facet of the world was changing. And the political systems of the world were no exception to that. The governing body which frames these laws is the government. The principal aim of the modern day democratic governments is to reach and serve the people. Now, there has to be a mechanism through which the government could reach the people and that mechanism for reaching the people is termed as governance. Over the years, the course of the way of reaching the people, the way of governance has changed significantly. Modern System of governance is E – Governance. E-governance, expands to **electronic governance**, is the integration of **Information and Communication Technology (ICT)** in all the processes, with the aim of enhancing government ability to address the needs of the general public. The basic purpose of e-governance is to simplify processes for all, i.e. government, citizens, businesses, etc. at National, State and local levels.*

INTRODUCTION

With the evolutionary process, each and every facet of the world was changing. And the political systems of the world were no exception to that. The world has witnessed rule of nature, the rule of barbarians (lack of law & order), rule of tribes, rule of kings, of emperors, colonial & imperial rule, rule of dictators & of fascist forces, socialist & communist rules and finally the rule of the people-Democracy. There are around 200 countries in the world and almost each one of them has been through this evolutionary process. This process has not only evolved the forms of rule, but also the way of rule. This began right with the tribal rule where they used to rule with superstitions, to the rule of kind and tyrant rulers who treated their people with their will, leading to the colonial rule of the empires who followed the word of the Queen/King & her/his council and made the policies accordingly and finally to the rule of the people, who elect their favorable candidates as their representatives and frame the governing rules and laws as per the will of the people. The governing body which frames these laws is the government. The principal aim of the modern day democratic governments is to reach and serve the people. Now, there has to be a mechanism through which the government could reach the people and that mechanism for reaching the people is termed as governance. Over the years, the course of the way of reaching the people, the way of governance has changed significantly. We have seen bad governance and we have seen good governance. Of course, the latter is much favorable than the former. To call governance good governance, there has to be many features like inclusiveness, equitability, accountability, responsiveness, transparency, integrity, opportunistic, simple accessibility and overall effectiveness & efficiency. The mnemonic S.M.A.R.T. very well summarizes the features of good governance. If the governance is S.M.A.R.T. (Simple, Moral, Accountable, Responsive, Transparent), the governance is good governance.

MEANING OF E- GOVERNANCE

E-governance, expands to **electronic governance**, is the integration of **Information and Communication Technology (ICT)** in all the processes, with the aim of enhancing government ability to address the needs of the general public. The basic purpose of e-governance is to simplify processes for all, i.e. government, citizens, businesses, etc. at National, State and local levels.

In short, it is the use of electronic means, to **promote good governance**. It connotes the implementation of information technology in the government processes and functions so as to cause **simple, moral, accountable and transparent governance**. It entails the access and delivery of government services, dissemination of information, communication in a quick and efficient manner.

The last few decades of the twentieth century have indeed changed the course of the modern world. The world-wide adoption and proliferation of digital computers and digital record keeping paved its way to the digital revolution, also known as Third Industrial Revolution which is roughly defined as the shift from mechanical and analogue electronic technology to digital electronics which today we refer to as ICT i.e. Information and Communications Technology. The emergence of ICT has provided means for faster and better communication, efficient storage, retrieval and processing of data and exchange & utilization of information to its users, be they individuals, groups, businesses, organizations or governments. With growing computerization and increasing internet connectivity, this process has presently reached where more and more users are motivated to modifying their ways of doing things in order to leverage the advantages provided by ICT. The third Industrial revolution

has yielded significant and evident ramifications in making the lives of the people better and easier. Inspiring from these ramifications, the modern day governments, to provide better, efficient and simpler services to the people, have adopted the concept of e-governance.

With the increasing awareness among citizens about their rights and resultant increase in expectations from the government to perform and deliver, the whole paradigm of governance has changed. Government, today, is expected to be transparent in its dealings, accountable for its activities and faster in its responses. This has made the use of ICT imperative in any agenda drawn towards achieving good governance. It has also led to the realization that such technologies could be used to achieve a wide range of objectives and lead to faster and more equitable development with a wider reach.

E-governance is basically the application of ICT to the processes of government functioning in order to bring about the desired (S.M.A.R.T.) governance. e-governance is a wider concept than e-Government. The Commonwealth Network of Information Technology for Development (COMNET-IT), in association with and with the financial support of UNESCO, has developed national profiles detailing current status and 39 developments in this area. Whilst impacts of e-governance in the commercial, NGO and professional areas are covered in these studies, the main focus centres on specific government initiatives, such as:

- The Development of Cyber Laws
- The Liberalization of Telecommunications
- Plans for e-Governance
- Plans for the Development of Community e-Centres
- The Deployment of Community e-Centres
- Instances of Public Feedback to statements of direction, Draft Legislation and so on
- Websites of Government Agencies, particularly if these offer value beyond a public relation image.

The concept of e-Governance has its origins in India during the 70s with a focus on development of in-house government applications in the areas of defence, economic monitoring, planning and the deployment of Information Technology (IT) to manage data intensive functions related to elections, census, tax administration etc. The efforts of the National Informatics Centre (NIC) to connect all the district headquarters during the eighties was a very significant development. From the early 90s, IT technologies were supplemented by ICT technologies to extend its use for wider sectoral applications with policy emphasis on reaching out to the rural areas and taking in greater inputs from 44 NGO's and private sector as well. There has been increasing involvement of international donor agencies under the framework of e-governance for development to catalyze the development of e-governance laws and technologies in developing countries like India. The initiative was carried forward by various governments through their respective projects like NeGP (under UPA-1) and the Digital India (under the NDA). Today each ministry, each government department, each state and each district has its own portal websites which are updated almost every minute to keep the citizens aware with all the activities carried by the state. Any citizen, from any place, at any point of time, whoever she/he is, without any kind of discrimination can avail the government services at their fingertips. All they require is an active internet connection. Citizens are now connected with the government through their Personal Computers and Cell Phones. It has made the tasks of the citizens as well as that of the government much easier and cost-time effective for receiving and providing services.

ADVANTAGES OF E-GOVERNANCE

There are numerous advantages of e-governance; some of them are as follows:

- The first and foremost advantage is that of a better access to information and quality services for citizens.
- ICT would make available timely and reliable information on various aspects of governance.
- Immediate impact in terms of savings in time, effort and money, resulting from online and one-point accessibility of public services backed up by automation of back end processes.
- Application of ICT could lead to simplification of complicated processes and thus enhance smooth functioning of the government.
- As mentioned earlier, e-governance has brought the government machinery to the citizens' doorsteps. Wide use of internet and mobile phones has facilitated delivery of a large number of services provided by the government much speedier and efficient.

- The concept of electronic voting, under e-governance could be of significant help for the voters who are away from home.
- Through e-governance, citizens can bring light to their concerns very easily as they could directly be accessed through the grievance redressal feature of respective websites.
- The concept of e-tendering could & has enhanced transparency in governmental projects and reduced corruption to a great extent.
- All the views of the citizens could be brought forward easily to the politicians thereby, enhancing participatory decision making process.
- Documentation services like Passport, Driving license, Voter ID, domicile certificates and various other documents could be availed online easily at minimal costs, diminishing the role of middlemen hungry for commissions.

DISADVANTAGES OF E-GOVERNANCE

With the advantages, there also come certain disadvantages of e-governance. Some of them are as follows:

- One of the major disadvantages of e-governance is lack of interpersonal connection, which is preferred by many.
- The cost of setting up and maintaining an infrastructure favourable for ICT is very high and also, the training of old employees for the hi-tech procedures is a very time and cost consuming process.
- E-governance, especially in developing countries like India has created a digital divide between the educated and the uneducated. With a major section of the population being uneducated, it has indeed created a digital ignorance.
- With the active prominence of unethical hacking, the personal information of the citizens and confidential information of the governments are at constant threat of getting misused and leaked. Thus, rise in cyber crimes.
- E-governance follows the concept of “Minimum government & maximum governance.” Therefore, there is a huge risk of retrenchment of personnel.

The advantages of e-governance evidently outnumber the disadvantages. Through effective education process and widespread awareness of ICT, with stringent and effective cyber laws, we can indeed create an environment appropriate for e-governance. The current generation is evident and a firm believer that e-governance is one of the best forms of governance.

CONCLUSION

The earliest tribes and civilizations of the world wouldn't even have a thought of the world we are living in today and the way it is being governed. Similarly, we, the self-proclaimed millennial of this very generation have no idea what the future has to offer us and how the world would possibly be governed in the next thousand years. But the emerging concepts like that of ICT-e governance & the knock of the fourth industrial revolution could indeed help us to sail in the right direction in this never-ending evolutionary voyage. Wisdom would be only in appreciating the process.

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EXPLORING THE FACTORS OF FINANCIAL INCLUSION AND WOMEN EMPOWERMENT IN RURAL TAMIL NADU

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ABSTRACT

Women's extensive role in economic, social and political transformation across all sectors has made the financial access more significant for women. The role and impact of financial inclusion for achieving women empowerment is significant and commendable in an overall perspective. The Reserve Bank of India (RBI) and the Government of India (GOI) are consistently favoring the utilization of innovative technology for possible and comprehensive financial inclusion. However, the underlying challenge that persists in the implementation of financial inclusion programs and the barriers affecting women to access financial products and services remains as an inevitable gap for social inclusion and women empowerment. This research work aims to provide an insight on the problems pertaining to the inclusive financing approach and its impact on social inclusion and women empowerment. The study is empirical in nature and the researcher has collected the primary data through well-structured interview schedule by utilizing judgment sampling. The secondary data utilized for the study comprises of information from books, journals and websites. This research work will be helpful to sort the challenges of achieving women empowerment through financial inclusion in India in order to provide practical suggestions to remove the hiccups that exist in the systematic process of implementation.

Keywords: Financial Inclusion, Women Empowerment, Inclusive Growth, Rural Tamil Nadu.

INTRODUCTION

Financial inclusion has been recognized as a key building block which forms the foundation in achieving several of the United Nation's Sustainable Development Goals. Gender equality and the empowerment of women acts as a vital component in achieving all the other sustainable developmental goals. By introducing core banking technology and accretion of alternate delivery channels in India, the process of inclusion on a larger scale has widened. The continuous propaganda by the Union Government on financial inclusion initiatives in India is a fallacy. As it needs strenuous practical measures to create a possible panacea for economically excluded rural communities in the nation.

The National Democratic Alliance (NDA) is envisioning for Digital India, as a result it has mandated the utility of the Information Technology's (IT) tools and techniques across all sectors in India. Likewise, the digitalization enabled financial inclusion has been forcefully worked out by the Government of India and Reserve Bank of India through the Banking industry in the nation. In effect of implementing financial inclusion, the women who constitute the major finance bearers of the majority of households face the barriers in significant saving, investment and access to the new age banking products and services. This research paper attempts to provide an understanding about the practical difficulties in achieving financial inclusion in India with regards to the women population and its significant impact on social equity and inclusion.

FINANCIAL INCLUSION

According to Dr. Raghuram G. Rajan (2009) "Financial Inclusion refers to universal access to a wide range of financial services at a reasonable cost. These include not only banking products but also other financial services such as insurance and equity products."

WOMEN EMPOWERMENT

In general, the term empowerment refers to the development of socio-economic and political strength of individuals and communities, which often means the capacity and capability of oneself. However, women empowerment is something quite extensive to study and understand in actual practice. The UN Women, the United Nations Entity for Gender Equality and the Empowerment of Women explains that Empowered women should hold the following components such as acquiring knowledge, understanding gender relations, developing a sense of self-worth, gaining the ability to generate choices, exercising bargaining power, developing ability to organize and direction of social change. Developing countries like India are potentially working on the issues pertinent to achieve women empowerment in order to increase the gender equality and self-sustainability among the nations population.

LITERATURE REVIEW

Chakrabarty K.C (2011) states financial inclusion and financial literacy are the twin pillars for economic Development the former acting on the supply side creating supply of financial products and services and the

later acting on the demand side. One of the key factors in achieving financial inclusion is developing on high-end and seamless banking services with advanced technology in all the sections of the society to bring the unbanked population into the formal banking. Dixit and Ghosh (2013) in their study focused on financial inclusion as major factor for economic growth and development. The study states there is a need for resource generation and mobilisation for attaining inclusive growth. In India access to financial products and services is constrained by several factors such as affordability, more paper work, inconvenience, high transaction cost etc.

Saiful Islam (2014) in his examined the role of microcredit as a tool of financial inclusion in empowering women and found that providing microcredit acts a significant tool. The study suggested in educating and training illiterate and rural women regarding the financial inclusion and microcredit facilities in order to help them access financial products. Thus, by giving significant importance to the women, who constitute 50% of the population financial inclusion could reach every household thereby empowering women which acts as a more equitable and social approach in achieving women empowerment.

RATIONALE OF THE STUDY

This research work is unique as it is focusing to identify the challenges in ensuring women empowerment through financial inclusion programmes in rural Tamil Nadu. The present study will help the Government to identify the problems and challenges in achieving equity and empowerment of women in rural Tamil Nadu. Inclusive financing pertaining to the rural population of the country in achieving women empowerment is the main focus of this research study which is found to be a grey part in the earlier literatures.

OBJECTIVES OF THE STUDY

1. To understand the various financial inclusion programmes that impact women empowerment.
2. To study the factors affecting Women Empowerment in Rural India.
3. To study the challenges in achieving women empowerment through financial inclusion programmes.
4. To suggest measures to overcome the problems in achieving women empowerment through financial inclusion programmes.

HYPOTHESES OF THE STUDY

1. H_0 - There is no significant difference between the financial institutions of the Respondents and their banking service usage.
2. H_0 - There is no significant association between factors affecting Rural Women's financial inclusion problems and Women Empowerment indicators.

RESEARCH METHODOLOGY

The research work is empirical in nature. A survey questionnaire designed and distributed under Judgment sampling method to find out the impact of financial inclusion towards women empowerment in rural Kancheepuram district. Out of 200 respondents only 159 valid samples are considered for the study. Books, Journals and web sites constitute the secondary data.

LIMITATIONS OF THE STUDY

1. The sample for the study is confined to Kancheepuram district only. Hence the findings cannot be treated as representative of the entire nation.
2. The random sampling method and the limited sample of 159 respondents have limited the findings of the study.
3. Time is also a major concern; with in the short span of time the research work has been done, this also causes a limitation for the study.

DATA ANALYSIS AND INTERPRETATIONS

The data analysis is completely done with the help of SPSS (15th version). The reliability of the data per Cronbach's Alpha is 88.9% (Cronbach's Alpha value 0.889 for 34 items). In order to achieve the objectives of the study statistical techniques are used and the results are presented below.

Table-1: Showing the one-way analysis between the financial institutions of the Respondents and the usage of various banking services

H_0 - There is no significant association between the financial institutions of the respondents and the usage of various banking services. One-way ANOVA f-test is conducted in order to test the hypothesis and the results are presented in the table below.

ANOVA

Usage of Banking Services	F-Value	P-Value
Bank Savings	5.302	.001*
Bank Loans	5.302	.000*
Insurance	4.842	.001*
ATM card (Debit card) Service	20.406	.000*
Credit Card Service	6.022	.000*
Internet/Mobile Banking services	3.209	.015*
Online Banking Transaction services	7.499	.000*

Source: Computed Data

***5% Level of Significance**

It is inferred from the above table that p-value of the usage of various banking services are less than 0.05 at 5% level of significance, the null hypothesis is rejected. Hence, there is significant difference between the financial institutions of the respondents and the usage of various banking services.

Table-2: showing Factor Analysis for Problems of Rural Women to access formal financial products and services

An exploratory factor analysis was performed on the 11 variables included in the questionnaire in order to determine the problems of rural women to access formal financial products and services. Principal component analysis with varimax rotation was conducted. The factor loading matrix is presented in the below tables through, and also includes tables on KMO and Bartlett's Test, Communalities, Total Variance Explained, Component Matrix and Rotated Component Matrix. The analysis of the data in these tables is presented below.

Table-2.1: KMO and Bartlett's Test & Total Variance Explained

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.					.816	
Bartlett's Test of Sphericity			Approx. Chi-Square		970.159	
			Df		55	
			Sig.		.000	
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1.000	5.166	46.965	46.965	3.022	27.470	27.470
2.000	1.523	13.847	60.813	2.538	23.074	50.544
3.000	1.065	9.684	70.496	2.195	19.952	70.496
Extraction Method: Principal Component Analysis.						

The KMO statistic indicates that correlations are relatively compact. Bartlett test also signifies that there is relationship between the variables.

In this context of the present study, Principal component analysis is performed for the problems of rural women to access formal financial products and services to verify whether it is possible to reduce the variables into few significant variables. The Eigen value associated with each linear factor is given in table. Initially before extraction there are 11 linear components and the first factor explains 27.470% of the variance whereas subsequent factors explain small amount of variance. It is clear that three factors can be extracted. Before rotation factor 1 accounted for considerably more variance than the remaining one (23.074% compared to 19.952%).

The communalities of 11 variables range from 0.507 to 0.893 indicating large amount of variance has been extracted by the factor solution. Using varimax orthogonal criterion and by suppressing the factor loadings less than 0.5 the rotated component matrix is obtained and is given in table. It is evident that all the variables are highly loaded in the first 3 components. In other words, 11 variables are grouped into three factors on the basis of the inter relationship among themselves.

Table : 2.2 Rotated Component Matrix, Communalities & Factor Loadings			
Rotated Component Matrix(a)	Component	Communalities	FACTORS
Lack of Documents	0.814	0.847	KNOWLEDGE & LEGAL FACTOR
Lack of Knowledge about financial services	0.765	0.893	

Lack of Trust	0.701	0.76	ECONOMIC FACTOR
Complicate Procedures	0.639	0.507	
High Transaction cost	0.571	0.509	
No Profitable services	0.898	0.74	
No Money to transact	0.894	0.652	
No Customer services	0.731	0.538	SERVICE FACTOR
No need for banking services	0.911	0.559	
No Banks in my area	0.91	0.86	
Delay in service	0.546	0.888	
Extraction Method: Principal Component Analysis.			
Rotation Method: Varimax with Kaiser Normalization.			
a) Rotation converged in 5 iterations.			

Source: Computed Data

Factor 1 contains maximum number of variables and explains most of the variance. Thus it is revealed that knowledge and legal factor is the major important factor affecting rural women to access formal financial products and services. Hence, the Knowledge & Legal factor, Economic factor and Service factor are to be considered for eliminating or to control the problems of rural women to achieve financial inclusion at greater level.

Table-3: Showing Factor Affecting Women Empowerment in Rural India

An exploratory factor analysis was performed on the 23 variables included in the questionnaire in order to determine the Factors affecting women empowerment in Rural India. Principal component analysis with varimax rotation was conducted. The factor loading matrix is presented in the below tables through, and also includes tables on KMO and Bartlett's Test, Communalities, Total Variance Explained, Component Matrix and Rotated Component Matrix. The analysis of the data in these tables is presented below.

Table : 3.1 KMO and Bartlett's Test & Total Variance Explained						
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.						.931
Approx. Chi-Square						3109.263
Bartlett's Test of Sphericity					Df	253
					Sig.	0.000
Component	Initial Eigen values			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.795	55.631	55.631	5.552	24.141	24.141
2	1.650	7.173	62.805	5.165	22.455	46.596
3	1.163	5.058	67.862	4.891	21.266	67.862
Extraction Method: Principal Component Analysis.						

Source: Computed Data

The KMO statistic indicates that correlations are relatively compact. Bartlett test also signifies that there is relationship between the variables.

In this context of the present study, Principal component analysis is performed for the factors affecting women empowerment in rural India to verify whether it is possible to reduce the variables into few significant variables. The Eigen value associated with each linear factor is given in table. Initially before extraction there are 23 linear components and the first factor explains 24.141% of the variance whereas subsequent factors explain small amount of variance. It is clear that three factors can be extracted. Before rotation factor 1 accounted for considerably more variance than the remaining one (22.455% compared to 21.266%).

The communalities of 23 variables range from 0.556 to 0.801 indicating large amount of variance has been extracted by the factor solution. Using varimax orthogonal criterion and by suppressing the factor loadings less than 0.5 the rotated component matrix is obtained and is given in table. It is evident that all the variables are highly loaded in the first 3 components. In other words, 23 variables are grouped into three factors on the basis of the inter relationship among themselves.

Table : 3.2 Rotated Component Matrix, Communalities & Factor Loadings			
Rotated Component Matrix	Component	Communalities	FACTORS
Access to Hygienic Sanitation facilities	.831	.732	ACCESSIBILITY FACTOR
Access to Nutritious food	.807	.736	
Access to desired clothing and safe place to live	.773	.686	
Awareness about women rights and welfare facilities	.764	.727	
Access to Education	.701	.638	
Getting Personal time & for child care	.692	.573	
Participation in Any Social Organization	.690	.569	
Voice to express own political and social views	.516	.556	
Control over Savings, Earnings and Resources	.772	.801	
Income spent on yourself and children	.764	.742	CAPABILITY FACTOR
Involvement in Major Household Decisions	.761	.679	
Having Own Source of Income	.732	.752	
Having an Ownership of productive assets	.706	.567	
Ability to visit friends, relatives and associates	.595	.659	
Access to Information and Technology	.543	.626	
Attitudes on women, work, mobility and violence	.819	.780	MENTALITY FACTOR
Ability to negotiate sexual and reproductive decisions	.792	.767	
Attitudes on own self-esteem	.751	.733	
Equity of domestic duty load	.684	.662	
Articulateness and confidence in speaking with authorities	.607	.698	
Financial independence	.574	.655	
Ability to use public transportation/travel freely in public spaces	.573	.630	
Psychological wellbeing	.534	.639	
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 6 iterations.			

Source: Computed Data

Factor 1 contains maximum number of variables and explains most of the variance. Thus it is revealed that Accessibility is the major important factor affecting Women Empowerment in Rural India. Hence, the Accessibility, Capability and Mentality factor are to be considered in order to enhance women empowerment in rural India.

Consolidated Table: 4 Showing Association between the factors of Rural Women's financial inclusion problems and Women Empowerment indicators.

H_0 - There is no significant association between factors of Rural Women's financial inclusion problems and Women Empowerment indicators. Chi-Square test is conducted in order to test the hypothesis. The results of the same are presented below.

RURAL WOMEN'S FINANCIAL INCLUSION PROBLEMS	FACTORS OF WOMEN EMPOWERMENT INDICATORS					
	ACCESSIBILITY FACTOR		CAPABILITY FACTOR		MENTALITY FACTOR	
	Chi - Square Value	P-Value	Chi - Square Value	P-Value	Chi - Square Value	P-Value
KNOWLEDGE & LEGAL FACTOR	477.000	0.000*	196.878	0.000*	240.567	0.000*
ECONOMIC FACTOR	181.658	0.000*	477.000	0.000*	369.286	0.000*

SERVICE FACTOR	228.453	0.000*	288.215	0.000*	636.000	0.000*

Source: Computed Data

5% Level of Significance

It is inferred from the above table that p-value of the considered factors are less than 0.05 at 5% level of significance, the null hypothesis is rejected. Hence, there is significant association between factors of Rural Women's financial inclusion problems and Women Empowerment indicators.

RESEARCH FINDINGS

1. There is significant difference between the financial institutions of the respondents and the usage of various banking services.
2. The Knowledge & Legal factor, Economic factor and Service factor are the major important factors affecting rural women to access formal financial products and services.
3. The Accessibility, Capability and Mentality factor are the major important factors affecting Women Empowerment in Rural India.
4. There is significant association between factors of Rural Women's financial inclusion problems and Women Empowerment indicators.

SUGGESTIONS

The Awareness and Education on banking services to the rural women population is mandatory for the quick achievement of financial inclusion digitally. The internet facilities, infrastructure for effective technology and training centres for the digitalization enabled banking services are important for rural India. Family is the unit of Indian society; therefore, the households are to be concentrated in order to execute the financial inclusion measures in the country without any delay. The economical services are to be provided to the rural sect people for making them economically inclusive at a faster pace. Hence, by providing better training and services, to the women population, the nation can establish substantial financial inclusion across the country.

CONCLUSION

Financial inclusion practices are quite challenging in the country like India where there are more economically deprived class people. Significant elimination is possible due to Digitalized Financial Inclusion (DFI) approach as the access to technology is limited or restricted among particular sect of people. Rural India seems to be partially served with the high end facilities and services due to the discriminative and defective policies and programmes that is prevailing in independent India. Hence, the Reserve Bank of India and Government of India should take necessary measures for the complete socio-economic inclusion at the earliest. Education and training programs for the illiterate and needy women population serves to be the need of the hour.

SCOPE FOR FURTHER STUDY

The present research study is taken studies the various tools used for financial inclusion and the challenges of women empowerment through financial inclusion programmes in India by analyzing the various factors affecting women access to banking services in India. There is further scope for studying challenges affecting social equity and social inclusion and its impact on financial literacy and inclusion.

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**IMPACT OF NUTRITION EDUCATION ON HYGIENIC AND PREVENTIVE PRACTICES OF THE
SELECTED ANAEMIC ADOLESCENT GIRLS**

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ABSTRACT

Nutrition and health during adolescence is important for the growing body and for preventing future health problems. The study was carried out to impart nutrition education to improve the hygienic practices to combat and prevent anaemia. The investigator selected a total of 1011 adolescent girls of age 12 – 15 years from classes 7th to 9th for screening anaemia and to identify anaemic subjects for the study. Based on the results of the haemoglobin level and the information collected using the questionnaire, a sub sample of 100 moderately anaemic adolescent girls with the haemoglobin level of 8-10.9gm/dl were selected for further research. Nutrition education sessions were organized and imparted to the subjects for one hour per day for a period of two weeks using the module prepared. After a gap of ten days the initial and final practice were reassessed by conducting a post test among both the subjects using the same questionnaire. The impact was assessed by comparing the scores of the pre test and post test on practice of the study group. The results revealed that there was an improvement in the hygienic practice among the anaemic adolescent girls.

Keywords: Anaemia, adolescent, nutrition education, hygienic, pre test and post test

INTRODUCTION

Adolescence in girls has been recognized as a special period of transition from girlhood to womanhood (Mitali *et al.*, 2014). Adolescent girls constitute one fifth of the female population in the world (Sushma *et al.*, 2014). In India, this group accounts for a little more than one fifth of the population (Minhas and Sekhon, 2014).

Nutrition and health during adolescence is important for the growing body and for preventing future health problems. For girls, puberty typically occurs between ages 12 and 13. It is one of the fastest growth periods of a person's life. During this time, physical changes affect the body's nutritional needs, while changes in ones lifestyle may affect the eating the habits and food choices.

According to the World Health Organisation (WHO, 2011a), anaemia is a haemoglobin(Hb) concentration <130 g/l in men and < 120 g/l in women.

Increasing awareness and knowledge among health care providers and correction of iron deficiency anaemia during adolescence will go a long way in improving the health of the future parents. The investigator felt that nutrition education may pave the way to combat anaemia and to prevent anaemia in future. Hence, the study was carried out to impart nutrition education to improve the hygienic practices to combat and prevent anaemia.

MATERIALS AND METHODS SELECTION OF THE AREA FOR THE STUDY

A school based survey was carried out in Dindigul District. Five schools from two blocks (Athoor and Dindigul) of Dindigul District viz., Thambithottam Higher Secondary School, Gandhigram; Sevigashram Girls Higher Secondary School, Gandhigram and Devanger Girls Higher Secondary School, Chinnalapatti from Athoor block and St. James Higher Secondary School, A.Vellodu and Government Higher Secondary School, Narasingapuram from Dindigul block were selected.

These schools were selected after getting prior permission from the concerned authorities. The area for the study was selected because of its proximity to the investigator and familiarity with the area and the ease of approach extended by the school authorities.

The ethical clearance for the study was obtained from Government Rajaji hospital, Madurai, Tamil Nadu. A proposal depicting the clear picture of the study was submitted to the ethical committee and the same was presented in the ethical committee meeting. After giving a clear explanation of the study it was approved (Ref.No.6087/E4/3/2011).

SELECTION OF THE SAMPLES

The respondents were selected by purposive random sampling procedure. The investigator selected a total of 1011 adolescent girls of age 12 – 15 years from classes 7th to 9th for screening anaemia and to identify anaemic subjects for the study.

SCREENING FOR ANAEMIA

Conducting the screening for anaemia was the first and foremost criteria used to select the subjects for the supplementation study. Haemoglobin level is an important parameter in diagnosing the iron status and to find out the prevalence of anaemia. The World Health Organisation (WHO) defines anaemia as a condition in which the haemoglobin content of blood is lower than normal (≥ 12.0 g/dl) as a result of deficiency of one or more essential nutrients, regardless of the cause of such deficiencies (Raghuram *et al.*, 2012). Haemoglobin level of the respondents was estimated by cyanomethaemoglobin method.

Based on the results of the haemoglobin level and the information collected using the questionnaire, a sub sample of 100 moderately anaemic adolescent girls with the haemoglobin level of 8-10.9gm/dl were selected for further research. From among the adolescent girls, 100 subjects were selected by purposive sampling method. The selection of 100 subjects was based on their willingness to participate in the study.

IMPARTING NUTRITION EDUCATION ON PREVENTION OF ANAEMIA (NEPA)

Preparation of nutrition education module

Nutrition education may help improve household food security status and unhealthful food-related behaviours associated with household food insecurity (Farrell, 2014).

A nutrition educational module, Nutrition Education on Prevention of Anaemia (NEPA) was developed by the investigator and approved by the nutrition experts. Lecture method, demonstration methods and visuals were used in nutrition education. Materials like charts, posters, booklets and a Power point Compact Disc(CD) on nutrition education to prevent anaemia were prepared. A questionnaire was framed dealing with the practice on anaemia. The questionnaire was ratified with the help of a social scientist and then it was validated and used. It was pretested, finalized and administered to the subjects to conduct a pre test on practice on anaemia. It took around 30-45mins for each subject to complete the questionnaire. Scores were given for all the questions.

DISSEMINATION OF NEPA AND ASSESSING THE IMPACT

Nutrition education sessions were organized and NEPA was imparted to the subjects for one hour per day for a period of two weeks using the module prepared. After a gap of ten days the initial and final practice were reassessed by conducting a post test among both the groups using the same questionnaire. The impact was assessed by comparing the scores of the pre test and post test on practice of both the study groups.

ANALYSIS AND INTERPRETATION OF THE DATA

The collected data was systematically analysed for arriving at the result of the impact of Nutrition Education on Prevention of Anaemia (NEPA) among the selected subjects. For the analysis of data, the data was coded, edited, tabulated and statistically analysed using the statistical package SPSS 17. Statistical tests like mean, Standard deviation and sign test were used.

RESULTS AND DISCUSSION

Prevalence Of Anaemia Among The Selected Adolescent Girls (N= 1011)

The prevalence of anaemia among the selected adolescent girls is presented in Table 1.

TABLE 1:- PREVALENCE OF ANAEMIA AMONG THE SELECTED ADOLESCENT GIRLS

Classification of anaemia (g/dl)	Age group 12- 15 years (N=1011)		
	N	%	Mean $\pm$ S.D
Non anaemic (≥ 12)	119	12	8.70 $\pm$ 1.85
Mild anaemic (11-11.9)	327	32	
Moderate anaemic (8-10.9)	398	39	
Severe anaemic (< 8)	167	17	

*WHO – World Health Organisation

N- Number of adolescent girls, % - Percentage, S.D – Standard deviation

Source: Haemoglobin concentration for the diagnosis of anaemia and assessment of severity, (WHO, 2011).

Screening for anaemia was conducted among the selected 1011 adolescent girls. Anaemia was classified according to the World Health Organisation, (WHO, 2011) classification as non anaemic(≥ 12 g/dl) mild(11-11.9 g/dl), moderate(8-10.9g/dl) and severe anaemic(<8g/dl). The screening revealed that most of the adolescent girls(39%) were moderately anaemic followed by mild anaemic(32%) and severely anaemic(17%). Only 12 per cent of the adolescent girls were found to be normal. The rest of the 88 per cent were found to be anaemic. The mean haemoglobin level and standard deviation was 8.70 $\pm$ 1.85 respectively.

Saravanakumar *et al.*, (2014) found that among adolescent girls of Tamil Nadu, majority(49.1%) of the girls were moderately anaemic. The study coincides with the results of the present study that majority of the adolescent girls were moderately anaemic. A study carried out in Maharashtra revealed that out of the 103 adolescent girls, 88(85.4%) were anaemic of which 52(50.48%) had mild anaemia, 34(33%) moderate anaemia and 2(1.9%) had severe anaemia (Sujata *et al.*, 2014). The prevalence rate of anaemia in the present study was intune with the above mentioned study. In a study among 400 adolescent girls of 13-17 years in Chennai nearly 315 subjects (78.75%) were anaemic with varying degrees ranging from mild, moderate and severe which were 37.5%, 35% and 6% respectively. The prevalence was higher in public schools (43.75%) than in private schools (35%) (Premalatha *et al.*, 2012).

Practices play an important role in one's health. Hygienic practices help to prevent anaemia. The hygienic and preventive practices of the adolescent girls of both the groups before and after intervention are given in Table 2.

TABLE 2:- HYGIENIC AND PREVENTIVE PRACTICES

Practice	Moderately anaemic subjects (N=100)		
	Pre test	Post test	P value
Usage of iron utensils are for cooking	82	99	.000
Cutting of nails	61	99	.000
Wearing of slippers while going out	80	100	.000
Washing of hands before taking food	100	100	.000
Washing of hands with soap after going for toilets	10	99	.000
Intake of iron tablets	60	99	.000
Usage of iron utensils	72	99	.000
Intake of deworming tablets	59	98	.000
Intake of greens	69	99	.000
Average Total Score	65.8	99.1	0.000*

N-Number of selected moderately anaemic adolescent girls, * (P<0.05) significant at 5% level

It is clear from the above table that the mean scores were 65.8 and 99.1 before and after intervention respectively. Particularly the score for washing hands using soap after going to toilets increased from 10 to 99 before and after intervention respectively. The change was mainly due to the nutrition education. The mean p value of Sign test was 0.00.

Statistically, it was inferred that as the p value (0.00) was lesser than the α value (0.05) at 5 per cent level of significance, the hypothesis framed that the nutrition education will improve the nutritional knowledge was accepted and it was concluded that there existed a significant difference between the pre test and post test. Therefore the result of the Sign test proved that the nutrition education intervention was found to be effective.

In a study conducted among the Korean community Shahla (2013) found that after nutrition education was delivered, nutritional knowledge, nutritional attitudes and dietary habits were increased significantly. Education has had an impact in reduction of other micronutrient deficiencies. In iron-deficiency, nutrition education can increase both iron intake and haemoglobin levels (Lanerolle and Atukorala, 2006). Education and supplementation is more effective than either approach alone (Kapur *et al.*, 2003).

CONCLUSION

Adolescence in India goes hand in hand with anaemia; effective use of locally available foods along with improved nutritional knowledge will help to overcome anaemia. The study revealed that nutrition education was effective in improving the hygienic practice which inturn will help to prevent anaemia in future.

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INCOME GENERATING HOUSING FOR WOMEN EMPOWERMENT IN INDIA: A STUDY OF THE NEED, RELEVANCE AND POLICY OPTIONS FROM AN INTERNATIONAL PERSPECTIVE

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ABSTRACT

In India, 'Affordable Housing for All by 2022' is a national goal and for attaining this goal all the stakeholders in the housing sector has been functioning in a concerted manner right from 2015 when the Prime Minister of India officially declared his vision to provide housing for all by the time the nation enters its 75th year of independence. In the context of attaining housing sufficiency in rural areas, a vital issue is that of empowering the poor, particularly the women, simultaneously with financing for their houses. This is possible by way of promoting income generating housing schemes like the PHIRA (Productive Housing in Rural Areas) of the National Housing Bank. This paper looks into the relevance and significance of such housing models from an international perspective.

Keywords: Affordable housing, Rural housing, Productive housing, PHIRA, Women Empowerment.

1. INTRODUCTION

In India, 'Affordable Housing for All by 2022' is a national priority today and for attaining this national goal all the stakeholders in the housing sector have to function in a sustained and concerted manner. The flagship scheme named PMAY (Pradhan Mantri Awaas Yojana) is in the forefront of attaining the above national housing goal. In fact, PMAY has got both urban (PMAY-Urban, or PMAY-U) and rural (PMAY-Gramin, or PMAY-G) sub-components, and has separate targets as well as budget allocations for both Urban and Rural (Gramin) sub-segments. An amount of Rs. 26,405 Crore has been allocated by the Union Government for PMAY scheme in its budget for 2018-19, and the same for budget 2019-20 was Rs. 25,853 Crore. In fact, it is envisaged to construct 5 Crore houses under PMAY of which 3 Crore houses are in rural areas and the rest 2 Crore in urban areas. During the period 2014-2018, about 1.53 Crore housing units have been constructed under PMAY as per the Budget Speech by Finance Minister Piyush Goyal in Feb. 2019. In the context of attaining housing sufficiency in rural areas, a vital issue is that of empowering the poor, particularly women, simultaneously with financing their houses. This is possible by promoting income generating housing schemes like the PHIRA (Productive Housing in Rural Areas) scheme of the National Housing Bank, or such other similar schemes.

2. RELEVANCE AND SIGNIFICANCE OF THE STUDY

Housing development has utmost priority in any nation because of its potential for multi-faceted development; right from the familial level to the social, and even to the national economy level. The vast linkages of the housing industry, both forward and backward, to about 350 other industries enable housing sector to accelerate the pace of economic development; and further, it can even kick-start a recession-hit economy because of this unique linkage effect. Besides, housing is one of the top employment generators in any economy, probably second only to agriculture in the Indian scenario. The dream of 'Housing for All by 2022' – the vision to see that all citizens of India have proper shelter by the time the nation enters its 75th year of independence – is a national priority in India since 2015. As rural development in general and that of the rural poor, particularly women, is as important as development rural housing, it is important to significance of productive housing in rural areas from a global perspective.

3. LITERATURE REVIEW

Gupta R. G. (1995) [1] in his book *Shelter for the Poor in the Fourth World* focused on the very poor housing conditions of the poor people in various under-developed (fourth world) countries. The vital need for addressing the shelter problems of the poor was discussed in detail in this book. Manoj P. K (2003) [2] in his research paper, 'Retail Credit– Strategies for Success in the Emerging Scenario' suggested strategies for the sustained growth of the retail credit portfolio of banks, which primarily comprises of housing finance, as a safe means of increasing business and also kick-starting the then recession-hit industry of India. The vital significance of the linkages that housing has got with other industries, and hence its immense potential for faster economic growth are pointed out by the author. Manoj P. K (2004) [3] in his another research paper, 'Dynamics of Housing Finance in India' has pointed out the growing appetite of commercial banks (CBs) towards housing credit, the declining share of housing finance companies (HFCs) in the housing finance market, and has suggested macro level strategies for the sustained and balanced growth of housing finance market in India. The needs for

promotion of a secondary mortgage market (like, RMBS), alternative models like Housing Micro Finance (HMF) etc. have been highlighted in the paper. Research agency IFMR (2007) [4] (through its Centre for Microfinance) in its Working Paper 19 entitled, 'Housing Microfinance: Designing a Product for the Rural Poor' has pointed out the vital significance of promoting Housing Microfinance (HMF) in addressing the chronic housing problem in India which is primarily that of the poor and marginalized, like those in the LIG (Low Income Group) and EWS (Economically Weaker Sections). Only through alternative financing models like HMF, which alone could reach the above sections which are beyond the access of the formal sector housing finance institutions, the real housing problem in India could be solved. The report, thus, seeks to design the suitable HMF product for the Indian poor. Manoj P. K (2008)[5] in his research paper, 'Learning from Cross-country Experiences in Housing Finance: A Microfinance Approach' seeks to suggest appropriate macro level strategies for promotion of housing micro finance (HMF) in the Indian context by suitably replicating successful and time-tested HMF and such other alternative housing finance models prevalent elsewhere in the world. Manoj P K (Ed.) (2009) [7] in his edited book, 'Emerging Technologies and Financing Models for Affordable Housing in India; has discussed many housing finance models and technologies which could promote affordable and low cost housing in the Indian context. The research agency ICRA (2010) [8] in its industry research report, 'Housing Finance Companies and the Indian mortgage market' has analysed the changing landscape of India's housing finance market, the greater growth rate and gradual re-emergence of housing finance companies (HFCs) vis-à-vis the housing finance portfolio of commercial banks (CBs), the superior asset quality and profitability of HFCs. The very significant role that HFCs has to play in the emerging scenario to meet the huge housing shortage in the country is highlighted in the study. In an empirical paper on the experience of housing microfinance (HMF) in Kerala by Manoj P K (2010) [9], "Prospects and Problems of Housing Microfinance in India: Evidence from 'Bhavanashree' Project in Kerala State" in *European Journal of Economics, Finance and Administrative Sciences* the author has studied in detail the causes leading to the failure of the Government-sponsored HMF project named 'Bhavanashree' in Kerala and has suggested strategies for fool-proof implementation of HMF schemes or such other similar pro-poor housing schemes in the state in the future. A research paper by Manoj P. K (2010) [10], 'Benchmarking Housing Finance Companies in India: Strategies for Enhanced Operational Efficiency and Competitiveness' in *European Journal of Economics, Finance and Administrative Sciences* (EJEFAS) has studied in detail the relative competitive position of the major HFCs in India and has suggested specific strategies for their enhanced operational efficiency and competitiveness.

Manoj P K, (2010) [11] in his another research paper 'Determinants of Successful Financial Performance of Housing Finance Companies in India and Strategies for Competitiveness: a Multivariate Discriminant Analysis' in *European Journal of Economics, Finance and Administrative Sciences* (EJEFAS) has sought to identify the determinants of superior financial performance of HFCs using MDA (Multivariate Discriminant Analysis) method and derived a discriminant function involving five parameters (from among 21 parameters used for analysis) that significantly influence the financial performance of HFCs, these five parameters being (i) Total Income to Housing Loan Assets, (ii) Other Income to Total Assets, (iii) Total Expenses to Housing Loan Assets, (iv) Interest Expenses to Housing Loan Assets, and (v) Interest Expenses to Total Expenses. The same author, Manoj P K (2010) [12] in his another paper, 'Financial Soundness Housing Finance Companies in India and Determinants of Profitability: A 'CAMEL' Approach along with ROE Decomposition Analysis' has used 'CAMEL' methodology and ROE decomposition analysis to identify the determinants of profitability of HFCs. Another research article by Manoj P K (2011) [13], 'Determinants of Profitability of Housing Finance Companies in India and Strategies for Competitiveness: a Multiple Partial Correlation Approach' has suggested competitive strategies for different groups of HFCs based on the basic parameters that significantly influence the respective groups of HFCs. The research report by the agency IFMR (2015) [14] entitled 'Affordable Housing Finance Sector: Overview' makes a detailed analysis of the need, relevance and significance of affordable housing in India in the context of the national goal 'Housing for All by 2022' adopted by the Government of India. The vital role that HFCs has to play in the above context is highlighted in the report. The fact that there has been a gradual re-emergence of HFCs since 2013, thus overtaking the CBs in growth rate and significantly improving their market share has been specifically pointed out. India Brand Equity Foundation (IBEF) (2018) [15] in its latest industry report on Banking has pointed out the immense growth prospects of India's banking sector in view of the favourable demographics, robust demand, high interest margins and asset quality. The growing importance of the role of housing finance and other personal finance products (retail banking products, in general) is specially pointed out in the above IBEF report.

In view of the foregoing, considering the fact that focused studies on the importance of productive housing in India are very scarce, particularly in the present context when the country is committed towards the attainment of the national goal of 'Affordable Housing for All by 2022', this paper seeks to bridge the above research gap

by making a closer analysis of the significance of productive housing from a global perspective, with a focus on PHIRA of NHB.

4. HOUSE FOR INCOME GENERATION ALSO: NOT SIMPLY FOR SHELTER

Housing is normally considered as a consumption activity. However, house is a catalyst or a primary agent for a change in socio-cultural pattern and other characteristics of human life, including economic development, since a house forms a nucleus for the functioning of many a human endeavor and is a vital contributory factor for improvement in life. Hence, housing can be used for productive purposes by combining housing with income generation. Houses in rural areas are predominantly used for both residential and livelihood activities. Therefore, a house is more than a shelter. House can be a potential platform and an income generating asset. The income generation aspect of houses is more relevant in respect of rural areas, particularly for low-income people who need finance for housing, but are unable to service housing advances because of the lack of regular income. Obviously they are outside the reach of formal institutional agencies in housing finance also. Thus, what is relevant in such cases of low income populace, especially those in rural areas is not just housing finance, but a housing scheme that provides shelter (housing) and enables running of some income generating activity which in turn can ensure prompt serving of the housing advance availed by the party. Thus, the beneficiary gets the twin benefits of shelter, and also some gainful business or enterprise adequate enough for repayment of the housing credit also.

The clear trend towards economic restructuring the world over leading to greater privatization and reliance on free market, has got implications like fast pace of urbanization, and devastating impact on the poor. Thus, more and more low income households have no option but to generate income from within their own resources and networks. Houses become workshops or home-based enterprises. In the Indian context, the empirical study of housing implications of home-based enterprises (based at Jahangirpuri, Delhi) done by Kellet, P & Tipple, A Graham (2000)[5] have pointed out, inter alia, that in rural areas home and workplace are frequently combined and intimately interrelated. Sometimes, the workplace itself, even if separate spatially from the dwelling, may be regarded as having some of the characteristics of home. The authors suggest "Recognition of the symbiosis between domestic and productive activities can enrich our understanding of the meaning of home and could lead to more sensitive and supportive policy responses. Such policy responses, in turn, would result in healthier communities and also in development of the whole economy". (Kellet, P & Tipple, A Graham) (2000)[5].

In India, as already noted, houses in rural areas are used for both residential and livelihood activities. Productive (income-generating) housing is a new concept in India. Proper housing facilities support home-based workers, especially women, to earn their livelihood apart from having a decent dwelling to live in. In this paper, an effort is made to look into the major international experience in respect of income-generating houses and then critically review the Indian scenario in this regard. The recently launched 'PHIRA' (Productive Housing in Rural Areas) scheme of National Housing Bank (NHB) in India, its potential to provide gainful employment to the rural women and improve their living standards, and its major limitations are studied with a view to suggest meaningful remedial strategies, based on global experiences.

5. OBJECTIVES OF THE PAPER

- (i) To study the major global experiences in income-generating houses and their development potential, particularly women empowerment.
- (ii) To study in detail the significance and relevance of PHIRA Scheme of NHB in India in enhancing the employment potential of rural women, and to apprise its salient features;
- (iii) To study the current status in respect of the PHIRA scheme, the anticipated levels of employment generation, income creation etc. and also its major weaknesses;
- (iv) To make pragmatic strategies for making PHIRA scheme more effective in meeting its ultimate goal of sustainable income to the rural poor, particularly rural women.

6. INCOME GENERATING HOUSING: SOME INTERNATIONAL EXPERIENCES

In Indonesia, different community housing schemes that insist on income generating houses are available. The State Savings Bank (BTN) introduced a new loan package called the Kredit Triguna (or, Triple Function Loan). In this package, the loans can be used for land purchases, housing construction and income-generating activities. The Kredit Triguna is designed for households which do not have a fixed income and no alternative means of credit and loans are only awarded to the Community on behalf of individual households. The community provides security to the special purpose fund (Dana Mitra) in the form of cash savings or property. Each community member should pay an additional amount, the solidarity fund (Dana Solidaritas) besides the

monthly loan repayment. The Dana Solidaritas refers to a compulsory saving scheme and forms part of the collective responsibilities of the borrowers to shoulder the cost of defaulters, if any. In case there are no defaulters, then the Dana Solidaritas remains with the community as part of their capital funds.

Another typical project in Indonesia has been the Ulu community-based urban renewal scheme covering 16 hectares of slum area on the banks of the Musi River in the Sumatran city of Palembang involving 4,456 inhabitants on very low incomes. The project which is on-going addressed serious physical infrastructural problems associated with slum clearance and also non-physical problems such as a low economic capacity, lack of environmental awareness and access to financial resources. Implementation of the project involves participation by the community (community self-surveys and participatory planning), income-generating activities (commercial activities integral in the development) and creation of community based management organisation.

Since the commencement of such low-cost housing schemes as noted above, there have been development of about 500 units using community resources. Nearly forty community-based organizations have been formed in more than twelve cities and villages. An extensive network of development consultants has been established to work with community groups. Progress of these schemes have been modest because Indonesia is still suffering the affects of the South East Asian Financial crisis which commenced in 1997. Though the crisis has severely affected the progress, about two decades of experience in community based housing initiatives has provided Indonesia a sound foundation for further initiatives in affordable and sustainable housing in the country.

Financial and other kinds of support to productive home communities in Nicaragua has been a successful initiative capable of improving the living standards and home-based enterprises of poor. As part of the UNDP/UNCHS regional project to overcome poverty in Latin America and Caribbean which later resulted in 'CUP' project in the "Rene Cisneros" neighborhood, around 200 permanent jobs have been consolidated or created. About 150 families have increased their income above minimum salary. 40% of loans have been addressed to women and they participated in training courses for productive activities. A demonstration Productive Home has been built and housing improvement loans have benefited 60 families. Accordingly, in less than two years of activities the initial proposal was replicated in several locations for further mass promotion. Top priority was to tackle un-employment /under-employment and lack of income through job self-creation and income generating activities. Results were 3 out of 10 families from "Rene Cisneros" neighborhood have increased their income above minimum salary.

7. THE DUAL ROLE OF RURAL HOUSING IN INDIA: RESIDENTIAL AND INCOME GENERATION

In 2005-06, NHB embarked on developing new products for rural housing as part of its strategy to focus on new product development to impart renewed thrust on the un-served and underserved business segments. Accordingly, NHB introduced a new Scheme viz. Productive Housing in Rural Areas (PHIRA) in which a composite loan for housing as well as undertaking income generating activity is provided as a single window. The concept underlying the Scheme is that, a house in rural area can be leveraged to generate additional income for the household, if institutional credit is available both for productive activity and for the additional housing required to carry out the activity. Thus, housing and productive activity combines to form a virtuous cycle, feeding each other, for the benefit of the family. NHB has been implementing the Scheme in partnership with SCBs, RRBs and MFIs.

8. PHIRA: FOR HOME-BASED INCOME GENERATING ACTIVITIES OF RURAL WOMEN IN INDIA

PHIRA envisages the provision of a composite loan comprising of housing loan together with a loan for an income generating activity to enable home based workers, mainly women, augment their income by undertaking productive activity at their homes.

8.1 RELEVANCE AND SIGNIFICANCE OF PHIRA IN INDIA: AN ANALYSIS

The concept called SOHO (Small Office, Home Office) has worked well in urban areas, leading to increase in per capita income and saving and improvement in life style. The data released by the Census of India on House, Households, Amenities and Assets for 2001, indicate that total number of households in rural areas is 138.27 million while the availability of houses is 135.05 million (used as residences and residences-cum-other purposes).

Majority of these houses used for residences-cum-other purposes are often without any demarcation, leading to sacrificing the habitat conditions. If places for residence and economic activity are demarcated, there will be

improvement not only in habitat conditions but also in working environment. This will help in improving the productivity leading to increased income, saving, etc. thereby helping improvement of the life style of rural people, which will have a long term significant impact on health, education and standard of rural living.

Home workers, particularly in rural areas, constitute a significant potential workforce, which if harnessed can generate additional economic growth in the rural areas. Also, majority of these home workers are women. It is estimated that home workers constitute 51% of the women workforce in the country.

8.2. PURPOSE OF FINANCIAL ASSISTANCE UNDER PHIRA SCHEME

The purpose of this composite loan is to provide financial assistance for construction of house/incremental housing and repairs and augmenting income generating activity in any of the following categories so as to enable the borrower to repay the loan.

- Small business/ Trade,
- Tiny/ cottage industry or service activity,
- Artisan activities,
- Agricultural and allied activities
- Diary activities
- Poultry & Piggery activities
- Any other productive activity.

8.3. SALIENT FEATURES OF THE PHIRA SCHEME

The objective of this scheme for rural housing is to facilitate construction of houses for rural families and also to provide a source of sustainable income to the rural poor which would develop their repayment capacity. Persons marginally above the poverty line in rural areas are covered under this composite housing scheme.

- **Loan Amount:** Not exceeding Rs. 75,000 of which
 - » 70 per cent for Housing
 - » 30 per cent for Income generating activity
- **Additional Loan:** After a minimum 2 years of track record for
 - » home upgradation
 - » expansion of productivity activity
- **Interest Rate:** Market related
- **Tenure:** Not exceeding 15 years with moratorium of 1 year on repayment of principal
- **Security:** Mortgage of property
 - » Hypothecation of current assets
 - » Personal / Group Guarantee
 - » Escrow of income inflows
- **Insurance cover :**Life Insurance cover could also be available from insurance company Premium to be borne by borrower
- **Implementing Agency**

NHB would provide housing loan component through banks/HFCs/Microfinance Institutions having reach in rural areas by way of 100% refinance. The banks/HFCs/ Microfinance institutions will further finance the target group either directly or through SHGs. NHB can also consider direct finance to SHGs/Societies/Federations with appreciate legal constitution.

9. Economic Benefits of the PHIRA Scheme: Employment and Income Generation

PHIRA has potential for scalability, NHB's estimates of PHIRA benefits, if implemented on a national scale by the banking system are as follows:

- Loan disbursement per annum Rs.6,700 crores
- Loan disbursement in XI Plan Period (2007-2012) Rs.33,600 crores
- Number of families covered 5 million
- Additional family income generated Rs.5,000 crores
- Additional income generated on account of Multiplier effect of housing construction Rs.160,000 crores
- Additional jobs created 1.1 million jobs p.a.
(includes the jobs created for housing construction)

10. MAJOR DRAWBACKS OF THE PHIRA SCHEME

In spite of the substantial potential for employment generation and income creation, PHIRA scheme has been observed to have certain operational bottlenecks and weaknesses. Empirical investigation made by the researcher with reference to Trichur District in Kerala has revealed the following as the major weaknesses of the PHIRA scheme:

- There are repayment problems in respect of sizeable number of beneficiaries.
- The repayment percentage is often quite lower than the that of typical microfinance loans.
- Often, the repayment capacity is lower than the projected ones while availing the facilities thus resulting in defaults in repayments. Sometimes, repayment problems arise because of the lack of awareness regarding the penal and other charges applicable in case of default.
- Many prospective clients were unaware of this hybrid housing finance product, PHIRA being a new product launched by the NHB in FY 2005-'06.
- Better methods and more scientific process are required for assessing the repayment capacity of the borrowers / prospective borrowers. Often repayment capacity is over estimated at the appraisal stage resulting in repayment problems during the loan period. [However, it is reported that systematic efforts to enhance the repayments initiated by the respective agencies (like, MFIs, banks etc.), of late, are bringing in positive outcomes].

11. STRATEGIES FOR ENHANCED REACH AND EFFECTIVENESS OF THE PHIRA SCHEME

- (i) Concerted efforts to popularize the scheme among all existing as well as prospective housing loan customers are required, to garner more business into this new segment.
- (ii) More realistic assessment of repayment capacity, particularly the cash flow projections is required at the sanctioning stage in order to reduce the repayment problems that may arise in the future.
- (iii) More closer monitoring of the beneficiaries of this scheme is required (than in the case of ordinary housing loan schemes which does not have a 'production finance' component).
- (iv) Governments, both at the Centre and States should develop affirmative action policies to provide better access of informal settlement residents to land titles and tenure, finance, education and training, and skill development. National Housing Bank (NHB) be given the responsibility as the regulating and coordinating agency at the national level.
- (v) National and regional financial institutions, like, commercial banks (CBs) and housing finance companies (HFCs) – the most important institutional agency groups in formal sector housing finance in India, should be encouraged to facilitate access to micro-credit or other micro-financing schemes and other economic opportunities for informal settlement residents and provide support of small-scale local skill development and capacity building programmes in skill based training in local communities.
- (vi) As part of a capacity building programme Governments, with the support and active participation of NGOs and other civil society groups should implement on the job training for disadvantaged groups as an important means to promote economic self-sufficiency.
- (vii) As part of a capacity building programme policies should include measures to improve empowerment of women, including measures that promote education, job security, entrepreneurial development and creating employment opportunities for women.
- (viii) As part of a capacity building programme information and knowledge centres need to be provided within the informal settlements.

12. CONCLUDING REMARKS

In spite of some operational drawbacks observed in respect of PHIRA loans and also relatively slow pace of its growth, being a new scheme launched by NHB in FY 2005-'06, it may be noted that given the immense potential for housing development in India in general and low and middle income housing in particular, there are excellent prospects for PHIRA to pick up in the days to come. A more realistic evaluation of the creditworthiness of the applicants and also a more focused marketing strategy to popularize the scheme among potential customers are quite important, as most of the prospective clients are unaware of such a scheme launched by NHB. Thus, future of the PHIRA scheme seems to be quite bright in India, going by global experiences in this regard particularly that of Nicaragua, some refinements as suggested may be required. In fact, promoting schemes like PHIRA is an imminent need in India in the present context when the country is committed towards the attainment of 'Affordable Housing for All by 2022'; and needless to mention such schemes promote rural development and women empowerment also.

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MATERIALISTIC ASPECT IN ARUN JOSHI'S NOVEL "THE APPRENTICE"

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ABSTRACT

Materialism comprises a set of values and goals focused on wealth, possessions, image and status. Values play an important role in man's life. But it has been noticed that values are deteriorating in today's generation. The materialistic world is very horrible and everyone has to face time to time. This work shows the materialistic aspects of modern world and setting of man and his material desires (his idols) above all else including God.

The novel ***The Apprentice*** is written in the form of dramatic monologue. The hero Ratan Rathor is a man of double inheritance who feels that his life is resulted into a "pile of dung." In man's life crisis is bound to occur and he is entangled in the maze of confusion of values and moral anarchy. The young man Ratan Rathor moves from place to place for job and circumstances force him to shed the honesty and the old world morality of his father becomes an "apprentice" to the corrupt civilization.

There are various aspects that lead to the selfish attitude, degrading values, corruption, dejection and frustration in the life of Ratan Rathor. The hero Ratan Rathor makes frantic efforts to retrieve his innocence and honour.

He is a child of double inheritance, brought up in an atmosphere of anti-athetical philosophies of life with Gandhian values. His mother had a pragmatic approach towards life and money that influenced Ratan because his mother was suffering from tuberculosis and he had no money for her treatment. Thus it is clear that no one can survive in this phony and materialistic world without money.

Money is also the corrupting force of traditional values. The mad rush of modern man to amass more and more wealth has resulted in the selfish nature of the man with no meaning for human values, ideals and morals. Man has become self centered looking after his own interest rather than that of the whole society. This has resulted in clash of values. The traditional values of honesty, faith generosity, tolerance, patience, fortitude, naturalness, feeling of brotherhood and innocence has given way to modern civilization, lacking the values and consequently leading to the deterioration of the individuals. The reality based words of his mother ringing his mind constantly that "Money made friends. Money succeeds where all else failed.....but money was law unto itself."¹ The sophisticated and materialistic attitude of his wife was compelling him to satiate her day to day needs engrossing himself for corruption.

The futile effort of job hunting has shattered Ratan's hope of idealism but the humiliation, insult, starvation and the trauma of physical breakdown drained his hopes and brought him to the verge of collapse.

In ***The Apprentice*** intense suffering changes the attitude of the hero frequently. He repents for his wrong doings but he desires to lead a happy life by seeing the attitude of the people around him. The prevalent corruption ties him to accept the indecent ways. He is shocked to hear that the modern society is corrupt and even the pujari, an agent of God, was immersed in corruption and finally also engrossed in it. The selfish attitude of Ratan is also reflected for selecting the girl for marriage as per the tradition, the consent of elders are respected. but he did not care for the same. The modern man is caught in the whirlpool of discontent, frustration and utter dejection, since the erosion of traditional values has taken place in the wake of scientific and technological progress. It has corroded man's inner self and he has become fond of materialism which leads to the major corruption. Some of the characters are completely involved in materialistic comforts and desires, result thereby neglect the interest of entire civilization and thinks about their own ambitions, interest and inclinations. This conflict of modern and traditional values create meaninglessness and hollowness in the life of individuals. The modern man is a blend of baselessness and nobility, intelligence and follies generate the feeling of hate, dislike and revenge between each other.

Mechanization has made the man monotonous and also deprived him of satisfaction. The present work force remains idle and there is no individual talent and creative potentialities. The idleness creates conflict between the labour force and the management. It profoundly affects the cultural norms, value system, beliefs and attitudes. The tremendous advancement of science and technology has made a psychological change and also obliterated man's faith in religion and due to the clash of values man has become restless, uprooted and a foreigner everywhere.

The Apprentice suggests that the values of pre-Independence India have undergone considerable change. Good people adopt favorable means for favorable ends. Now ends are more important than means. The novelist

presents the ultimate picture that telling lies, pretending as per needs, following favorable means for a happy life will split man's consciousness.

The novel is a powerful indictment on modern society and a lamenting song of a tormented soul of modern world. For any Indian the respect and honor for his nation is of prime importance because for achieving the independence and liberty, the nation requires the dedication and sacrifice of innumerable nationalist who love their country. But the present trend of modern society is just reversed. Now a day's people adopt favorable end. They desire to become rich regardless of any means. The character of Ratan painted by Joshi represents the trend of modern people for fulfilling his ends. He even accepts bribe for clearing the defective weapons, being used in the Indo-China war without caring for the life of innocent people. The gravity of an offence committed by Ratan Rathor is more intense than the solution of polishing the shoe in front of Krishna temple.

Seeing the ups and down's of the world Ratan forms a view that a successful career cannot be achieved through diligence and sincerity but it can be realized through flattery and cunningness. So he deceives his very close friend by giving false statement without admitting his crime. Ultimately the Brigadier commits suicide. Similarly Ratan played havoc with many lives who are sacrificing their lives for nation's cause. Ratan also deceives Himmat Singh a contractor holding him responsible for supply of defective materials but the words of Himmat Singh showing the character of Ratan Rathor are heart touching where he opines "You are bogus, Ratan Rathor.... from top to bottom. Your work, your religion, your friendship, your honour nothing but a pile of dung"²

This highlights the material attitude, degeneration of values, cunningness, deceitfulness etc delineated through the character of Ratan by Joshi. It shows the modern trend that for achieving the selfish end the life of near and dear ones are hanged on the pegs. This, rat race which is noticed in today's generation is just for fulfilling their needs irrespective of any means. But the modern generation have forgotten that who so ever will maintain double standard will have to bear the pangs of agony and mental torture whatever his position may be as the end drawn by Arun Joshi is unique one where he tells

"It is a cold dawn. But no matter. A dawn, after all, is a dawn."³

Notes

1. Joshi Arun, 1993, *The Apprentice*, Delhi: Orient Paper Backs, Pg 20
2. Joshi Arun, 1993, *The Apprentice*, Delhi: Orient Paper Backs, Pg 137
3. Joshi Arun, 1993, *The Apprentice*, Delhi: Orient Paper Backs, Pg 144

DESIGN OF INTERNAL MODEL CONTROLLER FOR TEMPERATURE CONTROL SYSTEM

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ABSTRACT

Control of time delay system is a tedious task. In the control of time delay systems controller tries to take corrective action for a situation that originated sometime before. The Internal Model Control (IMC) plays a vital role in controlling such systems. In this paper, a continuous and discrete IMC controller designed for second order inverse response system. Furthermore, IMC based PID controller designed, and a simulation study is carried out for First Order Plus Dead Time (FOPDT) and unstable systems. The designed controller validated by performing the experimental study on a temperature control system. However, the performance of IMC and IMC based PID controller is satisfactory as compared to the conventional PID controller.

Keyword: IMC, PID controller, Temperature controller system

1. INTRODUCTION

IMC is one of the widely used robust control model-based methods [1]. IMC has significant characteristics, such as simple designing, better controlling performance and tuning parameters conveniently. This method has been widely used in the field of engineering. The main advantage of IMC is, it contributes a transparent framework for control-system design and tuning. The IMC control structure can be composed in a standard feedback control structure. Many advantages of IMC compare to feedback structure. IMC is effortless to than controllers in feedback structure. In industries, various applications control through model-based control systems are commonly used to track set-points and reject low disturbances [3]. Basically according to IMC principle controlling of a process can be achieved if and only if the control system summarizes either implicitly or explicitly, some representation of the process to be controlled. If we use an exact model of the process for designing a control system, then perfect control is theoretically possible. In IMC tuning parameter adjust to varying the response. The PID algorithm is commonly used, in the control system [6, 7]. Effective performance using a conventional PID controller is difficult to achieve [9]. Tuned 2DOF PID controller, using different PID tuning techniques and performance of the tuning methods are analyzed by time domain response specifications [5]. In [10], IMC design concept is extended to multi input-multi output for designing a controller for a Stirred Water Tank System. In [12] the implementation of an IMC based PID controller for the level control application is discussed.

2. DESIGN OF IMC CONTROLLER

In this section, designing of continuous IMC, discrete IMC, IMC based PID for FOPDT and the unstable process is presented.

2.1 Design of IMC Controller

1. Find the process model ($\tilde{G}(s)$) factor into invertible ($\tilde{G}_-(s)$) and non-invertible ($\tilde{G}_+(s)$) elements. Invertible, i.e., good stuff and non-invertible, i.e., bad stuff it generally includes time delays and RHP zeros. An all-pass factorization is used [1].

$$\tilde{G}(s) = \tilde{G}_+(s) \tilde{G}_-(s)$$

This factorization is performed so that the resulting controller will be stable.

2. From the idealized IMC controller. The ideal internal model controller is the inverse of the invertible portion of the process model (the good stuff).

$$\tilde{C}(s) = \tilde{G}_-^{-1}(s)$$

3. Add a filter $F(s)$ which make the controller ($C(s)$) proper.

$$C(s) = \tilde{C}(s) F(s)$$

If it is most desirable to track set-point changes, the filter transfer function usually has the form

$$F(s) = \frac{1}{(\lambda s + 1)^n}$$

And n is selected to make the controller proper (or semi-proper). If it is most desirable to track ramp set point changes, then

$$F(s) = \frac{n\lambda s + 1}{(\lambda s + 1)^n}$$

3. To vary the speed of response of the closed-loop system, filter-tuning parameter λ is adjusted. If λ is small, the closed-loop system is fast, if λ is large the closed-loop system will be more robust.

2.1.1 Discrete IMC

1. The design procedure of discrete IMC is similar to the continuous IMC design [1]. The primary difference is that the factorization performed on a discrete-time model. Factorize into invertible and noninvertible parts of the discrete model.

$$\tilde{G}(z) = \tilde{G}_-(z) \tilde{G}_+(z)$$

2. The controller is inverse of the "invertible" part with a discrete filter to make the controller physically realizable.

$$C(z) = \tilde{G}_-^{-1}(z) \cdot F(z)$$

Where $F(z)$ (filter) has the following form

$$F(z) = \frac{(1-\alpha)z^{-1}}{1-\alpha z^{-1}} = \frac{1-\alpha}{z-\alpha}$$

3. Where α is the discrete tuning parameter. It is related to the continuous IMC filter factor (λ).

$$\alpha = e^{-\frac{\Delta t}{\lambda}}$$

Where Δt is the sample time.

2.2. IMC BASED PID CONTROLLER DESIGN

2.2.1 IMC-based PID Controller for FOPDT Process Model

To arrive the controller equivalent to PID form with time delay, approximations for dead time are to be done [1]. This kind of approximations is done only during the design of IMC-based PID controller for processes with time delay, not for pure IMC strategy. FOPDT representation is most common in various chemical processes; PID equivalent form developed here is useful for a large number of process control loops.

Consider a standard form of first-order plus time delay process model as

$$\tilde{G}(s) = \frac{K_p e^{-\theta s}}{\tau_p s + 1} \quad (1)$$

The first-order Pade approximation for dead time is given by

$$(e^{-\theta s} = \frac{-0.5\theta s + 1}{0.5\theta s + 1})$$

Thus, process model becomes,

$$\tilde{G}(s) = \frac{K_p (-0.5\theta s + 1)}{(\tau_p s + 1)(0.5\theta s + 1)} \quad (2)$$

Further following steps to design IMC controller an IMC controller for this process model is designed as per the procedure discussed in section 2.1. Thus $C(s)$ will be

$$C(s) = \tilde{C}(s) F(s) = \frac{(\tau_p s + 1)(0.5\theta s + 1)}{K_p} \frac{1}{\lambda s + 1} \quad (3)$$

Thus, to find PID equivalent form

$$G(s) = \frac{C(s)}{1 - \tilde{G}(s)C(s)} = \left(\frac{1}{K_p}\right) \frac{0.5\theta s^2 + (\tau_p s + 1)(0.5\theta s + 1)}{(0.5\theta s + \lambda)s} \quad (4)$$

Thus by expanding the numerator term to find

$$G(s) = \left(\frac{1}{K_p}\right) \frac{0.5\tau_p \theta s^2 + (\tau_p + 0.5\theta)s + 1}{(0.5\theta + \lambda)s} \quad (5)$$

Thus, by comparing this Eq. (5) with standard PID equation, IMC based PID tuning parameters are obtained as

$$K_c = \frac{\tau_p + 0.5\theta}{K_p(0.5\theta + \lambda)} \quad (6)$$

$$\tau_i = \tau_p + 0.5\theta \quad (7)$$

$$\tau_d = \frac{\tau_p\theta}{2\tau_p + \theta} \quad (8)$$

2.2.3 IMC-based PID Controller for Unstable Process Model

An IMC-based PID controller designed for the unstable process [1]. IMC procedure is modified to some extent. Modifications are done in the filter selection. These steps are followed to design IMC-based PID controller for unstable processes.

1. Firstly, find IMC-controller transfer function $C(s)$ which include filter $F(s)$ for making $C(s)$ proper. In IMC additional requirement for designing filter is that the value of $f(s)$ at $s = P_u$ where $s = P_u$ is the unstable pole, must be equal to one .i.e. $F(s=P_u) = 1$

Morari and Zafiriou (1989) recommend a filter transfer function that is having a form as

$$F(s) = \frac{\gamma s + 1}{(\lambda s + 1)^n} \quad (9)$$

Where n is selected to make $C(s)$ proper (usually semi-proper). Its value can be found by satisfying the filter requirement $F(s=P_u) = 1$

2. By using transformation the equivalent standard feedback controller can be found as,

$$G(s) = \frac{C(s)}{1 - \tilde{G}(s)C(s)} \quad (10)$$

3. Converting the controller into PID equivalent form

$$G(s) = K_c \left(\frac{\tau_i \tau_d s^2 + \tau_i s + 1}{\tau_i s} \right) \left(\frac{1}{\tau_f s + 1} \right) \quad (11)$$

Let us consider the second-order unstable process

$$\tilde{G}(s) = \frac{K_p(\tau_n + 1)}{(-\tau_u s + 1)(\tau_p s + 1)} \quad (12)$$

Where τ_u is the positive value, and P_u is $1/\tau_u$ which indicates instability of the system. Thus by following similar steps to design an IMC controller, we can find out.

$$C(s) = \tilde{C}(s)F(s) = \tilde{G}^{-1}(s)F(s) = \frac{-\tau_u s + 1}{K_p} \frac{\gamma s + 1}{(\lambda s + 1)^2} \quad (15)$$

Select $F(s)$ as a second order filter to make the controller proper, put $s = 1/\tau_u$

$$F\left(\frac{1}{\tau_u}\right) = \frac{\gamma(1/\tau_u) + 1}{(\lambda(1/\tau_u) + 1)^2} \quad (16)$$

By solving equation (16) we get,

$$\gamma = \lambda \left(\frac{\lambda}{\tau_u} + 2 \right)$$

Thus, equivalent standard feedback controller is

$$G(s) = \frac{C(s)}{1 - \tilde{G}(s)C(s)} = \left(\frac{-\tau_u(\gamma + \tau_u)}{K_p \lambda^2} \right) (\gamma + \tau_p) \left(\frac{\gamma \tau_p}{\gamma + \tau_p} \right) \quad (17)$$

This is the form of PID controller and tuning parameters are obtained as

$$K_c = \frac{-\tau_u(\gamma + \tau_u)}{K_p \lambda^2}$$

$$\tau_i = \gamma + \tau_p$$

$$\tau_d = \frac{\gamma \tau_p}{\gamma + \tau_p} \quad (18)$$

3. SIMULATION STUDY

In this section, a simulation study is carried out using the MATLAB simulation platform R2010a.

Example 1: Designing of continuous and discrete IMC

Design of continuous and discrete IMC controller. A reactor continuous transfer function is [1]:

$$\check{G}(s) = \frac{0.5848(-0.3549s+1)}{0.1828s^2+0.8627s+1} \quad (19)$$

As per above mention procedure design the IMC for process model in equation (19). In this system value of $\lambda = 0.2$ min, Then the above equation is converted into a discrete time model as,

$$\check{G}(z) = \frac{-0.075061(z-1.334)}{(z-0.7995)(z-0.7863)} \quad (20)$$

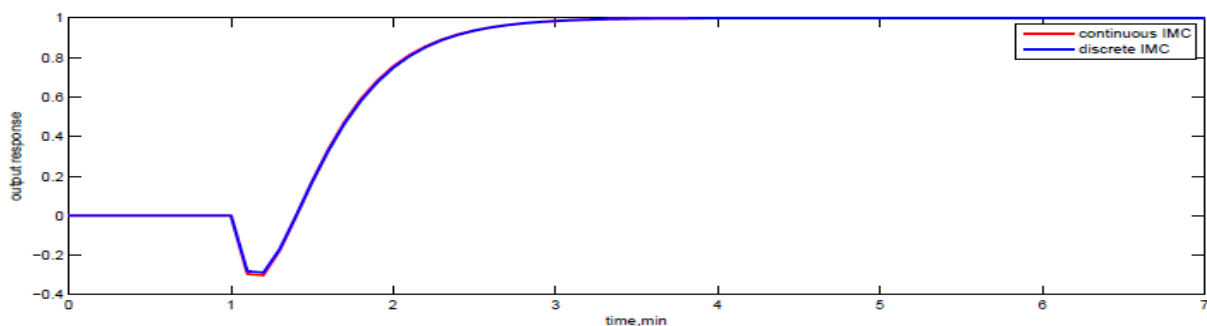


Fig-1: Output response for continuous and discrete IMC controller for example

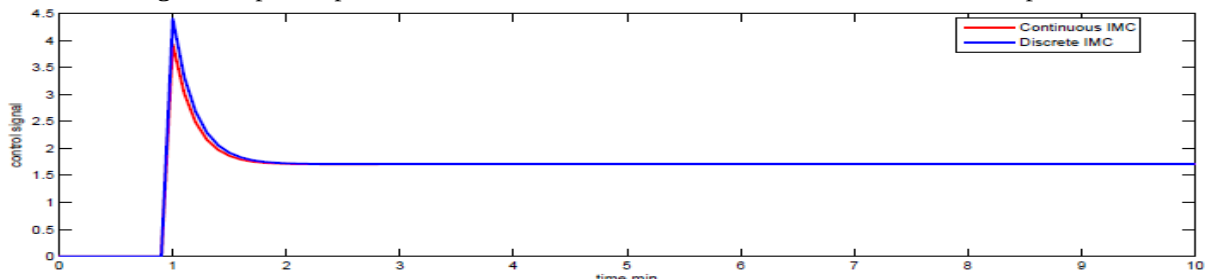


Fig-2: Control signal for continuous and discrete IMC controller for example1

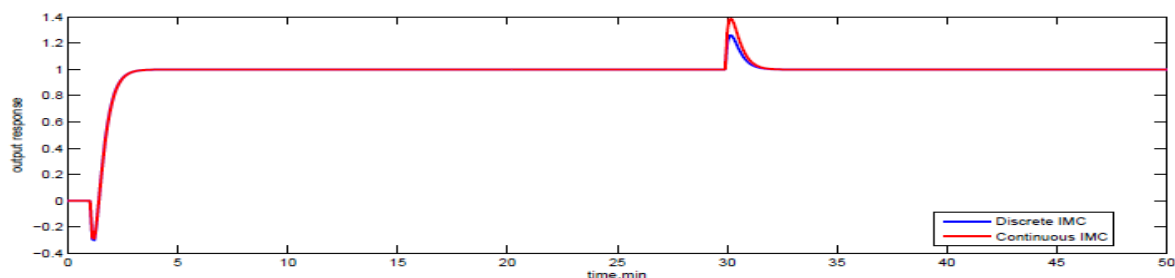


Fig-3: Output response for continuous and discrete IMC controller for example1 for a disturbance at t=30sec

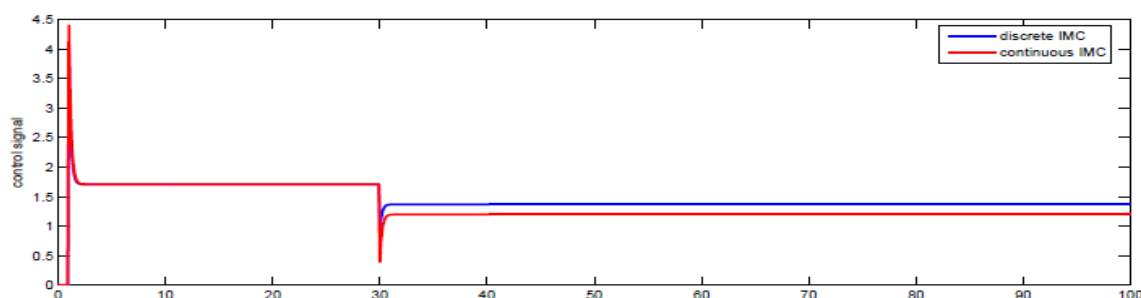


Fig-4: Control signal for continuous and discrete IMC controller for example1 for a disturbance at t=30sec

Table-1: Time domain specifications of Example1

Tuning Method	Rise time (sec)	Settling time(sec)	Overshoot
IMC-based PID	0.0764	0.9966	0
Auto-tuned PID	0.0764	1.002	0

Example 2: Consider a First-order plus Time Delay process given by [1]

$$\check{G}(s) = \frac{25}{15s+1} e^{-20s} \quad (21)$$

Here there is a time delay in the process, so we use first-order Pade approximation for dead time.

Thus, by using above design procedure PID controller tuning parameters are obtained as for $\lambda=30$ as $K_c=0.025$, $K_i=0.001$ and $K_d=0.15$. Simulation results are as shown in Figure 5 to 8. Figure 5 and 6 show the process output response and control signal without disturbance and Figure 7 and 8 shows with disturbance.

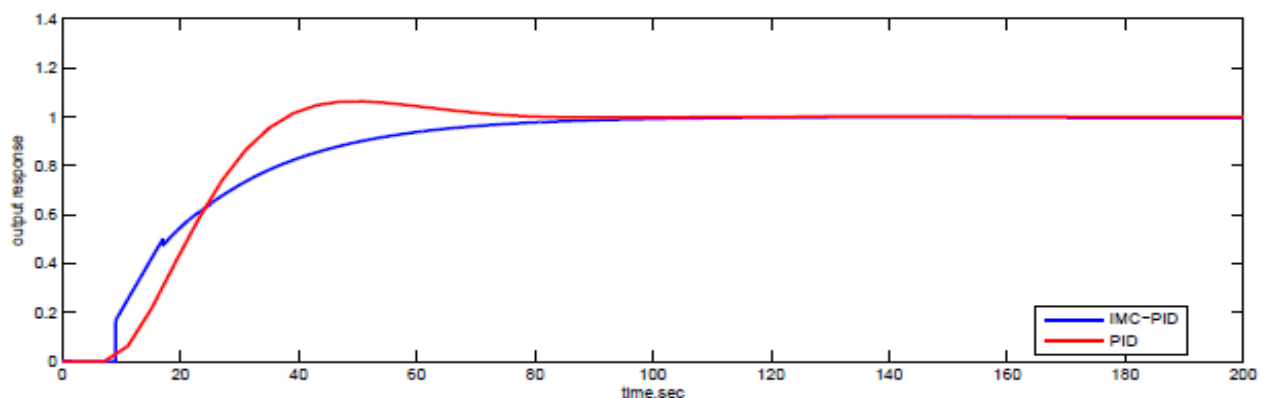


Fig-5: Output response for IMC-based PID and auto-tuned PID for Example2

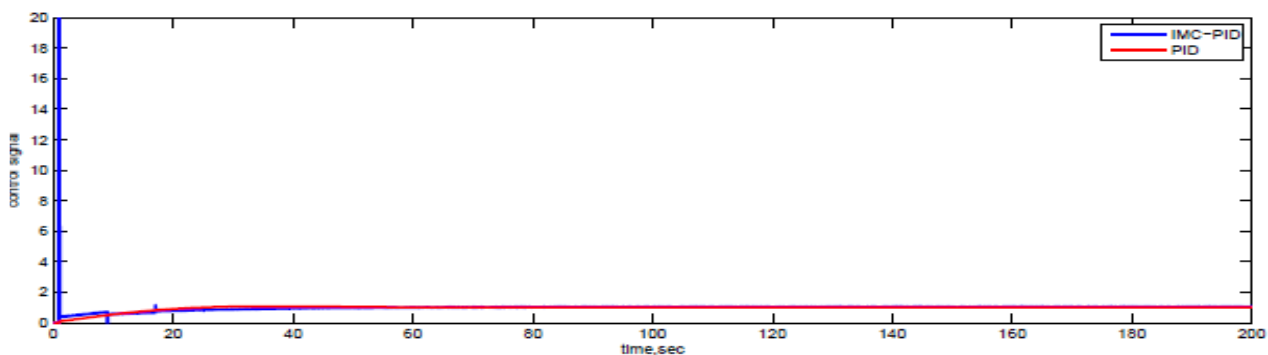


Fig-6: Control signal for IMC-based PID and auto-tuned PID for Example2

Table-2: Time domain specifications of Example2

Tuning Method	Rise time(sec)	Settling time(sec)	Overshoot
IMC-based PID	57.4	127	0
Auto-tuned PID	56.6	187	6.44

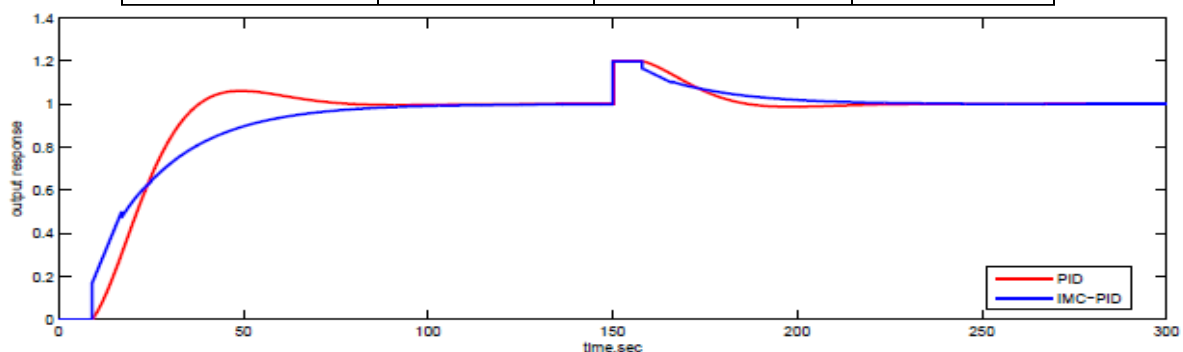


Fig-7: Output response for IMC-based PID and auto-tuned PID controller for Example2 for a disturbance at t=150sec

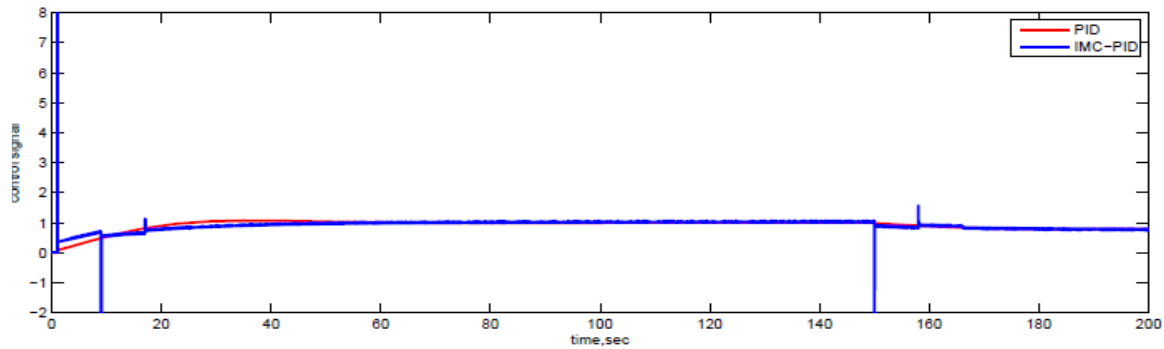


Fig-8: Control signal for IMC-based PID and auto-tuned PID controller for Example2 for a disturbance at t=150

Example 3: Unstable Process Model

Consider here a reactor process model given by following transfer function with an unstable pole as [1]

$$\check{G}(s) = \frac{-2(3s+1)}{(-4s+1)(5s+1)} \quad (22)$$

IMC based PID parameter for unstable system find from equation (20) $K_c = 20.5$, $K_i = 50$, for $\lambda = 30$. Simulation results as shown in Figure 9 to 12. Figure 9 and 10 show a process control signal and output response for set-point tracking. Figure 11 and 12 shows the control signal and output response with disturbance.

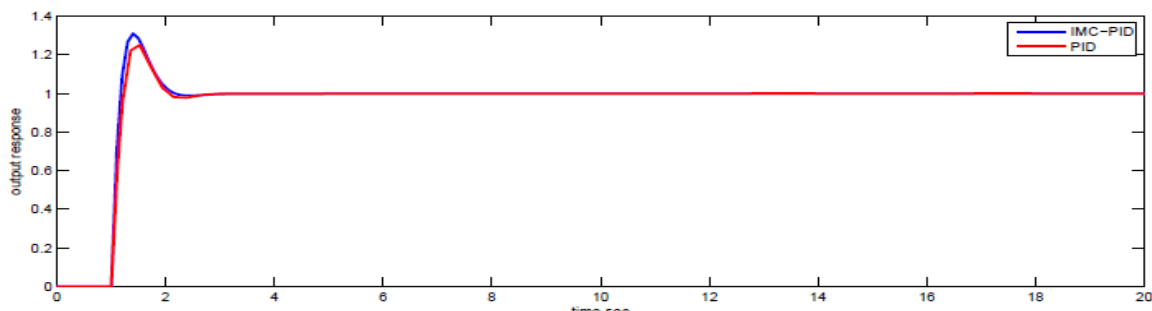


Fig-9: Output response for IMC-based PID and auto-tuned PID for Example3

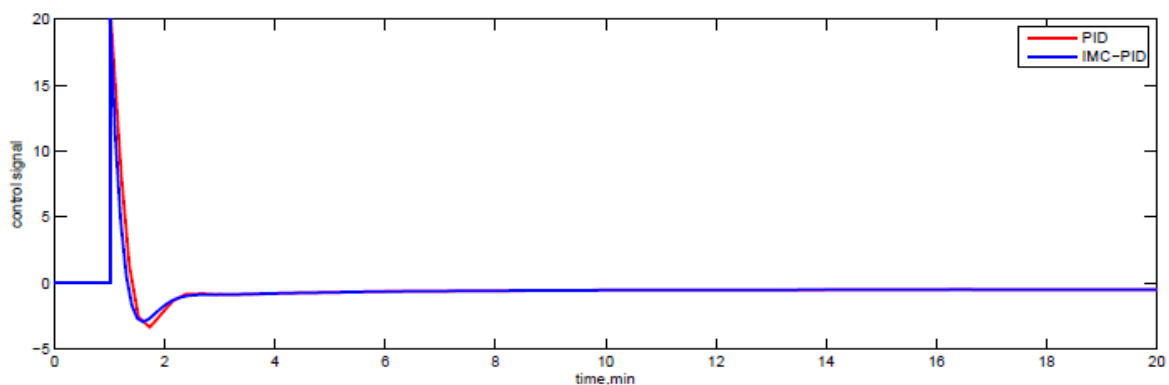


Fig-10: Control signal for IMC-based PID and auto-tuned PID controller for Example3

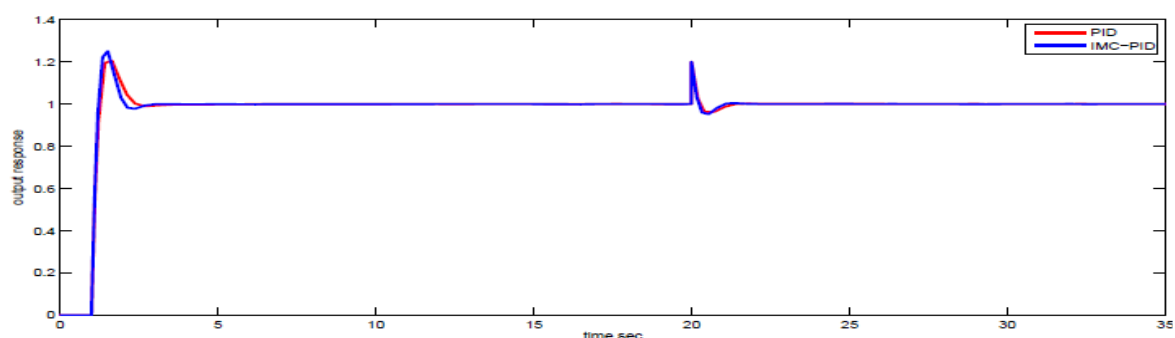


Fig-11: Output response for IMC-PID and auto-tuned PID for Example3 for a disturbance at t=20sec

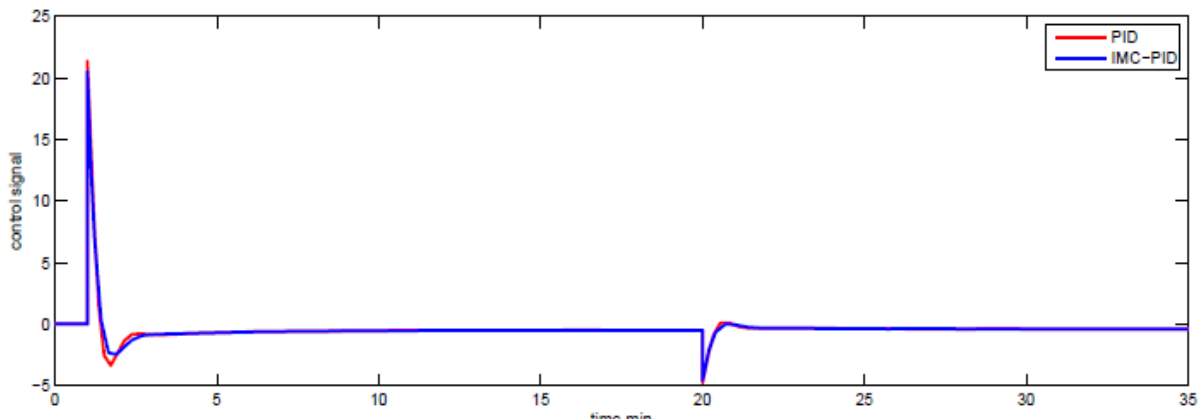


Fig-12: Control signal for IMC-PID and auto-tuned PID for Example3 for a disturbance at t=20sec

Table-3: Time domain specifications of Example3

Tuning Method	Rise time(sec)	Settling time(sec)	Overshoot
IMC-based PID	0.164	1.06	30.1
Auto-tuned PID	0.335	2.52	24.1

4. EXPERIMENTAL STUDY

Experimentation is performed on a temperature control system. The process setup consists of a tank, solid state relay (SSR), temperature sensor, rotameter, digital indicating controller. The heater consists of two coils each 1.5 kW is fitted on process tank. Temperature sensor PT100 is used to sense the temperature. SSR operates on 4-20 mA DC.

The model of the process is [16,17],

$$\tilde{G}(s) = \frac{2.2}{1 + 40.484s} e^{-6s}$$

Thus, by following the steps given for IMC-based PID controller design, tuning parameters are obtained as, $K_c = 1.5204$, $K_i = 0.03496$ and $K_d = 4.2006$. The output response and a control signal of an experimental and simulation study are as shown in Figure 13 and 14.

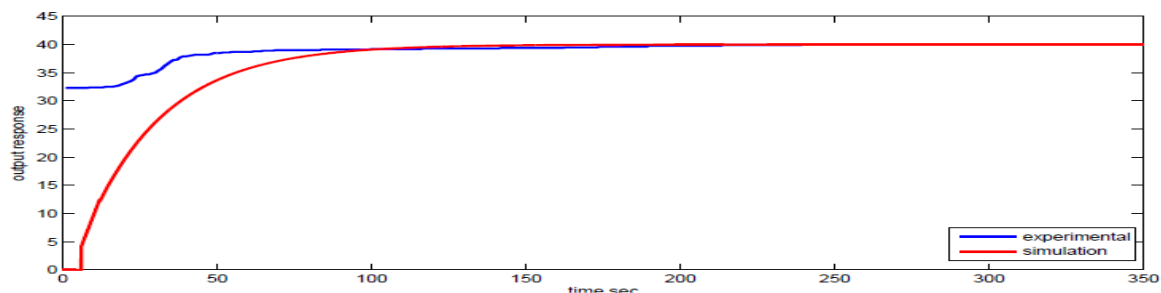


Fig-13: Output response of experimentation and simulation for temperature control system

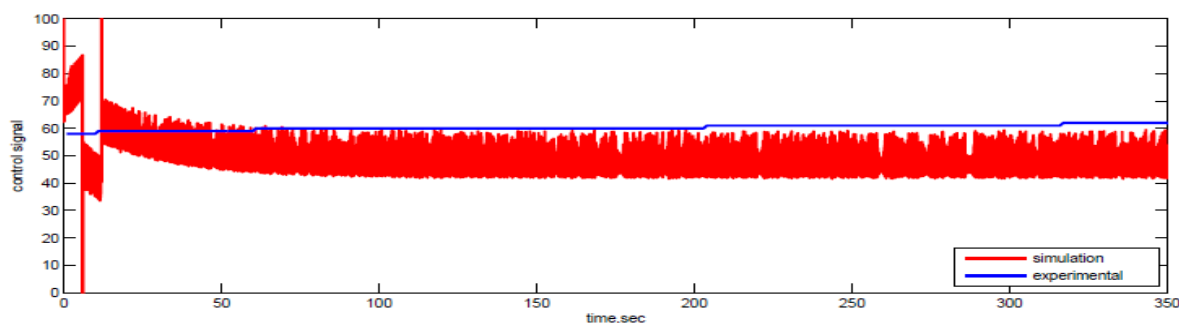


Fig-14: Control signal of experimentation and simulation for temperature control system

4. CONCLUSION

In this work, IMC and IMC based PID controller is designed for FOPDT, second order inverse response and unstable systems. In simulation study performance of continuous and discrete IMC controller is compared. Further, the IMC based PID controller is designed for an unstable system, and results show improved

performance and smooth controller effort as compared PID controller. Simulation results show that the performance of IMC based PID controller is better than a conventional PID controller. From the experimental study, it can be observed that the IMC based PID controller provides good set point tracking and minimal controller effort.

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EVALUATION OF TWO VARIETIES OF CHICKPEA GROWN UNDER THERMAL POWER PLANT WASTEWATER AND COAL FLY ASH APPLICATION

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ABSTRACT

A field experiment was conducted to investigate the effect of thermal power plant wastewater (TPWW), ground water (GW) and coal fly ash (FA) on the growth and seed yield of chickpea at Department of Botany, Aligarh Muslim University, Aligarh. Two chickpea varieties (BG-256 and Avarodhi) were evaluated against TPWW, GW and four fly ash-soil amendments (0, 10, 20 and 40%). Uniform dose of NPK fertilizers were applied and the seeds were sown. The results revealed that all growth and yield traits of chickpea were significant at ($P < 0.05$) and positively influenced by TPWW and fly ash soil amendments; and chickpea varieties also responded differently. TPWW proved better as compared to GW, while fly ash (10%) showed better response in comparison to control i.e. FA₀ whereas, FA₂₀ and FA₄₀ proved deleterious for both the varieties of chickpea. However, least performance was resulted by the crop at control. In case of varieties, BG-256 showed its superiority over Avarodhi. It was concluded that the growth and seed yield of chickpea varieties improved with the application of TPWW and FA (10%); while chickpea variety BG-256 showed its superiority over Avrodhi for all the growth and yield traits. Hence, variety BG-256 may preferably be cultivated and along with TPWW, FA (10%) may be applied for maximizing the chickpea yields.

Keywords: Chickpea, thermal power plant wastewater, fly ash, NPK, yield.

INTRODUCTION

Grain legumes are a major source of protein in human and animal nutrition and play a key role in crop rotations in most parts of the world. Chickpea (*C. arietinum* L.) is the third most widely grown grain legume in the world after bean and soybean. The agronomical significance of chickpea depends on its high protein content (approx. 19.3– 25.4%) for the human and animal diet, being utilized increasingly more as an elective protein source. Moreover, Growth is generally a function of environmental factors (such as temperature and solar radiation) and mineral nutrition, along with genotype and production practices (Alam and Haider, 2006). Growth analysis is one way to verify the crops ecological adaptation to new environments, the competition between species, crops management effects and the identification of the productive capacity of different genotypes. The elements of dry matter distribution to different plant organs, their yielding and efficiency might be described by utilizing various indices of growth analysis (Zajac et al., 2005; Kibe et al., 2006). Growth investigation is as yet the most straightforward and exact strategy to assess the commitment of various physiological procedures in plant development. It provides a considerable insight into the functioning of a plant as depends on genotype or environment. The motivation behind growth analysis is the assurance of the expansion in dry matter alluded to a reasonable reason for photosynthetically active tissue, leaf area and measure of leaf protein (Ali et al., 2004; Gupta and Gupta, 2005; Alam and Haider, 2006; Yasari and Patwardhan, 2006).

Fly ash is produced by burning coal in thermal power plant and it poses a serious environmental hazard. Disposal of the huge amount of ash produced by burning of coal for energy purpose in different industry is a major concern today (Gautam et al. 2012). The disposal of fly ash by conventional methods leads to degradation of arable land and contamination of ground water therefore, development of proper technologies for disposal of this solid waste in an eco-friendly manner becomes essential to derive maximum benefit from its heterogeneous nature, since it is a store house of readily available plant macro and micronutrients (Gupta et al 2002). In combination with organic manure, microbial inoculants or fertilizers, fly ash can be used to design a soil benefaction strategy, which can help in improving soil properties and enriching its nutrient status. The presence of almost all essential plant nutrients in ionic form and the ameliorating effect on the physical, chemical and microbial nature of soil makes fly ash an important input for biomass production, especially on various degraded soils and waste land (Gupta et al 2002). Lower amendment levels of fly ash caused enhancements of both growth and yield while adverse effects at higher levels were observed for several crops including maize, soybean barley, cabbage, apple, alfalfa, beet (Kumar et al, 2002; Marten, 1971).

Water is visibly so much that its value is accounted low as it is believed that the water resources are inexhaustible or at least more than sufficient for all our needs. However, the habitable land areas have only limited fresh water resources, and only about 0.5% is present either as ground water or as surface water in lakes,

rivers, ponds and dams etc. (Cunningham and Saigo, 1995). Contrarily, enormous amount of waste water is generated every year from urban population and industrialization and may cause environmental threat worldwide including India. Therefore, planned collection, treatment and disposal of the waste water are an important component in the protection of public health, surface soil and fresh water. The treatment of waste water is given low priority in India due to the financial constraints. Thus, alternative option appears to be reuse of waste water in agriculture for profitable crop production. This option may lessen the problem of water pollution and also serve as fertilizing components. The waste water contains nutrients of fertilizing value (Soumare et al., 2003) that enhances growth and yield of crop plants (Shah et al., 2004; Gupta et al., 2005; Javid et al., 2006). Therefore, keeping in mind the beneficial effects of TPWW and FA, two varieties (BG-256 and Avarodhi) were evaluated to find a suitable method for waste management and to reduce the use of inorganic fertilizers. Both the varieties were also tested to understand the varietal differences on the basis of growth and yield parameters.

MATERIALS AND METHODS

To achieve the aim, five pot experiment was performed in the net house of Environmental Plant Physiology, Department of Botany, Aligarh Muslim University, Aligarh. TPPW was collected from the outlet of the leachate reservoir of Harduaganj Thermal Power Plant, Kasimpur, located 13km away from Aligarh city, whereas tap water was the source of GW. Fly ash was also collected from the fly ash pond of the same thermal power plant. Each pot received 500ml water on alternate days for the duration of about 125 days starting from 10th day after sowing (DAS) i.e. after seedling emergence. Four different concentrations of fly ash as 0, 10, 20 and 40% were thoroughly mixed with soil making the total of soil/fly ash weight up to 7kg pot⁻¹. The control consists of only soil without fly ash. Uniform starter basal dose of nitrogen (20kg ha⁻¹), phosphorus (20kg ha⁻¹) and potassium (20kg ha⁻¹) was also applied before sowing. The sources of NPK were urea, single super phosphate (SSP) and muriate of potash (MoP) respectively.

Seeds of BG-256 and viable *Rhizobium* culture (*Rhizobium* sp.) specific for chickpea were procured from Indian Agricultural Research Institute (IARI), New Delhi. Seeds of locally grown variety of chickpea (Avarodhi) were obtained from Agricultural Directorate, Aligarh. Healthy seeds were surface sterilized with absolute alcohol and dried in shade before applying the inoculum (Rao 1982). Before irrigation the water samples were collected and analyzed for physico-chemical characteristics (Table 1) adopting the procedures outlined in the standard methods (APHA 1998). Similarly, soil/fly ash samples were collected before the start of the experiment and analysed (Table 2) for standard physico-chemical properties (Jakson 1973; Ganguly 1951; Walkley and Black 1934; Dickman and Bray 1940; Chopra and Kanwar 1982; Richards 1954; Ghosh et al 1988).

For investigating the comparative effect of TPPW, GW and fly ash under inoculated conditions, observations were carried out at 60 days after sowing (DAS). For the study of the root, the plants were uprooted carefully and washed gently to clear all the adhering particles. For assessing dry weight, three plants from each treatment were dried, after taking their fresh weight, in hot air oven at 80°C for two days and weighed. The area of leaves was measured using leaf area meter (LA 211, Systronics, India). For nodule number, whole plant was uprooted with the precaution that the roots or the nodules may not be damaged. Samples were washed gently to wipe away all the adhering foreign particles and the number was carefully counted.

NRA and chlorophyll were estimated (Jaworski 1971; Mac-kinney 1941). Healthy leaves were for the estimation of N, P and K contents (Lindner 1944; Fiske and Row 1925). Potassium was estimated with the help of flame photometer. At harvest, yield attributes including seed yield per plant, biomass, seed protein (Lowry et al 1951) and harvest index were measured.

The data for the growth and yield of each experiment were analysed statistically taking into consideration the variables (Panse and Sukhatme 1985). The 'F' test was applied to assess the significance of data at 5% level of probability ($p \leq 0.05$). The error due to replication was also determined.

RESULTS AND DISCUSSION

The results (Table 3) clearly indicate that TPWW proved better in enhancing all the parameters studied of both the varieties (BG-256 and Avarodhi) when compared with GW. While growth and yield parameters get benefitted by the lowest concentration of FA i.e. 10%, however higher concentrations of FA (20%, 40%) proved deleterious for chickpea. Regarding the performance of both the varieties of chickpea, BG-256 gave better results as compared to locally grown Avarodhi suggesting sowing of BG-256 for better production. Nitrogen is the single most important element limiting plant growth and is invariably required in large quantities deserves special consideration in this regard. As vegetative growth includes the formation of new leaves, stems and roots, the involvement of N through protein metabolism controls the growth (Table 3). On application to soil, most of

the non-organic forms of N remain readily available for uptake, during vegetative plant growth. In comparison, only about 5-75% of the organic forms is commonly mineralized and that too in about one year after application (Sommers and Giordano, 1984). This lends support to the above observation of the suitability of wastewater as a good source of this nutrient. Another aspect that requires consideration here is the fact that both $\text{NH}_4^+\text{-N}$ and $\text{NO}_3^-\text{-N}$ were present in wastewater, the former being about five times more than the latter (Table 2). It is noteworthy that applied $\text{NH}_4^+\text{-N}$ is toxic for some higher plants, including bean and pea (Maynard and Barker, 1969). However, in the presence of $\text{NO}_3^-\text{-N}$, it has been reported to benefit sunflower (Weisman, 1964) and wheat (Cox and Reisenaver, 1973). The observed nutritional superiority of wastewater (containing both $\text{NH}_4^+\text{-N}$ and $\text{NO}_3^-\text{-N}$) for growth of chickpea in this study is thus not exceptional. Similarly, the presence of additional P in wastewater might have primarily influenced root growth (Tables 2&3). It is known that for the effective use of P, various factors operate together, such as rooting pattern, length of crop growth, soil characteristics including pH as well as dose and source of P, in addition to the presence of water. Since wastewater was one source of irrigation and was comparatively richer than the other source (groundwater) by about 58% in all experiments (Table 2) the observation of improved performance of the crop under wastewater is understandable. It is all the more noteworthy because application of phosphate fertilizers was its limitation as P fertilizer applied to the soil are very rapidly changed to less soluble forms and, therefore, become less and less available with time (Russel, 1950). Admittedly in short season crops, like some vegetables, growth responses to applied P may persist upto harvest. However, long season crops, like corn and chickpea, show only early growth responses and comparatively much lesser effect at seed formation and maturity. Frequent wastewater application until this late stage, therefore, enhanced P availability to the crop and ultimately lead to higher seed productivity (Table 3) in chickpea.

It is well known that N is fully utilized for crop production only when K is adequate (Mengel and Kirkby, 1982). The presence of K in almost double the amount in wastewater than in groundwater (Table 2). Therefore, benefited the treated crop not only due to its own physiological role (Wolf *et al.*, 1976) but also by enhancing the effect of N. While it increased the chlorophyll content of alfalfa leaves and also the CO_2 exchange rate on plant⁻¹ basis (Collin and Duke, 1981), it is not surprising that this nutrient (along with Mg) improved the chlorophyll content in the present study also (Table 3).

The presence of higher NPK contents in leaves (Table 3) grown under wastewater further confirm these observations. This ultimately led to increase seed yield (Table 3). In addition to N, P and K, presence of S also improves growth and N fixation (Walker and Adams, 1958). Therefore, in our study S as well as Ca and Cl present in wastewater (Table 2) might have contributed further towards enhanced growth and led to the promotion of the crop's yield. It may be pointed out that yield potential is the yield of a crop grown in an environment to which it is adapted and is provided with sufficient nutrients and water, in addition to other stresses being effectively controlled. Thus, considerable yield increases are possible by improving one or more physiological or morphological traits of crop, which in turn are dependent upon the availability of essential nutrients (Evans and Fischer, 1999). Obviously, all these were provided by the wastewater.

Nodule number and nodule dry weight was increased under wastewater. As pointed out earlier, with the increased amount of nutrients in the medium roots had a better chance to exploit them. This could not only result in increased root proliferation but also nodulation. Franco (1977) has cited several authors who obtained increased nodulation and N_2 fixation in legumes by utilizing optimum amounts of N in the medium. Similarly, frequent supply of additional P and K in the wastewater also play an important role in enhancing nodulation. In this connection the review by Andrew (1977) gives support to this report of the effect of P contention. Moreover, the importance of K for tropical legumes, specially in N_2 fixation by increasing either nodulation or nodule productivity (Duke *et al.*, 1980) further strengthens our assertion. Add to it the role of Ca (Table 2) in symbiotic N_2 fixation (Lowther and Loneragan, 1968; Freire, 1977) and the picture becomes brighter.

Increase in NRA was observed (Tables 3). The presence of nitrate-nitrogen in the irrigation water (TPPW) as recorded in Table 2 could be mainly responsible for it. NR is a substrate-dependent enzyme (Afridi and Hewitt, 1964; Campbell, 1999). After absorption by roots the N was translocated to leaves (Table 3), which is a major site for its reduction. NRA seems to be indirectly affected by the presence of P in wastewater. P is involved in phosphorylation and diversion simple sugars towards respiration as a result of which oxidation of photosynthates produces more reducing power subsequently for nitrate-mediated NO_3^- reduction. In comparison to N and P, K is proved to be an activator of many enzymes including NRA (Suelter, 1970).

Similar to above observations, effect of wastewater was noted to be significant (Table 3). Increase in seed protein content was due to the presence of N, P and K in wastewater (Table 2). The data reveals that protein content of seeds of the plants grown with wastewater was at par with the seed protein content of those grown

under GW. This was also observed earlier at Aligarh by Aziz *et al.* (1999) while working with petrochemical refinery wastewater. The reason may be traced to the “dilution factor”. Because of increased seed yield, apparently due to enhanced seed production in wastewater treated plants. Thus, the tendency to cross the level of significance was nullified by the dilution effect. However, it may be inferred that wastewater has neither deleterious nor beneficial effect on seed quality. This may still be considered as a plus point for wastewater irrigation of chickpea.

All the growth and yield parameters were found to be increased due to 10% fly ash application, whereas higher levels of FA (20% and 40%) proved deleterious for chickpea (Table 3). It has been supported that fly ash can increase the soil fertility by improving its texture (Chang *et al.*, 1989) and water holding capacity (Sharma *et al.*, 1990), thereby affecting the plant growth indirectly. Its most important direct role is to correct the nutrient balance in the medium (Hill and Lamp, 1980) as some of the naturally existing essential nutrients enrich it (Klein *et al.*, 1975; Koakinen *et al.*, 1975). It is known to be source of B (Wallace and Wallace, 1986), Ca (Martens and Beahm, 1976), Cu (Wallace *et al.*, 1980), K (Martens *et al.*, 1970), Mg (Hill and Lamp, 1980), Mo (Cary *et al.*, 1983), S (Elsewi *et al.*, 1978) and Zn (Schnappinger *et al.*, 1975). Expectedly, it was due to the presence of these essential element in our fly ash samples (Table 1) that supplemented those supplied by the soil and wastewater. However, the benefit of fly ash proved only of limited nature as noted above. The decrease in yield was probably due to increased levels of sulphate, chloride, carbonate and bicarbonates (Table 1). Some toxic compounds i.e. dibenzofuran and dibenzo-p-dioxine mixture (Helder *et al.*, 1982; Sawyer *et al.*, 1983) and elements like Ni, As, Cd, Cr, Pb, Se, Zn, Cu (Wadge and Hutton, 1987) were reported to occur in fly ash might have also contributed towards the lesser yield under higher fly ash concentrations. Detrimental effects of higher levels of fly ash on plants have also been reported earlier due to either the phytotoxicity of B (Adriano *et al.*, 1978) or a shift in the chemical equilibrium of the soil (Singh and Yunus, 2000).

Nodulation, like growth and yield, was increased on adding fly ash albeit upto a limited level (10%). More than 10% amendment decreased it due to variation in pH. At higher levels, toxic amounts of soluble salts released from fly ash seem to affect roots and rhizosphere adversely. It may also be added that high doses of fly ash added to the soil decrease the microbial activity due to change in soil salinity or concentrations of potentially toxic elements (Singh and Yunus, 2000). This could not only delay nodulation but also cause a decrease in their number as noted by Martensson and Witter (1990). NRA and leaf N, P and K were also decreased by higher doses of fly ash (Table 3). Although fly ash contained an extremely small amount of nitrogen, an increase in NRA by its application was observed in the present study. The presence of Mo (Cary *et al.*, 1983) in fly ash and sufficient quality of available nitrogen in the soil (Table 1) might have accelerated the rate of NR activity. Considering the increase in seed protein content due to the application of fly ash (Table 3) the pressure of additional P and K in it may be responsible for it. This has also been reported by Bhaisare *et al.* (2000), Khan *et al.* (1996), MiLovsky (1992), Sriramachandrasekharan (2001). Similarly, due to phytotoxicity of some heavy metals and conversion of some trace elements like Mo and B into some inorganic complexes availability of nutrients including NPK was adversely affected under high levels of fly ash (Bilteanu *et al.*, 1973). The ameliorative effect of nutrients present in the applied wastewater and fly ash, together with the N and P applied as fertilizers, was pronounced when interaction was considered. On defining interaction, Russell (1973) states that if two factors are limiting or nearly limiting growth, adding only one of them will have little effect, while adding both together will have a very considerable effect. In the context of crop plants, two such factors show a positive interaction if the response of the crop to both together is larger than the sum of responses to each separately. . It may be emphasized that wastewater and fly ash supplemented these nutrients thereby proving economically efficacious on the one hand and environmentally acceptable on the other. Among the significant interactions, low concentration of fly ash plus wastewater i.e. TPPW $\times$ FA₁₀ proved beneficial due to the positive nutritional role played by the constituents of the wastewater products generated from the same source (Thermal Power Plant). As mentioned earlier fly ash was deficient in N which was amply compensated by the application of wastewater having sufficient nitrogen in the form of NH₄⁺ and NO₃⁻ in the presence of low doses of N and P fertilizers. Crop species differ in their morphological and physiological characteristics as well as yielding ability in response to their surroundings. Genetic variability is supposed to be largely responsible for such observations (Frageria *et al.*, 1991) although environmental factors do play a role. In agricultural crops, therefore, genetic potential must be of sufficient magnitude and flexibility so that they may be grown over a wide range of agroclimatic conditions. This accounts for differences in crop productivity and simultaneously allows a particular crop or cultivar to adapt itself to a particular environmental conditions (Lafever, 1981; Heinrich *et al.*, 1983; Bruckner and Frohberg, 1987). Under fly ash treatments, BG-256 performed better than Avarodhi as growth of the former was enhanced by fly ash in general and FA₁₀ in particular. The present investigation thus showed that due to the superior inherent genetic potential of BG-256, it proved more efficient

in comparison to Avarodhi. However, it must be admitted that the amount and kind of nutrient applied for better growth and yield in particular crop, and even its species or cultivars, is important as the magnitude of differences varies between the species well adapted to the same climate, same soil and in some cases even the same management. The superior performance of BG-256 was due to increased nodulation and dry weight as well as better developed root system (Table 3) in comparison to Avarodhi. It also showed enhanced leaf area resulting into higher matter accumulation (Table 3). The results showed that BG-256 significantly differed from Avarodhi in leaf NRA, chlorophyll content, leaf NPK contents, seed yield and seed protein contents (Table 3) under wastewater and fly ash. The better performance of BG-256 in this regard could be traced back to enhanced shoot dry weight and root dry weight – the most important criteria to assess vegetative growth. The differences in N, P and K status of the two cultivars reflected their differential efficiency to absorb and accumulate these nutrients (Table 3). These findings thus provide a positive conclusion with regard to the objectives of the present study. Therefore, for the cultivation of chickpea, basal application of 10 kg fly ash ha⁻¹ may be recommended under TPPW irrigation. Among the available varieties, BG-256 may be preferred for cultivation in this region (Western Uttar Pradesh, India). Finally, TPPW and fly ash, which is by all means waste product of Thermal Power Plant, may be profitably utilized for agriculture purpose.

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Table-1: Chemical characteristics of soil and fly ash before sowing. All determinations in mg l⁻¹ in 1: 5 (soil-water extract) or as specified.

Soil		Fly ash	
Determinations		Determinations	
Texture	Sandy loam	CEC (meq 100g ⁻¹ fly ash)	9.20
CEC (meq 100g ⁻¹ soil)	2.78	pH	8.70
pH	7.6	Organic carbon (%)	1.42
Organic carbon (%)	0.382	EC (μ mhos cm ⁻¹)	990.00
EC (μ mhos cm ⁻¹)	226.00	NO ₃ -N (g kg ⁻¹ fly ash)	0.02
NO ₃ -N (g kg ⁻¹ soil)	0.217	Phosphorus (g kg ⁻¹ fly ash)	2.13
Phosphorus (g kg ⁻¹ soil)	0.109	Potassium	13.00
Potassium	16.00	Calcium	21.24
Calcium	32.37	Magnesium	16.37
Magnesium	18.66	Sodium	13.29
Sodium	11.01	Carbonate	12.37
Carbonate	19.65	Bicarbonate	51.86
Bicarbonate	62.17	Sulphate	26.13

Sulphate	16.34	Chloride	19.71
Chloride	22.43		

Table-2: Chemical characteristics of ground water (GW) and thermal power plant wastewater (TPPW). All determinations in mg l⁻¹ or as specified.

Determinations	Sampling			
	I		II	
	GW	WW	GW	WW
Ph	7.6	7.7	7.8	8.3
EC (μ mhos cm ⁻¹)	750	930	720	930
TS	934	1281	917	1314
TDS	519	622	504	630
TSS	423	674	431	687
BOD	17.28	70.34	16.16	68.29
COD	40.24	129.37	38.31	120.17
Mg	18.83	26.24	16.58	25.19
Ca	26.21	42.31	25.39	43.17
K	8.34	17.29	8.09	18.36
Na	16.30	47.20	16.11	48.34
HCO ₃ ⁻	62	90	60	86
CO ₃	18	37	19	35
Cl ⁻	72.48	104.18	68.37	100.24
PO ₄	0.73	1.15	0.65	1.04
NO ₃ -N	0.80	1.04	0.78	1.10
NH ₃ -N	2.58	5.27	2.41	5.22
SO ₄	49	75	51	70

Table-3: Effect of ground water (GW) and thermal power plant wastewater (TPPW) on growth and yield parameters of chickpea (*Cicer arietinum* L.) grown with different levels of fly ash

N.B: Subscript values denote the amount of fly ash (FA) in kg ha⁻¹. A uniform basal dose of nitrogen, phosphorus and potassium at the rate of 20 kg ha⁻¹ each was applied at sowing.

	Shoot length plant ⁻¹ (cm)	Shoot dry weight plant ⁻¹ (g)	Leaf area plant ⁻¹ (cm ²)	Root length plant ⁻¹ (cm)	Root dry weight plant ⁻¹ (g)	Nodule number plant ⁻¹	Nodule dry weight plant ⁻¹ (g)	Leaf nitrate reductase activity (μ mol g ⁻¹ fresh weight h ⁻¹)	Total chlorophyll content (mg g ⁻¹ fresh weight)	Leaf nitrogen content (%)	Leaf phosphorus content (%)	Leaf potassium content (%)	Seed yield (g plant ⁻¹)	Biomass (g plant ⁻¹)	Seed protein content (%)	Harvest index (%)
Avarodhi																
GW FA ₀	34.81	4.34	596.72	10.91	0.188	19.08	0.033	346.93	1.070	1.303	0.149	1.906	2.41	6.84	19.79	35.21
WWFA ₀	40.70	5.14	728.19	12.75	0.263	24.12	0.042	395.69	1.159	1.522	0.166	2.115	2.99	7.87	19.98	37.99
GW FA ₁₀	39.82	5.59	896.49	13.76	0.282	24.38	0.047	423.71	1.258	1.487	0.176	2.236	3.07	8.34	21.26	36.82
WWFA ₁₀	46.13	6.66	1100.60	16.33	0.395	31.38	0.060	497.74	1.377	1.768	0.198	2.496	3.88	9.77	21.42	39.72
GW FA ₂₀	36.01	4.68	660.19	11.53	0.219	20.34	0.037	368.35	1.130	1.352	0.154	1.973	2.56	7.17	20.45	35.69
WWFA ₂₀	42.11	5.56	811.62	13.40	0.306	26.08	0.047	402.68	1.227	1.579	0.172	2.211	3.19	8.28	20.62	38.51
GW FA ₄₀	35.01	4.40	598.23	10.99	0.191	19.15	0.035	347.24	1.093	1.314	0.151	1.917	2.46	6.98	19.84	35.23
WWFA ₄₀	40.97	5.17	729.42	12.85	0.265	24.18	0.044	395.84	1.168	1.530	0.168	2.121	3.07	8.07	20.05	38.03
BG-256																
GW FA ₀	49.88	6.81	805.46	16.11	0.288	31.04	0.051	433.29	1.197	1.337	0.165	2.039	4.57	10.78	21.89	42.38
WWFA ₀	58.40	7.81	1002.04	19.56	0.440	39.92	0.064	487.11	1.300	1.606	0.191	2.229	5.70	12.47	22.14	45.72
GW FA ₁₀	57.62	8.86	1262.68	21.76	0.431	40.37	0.075	544.60	1.446	1.549	0.202	2.437	5.94	13.34	24.04	44.54
WWFA ₁₀	67.34	10.34	1562.39	26.78	0.667	52.40	0.094	624.96	1.578	1.855	0.234	2.687	7.53	15.67	24.38	48.05
GW FA ₂₀	51.57	7.30	923.60	18.00	0.336	33.74	0.059	480.08	1.287	1.402	0.174	2.154	5.03	11.70	23.18	42.99
WWFA ₂₀	61.46	8.80	1157.10	22.21	0.502	43.69	0.074	526.39	1.399	1.688	0.204	2.350	6.29	13.56	23.51	46.37
GW FA ₄₀	49.98	6.92	808.38	16.37	0.289	31.13	0.053	435.01	1.204	1.342	0.167	2.043	4.59	10.82	22.09	42.39
WWFA ₄₀	58.68	7.94	1005.30	19.69	0.442	39.99	0.066	489.12	1.315	1.613	0.193	2.234	5.73	12.53	22.26	45.74

SYNTHESIS, CHARACTERISATION AND ANTIMICROBIAL STUDIES OF ZINC (II) AND MOLYBDENUM (VI) COMPLEXES WITH N-(4-NITROBENZYLIDENE)-1-NAPHTHYLAMINE

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ABSTRACT

Schiff base ligand (4-nitrobenzylidene)-1-naphthylamine was prepared by the condensation between 4-nitrobenzaldehyde and 1-naphthylamine. The Zn and Mo complexes of the corresponding ligand were prepared and was characterized by different methods like CHN analysis, IR and UV spectra. The biological activity of the complexes were studied by conducting antibacterial and antifungal studies. The Zn and Mo complexes shows antibacterial and antifungal activities at different concentrations. From CHN analysis and IR spectral data, the structure of Zn complex is found to be square planar and that of Molybdenum complex is octahedral structure.

Indexterms: Schiff base, 4-nitrobenzaldehyde, 1-naphthylamine, antibacterial, antifungal.

1. INTRODUCTION

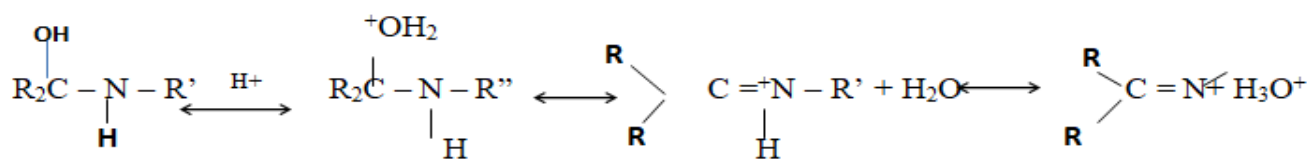
Coordination chemistry is one of the advanced branches of chemistry that hold great promise for future by embracing areas ranging from purely academic synthesis to large scale industrial products. The term coordination is used to describe the chemistry of metals and metal ions and their interaction with other molecules or ions.

Research in the field of coordination chemistry has developed considerably. The increased sophistication in spectroscopic analysis such as IR, UV, Raman, NMR, ESR, ESEEM, ENDOR, X-ray absorption spectroscopy, mass spectroscopy and sensitivity of many physical techniques facilitated the progress of research in coordination compounds. Most of the coordination compounds originally studied were purely inorganic in nature.

The renaissance in the area of complex began in 1893 when Alfred Werner put forward the coordination theory of complex compounds which provide the first successful explanation for the formation of metal complexes. The nobel prize in chemistry (1913) was a fitting tribute to the pioneering contribution of Alfred Werner. Coordination compounds played a significant role in the domain of stereochemistry, structure, isomerism, magnetism, spectroscopy, kinetics and mechanism of reactions, reactions of coordinated polymers, pigments and dyes, pharmaceutical industries and agriculture. Transition metal ions with different oxidation states have a major role in bioinorganic chemistry and provide the basis of models for active sites of biological systems. Transition metal catalyzed oxidation is important both in biological and industrial processes.

Transition metal complexes with Schiff bases as ligands have been the most widely studied coordination compounds. Schiff base was first reported by Hugo Schiff. Studies shown that the presence of lone pair of electron on trigonally hybridized N atom of C=N group is fundamental chemical and biological importance. The formation of chelate ring is essential for the production of stable complexes with the ligands containing azomethine groups. The availability of different types of amines and carbonyl compounds enable the synthesis of Schiff bases of diverse structural features.

The formation is generally driven to the completion of the product or removal of water or both. Many Schiff bases can be hydrolysed back to their aldehydes or ketones and amines by aqueous acid or base. The mechanism of Schiff base formation is another variation on the theme of nucleophilic addition to the carbonyl group. Here, the nucleophile is the amine. In the first part of the mechanism, the amine react with aldehyde or ketone to give an unstable compound called carbinolamine. The carbinolamine loses water by either acid or base catalyzed pathways. Since the carbinolamine is an alcohol, it undergoes acid catalyzed dehydration.



Schiff bases are pale yellow or orange coloured crystals having melting point in the range of 160°C – 240°C. Schiff bases show C = N stretching frequency in between 1562 – 1650 cm⁻¹ in IR spectrum.

Ligand field and molecular theories can be applied to a great extent in the case of 3d transition elements. Azomethine forms an important class of compounds and find various applications in biological field. They are

used as catalysts, stabilizers, polymers, pigments, dyes and photography. Besides, some of them are used as analytical reagents, inhibitors against corrosion and as flocculants.

2. MATERIALS AND METHODS.

2.1 MATERIALS

The chemicals used for the synthesis in this present investigation were C.P grade and analar for analytical purposes. Commercial solvents were distilled and used for synthetic purpose. For physical and physiochemical measurements, solvents were purified by standard methods. The complexes reported were analytically pure, stable and possessing good keeping qualities. For the preparation of the ligand, 4- nitrobenzaldehyde and 1-naphthyl amine are used and methanol is used as the solvent.

2.2: METHODS

2.2.1: SYNTHESIS OF N-(4-NITROBENZYLIDENE)-1-NAPHTHYLAMINE

4-nitrobenzaldehyde (0.151g, 0.001M) dissolved in 20 ml methanol and 1-naphthylamine in 20 ml methanol was mixed well. The resulting mixture was refluxed for about four hours. On cooling, yellow crystals were separated from the solution. These crystals were filtered and dried.

2.2.2: SYNTHESIS OF METAL COMPLEXES

, Zinc chloride and Molybdenum acetate are used as the synthetic intermediate for the preparation of Zn(II) and Mo(VI) complexes. The methanolic solution of the ligand (0.001 M) was just heated to dissolve the ligand and to this, methanolic solution of the salts (0.0005 M) was added and refluxed for four hours. The pH is maintained between 6 – 7. Then the volume is concentrated to half its initial volume and was cooled. All the complexes were dark yellow in coloured. It is filtered, washed with methanol and dried in vacuum.

Physical properties .

COMPOUND	COLOUR	SOLUBILITY	YIELD
Ligand	Yellow	DMSO	76.3
Zinc complex	Dark yellow	DMSO	76
Molybdenum complex	Dark yellow	DMSO	70

2.3 INFRARED AND ELECTRONIC ABSORPTION SPECTROSCOPY

IR spectroscopy is used to study the chemical composition and to find the mode of linking in complexes. The shift in the IR stretching frequencies observed before and after coordination is used to identify the coordination sites in the complexes. The IR spectra of the solid sample is recorded in the range of 4000 – 400 cm^{-1} using KBr of spectroscopic grade.

Metal – ligand interaction can be studied from UV – Visible spectra of free ligand and complexes by observing the d – d transitions. The UV – Visible spectra is taken in DMSO solution in the range of 200 – 800 nm.

2.4 CHN ANALYSIS

CHN analysis is conducted using Vario- III CHN elemental analyser at Saif, Cochin University Of Science And Technology, Kochi.

2.5 MOLAR CONDUCTANCE

Molar conductance were measured in DF at room temperature using a systolic conductivity meter 304. The cell constant is 1 cm^{-1} . The molar conductance is given by the equation,

$$M = 1000 \text{ K/ c}$$

2.6 MAGNETIC SUSCEPTIBILITY

Magnetic susceptibility measurements were made using simple Gouy balance at room temperature using mercury (II) tetrathiocyanatocobaltate (II) as magnetic standard. Diamagnetic corrections were computed using Pascal's constant. The effective magnetic moment is given by,

$$\mu_{\text{eff}} = 2.84 \sqrt{X_m T}$$

2.7 ESTIMATION OF METAL SALTS

2.7.1 Estimation of molybdenum

Molybdenum in the complexes was estimated gravimetrically as oxinate $\text{MoO}_2(\text{C}_9\text{H}_6\text{ON})_2$. About 0.2g of the complex was accurately weighed and digested with 10 ml of conc. H_2SO_4 and a few drops of perchloric acid. The resulting clear solution was quantitatively transferred into 500 ml beaker. A drop of methyl red indicator was added and neutralised with conc. HNO_3 solution. The solution was then acidified with a few drops of 1M

H₂SO₄ and then 5ml of 2M ammonium acetate were added and diluted to 100 ml. After adjusting the pH between 3.3 – 7.5, the solution was heated to boiling and 3% solution of oxine in dil.acetic acid was added dropwise with stirring till the supernatant liquid become yellow. The boiling and stirring were continued for 3 minutes. The precipitated Molybdenum oxinate was filtered through a sintered glass crucible (G₄), washed with hot water until free from the reagent, dried to constant weight at 130 – 140°C and weighed as MoO₂(C₉H₆ON)₂.

2.7.2 ESTIMATION OF ZINC

About 0.2g of the complex was accurately weighed and digested with 10 ml of conc.H₂SO₄. The solution was made up to 25 ml and 5 ml of the made up solution is pipetted out into a conical flask and diluted to 25 ml. 1 ml of buffer solution is added from the burette followed by a few drops of Eriochrome black T indicator. The solution is titrated against standard EDTA until the wine red changes to blue.

2.8 ANTIBACTERIAL ACTIVITY

AGAR- WELL DIFFUSION METHOD

Petriplates containing 20ml Muller Hinton Agar Medium were seeded with bacterial culture of *E.coli*, *Pseudomonas aeruginosa*, *Bacillus cereus*, and *klebsiella pneumoniae* (growth of culture adjusted according to McFards Standard, 0.5%). Wells of approximately 10mm was bored using a well cutter and different concentrations of sample such as 250µg/mL, 500µg/mL and 1000µg/mL were added. The plates were then incubated at 37°C for 24 hours. The antibacterial activity was assayed by measuring the diameter of the inhibition zone formed around the well (NCCLS, 1993). Streptomycin was used as a positive control

2.9: ANTIFUNGAL ACTIVITY

AGAR- WELL DIFFUSION METHOD

PROCEDURE

Potato Dextrose agar plates were prepared and overnight grown species of fungus, *Aspergillus niger* and *Candida kefyr* were swabbed. Wells of approximately 10mm was bored using a well cutter and samples of different concentrations such as 250µg/mL, 500µg/mL and 1000µg/mL were added. The zone of inhibition was measured after overnight incubation at room temperature and compared with that of standard antimycotic (Clotrimazole). (NCCLS, 1993).

3. RESULT AND DISCUSSION

The analytical properties of the ligand and metal complexes are determined and are tabulated as below.

COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	YIELD	COLOUR
Ligand	C ₁₇ H ₁₂ O ₂ N ₂	276.31	76.3	Yellow
Zinc complex	[VO(C ₁₇ H ₁₂ O ₂ N ₂)(H ₂ O) ₃]	395.69	76	Dark yellow
Molybdenum complex	[Mo(C ₁₇ H ₁₂ O ₂ N ₂) ₂ (H ₂ O) ₄]	720.56	70	Dark yellow

3.1: ANALYSIS

Metal content in the complexes were determined by standard method after decomposing the complexes with hydrochloric acid-sulphuric acid mixture. The metal complexes of Schiff base ligand were prepared by the stoichiometric reaction of the corresponding metal and ligand in 1:2 ratio. The gravimetric analysis of Molybdenum complex and volumetric analysis of Zinc complex are found to be successful and from these, the metal content in the complexes are determined.

3.2: MOLAR CONDUCTANCE AND MAGNETIC SUSCEPTIBILITY

The Schiff base metal complexes were dissolved in DMSO and their molar conductivities were measured at 25°C. Magnetic susceptibility of the complexes were determined using gouy balance. Some indications about the structure and geometry is obtained from the magnetic susceptibility values. The molar conductivity and magnetic measurement values are tabulated in table 3.2

COMPLEX	MOLAR CONDUCTANCE	MAGNETIC MOMENT
Zinc complex	1.2	Diamagnetic
Molybdenum complex	6.1	Diamagnetic

Table-3.2

The lower values of molar conductance indicates that the complexes are non-electrolyte in nature.

3.3: CHN ANALYSIS

The experimental percentage values of carbon, hydrogen and nitrogen in the two complexes found out by CHN analysis were similar to the percentage calculated from the theoretical aspects. So from CHN analysis, the structure and denticity of the ligand and complex can be confirmed.

COMPLEX	C%		H%		N%	
	experimental	calculated	experimental	calculated	experimental	calculated
Zn complex	52.13%	51.55%	4.6639%	4.55%	7.201%	7.1%
Mo complex	55.84%	56.62%	4.305%	4.44%	8.12%	7.77%

Table 3.3

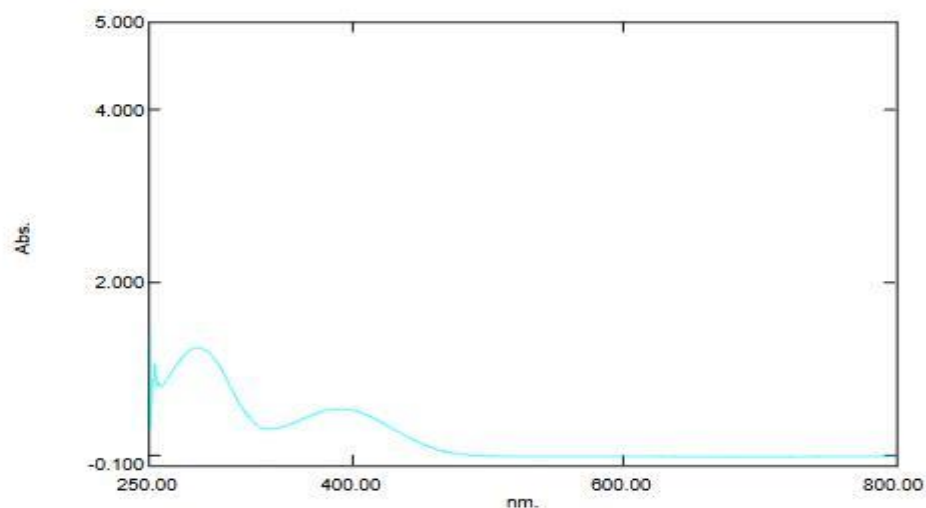
The CHN analysis values are in good agreement with the calculated percentage of carbon, hydrogen and nitrogen in the complex. The structures of the complexes can also be confirmed from CHN analysis value. The structure of Zn complex is found to be square planar and that of molybdenum complex is octahedral.

3.4: ELECTRONIC SPECTRA

The electronic absorption spectra of the Schiff base complexes were recorded at room temperature using DMSO as solvent.

3.4.1: ELECTRONIC SPECTRA OF LIGAND

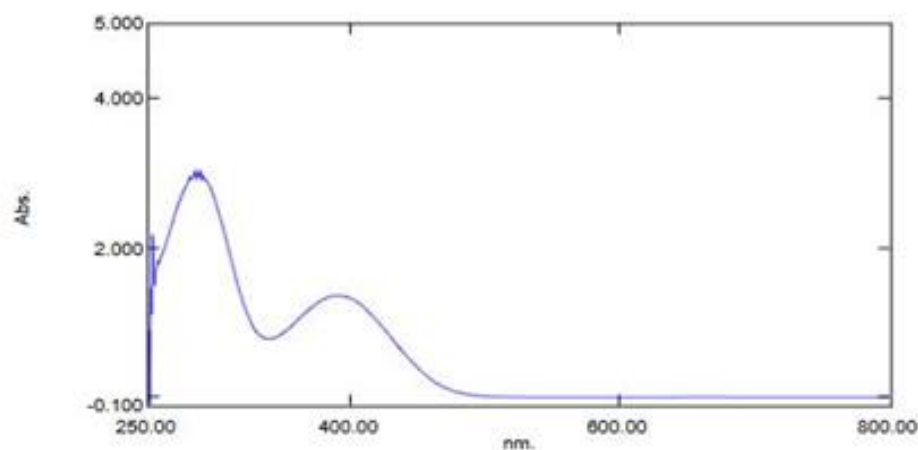
DST FIST UV Vis
spectrophotometer Department of
Chemistry
Sample: 4 nitro ligand
5.10.2018



No.	P/V	Wavelength	Abs.	Description
1	⊕	390.00	0.542	
2	⊕	286.50	1.247	
3	⊕	226.50	1.204	
4	⊕	213.50	1.712	
5	⊕	204.50	2.988	
6	⊖	339.50	0.313	
7	⊖	237.00	0.137	
8	⊖	224.00	-4.000	
9	⊖	211.50	-0.142	

Ultraviolet spectra of the ligands recorded in DMSO showed strong bands around 286.5 nm and at 339.5 nm region which confirms the presence of benzenoid and azomethine linkages, which are characteristic of $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transition respectively.

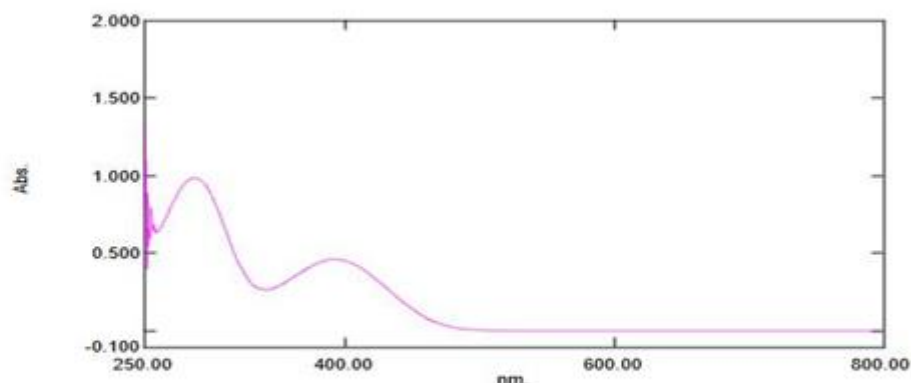
3.4.2: ELECTRONIC SPECTRA OF ZINC COMPLEX

DST FIST UV Vis
spectrophotometer Department of
Chemistry

No.	P/V	Wavelength	Abs.	Description
1	③	391.50	1.362	
2	③	252.92	3.032	
3	③	217.50	3.168	
4	④	358.4	0.782	
5	④	251.50	-0.263	

Ultraviolet spectra of the ligands recorded in DMSO showed strong bands around 252.92 nm and at 358.4 nm region which confirms the presence of benzenoid and azomethine linkages, which are characteristic of $\Pi \rightarrow \Pi^*$ and $n \rightarrow \Pi^*$ transition respectively.

3.4.3: ELECTRONIC SPECTRA OF MOLYBDENUM COMPLEX

DST FIST UV Vis
spectrophotometer Department of
Chemistry

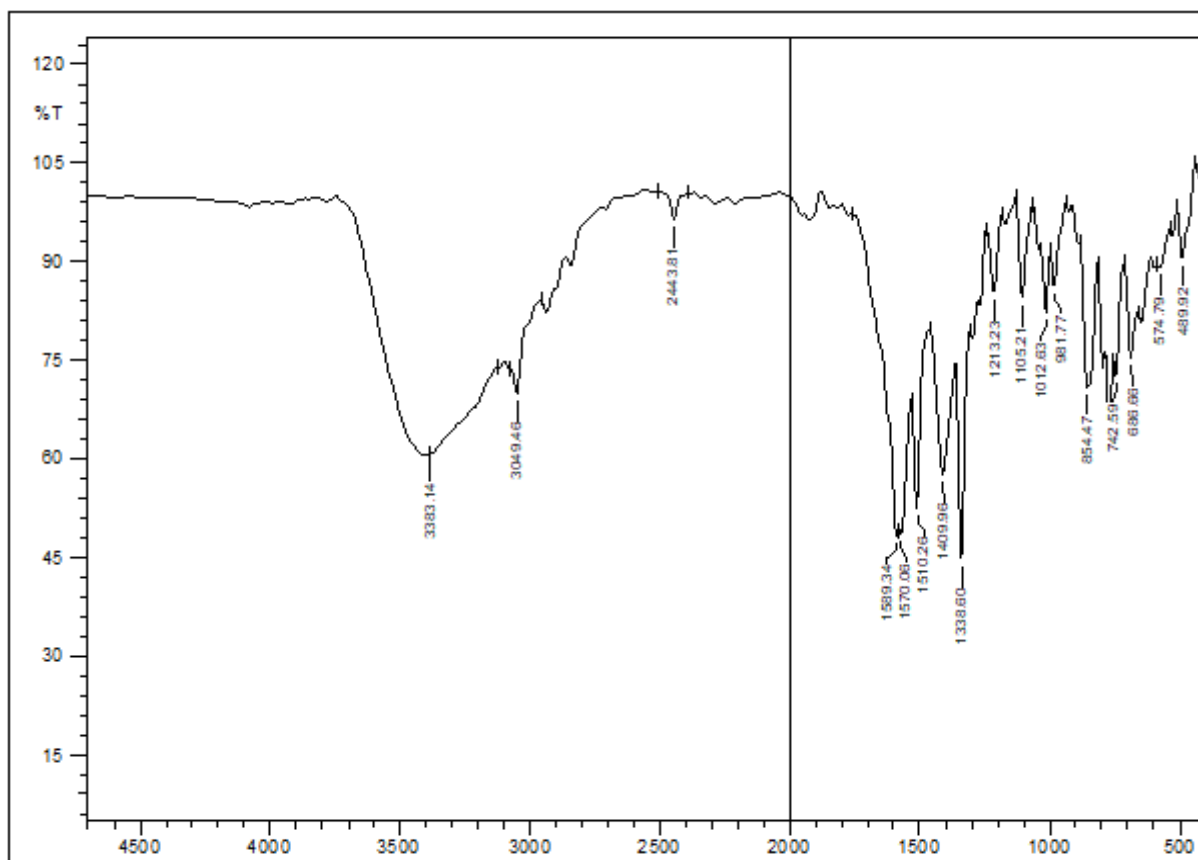
No.	P/V	Wavelength	Abs.	Descripti
1	③	392.00	0.460	
2	③	286.50	0.986	
3	④	339.50	0.265	
4	④	259.00	0.634	

Ultraviolet spectra of the Vanadium complex recorded in DMSO showed strong bands around 286.5 nm and at 339.5 nm region which confirms the presence of benzenoid and azomethine linkages, which are characteristic of $\Pi \rightarrow \Pi^*$ and $n \rightarrow \Pi^*$ transition respectively.

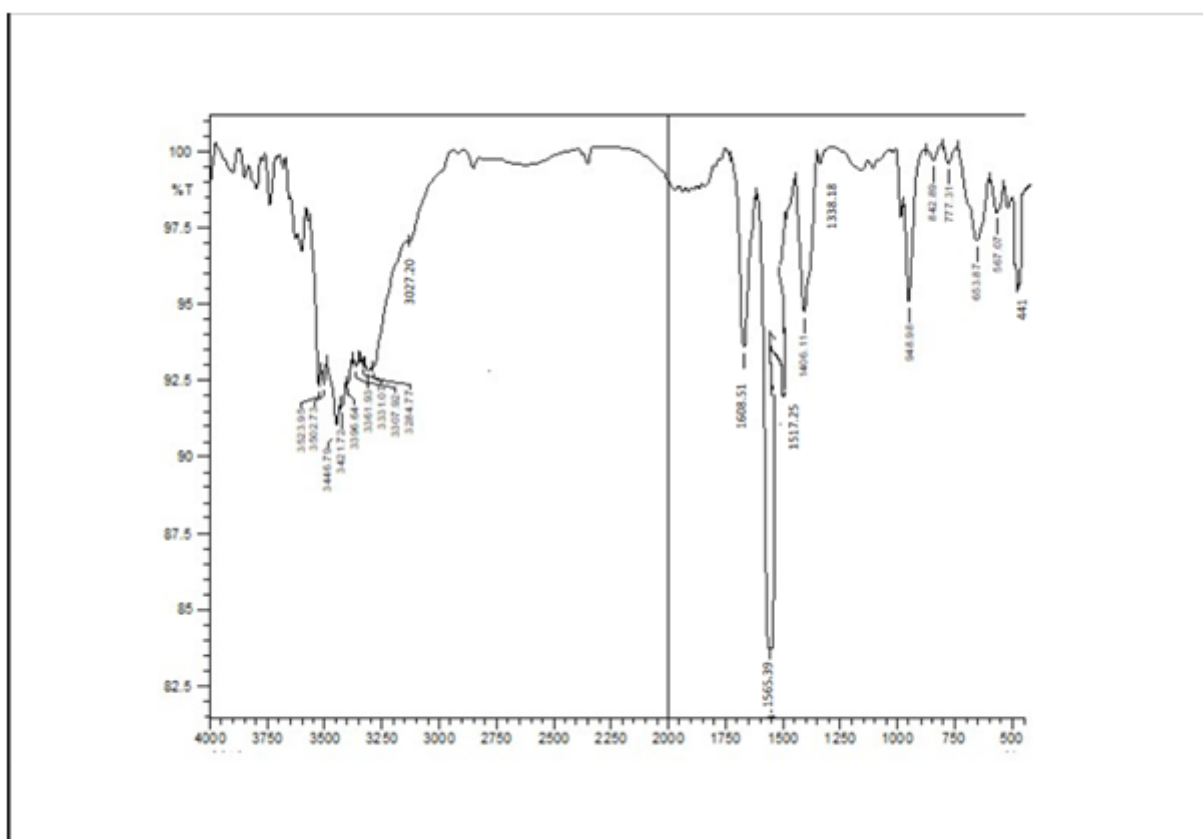
3.5: INFRARED SPECTRA

The IR spectra provides valuable information about the nature of functional group attached to the metal atom. The ligand and metal complexes were characterized using the C = N bands.

3.5.1: IR SPECTRA OF LIGAND



3.5.2: IR SPECTRUM OF ZINC COMPLEX

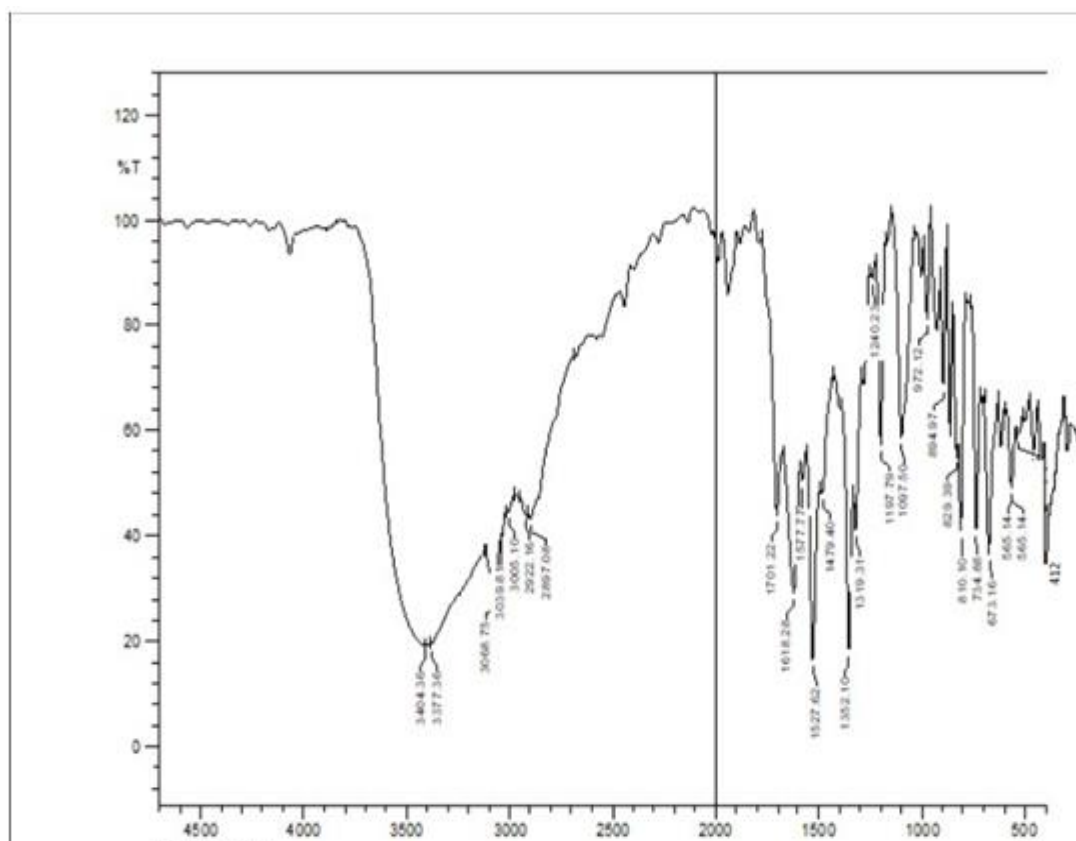


Ligand	Zn Complex	Assignment
-	3331.07	Coordinated water molecule
3049	3027.20	=CH
1589.34	1608.51	C=N
1510.26	1517.25	C=C
1570	1565.39	N=O (Sym. Bending)
1338.60	1338.18	N=O (asym. Bending)
742.59	777.31	Monosubstituted
-	441	Zn-N

Table 3.5.2

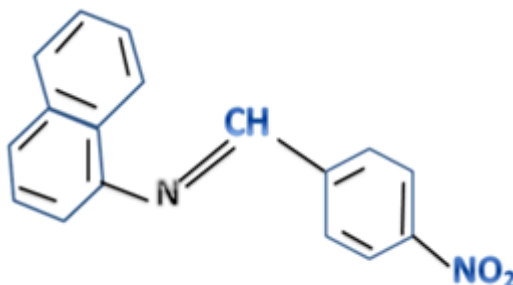
In the IR spectrum of the ligand, a medium strength band is observed at 3049 cm^{-1} which corresponds to =CH group. In the complex, it is shifted to a lower frequency of 3027.20 cm^{-1} . The intense band near 1589 cm^{-1} can be attributed to $\nu(\text{C}=\text{N})$ of the ligand. It is shifted to a higher frequency of 1608.51 cm^{-1} which indicates the presence of coordination. Two peaks at 1570 cm^{-1} and 1338.60 cm^{-1} corresponds to the symmetric and asymmetric bending of NO_2 group. In Zn complex, a strong band is obtained in 3331.07 cm^{-1} which indicates the presence of coordinated water molecule. The peak at 441 cm^{-1} can be attributed to Zn-N bond which is absent in the free ligand. This peak at 441 cm^{-1} confirms the coordination in Zn complex.

3.5.3: IR SPECTRUM OF MOLYBDENUM COMPLEX



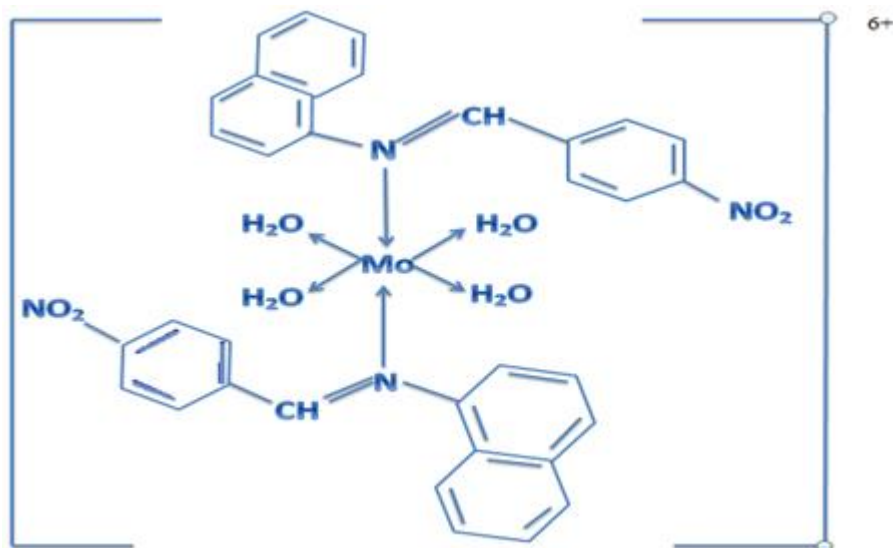
Ligand	Mo Complex	Assignment
-	3377.36	Coordinated water molecule
3049	3005.10	=CH
1589.34	1616.28	C=N
1510.26	1527	C=C
1570	1577.77	N=O (Sym. Bending)
1338.60	1319.31	N=O (asym. Bending)
742.59	734	Monosubstituted
-	412	Mo-N

In the IR spectrum of the ligand, a medium strength band is observed at 3049 cm^{-1} which corresponds to $=\text{CH}$ group. In the complex, it is shifted to a lower frequency of 3005.10 cm^{-1} . The intense band near 1589 cm^{-1} can be attributed to $\nu(\text{C}=\text{N})$ of the ligand. It is shifted to a higher frequency of 1616.28 cm^{-1} which indicates the presence of coordination. Two peaks at 1570 cm^{-1} and 1338.60 cm^{-1} corresponds to the symmetric and asymmetric bending of NO_2 group. In Mo complex, a strong band is obtained in 3377.36 cm^{-1} which indicates the presence of coordinated water molecule. The peak at 412 cm^{-1} can be attributed to Mo-N bond which is absent in the free ligand. This peak at 412 cm^{-1} confirms the coordination in Mo complex.

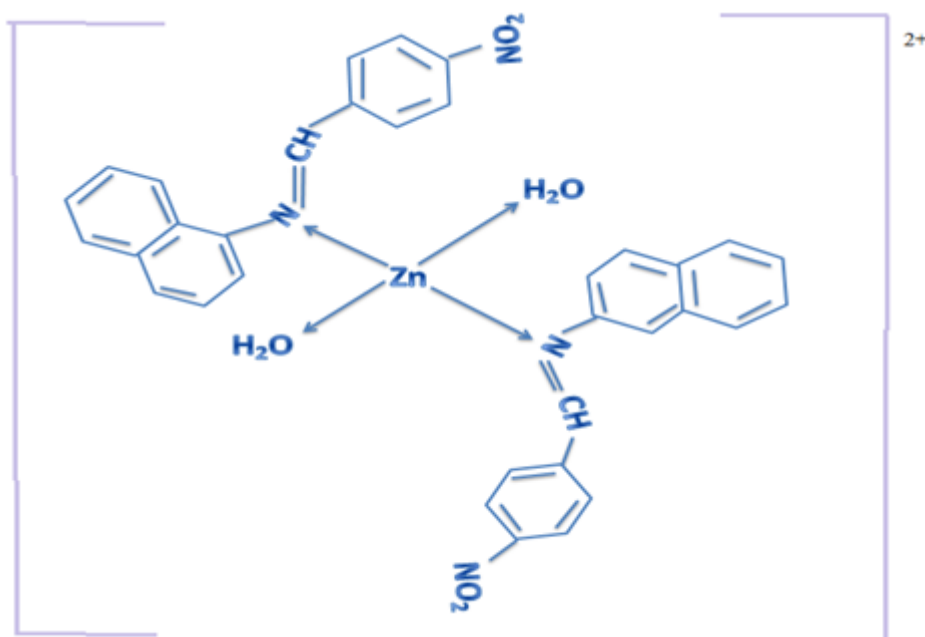


STRUCTURE OF LIGAND

STRUCTURE OF MOLYBDENUM COMPLEX



STRUCTURE OF ZINC COMPLEX



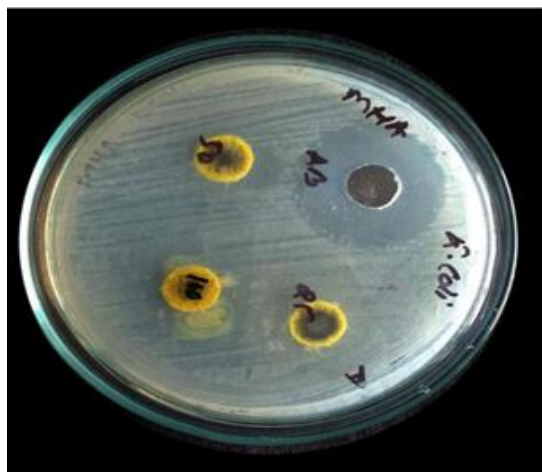
3.6: ANTIBACTERIAL AND ANTIFUNGAL STUDIES.

Antibacterial studies

The antibacterial and antifungal studies were conducted by comparing the zone of inhibition of a standard bacterial agent with the complexes and their extend of antimicrobial activity is measured.

3.6 (a): ANTIBACTERIAL STUDIES OF ZINC COMPLEXES

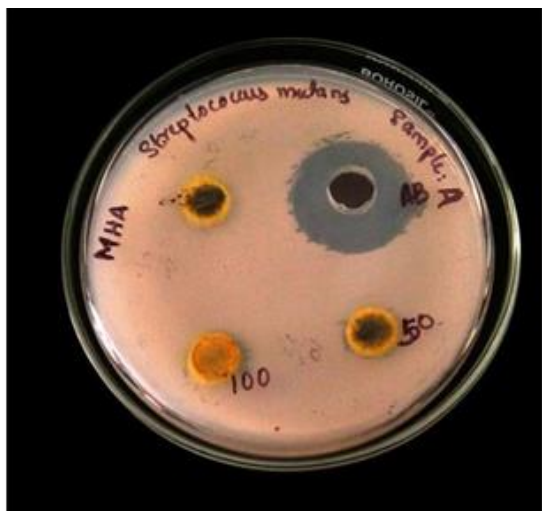
E COLI



PSEUDOMONAS AERGINOSA



BACILLUS CEREUS



KLEBSIELLA AERUGINOSA

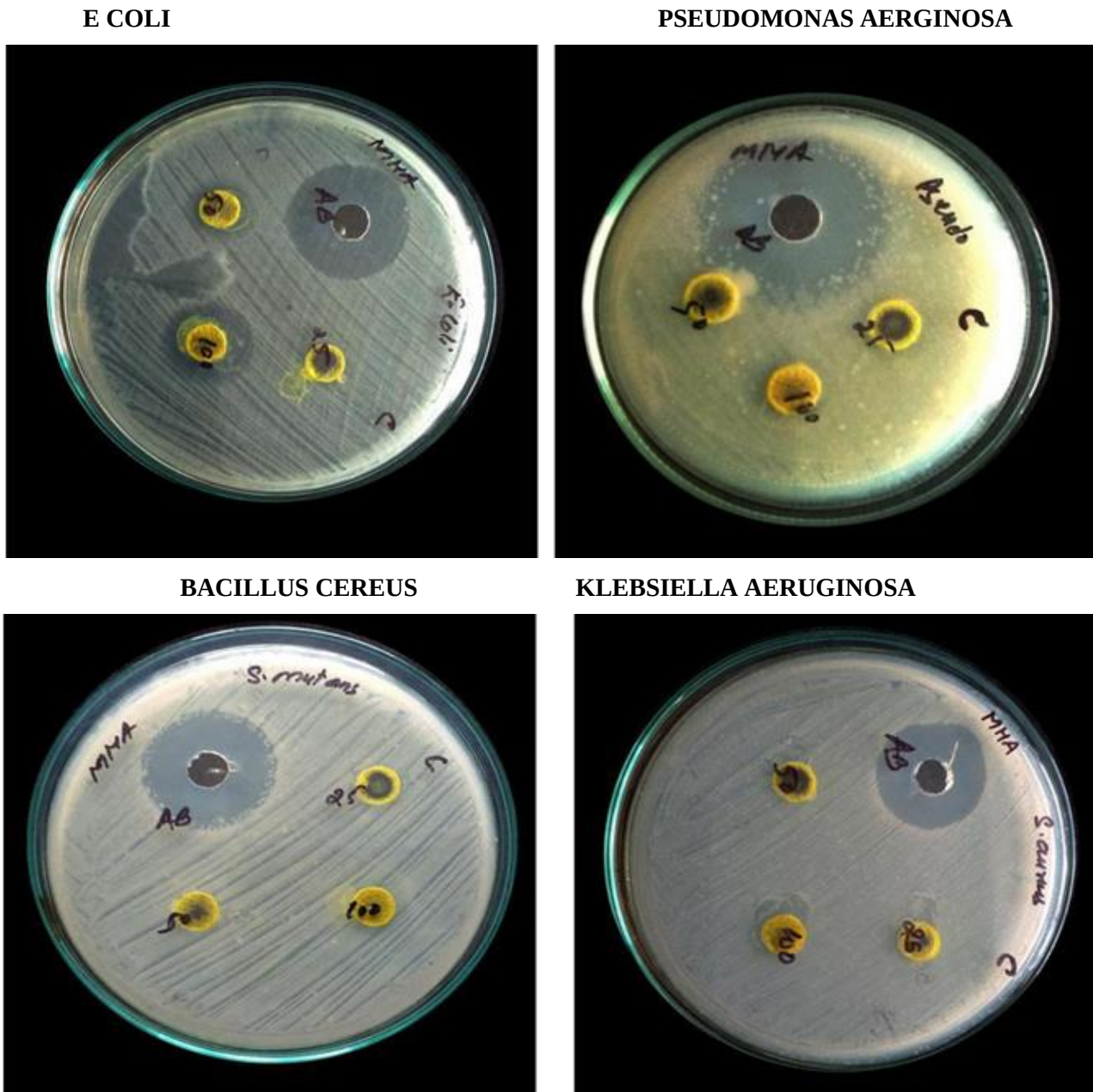


ORGANISM	ANTIBACTERIAL AGENT	ZONE OF INHIBITION			
		AGENT	250	500	1000
E Coli	Streptomycin	20	-	12	18
Pseudomonas Aerginosa	Streptomycin	30	-	10	11
Bacillus cereus	Streptomycin	26	-	-	11
Klebsiella aeruginosa	Streptomycin	27	-	-	11

Table 3.6 (a)

4-nitro Zinc complex is inactive for Gram negative Bacteria like E Coli at the concentration of 250 and shows moderate activity at the concentrations of 500 and 1000. The complex is inactive for Pseudomonas aeruginosa at 250 concentration and shows slight activity at 500 and 1000 concentration. The Zinc complex is inactive for the bacteria Bacillus cereus at the concentration of 250 and 500. But it is slightly active at the concentration of 1000. The complex is inactive for the bacteria Klebsiella aeruginosa at 250, 500 and shows slight activity at 1000 concentrations.

3.6 (b) :ANTIBACTERIAL STUDIES OF MOLYBDENUM COMPLEXES



ORGANISM	ANTIBACTERIAL AGENT	ZONE OF INHIBITION (mm)			
		AGENT	250 (ml)	500 (ml)	1000 (ml)
E Coli	Streptomycin	20	10	12	14
Pseudomonas Aerginosa	Streptomycin	30	-	-	10
Bacillus cereus	Streptomycin	26	12	14	16
Klebsiella aeruginosa	Streptomycin	27	11	12	15

Table 3.6 (b)

4 – nitro Molybdenum complex shows moderate antibacterial activity for gram-negative stain *E. coli*. It shows 10mm, 12mm, 14 mm values at concentrations of 250, 500 and 1000 ml. The complex is inactive for gram-negative stain *Pseudomonas Aeruginosa* at 250 and 500 ml concentration, but it shows slight activity at 1000 ml concentration. 4-nitro Molybdenum complex shows moderate activity for *Bacillus cereus* and *Klebsiella aeruginosa* at 250, 500, 1000 ml concentrations.

Antifungal studies

3.6 (c) : ANTIFUNGAL RESULTS OF ZINC COMPLEX

ASPERGILLUS NIGER



CANDIDA KEFYR



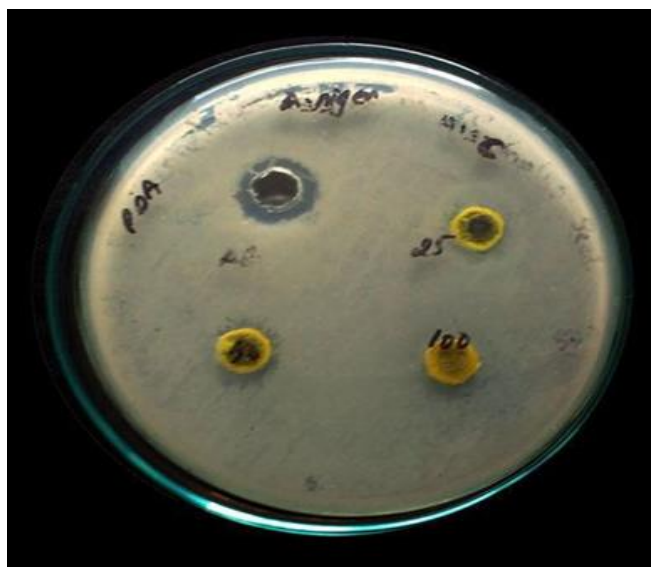
ORGANISM	STANDARD ANTIFUNGAL AGENT	ZONE OF INHIBITION			
		AGENT	250	500	1000
Aspergillus niger	Clotrimazole	15	–	–	–
Candida kefyr	Clotrimazole	15	–	–	–

Table 3.6 (c)

The standard antifungal agent used for the antifungal studies is Clotrimazole. The 4 nitro – Zinc complex is inactive for both *Aspergillus niger* and *Candida albicans* at all concentrations of 250, 500 and 1000.

3.6 (d) : ANTIFUNGAL RESULTS OF MOLYBDENUM COMPLEX

ASPERGILLUS NIGER



CANDIDA KEFYR



ORGANISM	ANTIFUNGAL AGENT	ZONE OF INHIBITION (mm)			
		AGENT	250 (ml)	500 (ml)	1000 (ml)
<i>Aspergillus niger</i>	Clotrimazole	15	-	11	14
<i>Candida kefyr</i>	Clotrimazole	15	-	-	-

Table 3.6 (d)

4-nitro Molybdenum complex shows antifungal activity. In the antifungal stain such as *Aspergillus niger* the complex is inactive at 250 ml concentration. But increasing the concentration it become active and reaches near to standard value of antifungal agent. In *Candida kefyr* the complex does not show any activity at all concentration.

SUMMARY AND CONCLUSION

The Schiff base ligand, (4- nitrobenzylidene)-1-naphthyl amine has been synthesized by the condensation of 4-nitrobenzaldehyde and 1-naphthyl amine. It is yellow in colour and having 76.3% yield and soluble in dimethyl sulphoxide. The spectral data of the ligand concluded that the ligand is monodentate.

The Zn complex of this ligand is dark yellow in colour and having 76% yield and soluble in DMSO. The molar conductance value of this complex were found to be $1.2 \Omega^{-1}\text{cm}^2\text{mol}^{-1}$. This value indicates that the complex is

non-electrolytic in nature. The complex is diamagnetic in nature and has square planar structure. The appearance of new bands at 441 cm^{-1} in the IR spectrum is assigned to Zn-N stretching vibration. The spectral data of the ligand concluded that the ligand is monodentate.

The Molybdenum complex of this ligand is dark yellow in colour and having 70% yield and soluble in DMSO. The molar conductance value of this complex were found to be $6.1\ \Omega^{-1}\text{cm}^2\text{mol}^{-1}$. The complex is diamagnetic in nature and has octahedral structure. This value indicates that the complex is non-electrolytic in nature. The appearance of new band at 412 cm^{-1} in the IR spectrum are assigned to Mo-N stretching vibrations.

The UV spectra of ligand and complexes shows characteristic absorption at the range of 285 nm and at 340 nm region which confirms the presence of benzenoid and azomethine linkages, which are characteristic of $\Pi \rightarrow \Pi^*$ and $n \rightarrow \Pi^*$ transition respectively.

4-nitro Zinc complex is inactive for Gram negative Bacteria like *E. coli* at the concentration of 250 and shows moderate activity at the concentrations of 500 and 1000. The complex is inactive for *Pseudomonas aeruginosa* at 250 concentration and shows slight activity at 500 and 1000 concentration. The Zinc complex is inactive for the bacteria *Bacillus cereus* at the concentration of 250 and 500. But it is slightly active at the concentration of 1000. The complex is inactive for the bacteria *Klebsiella aeruginosa* at 250, 500 and shows slight activity at 1000 concentrations. The standard antifungal agent used for the antifungal studies is Clotrimazole. The 4 nitro – Zinc complex is inactive for both *Aspergillus niger* and *Candida albicans* at all concentrations of 250, 500 and 1000.

4 – nitro Molybdenum complex shows moderate antibacterial activity for gram-negative stain *E. coli*. It shows 10mm, 12mm, 14 mm values at concentrations of 250, 500 and 1000 ml. The complex is inactive for gram-negative stain *Pseudomonas Aeruginosa* at 250 and 500 ml concentration, but it shows slight activity at 1000 ml concentration. 4-nitro Molybdenum complex shows moderate activity for *Bacillus cereus* and *Klebsiella aeruginosa* at 250, 500, 1000 ml concentrations. 4-nitro Molybdenum complex shows antifungal activity. In the antifungal stain such as *Aspergillus niger* the complex is inactive at 250 ml concentration. But increasing the concentration it become active and reaches near to standard value of antifungal agent. In *Candida kefyr* the complex does not show any activity at all concentration.

The experimental percentage values of carbon, hydrogen and nitrogen in the two complexes found out by CHN analysis were similar to the percentage calculated from the theoretical aspects. So from CHN analysis, the structure and denticity of the ligand and complex can be confirmed.

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**MICROBIOLOGICAL ASSESSMENT OF BIOLOGICAL PARTICLES AND NANOPARTICLES
USED IN THE IMPROVISATION OF HEALTHCARE TEXTILES**

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ABSTRACT

Antimicrobial textiles have been tested to be used inside the medical industry from last few years. Currently, the simplest antimicrobial textiles getting used in the area of medication are disposable and nonwoven. Some of the treatments being used are harmful to our environment not only because of the chemicals used in the treatments but also because the treated textiles are not reusable. To address the growing concerns about the environment, research should focus on the use of reusable textiles with durable finishes. By developing this type of textile, consumers are reducing the amount of chemicals and trash being disposed of in landfills, resulting in a negative effect on the environment. The need for antimicrobial textiles goes hand-in-hand with the rise in resistant strains of micro-organisms. Durable antimicrobial textile effective against harmful pathogens will not only be beneficial to both medical industry workers and patients but also to the general public as well. This analysis principally intends to supply an outline of the diverse antimicrobial treatments that may be accomplished to supply antimicrobial textiles, chemical or physical procedures, supplying an intensive listing of remedies underneath development and commercially accessible fibers or materials.

Keywords: Textiles, Antimicrobial fibers, Durability, Health Impact.

INTRODUCTION

Combination of textile generation and clinical sciences has resulted right into a replacement area called medical textiles (1). Medical textiles are the products and constructions used for medical and biological applications and are used primarily for first aid, clinical and hygienic purposes. It consists of all those textile materials used in health and hygienic applications in both consumer and medical markets. In case of medical textiles the main requirement of the textile material is bioreceptivity and biocompatibility at the application site in human beings. Eg: antimicrobial sutures based on nylon and polypropylene mono filaments (2). They are used for first aid, clinical or hygienic purposes and rehabilitation. Their application also includes protective and healthcare textiles, dressings, bandages, pressure garments and prosthetics, diapers and hygiene products and antiseptic wound dressings. Healthcare textiles also includes products like surgeon's robes, caps and masks, patient drapes (3), bedding, clothing, pad covers, incontinence product, cloths and wipes, and cotton leno plain-woven blankets (4).

TEXTILES AS CARRIERS OF MICROORGANISMS

Bacteria, each harmful and odour inflicting, act with fibers in many phases together, however, these fibers encourage the holding of stale perspiration within the interstices, whereby the microbes multiply readily (5). A matter of larger concern, however, is that the textiles not solely act as substrates for microbic growth however they'll act as active agents in propagation of microbes. The presence and growth of those microorganisms will cause health issues, odors and eventually material deterioration. e.g. the metabolism of gram-positive bacterium *S. aureus* is believed to come up with 3-methyl-2-hexanoic acid that causes the characteristic malodorousness. The unpleasant odour develops once among different things, bacterium convert human perspiration into foul smelling substances, like acid, aldehydes and amines. Gram-negative bacterium *P.vulgaris* is understood to be able to metabolize carbamide to create ammonia and is that the cause for generation of odour in baby diapers (6).

Studies on fabric clothes Kloos and Musselwhite (1975) discovered the incidence of assorted bacterium on human skin and their persistence once a year within the same person (7). Microbial growth will increase with increasing moisture and continual lavation of textiles, and is maximal at neutral pH scale (7-8) (8)

ANTIMICROBIAL FINISHING

Antimicrobial finishes add worth to textiles and clothes by providing protection in numerous ways in which, like they forestall the expansion of microorganism and fungi acting as a protective textiles against unpleasant odors, mildew spots and therefore the premature loss of purposeful properties; they shield the user of a textile against microorganism, yeast, dermatophytic fungi and other microorganisms for aesthetic, healthful or medical purposes; it also shield the textile itself against bio-deterioration caused by mold, mildew, insects and different pests for preservation of the fiber and/or protection of clothing from insects and pests (9).

Several types of antimicrobial finishes exist. The finishes are derived from absolutely different sources; some finishes are herbal and some are chemically produced. This fabric finishes are based on these principles firstly the finish must not be dangerous to the surroundings. Second, the finish have to be effective till the user is completed the use of the fabric and if essential, endure persistent wash and third most significantly, the finish have to not be harmful to the consumer (2). Many components and herbal compounds have inherent antimicrobial houses. Significant metals and auriferous compounds keep a huge portion of the marketplace share antimicrobial textiles.

ANTIMICROBIAL FINISHING AGENTS

Chitosan has been shown to be effective towards every gram positive and gram negative microorganism (10). Chitosan is a linear polycationic polysaccharide and has several features like biodegradability, non-toxicity, non-allergic, cationic tendency, and biocidal. Its affinity on cotton would be due to Van der Waal's forces and H-bonding due to similar structure as of cellulose (11). Chitosan is the second most plentiful natural biopolymer and is relatively cheap (17). The proposed mechanism for its antimicrobial action is binding to the negatively charged bacterial cell wall, with consequent destabilization of the cell envelope and altered permeability, followed by attachment to DNA with inhibition of its replication (18). Silver (Ag) ions decreases the enzymatic activity of cell that effects the microorganism metabolism which further results in microbial mobile demise. It additionally catalyzes the manufacturing of active species along with oxygen radicals which leads to oxidation of the molecular shape of microorganism (12). Silver nanoparticles are widely taken into consideration as useful therapeutic marketers for the prevention and eradication of wound colonization by means of microorganisms (13). Ag nanoparticles are a well-known disinfectant that is effective for a wide spectrum of bacteria and viruses. It is thought to be more effective and is more widely used for Gram-negative bacteria (14). Silver nanoparticles were incorporated in cotton fabrics and the treated cotton fabrics inactivated *S.aureus* (Gram-positive bacteria) significantly (15). Similar treatment of cotton fabrics with colloidal silver nanoparticles showed excellent inactivation against *E.coli* (Gram-negative bacteria), *S.aureus*, and *C.albicans* (16). Chitosan/Silver nanocomposites were therefore expected to demonstrate effective antibacterial activity against *Escherichia coli* and *Enterococcus faecalis* bacteria, which served as representatives of gram-negative and gram-positive bacteria, respectively (18). Honey is the oldest medicine known and in many ancient races of people was prescribed by physicians for a wide variety of ailments (19). Adcock found that the antibacterial activity of honey could be removed by the addition of catalase (which catalyzes the destruction of hydrogen peroxide (20). Apart from its antibacterial activity honey has a potent anti-inflammatory activity, due to which it is been used in medical textiles. It rapidly brings about autolytic debridement of slough and necrotic tissue from wounds, rapidly deodorizes malodorous wounds, speeds up the healing process, and gives healing with minimal scarring (21). Honey and turmeric concentration was optimized and applied on cotton fabric by means of direct padding and microencapsulation technique and compared its antimicrobial property before and after wash against two different bacteria *Pseudomonas* and *Staphylococcus aureus* (22). Turmeric has been extracted from the rhizome of *C.longa*, attributing biological properties which include antioxidant, anti-inflammatory, wound-recuperation, anticancer, anti-proliferative, antifungal, and antibacterial interest (23). Ghoreishian and coworkers dyed silk material with turmeric and proved antibacterial properties to silk fabric (24). Sundrarajan et al. treated cotton fabric with enzymes and chitosan, and mentioned the enhancement of dye uptake and washing fastness of cotton fabrics dyed with turmeric (25). It is been shown that curcumin-treated wool fabric had antimicrobial capability that turned into semi-durable to domestic laundering and mild exposure (26). Complexes of curcumin with cobalt nanoparticles confirmed improved antibacterial effect in opposition to *E.coli* (27). The novel antimicrobial films with said antimicrobial exhibition towards *E.coli* proved to be capacity antibacterial fabric for treating infections or wound dressing (28).

Further metallic salt nanoparticles were found to be useful and efficient in providing the antimicrobial textiles. Metal oxide nanoparticles are more preferable than nano-silver because of cost considerations. In fact, both zinc oxide and titanium dioxide are non-toxic and chemically stable under exposure to both high temperatures and capable of photo catalytic oxidation. Furthermore, nanoparticles have a large surface area to volume ratio that results in a significant increasing of the effectiveness in photo catalytic oxidation activity when compared to bulk materials (29). Titanium dioxide and zinc oxide are widely used indifferent areas because of their unique photo-catalytic, electrical, electronic, optical, dermatological, and antibacterial properties (30).The performances of both TiO_2 and ZnO nanoparticles are more or less similar and we can find that TiO_2 nanoparticles are marginally better than the nanoparticles of ZnO in both the size ranges. The antibacterial activities of all the treated samples remained at the same level even after repeated washings upto 45 washes (31).

EXPERIMENTAL PROCEDURES

The fabric used for this research was a 100% cotton with specific weight and thickness. This fabric is one of the most widely used textiles in health care environments. Antimicrobial agents Chitosan/Ag nanoparticles, Honey, Turmeric, TiO₂ and ZnO nanoparticles were obtained commercially. Depending on the antimicrobial agents various chemical and/or physical processes were applied along with the standard pad dry cure technique for the production of antimicrobial fabric. Physical Characterization of Nanoparticles on textiles was done through Fourier transform infrared spectroscopy (FTIR).

Qualitative evaluation was carried out using Agar well Diffusion method and AATCC Test Method 147- Parallel Streak Method. The quantitative evaluation was done using AATCC Test Method 100- Percentage reduction test. The percent reduction of bacteria was calculated using equation

$$R = \frac{(B - A) * 100}{B}$$

Where:

R = percent reduction of bacteria

A = the number of bacteria recovered from the inoculated treated test specimen swatches in the jar incubated over the desired contact period

B = the number of bacteria recovered from the inoculated untreated test specimen swatches in the jar incubated over the desired contact period.

The treated fabrics were laundered using AATCC Test Method 135-2004 with modifications to mimic harsher conditions. Laundering was carried out at MLR of 1:10 with 0.5% on weight of fabric of AATCC detergent at a temperature of 90⁰ C for 30 minutes.

Comparison of the different treatments used in the study was an important part to find out the best utilizable agent for antimicrobial textile production. On the basis of the antibacterial inhibition zone (AATCC 147 test method) and percentage reduction capacity (AATCC 100 test method) of various agents used were measured both at pre washing and post washing stages.

EXPERIMENTAL FINDINGS AND DISCUSSION

First agent to be used as antimicrobial on textiles was Chitosan coated with silver nanoparticles. It was found to be having increasing zone of inhibition with increasing concentrations. Optimum concentration effective against was found to be 20 g/l against *E.coli* and *S.aureus*. It was seen that antimicrobial properties were increased after coating it with silver. Physical characterization was further confirmed by the FTIR method. It was found that Chitosan – Ag inhibit growth of the tested strains of *E.coli* and *S.aureus* forming a zone of Inhibition of 34 mm against *E.coli* and 46 mm against *S.aureus*. It shows that this nanocomposites are much active against gram positive bacterial species. Cao *et.al.* (2010) also reported antibacterial activity of Silver/chitosan nanocomposites against *S. aureus* and *E.coli*, in which they showed similar results (32, 33, 34, 35, 36). The present study shows that Chitosan – Ag proved to be a powerful antibacterial coating with 98.90 % reduction of *S.aureus* and 97.70 % reduction in *E.coli*. Present study found the Optimum inhibitory effect of Honey at 40 g/l concentration against *E.coli* and *S.aureus*.

Present study shows that honey concentration of 40 (g/l) was found to inhibit the growth of *S.aureus*. It was also seen that honey was having maximum zone of inhibition against *S.aureus* instead of *E.coli*. Honey that has a median level of antibacterial activity it is possible to have it diluted to as low a concentration as 2% (v/v) and still have it completely inhibit the growth of *S.aureus* (37) Coulthard, C.E *et.al.*, found that as honey is diluted the activity of glucose oxidase increases to a peak at a concentration around 30–50% (v/v) honey as the water activity is increased, then falls again as the enzyme and substrate concentrations are decreased by further dilution (38). The maximum concentration of hydrogen peroxide achieved when a 50% (v/v) solution of a honey with a high level of antibacterial activity. Present Study shows the optimum concentration at 40 (g/l) as a high level of antibacterial activity. Suguna, L., Chandrakasan found a zone of inhibition against *S. aureus* (Rosenbach) in winter honeys was recorded maximum (39). Similarly it was seen that honey was having maximum zone of inhibition against *S.aureus* instead of *E.coli*. It was also observed that the antimicrobial activity of the samples reduces with washing specifically with direct padded sample.

Dye uptake was found very strong in the fibers treated with turmeric in present study. The zone of Inhibition was found to be maximum 50 mm against *S.aureus*. Similar to the present study, Han S. and Yang Y also find that curcumin-treated wool fabrics had antimicrobial activity that was semi-durable to home laundering and light exposure (40). It was reported that curcumin-dyed fibers had average wash and light fastness rating (2.8 of 5), which was attributed to the stability of curcumin structure (41).

The antibacterial coatings mentioned by Yuranova, 2006 (42); Vigneshwaran, *et al*, (43) and Lee, Yeo, and Jeong, (44) use different pad-dry-cure methods to provide the textile with an antibacterial Ag, Ag/TiO₂ or ZnO coatings. In accordance with the study of Shahid-ul-Islam *et.al.*, nano size TiO₂ particles were successfully applied on cotton fabric by Pad-dry-cure technique. The dispersion of nano on fabric surface is observed by FTIR (45). In the present study pad dry cure technique was effectively used for the textile finishing with TiO₂ and ZnO. Use of nanoparticles like TiO₂ and ZnO shows the antibacterial effect against *E.coli* and *S.aureus*. (42). Present study also shows that both the nanoparticle agents TiO₂ and ZnO have similar antibacterial effect. It also shows functional activity upto 25 washes. S.Kathirvelu reported that the woven cotton fabric treated with 1.0 % Titanium dioxide nanoparticles solution shows better antibacterial property (93%,94%) also Zinc oxide nanoparticles solution shows better antibacterial property (93%,94%) for both *E.coli* and *S.aureus* respectively (46). It was found that in present study TiO₂ also shows the better antibacterial property (86%,98%) and ZnO nanoparticles shows growth reduction against *E.coli* and *S.aureus* (86%, 94%). Present study also shows that ZnO nanoparticles treated fabric show the maximum inhibitory zone of Inhibition of 5.2 cm against *S.aureus* and 3.4 cm against *E.coli*. The ZnO nanoparticles treated fabric showed maximum percent of reduction with a reduction percentage of 94.16% for *S.aureus* followed via 86.5% for *E.coli* (47). In accordance with this result it turned into discovered that ZnO nanoparticles shows the share discount of 94% for *S.aureus* and 86.20% for *E.coli*. It was also seen that ZnO in present study showed active upto 15 washes after which % bacterial reduction diminishes.

Present study likewise includes the comparison of 5 unique antibacterial agent which can be found to be having an effective antimicrobial interest in opposition to *E.coli* and *S.aureus*. Comparison was performed qualitatively and quantitatively and on the basis of washing durability. In the present comparison of different antibacterial agent it was found that Chitosan a naturally originated product when get coated with Ag nanoparticles, not only shows the best antibacterial activity but also is having stronger was durability.

In present study although the naturally originated antibacterial agent confirmed an effective activity towards test organisms but the washing sturdiness observed to be weaker than other agents. A comparative look at of multifunctional finishing of cotton and polyester blend fabric dealt with TiO₂ and ZnO oxide nanoparticles become accomplished by Kathirvelu (48) Windler (49).

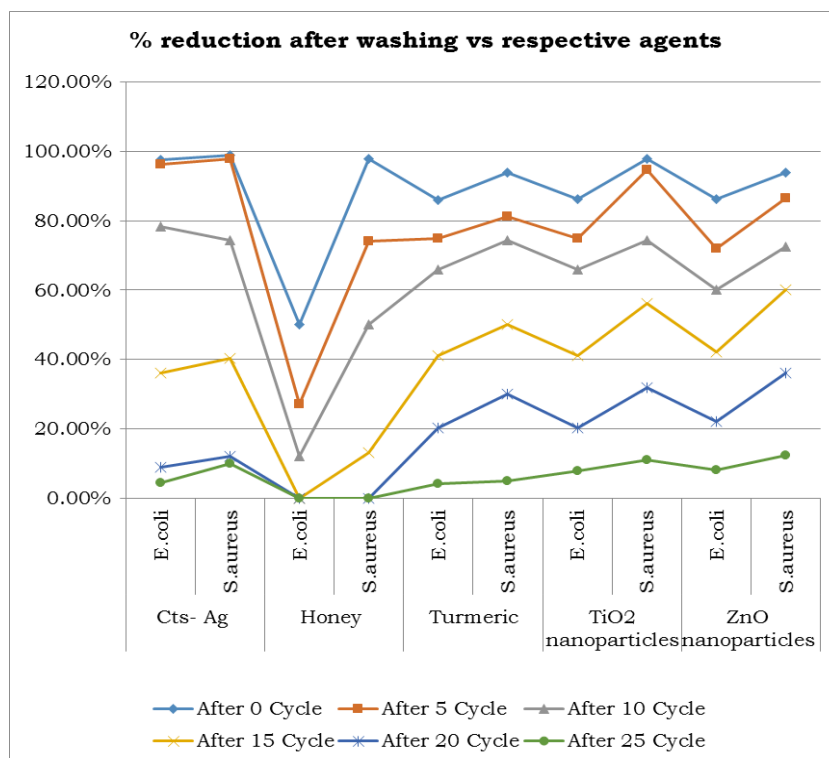


Fig 1 -Percentage reduction test of the 5 antibacterial agents tested against *E.coli* and *S.aureus*.

CONCLUSION

Antibacterial textiles have emerged on the market for the general public in the form of socks, under clothing, towels, duvets and other clothing sport. While they certainly provide an advantage in the hygiene, they are likely to play a crucial role in the social environment. The study showed the antimicrobial properties of silver-containing chitosan coated fabrics, TiO_2 , ZnO , honey coated fabrics and turmeric coated fabrics. The study indicated that the wash durability of the finished goods coated with respective agents had different sustainability. Results indicated that antibacterial activity of chitosan- silver nanoparticles was sustained even after 5th laundry wash cycle and percentage reduction at 96.30 % for *E.coli* and 97.80 % for *S.aureus*. Therefore, the present study clearly provides novel antimicrobial material with washing durability which is also required for the potential medical textile fabric.

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CERAMBYCIDS DIVERSITY FROM WANI AREA DIST- YAVATMAL (M.S.) INDIA

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Cerambycidae is an important family of Coleoptera and members of family are commonly called as long-horn or longicorn beetles. The members of this family are natural forest pests at larval as well as adult stages. During the study period eighteen different species of sixteen various genera from four sub-families of Cerambycidae are found which varies in body length from 9.5mm to 86mm and are identified with key characters. To assist identification and taxonomic study of long-horned beetles of order Coleoptera in Wani area, we have prepared a checklist of long-horned beetles with 18 color photographs in concurrence with preliminary studies from different region in India.

Keywords: Long-horn beetles, Forest pests, Checklist, Wani.

INTRODUCTION

To Study the diversified form of life on the earth and their interrelationship with other living forms, conservation has become an important activity due to rapid loss of species and increasing degradation of habitat around the world. It's now time to study, record and try to conserve what is globally present today. The study area, Wani is situated at eastern side of Yavatmal district (M.S.), located at co-ordinates 20°07' N latitudes and 78°05' E longitude. About seventeen coal-mines are located around Wani area which imparts its effect on the environment affecting the coleopteran diversity. With this view the long-horned beetle diversity is studied during January 2011 to December 2018.

The order Coleoptera is one of the largest orders in Class Insecta that includes more number of species than any other order of this class, constituting almost 25% of all known life-forms (Hunt *et al.*, 2007). The beetle diversity is very widespread found in all major habitats, except marine and the Polar Regions. However there are particular species which are adapted to every kind of diet. Moreover, beetles are indicator of soil properties (Avgin S and Luff M, 2010), temperature and humidity variation of the environments (Mantilla-Contreras J, *et al.*, 2012), forest disruptions (Schirmel J, *et al.*, 2014) and environmental disturbances in the landscape structure (Buchs W, 2003). Beetles are remarkably variable both biologically and ecologically. The major varieties of beetle are terrestrial herbivores; many are predatory, some are pests, frequently with highly specialized host ranges or life cycles (Thakkar B and Parikh P, 2016). The present study aims to focus on diversity of long-horned beetles in Wani region.

MATERIALS AND METHODS**1. Sampling of Long-horn beetles**

Specimens for the present study were collected from various areas by hand picking. Some beetles were collected during night near street light.

2. Study Area:

Wani region represents coal-mines and lime stone mine however, is surrounded by patches of reserve forest nearby such as Nilgiri reserve forest, Suknagaon reserve forest, and also have agricultural land. The survey of beetles was carried out in five different transects.

Transect I - Mukutban road

Transect II - Suknagaon forest

Transect III - Nandepera road

Transect IV - Warora road

Transect V - Nilgiri reserve road

RESULTS AND DISCUSSION

In the present study, 18 species from 16 genera of beetles were identified. The checklist of beetles is given in Table 1. In present study diversity of beetles of 4 different sub families such as Cerambycinae, Lamiinae, Prioninae and Spondylidinae were recorded. From Maharashtra 59 species belonging to 50 genera spread over four subfamilies of Cerambycidae are reported (Ghate H., 2012). A preliminary study (Jiji T. *et al.*, 2016) was conducted on beetles of southern Kerala that listed 16 species over three sub families. The Coleopteran fauna of

Cerambycidae from Bihar was examined (Kariyanna B. *et al.*, 2018) in which 15 species of 14 genera over three different sub families were recorded.

The members of subfamily Cerambycinae are major contributors as per diversity. Beetles of subfamily Lamiinae are the second dominant Cerambycids diversity-wise reported in the present study. However, members of Prioninae and Spondylidinae equals as per diversity. This study shows that the survey of longhorn beetle from Wani area is still in budding stage and this needs to be focused by scientific community. The monitoring of Cerambycidae beetles from Wani region should be continued to know their seasonal occurrence, host preferences and other abiotic and biotic factors leading to their abundance in nature.

Table 1: Long horned beetle diversity collected from Wani

Sr. No.	Scientific Name	Subfamilies	Number of individuals
1	<i>Batocera rubus</i> (Linnaeus, 1758)	Cerambycinae	1
2	<i>Ceresium</i> sp. (Perroud, 1855)	Cerambycinae	1
3	<i>Noserius indicus</i> (Gahan, 1906)	Cerambycinae	1
4	<i>Pachydissus</i> sp.	Cerambycinae	1
5	<i>Stenomolus</i> sp. (Pascoe, 1859)	Cerambycinae	1
6	<i>Stromatium barbatum</i> (Fabricius, 1775)	Cerambycinae	3
7	<i>Stromatium longicorne</i> (Newman)	Cerambycinae	2
8	<i>Xylotrechus smeii</i> (Laporte and Gory, 1841)	Cerambycinae	1
9	<i>Xystrocera globosa</i> (Olivier, 1795)	Cerambycinae	1
10	<i>Aeolesthes</i> sp. (Fabricius, 1787)	Lamiinae	1
11	<i>Apomecyna quadrifacita</i> (Thom., 1868)	Lamiinae	1
12	<i>Apomecyna saltator</i> (Fabricius, 1787)	Lamiinae	2
13	<i>Apriona germari</i> (Hope, 1831)	Lamiinae	8
14	<i>Monohammus nivosus</i> (White, 1858)	Lamiinae	1
15	<i>Niphona fuscatrix</i> (Fabricius, 1781)	Lamiinae	1
16	<i>Stibara nigricornis</i> (Fabricius, 1781)	Lamiinae	1
17	<i>Acanthophora serraticornis</i> (Olivier, 1795)	Prioninae	2
18	<i>Arhopalus tristis</i> (LeConte, 1850)	Spondylidinae	1



Fig. 1. *Batocera rubus*



Fig. 2. *Ceresium* sp.



Fig. 3. *Noserius indicus*



Fig. 4. *Pachydissus* sp.



Fig. 5. *Stenomolus* sp.



Fig. 6. *Stromatium barbatum*



Fig. 7. *Stomatium longicorne*



Fig. 8. *Xylotrechus smei*



Fig. 9. *Xystrocera globosa*



Fig. 10. *Aeolesthes sp.*



Fig. 11. *Apomecyna quadrifacita*



Fig. 12. *Apomecyna saltator*



Fig. 13. *Apriona germari*



Fig. 14. *Monohammus nivosus*



Fig. 15. *Niphona fuscatrix*



Fig. 16. *Stibara nigricornis*



Fig. 17. *Acanthophora serraticornis*



Fig. 18. *Arhopalus tristis*

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BIOMETHANATION OF HIGH SOLID CONTAINING DISTILLERY SPENTWASH USING DEVELOPED ACCLIMATIZED MICROBIAL CONSORTIA

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ABSTRACT

Biomethanation of spentwash (SW) is now a well established technology in distilleries. At present in distilleries average COD reduction could be achieved around 60-65% for SW having COD in the range of 100000-130000 mg/l. But SW obtained from integrated evaporation system has COD 230000-250000 mg/l. However, biomethanation of concentrated SW (20-30°brix) is problematic due to relatively poorer digestion efficiency and intolerance of consortia of microbes to some inhibitors. The objective of the current study is to understand the acclimatization of methanogenic consortia to concentrated SW. The sludge containing methanogenic bacterial consortia from biogas plant was used for acclimatization. The developed acclimatized consortia of methanogenic bacteria were used for biomethanation of concentrated SW.

The performance of developed bacterial consortia for the production of methane was evaluated on bench (10 l) and pilot scale (16000 l). This study successfully demonstrates the application of acclimatized consortia of methanogenic bacteria for operation on bench and pilot scale with enhanced COD reduction in the range of 64 to 74% using 25 to 30°brix SW. On bench scale, the control biodigester using un-acclimatized inoculum at 30°brix SW showed maximum 43% COD reduction and less gas production compared to experiment. Using 25°brix SW, control pilot biodigester have been disturbed and achieved maximum 51% COD reduction with less biogas (27.37 m³/day). At same conditions, pilot experiment biodigester shows maximum biogas generation of 39.72 m³/day without affecting stability of biodigester.

Keywords: Biomethanation, Biodigester, COD reduction, Spentwash.

INTRODUCTION

Distilleries are considered one of the tremendously polluting industries worldwide [K. H. Kim et al., 2010]. Hence Central Pollution Control Board, Government of India has decided distilleries as one of the major polluting industries [CPCB, New Delhi, 2003]. Indian distilleries mainly use sugarcane molasses as a preferred substrate for alcohol production due to its easy availability. Distilleries utilize huge quantity of fresh water and create large volumes of spentwash (SW) which is highly polluted. Various aerobic and anaerobic techniques are available for treatment of SW. Out of these; biomethanation is one of the preferred technologies used for SW treatment. Biomethanation through anaerobic digestion (AD) is a process utilized worldwide for reduction of organic waste and production of biogas. Comparing with the aerobic treatment methods, AD is widely accepted method. Waste streams are subjected to AD for biogas production [P. L. McCarty et al., 2011, PSA, New Delhi, 2014]. Biomethanation result in waste stabilization, reduces pollution load in terms of COD, requires less power requirement as compared to other treatment processes and develops little sludge. [X. Wang et al., 2008, P. Venkateswara Rao et al., 2010, M. Carmen et al., 2010, L. Gang et al., 2015].

A dark brown colored SW has pH 4.0-4.3; COD 100000-130000 mg/l and SW obtained from integrated evaporation system have COD in the range of 230000-250000 mg/l. Also SW contains high concentration of inorganics such as chlorides, sulfates, phosphates, sodium, potassium and calcium. Direct disposal of untreated distillery SW into natural resources poses a severe risk to aquatic organisms. High COD and other inorganics may contribute to eutrophication of natural water bodies [M. Premalatha et al., 2014, R. Sowmeyan 2008]. Therefore, it is crucial to pre-treatment of SW prior to its disposal in the environment [R. Chandra et al., 2008].

At present, the performance of biogas plants in the distilleries shows an average COD reduction of 60-65% for SW having COD 100000 -130000 mg/l. Recently integrated evaporation has emerged as a potential technology for reducing the SW volume from 14-15 l/l to 3.0-3.5 l/l of alcohol produced [PSA, New Delhi, 2014]. Generally, biomethanation of concentrated SW (COD 230000-250000 mg/l) is problematic due to intolerance of consortia of microbes to some inhibitors and relatively poorer digestion efficiency. This is the major limitation of existing biomethanation technology. Therefore, a scope to be developed for the biomethanation process to treat concentrated SW. Microbiology of biomethanation involves four different bacterial groups. The hydrolytic bacteria catabolize organic matter to fatty acids, H₂ and CO₂. The hydrogen producing acetogenic bacteria

catabolizes fatty acids and neutral end products to acetate, H_2 and CO_2 . The homo acetogenic bacteria produce acetic acid. Finally, the methanogenic bacteria produce methane [S. Banerjee et al., 2004].

Microbes have a great capacity of adaptation to the environmental adverse conditions. Hence the strategy of acclimatization was used for development of bacterial consortia responsible for biomethanation in the current research studies. Several mechanisms have been described to explain the acclimatization. Acclimatization may be the result of either internal change in the predominant species of methanogens or of a shift in the methanogenic population [G. Zeeman et al., 1985]. Once the microbes are adapted, they can retain viability at concentrations far exceeding the initial inhibitory concentrations [I. Angelidaki et al., 1993]. A study on acclimatization suggests that there is a selection and a multiplication of particular microorganisms developed during acclimatization. It is reported that using swine waste achieved COD reduction by adapting microbial community to the continuing increase of total ammonium nitrogen [S. Esquivel-Elizondo et al., 2016].

The aim of this study was to operate biomethanation of high solid containing SW using acclimatized methanogenic bacterial consortia developed during this research work. Performance of developed bacterial consortia was evaluated on two levels viz. bench (10 l) and pilot (16000 l) scale. Control experiments were also conducted using un-acclimatized consortia as inoculum.

MATERIALS AND METHODS

Acclimatization of bacterial consortia

The set up of biodigester used for acclimatization is shown in figure 1A. The sludge containing the bacterial consortia was collected aseptically in a sterile container from the bottom of the biodigester of Pandurang Sahakari Sakhar Karkhana Ltd. Solapur, Maharashtra, India operating feed SW of 20°brix. It was stored in refrigerator at 4°C prior to inoculation. The nutrients for optimum microbial growth were supplemented as (g/l) NH_4Cl -0.5, K_2HPO_4 -0.25, $CaCl_2$ -0.005, $CuCl_2$ -0.0105 and $MgCl_2 \cdot 6H_2O$ -0.3 [P. Mullai et al., 2013]. The sludge of 0.270 l was acclimatized in a 10 l capacity biodigester by feeding 100 ml sterile SW (pH 7.0) per day starting from 21°brix up to 30°brix. After every ten days, concentration of SW was increased by 1°brix. Acclimatization was conducted at $37 \pm 0.5^\circ C$ anaerobically [M. Westerholm et al., 2011].

Bench scale biodigester experiments using acclimatized and un-acclimatized inoculum

The diagrammatic representation of the bench scale biodigester set up used during studies is shown in figure 1A. A wide mouth glass bottle of 10 l capacity with a working volume of 9 l was used as the biodigester. The gas was measured using water displacement method by monitoring water level displaced in the cylinder twice in a day and average value was considered to quantify the gas [C. H. Pham et al., 2013].

Three different experiment sets were conducted using acclimatized and un-acclimatized consortia on bench scale. The experiment sets A, B and C were performed using SW of 15, 20 and 30°brix respectively. Generally distilleries perform the biomethanation using raw SW of 15 to 20°brix. Hence at both the concentration of SW the performance of inoculum collected from the distillery was validated. The developed consortium of microbes (30%, v/v) was fed to the experiment biodigester as inoculum for set C only [R. Thiyaagu et al., 2018]. The biomethanation was operated at 37°C, correspondingly hydraulic retention time was of 24 days [Metcalf & Eddy, Inc. 1972]. Hence 0.375 l SW of respective solid content was fed daily to the biodigester via peristaltic pump. The content of biodigester was mixed thoroughly at an interval of 6 hours at 150 rpm for 10 minutes magnetic stirring. SW used during studies was collected from distillery and preserved at 4°C having pH- 4.05-4.45, brix-15-25° and COD-112000-242000 mg/l. The desired concentration of SW was obtained either by dilution with distilled water or concentrated by heating at controlled temperature. pH of SW close to 7 was maintained by using sodium bicarbonate as a buffer during the hydraulic retention time of 24 days. After the process got stabilized, SW was fed without pH adjustment.

After the stabilization of biodigesters, the feed concentration of SW and organic loading rate was gradually increased per 3 days by 1°brix. In case of A, B and C sets, initial COD of SW were 51000 mg/l. The final feed COD of SW in case of A was 125000 mg/l, B was 181000 mg/l and C was 242000 mg/l. The overflow of the biodigester was collected for analysis of various parameters. Control biodigester was inoculated using sludge of biogas plant (un-acclimatized inoculum). The feeding strategy of SW and experimental conditions were same for experiment set.

Pilot scale biodigester set-up for experiment and control

The schematic experimental set-up of the pilot scale biodigester is shown in figure 1B. The study was conducted on pilot scale biodigester (16000 l capacity, working volume 15000 l, each for experiment and control) established at Shree Renuka Sugars Ltd., Athani, Karnataka, India. The biomethanation experiments were conducted for

duration of 155 days during the period of December 2016 to May 2017. SW used had pH- 4.00-4.30, brix-15-25° and COD-112000-241000 mg/l.

Start-up of pilot biodigesters

The experiment pilot biodigester was inoculated using developed acclimatized bacterial consortia as inoculum (150 l). The biodigester was also charged with cow dung slurry of total 2850 l. A pH of the SW was maintained using soda lime within the optimum range of 7. SW feeding was started initially of 5°brix for 14 days @ 11 to 12 l/h with continuous agitation at 150RPM. The pilot control biodigester was inoculated using the distillery sludge (un-acclimatized inoculum) and charged with cow dung slurry.

Feeding pattern of pilot biodigesters

In the current pilot biodigesters, the SW concentration was gradually increased after 5 days by 1°brix and reached up to 25°brix. After 70 days, COD of feed SW was 112000 mg/l, after 105th day onwards it was more than 200000 mg/l and gradually increased to 244000 mg/l.

Analytical methods

The analytical methods used in order to monitor the performance of the biodigester, were performed using the methods given in the Standard Methods for the Examination of Water and Wastewater [B. Laura, 2012]. COD digester (2015M, Spectralab, India) and autotitrator (CT15 Spectralab, India) used for estimation of COD.

Methane concentration was estimated by gas chromatography (Model 6980-Agilent Technologies USA). Gas chromatograph fitted with a capillary column (Make: GS-Carbon Plot, length: 30 m, ID: 0.530 mm, film: 3µm); Programme: Carrier gas: Hydrogen, Inlet-Heater: 230°C, Pressure: 6.3405 psi, Column flow: 14.513 ml/min; Temperature: 50°C for 2 minutes-5°C/min-230°C. Detector: TCD, Heater: 200°C, make up flow: 5 ml/min. Chromatogram obtained using EZ Chrome Elite software (Agilent Technologies).

RESULTS AND DISCUSSION

Acclimatization of bacterial consortia

The set up used for acclimatization studies is shown in figure 1A. Use of a good microbial community sludge for starting process of biomethanation is also a vital feature for successful biogas production [X. Kong et al., 2016, R. Wirth et al., 2015]. The developed consortia of acclimatized methanogenic bacteria were adjusted to the environment of SW. Initially the volatile fatty acid (VFA) concentration was more, which may be due to the higher growth of acidogenic microorganisms. This indicates that VFAs produced by acid forming bacteria may be utilized by acclimatized methanogens in a suitable mode, resulting in a stable pH range of 6.90-7.20 (shown in table 1) which is optimum for AD. Therefore, inoculation of biodigester with developed acclimatized microbial consortia may enhance biodigester stability.

Structure and composition of *Archaea* may be changed after acclimatization. Acetoclastic and hydrogenotrophic methanogens play key roles in methane generation [A. Godina et al., 2012]. Hydrogenotrophic methanogens are most resistant to various toxic substances including ammonia than acetoclastic methanogens. It may be possible that acetoclastic methanogen population decrease if concentration of free ammonia is maintained above 0.37 g/l [J. Liu et al., 2012]. Protein decomposition produces VFAs and ammonia nitrogen. Methanogens may be inhibited when ammonia nitrogen concentration reaches 2000 mg/l [R. Jose et al., 2008]. Species of the phylum Thaumarchaeota may utilize ammonia and reduce its concentration in the biodigester [R. Vaidyanathan et al., 1995]. Thaumarchaeota species appeared in the developed acclimatized inoculum, may have reduced the negative effects of ammonia nitrogen on the biomethanation. Ultimately methane content of experiment biodigester was enhanced.

PERFORMANCE OF BENCH SCALE BIODIGESTERS

Set A: Lab scale trial using un-acclimatized consortia using 15°SW

The biodigester pH during initial 10 days was 4.30-4.50, afterwards increased to 6.85 within 18 days and reached its steady state values 7.10-7.20 within 35 to 45 days as shown in Table 1. COD is considered to quantify the quantity of organic material in effluent and predicts the potential for generation of biogas [Gerardi M. H. 2003]. Theoretical yield of methane can be calculated from the COD of the effluent [Kwietniewska E. et al., 2014]. In relation to COD, biogas production is 0.5 L g⁻¹ COD removed [Angelidaki I et al., 2004]. After stabilization of biodigester, the rate of COD reduction goes on increasing. At feed COD of 125000 mg/l, 60% COD reduction was achieved. On bench scale using 15°brix SW, maximum gas generation of 13.2 l/day was achieved after 45 days of biomethanation. The graphical representation of feed COD, outlet COD and rate of COD reduction is presented in figure 2.

Part B: Lab scale biodigester trial using un-acclimatized consortium using 20°SW

The bacterial consortia used for acclimatization having previous maximum tolerance of 20°SW. To check the performance of the un-acclimatized consortia in the laboratory, trial using 20°SW was conducted. The trend of pH was shown in table 1. At feed COD of 181000 mg/l, the COD reduction achieved was 64%. Using 20°SW, maximum gas generation of 20 l/day was achieved within 60 days. It was confirmed that the un-acclimatized consortia was able to tolerate shock upto 20°SW. The trend of the feed & outlet COD and COD reduction is shown in figure 3.

Part C: Lab scale biodigester trial using acclimatized consortia and un-acclimatized consortia for concentrated 30°SW**Performance of bench scale control biodigester using 30°SW**

The trend of pH observed using 30°SW on bench scale trial is shown in table 1. Bench scale control biodigester also showed consistent COD removal of above 60% after 45 to 65 days. However, as the concentration of feed SW increased from 21°brix, the biodigester started to disturb after 66 days. This may be due to sensitivity of microbial consortium to various inorganics of concentrated SW. More VFAs were produced and ratio of VFA to alkalinity was raised from 0.06 to 0.17. However, in control biodigester at feed concentration above 21°brix started to increase VFA from 1230 mg/l to 3150 mg/l at feed of 30°SW. The disturbance of biodigester was noticed and this is evident from continuous decrease in COD reduction (from 64% to 45%, maximum gas generation of 21.5 l/day) with increase in VFA concentration from 17200 mg/l to 18200 mg/l. These results are contradictory to the experiment biodigester.

Performance of bench scale experiment biodigester

It is reported that pH in the range of 7.30-7.90 attributed during the biometanation using SW [X. Goux et al., 2015]. The concentration of CO₂ and VFA produced during the AD affects the pH of the biodigester [M. A. Mir et al., 2016]. The trend of pH observed on bench scale is shown in Table 1. The concentration of alkalinity was 9900 mg/l after 25 days and gradually increased to 17500 mg/l within 85 days. The alkalinity was mainly increased due to the microbial biomass which had to be acclimatized. VFA to alkalinity ratio was 0.33 after about 25 days. Bench scale experiment biodigester showed steady state condition with consistent COD removal indicating successful acclimatization of methanogens to concentrated SW. Rate of COD reduction increased from 38 to 55% within 41 days. It was more than 60% after 45 days and reached maximum to 64% at feed COD of 242000 mg/l with actual gas generation of 28 l/day (theoretical gas generation-28.3 l/day). Trend of feed & outlet COD and corresponding COD reduction using 30°SW is shown in figure 4.

Performance of pilot scale control trial

The analytical data of the control pilot scale trial is presented in Table 2. After 70 days, the biodigester pH (data not shown) was 7.30. During stabilization period of biodigester, the pH was increased and maintained within range through self regulation. After 70 days the VFA concentration was 3771 mg/l and slowly decreased to 1050 mg/l after complete stabilization. After 80 days to 125 days, the COD removal efficiency of above 60% was observed.

After stabilization of the biodigester, the COD loading rate was increased as shown in Table 2. It can be seen that up to 105 days, COD reduction was in the range of 71-72%. However, as the concentration of feed SW increased to 22°brix, VFA to alkalinity ratio raised from 0.06 to 0.11. COD loading rate increased after 110 days from 3.50 kg/m³/day to 7.95 kg/m³/day, COD reduction rate was start to decrease from 72% to 51%. Eventually biogas generation process was reduced because the parent bacterial consortium was unable to tolerate load of various inorganics content of 30°SW. The gas analysis profile shows methane content of 61-64%. It was observed that using 25°SW, maximum actual gas generation of 27.37 m³/day (figure 5) was achieved which is lesser by 2/3rd in comparison with experiment pilot biodigester.

Performance of experiment pilot scale trial

After conducting successful bench scale trial of acclimatized consortium, the pilot scale trial was conducted. The analytical data of experiment pilot scale trial is shown in Table 3.

The COD reduction slowly increased throughout the pilot scale trial. This initial period was mentioned as "stabilization period". This period was considered as most essential for the better development of bacterial consortium [Herbert H.P. et al., 1995]. The pilot experiment biodigester showed COD reduction of above 65% after 85 days. This clearly indicates successful acclimatization of developed bacterial consortia to high solid containing SW.

After 95th day onwards, COD reduction was in the range of 71-73% while after 115 days it was 74%. After 70 days, the COD loading rate was increased gradually from 2.15 kg/m³/day to 7.95 kg/m³/day as shown in Table

2. It is reported that Indian distilleries generally operate biodigester at the designed COD loading rate of 6.00-6.50 kg/m³/day [Ashwani Kumar,2003]. The current studies indicate that experimental pilot biodigester was able to tackle COD loading rate of 7.95 kg/m³/day which is higher by 1.45 to 1.95 kg/m³/day than the reported data. Still there was no disturbance of biodigester observed though COD loading rate was 7.95 kg/m³/day. This was possible only due to use of developed acclimatized microbial consortium to high solid containing SW. Apart from COD loading rate, the biodigester was stabilized by improved overall reactions and stability (pH control in each phase by the activity of developed bacterial consortia) to shock loads of various inorganics and other contents of SW. The quantity of biogas generated during AD depends on the factors such as organic matter, total volatile solid and the C/N ratio of the effluent. The most reported content of biogas has major amount of methane (60%) followed by carbon dioxide (35%) and other gases (5%) [Igon A. H. et al., 2007, Osoria F et al., 2009]. The gas analysis profile shows methane content of 62-64%. The actual gas generation profile of pilot scale biodigesters is presented graphically in figure 5. Using feed of 25°brix SW, maximum actual gas generation of 39.72 m³/day was achieved.

CONCLUSION

The developed acclimatized bacterial consortia of methanogenic microorganisms in the biodigester were able to utilize high strength SW resulting into maximum biogas generation. Based on the bench and pilot scale studies, it can be concluded that the developed acclimatized consortia of methanogenic microorganisms is very effectively useful for utilization of concentrated SW. On bench scale, the control biodigester for feed SW of 20 to 30°brix shows maximum 43% COD reduction against 64% in experiment biodigester. As compared to experiment biodigester, the biomethanation process of control biodigester was disturbed and less gas was produced.

On pilot scale, experiment biodigester using 25°SW with COD of 244000 mg/l achieved maximum COD reduction of 74%. Using acclimatized bacterial consortia, pilot biodigester was able to accept COD loading rate of 7.95 kg/m³/day without affecting stability of the biodigester. Pilot control biodigester using 25°SW showed maximum 51% COD reduction and less biogas generation (27.37 m³/day).

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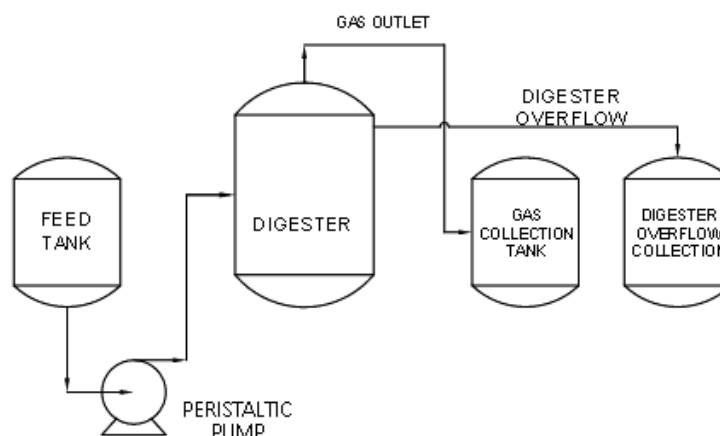
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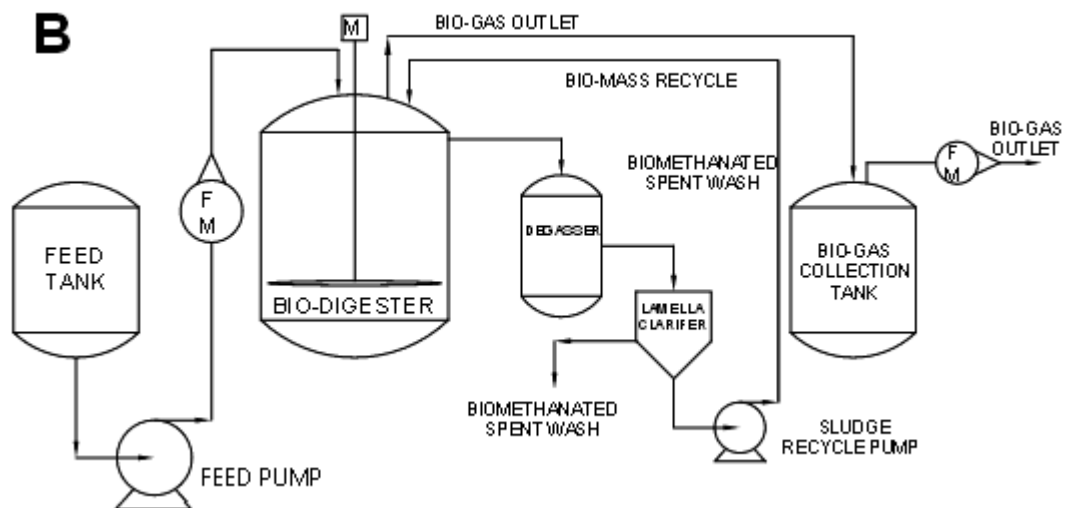


Figure 1A & 1B: Schematic representation of bench and pilot biodigesters respectively

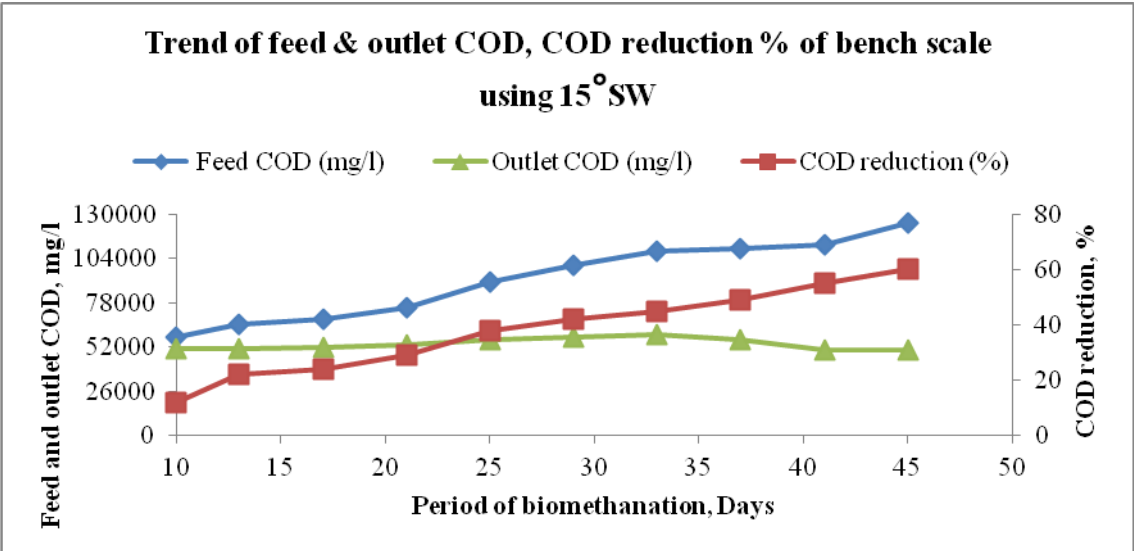


Figure 2: Trend of feed & outlet COD and percentage of COD reduction of bench scale trial using 15° SW

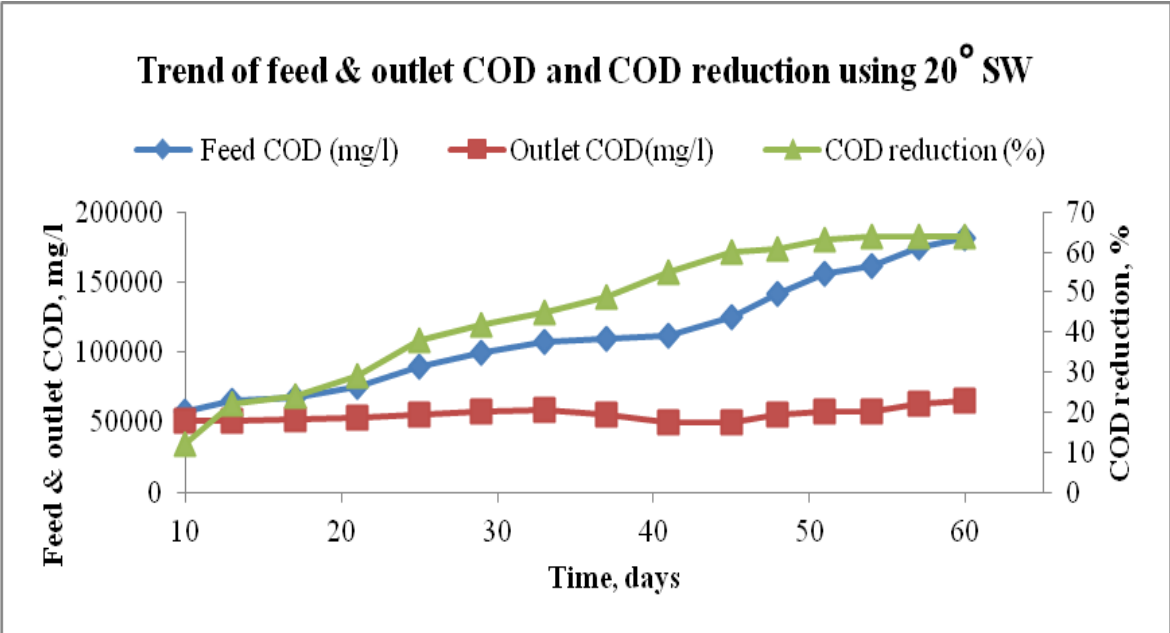


Figure 3: Trend of feed COD, outlet COD and percentage COD reduction of bench scale trial using 20°SW

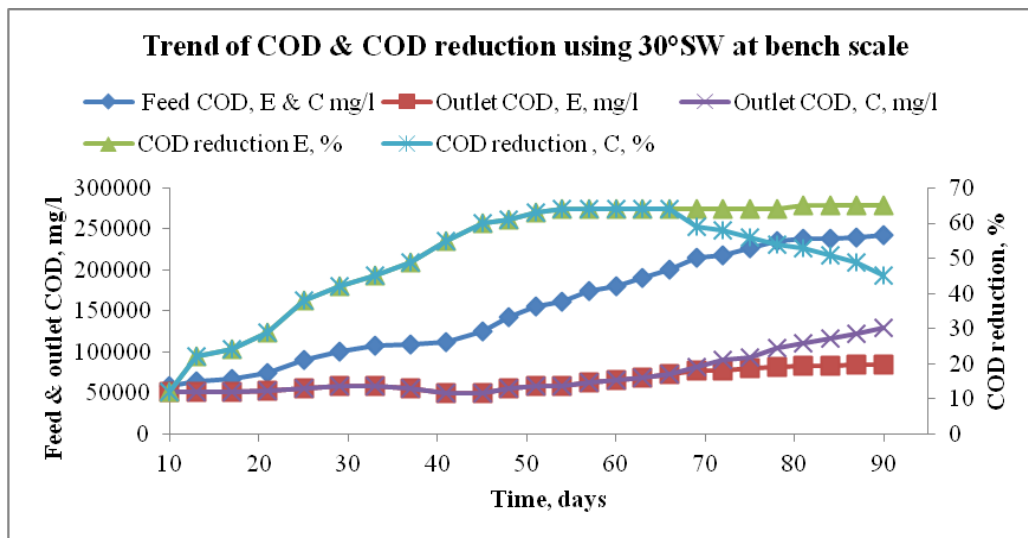


Figure 4: Trend of feed & outlet COD and corresponding COD reduction of bench scale biodigester using 30°SW

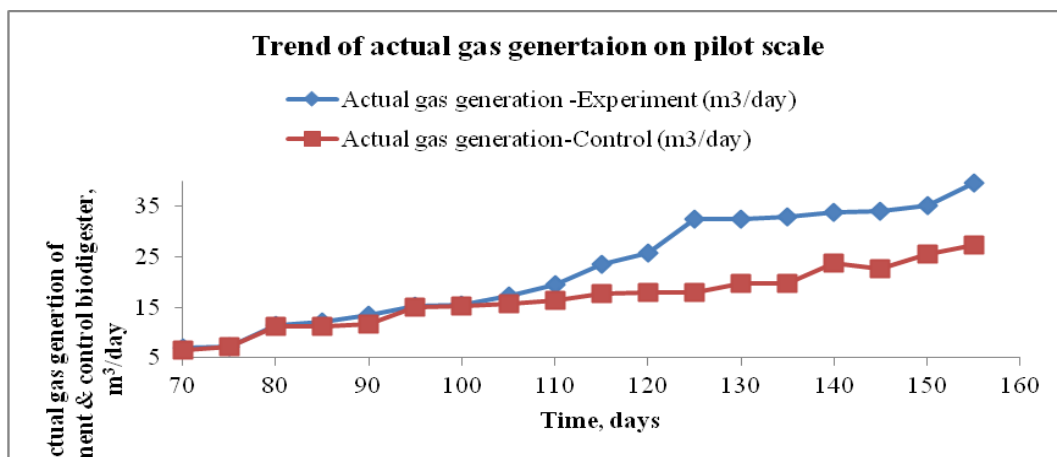


Figure 5: Trend of actual gas generation on pilot scale

Days	Set A pH	Set B pH	Set C pH
5	4.30	4.28	4.32
10	4.8	4.85	4.87
15	6.85	6.92	6.93
20	6.98	7.02	7.04
25	7.05	7.08	7.10
30	7.08	7.13	7.15
35	7.10	7.15	7.18
40	7.17	7.20	7.22
45	7.20	7.25	7.27
50	Set A: Feed SW concentration 15° Brix Set B: Feed SW concentration 20° Brix Set C: Feed SW concentration 30° Brix	7.29	7.32
55		7.32	7.35
60		7.35	7.38
65			7.40
70			7.43
75			7.45
80			7.48
85			7.50
90			7.52

Table 1: Trend of pH of biodigetsers of bench scale trials using various concentrations of SW

Feed parameters								Outlet parameters				
Days	Flow rate (l/day)	Brix(°)	VFA (mg/l)	Alkalinity (mg/l)	COD (mg/l)	Loading rate (kg/m ³ /day)	Retention Time (days)	Brix(°)	COD (mg/l)	COD reduction (%)	Gas generation /kg of COD	Actual gas generation (m ³ /day)
70	288	14	3771	9650	112000	2.15	49	4.8	62000	45	7.26	6.55
75	242	15	3257	10150	122000	2.10	58	5.7	56000	54	7.97	7.33
80	240	16	2571	14800	160000	2.88	58	6.1	60000	67	12.97	11.20
85	240	17	2500	15000	165000	2.64	58	6.5	56000	66	13.06	11.27
90	240	18	2400	16624	175000	2.74	58	7.1	56000	65	13.65	11.60
95	242	19	2025	16700	191000	3.05	58	7.9	56000	71	16.40	15.13
100	241	20	1800	17000	195000	3.13	58	8.2	56000	71	16.68	15.25
105	260	21	1721	16950	202000	3.25	58	8.6	56000	72	18.90	15.83
110	272	22	1050	17250	218000	3.50	58	8.8	74000	69	20.45	16.32
115	322	23	1150	17500	225000	4.83	43	9.0	72000	68	24.63	17.75
120	350	24	1265	17900	232000	4.02	54	9.5	58000	65	26.39	18.03
125	399	25	1600	17850	238000	4.31	51	9.8	96000	60	28.48	17.89
130	399	25	1800	18350	240000	5.15	43	10.3	104000	57	27.29	19.82
135	405	25	2000	18290	240000	5.60	40	10.6	108000	55	26.73	19.75
140	410	25	2010	18300	240000	6.38	35	11.0	112000	53	26.07	23.83
145	420	25	2190	18500	241000	6.41	35	12.3	116000	52	26.31	22.60
150	446	25	2200	18400	244000	7.25	31	12.3	117000	52	28.29	25.57
155	495	25	5210	27390	241000	7.95	28	12.4	119500	51	30.42	27.37

Table 2: Performance of control pilot biodigester including feed and biodigester outlet parameters

Feed parameters								Outlet parameters				
Days	Flow rate (l/day)	Brix(°)	VFA (mg/l)	Alkalinity (mg/l)	COD (mg/l)	Loading rate (kg/m ³ /day)	Retention Time (days)	Brix(°)	COD (mg/l)	COD reduction (%)	Gas generation m ³ /kg of COD	Actual gas generation (m ³ /day)
70	288	14	3771	9650	112000	2.15	49	4.8	62000	45	7.25	6.95
75	242	15	3257	10150	122000	1.96	58	5.7	56000	54	7.97	7.25
80	240	16	2571	14800	160000	2.56	58	6.1	60000	63	12.09	11.45
85	240	17	2500	15700	165000	2.64	58	6.5	58000	65	12.87	12.10
90	240	18	2400	16624	175000	2.80	58	7.1	56000	68	14.28	13.57
95	242	19	2025	16700	191000	3.08	58	7.9	56000	71	16.40	15.20
100	241	20	1800	16900	195000	3.13	58	8.0	56000	71	16.68	15.45
105	260	21	1721	16950	202000	3.50	58	8.6	56000	72	18.90	17.25

					0							
110	272	22	1500	17250	21800 0	3.95	58	9.3	58000	73	21.64	19.50
115	322	23	1300	17500	22500 0	4.83	43	9.5	58000	74	26.80	23.65
120	350	24	1265	17900	23200 0	5.41	54	9.6	59000	74	30.04	25.74
125	399	25	910	17850	23800 0	6.33	40	10. 2	62000	74	35.13	32.58
130	399	25	800	18200	24000 0	6.38	35	11. 3	63000	74	35.43	32.61
135	405	25	770	18250	24000 0	6.48	40	12. 6	63000	74	35.96	32.97
140	410	25	857	18250	24000 0	6.56	35	13. 3	62000	74	36.40	33.88
145	420	25	1020	18250	24100 0	6.74	35	13. 5	62000	74	37.45	34.01
150	446	25	1028	18300	24400 0	7.25	31	14. 0	63000	74	40.26	35.23
155	495	25	1110	18250	24100 0	7.95	28	14. 5	63000	74	44.13	39.72

Table 3: Analytical data of the pilot scale experiment trial

COMPARATIVE STUDY OF PHYTOPLANKTON AND ZOOPLANKTON DIVERSITY OF MAISDODAKA LAKE AND WAI LAKE IN DISTRICT YAVATMAL, (M.S.) INDIA

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ABSTRACT

Phytoplankton and zooplankton are an important component of aquatic flora and fauna respectively. They serve as food for many aquatic animals especially fishes and play a key role in maintaining proper equilibrium between abiotic and biotic components of the aquatic ecosystem. In the present investigation an account of occurrence of phytoplankton and zooplankton, their nature, number and seasonal periodicity have been studied to assess the state of the nature of water. Zooplanktons are heterotrophic planktonic animals floating in water. They serve as good indicators of changes in water quality. Zooplankton dynamics have been studied extensively in lentic fresh waters (lakes and reservoirs), yet comparatively little research has focused on lotic waters (rivers).

The present study was undertaken to observe the seasonal changes in plankton population. The data on plankton in reservoir was collected seasonally during Feb.2017 to March.2019. In plankton flora, the green algae dominated over the other groups. The phytoplanktons identified are members of Chlorophyceae, Bacillariophyceae, Cynophyceae, Euglenophyceae, Dinophyceae respectively. The recorded groups of zooplankton belonged to Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda respectively. The beautiful biodiversity of the animal fauna is represented through these diverse zooplanktonic forms. Through these qualitative studies a beautiful picture of biodiverse zooplanktonic forms of nature emerge on which the world of fishes sustain. They serve as food for many aquatic animals especially fishes and play a key role in maintaining proper equilibrium between abiotic and biotic components of the aquatic ecosystem.

Keywords: Zooplankton, Seasons, Population, Ecosystem.

I. INTRODUCTION

The reservoirs have played a significant role in the India's social and economic progress during the past five decades. Without the dams and reservoirs India would have been a thirsty, hungry dark land ravaged with floods and draughts every year. These reservoirs store precious rainwater to irrigate farmlands, generate electricity, supply drinking water and save land from floods and draughts. Reservoir fishery in India is also important from socio-economic point of view as it has the potential of providing employment to about two million people and caters the food demand of millions of people. Zooplanktons are minute aquatic animals that are non-motile or are very weak swimmers. They contribute significantly to biological productivity of freshwater ecosystem. They serve as good indicator of changes in water quality, because it is strongly affected by the environmental conditions and it is quickly responded to changes in environmental quality (Gannon and Stemberger, 1978). They are not only useful as bioindicators, but also helpful for ameliorating polluted waters. Zooplankton species are cosmopolitan in nature. They consist of fresh water, brackish and marine water forms. The freshwater zooplankton comprises Protozoans, Rotifers, Cladocerans, Copepods and Ostracods.

Phytoplankton Serve as important biological indicators of an aquatic Ecosystems, as they both effect and are affected by many characteristics of a fresh water Ecosystem. Phytoplanktons are often considered powerful biological indicators of fresh water ecosystem.

Biological indicators act as important measures of the state of an Ecosystem more so when combined with chemical data (Dixit et al. 1992). Planktonic algae are an integral part of lake food chains, nutrient cycles and oxygen production.

Zooplankton and phytoplankton are essentially non-motile organism relative to water mass, but drift with it (Dicks,1976). The use of living organisms to determine the presence, amounts, changes in and effects of physical, chemical and biotic factors in the environment is termed biological monitoring (Baker, 1976). Different types of invertebrates have different tolerances to pollution and are also affected by quality of their habitat. This means we can tell how good the water and habitat quality is by the types and numbers of invertebrates living in the water body (Environment Waikato, 2006).

Zooplankton plays an important role to study the fauna bio diversity of aquatic ecosystem. They include representatives of almost every taxon of the animal kingdom and occur in pelagic environment either as adults (holoplankton) or eggs and larva (meroplankton). By sheer abundance of both types and their presence at varying depths, the zooplanktons are utilized to assess energy transfer at secondary trophic level. They feed on phytoplankton and facilitate the conversion of plant material into animal tissue and in turn constitute the basic food for higher animals including fishes particularly their larva (UNESCO, 1968).

The major zooplankton groups found in most tropical freshwater lakes are the rotifers, cladoceran, copepods and ostracods(Witty,2004;Wayaaand Mwambungu,Direct Res. J. Public Health and Environ. Technol. 222004). The zooplanktons play a very important role in the aquatic system due to their link between phytoplankton and higher tropic levels (Gajbhiye, 2002). Their composition of proteins, minerals, fatty acid, lipids provides an important source of feed for fish (Kribia et al., 1997 in Khalid, 2012). The zooplankton responds to different types of stresses in different ways,therefore, they are increasingly used as biological indicators in aquatic ecosystem (Wanessa et al., 2008) and (Okorafor et al., 2013).

Phytoplanktons are single-celled marine algae, some of which are capable of movement through the use of flagella while others shift with current. These microscopic plant range in size from 1/1000 of a millimetre to 2 millimetres and float or swim in the upper 100 m of the ocean, where they depend on sun light for photosynthesis. In addition to light and oxygen (O₂), they require basic simple organic chemical nutrients such as phosphate (PO₄) and nitrate (NO₃), then also require carbon in form of carbon dioxide (CO₂). Some phytoplankton, the diatom also requires a form of silicon (Silicase, SiO₄) because they have a glasslike shell, (Sournia, 1978). The phytoplankton are of great importance as these are the primary producers of the oceans and thus provide the principal source of primary nutrition for organisms such as the zooplankton, the phytoplankton itself can be further divided with three orders of algae predominating.

II. MATERIALS AND METHODS

Study Area: Wai Project and Dam's Official Designation is "Wai, D -0 5040". Wai Dam was constructed as part of irrigation projects by Government of Maharashtra in the year 1997. Nearest city to dam is Kelapur and the Dam is situated in Kelapur Taluka of Yavatmal District of Maharashtra. Maisdodaka Project and Dam's Official Designation is "Maisdodaka, D -0 4284". Locally also known as " Maisdodaka Lake" / " MaisdodakaTalav". Maisdodaka Dam was constructed as part of irrigation projects by Government of Maharashtra. Year of completion is not known. Nearest city to dam is Maregaon and the Dam is situated in Maregoan Taluka of Yavatmal District of Maharashtra.

MATERIALS /INSTRUMENT USED

Plankton net, Sample bottles, Microscope slide, Microscope cover, 70% ethanol, Light binocular microscope and Pipette.

Sampling collection and data analysis

The experiment was between Feb. 2017 to March 2019. The samples of planktons (zooplankton and phytoplankton) were collected between 7 – 9 am twice in week. Samples were collected by Deeping the plankton net about 5cm below the water surface which are then transferred into samples bottles. Samples of 20 ml each were collected in each sample bottle with a duplicate and 10 ml of 70% ethanol was added into it. The samples were then stored for three days before laboratory analysis for planktons. In the laboratory, samples were decanted; the sediment was dropped on a microscope slide using a pipette and was cover with a microscope cover.

The samples were then viewed under a light binocular microscope with magnification of x25. The duplicate sediment was decanted and analyzed for comparison. Identification of planktons was carried out using a relevant reference. Planktons were identified up to species level. The frequency level and occurrence, number of abundance of each species in monthly samples were estimated. The data was recorded seasonally as summer, winter and Monsoon. The zooplankton samples were collected by filtering 50 to 60 litres of water through plankton net made up of bolting silk cloth no.22 and collected samples were fixed in 4% formalin. The qualitative analysis of the organisms is carried out using microscopic study. Samples were examined under the microscope in 10x and 3.2X magnification for identification of zooplankton. The Zooplankton are identified with the help of standard literature up to generic level by using standard keys of Edmondson(1963), Pennak (1978) Dhanapathi (2000) and APHA (2005).

III. RESULT AND DISCUSSION

The present research work reports the phytoplankton and zooplankton diversity composition from the lake of village Maisdodka and Wai. The species belongs to rotifer, copepod, protozoa, cladocera and ostracoda groups

in both the lakes. According to diversity, Rotifers indicated maximum diversity during the study period followed by protozoa, cladocera, copepod, ostracoda.

The present investigation showed different algal members belonging to different classes namely Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae. Chlorophyceae ranks first in all observations and next to Cyanophyceae, Bacillariophyceae was the third dominating group and Euglenophyceae are recorded few. Dominant species of phytoplankton observed in the lake. The main objective of the present paper is to determine the nutrient status of the reservoir. As the water content dissolved and suspended constituents in varying proportions, they have different physicochemical properties along with biological variations. Distribution of phytoplankton and zooplankton and their variation at different zones of a water body can be influenced by the physico-chemical parameters of water (Yeragi et al, 2003).

Environmental condition is the main controlling factor for the formation of the phytoplanktons and zooplanktons. Phytoplankton and zooplankton study provide relevant and convenient point of focus for research on the mechanism of eutrophication and its adverse impacts on an aquatic ecosystem. Phytoplankton and zooplankton are found to be temperature dependent particularly during summer and winter. Phytoplanktons encountered in the water body reflect the average ecological conditions and therefore, they may be used as indicator of water quality. The metabolic activities of the organisms depend on the physicochemical factors of their aquatic environment and these factors in turn play an important role in qualitative distribution of phytoplankton during different seasons (Joshi et al 1981, Munawar, 1970, Qadri and Yousuf, 1980, Ramanibai and Ravichandran 1987 and Sharma and Renu Sharma 1992). In Maisdodka and Wai reservoir, species belonging to chlorophyceae, Cynophyceae Bacillariophyceae, Euglenophyceae and Dinophyceae represented as true planktonic forms whereas the diatoms exhibited a mixed population consisting mostly the benthos species that are detached from substratum. The blue green algae also show a similar picture like diatoms. The green algae Chlorophyceae are found in varying number at all the three stations.

Table-1 : Seasonal variations of Phytoplankton of Maisdodka Lake and Wai lake during Feb.2017 to March. 2019

Sr. No.	Phytoplanktons	Maisdodka Lake			Wai Lake		
		Winter	Summer	Monsoon	Winter	Summer	Monsoon
1.	Chlorophyceae	1101	1403	1207	1126	1637	1346
2.	Cynophyceae	504	657	553	538	757	608
3.	Bacillariophyceae	706	1503	856	813	1323	978
4.	Euglenophyceae	257	804	458	348	727	459
5.	Dinophyceae	209	705	353	239	673	375

Table- 2: Seasonal variations of Zooplanktons in Maisdodka Lake and Wai Lake during Feb. 2017 to March 2019

Sr. No.	Zooplankton	Maisdodka Lake			Wai Lake		
		Winter	Summer	Monsoon	Winter	Summer	Monsoon
1.	Protozoans	249	449	168	254	501	199
2.	Rotifers	499	660	204	533	701	220
3.	Cladocerans	197	530	192	184	621	119
4.	Copepods	94	191	163	301	330	106
5.	Ostracods	84	93	69	93	83	57

IV. CONCLUSION

The present study reveals phytoplankton and zooplankton in the lake assessing the quality of water. The algal data has been used as an important tool in lake study. All the species observed in lake belongs to unpolluted water organisms. It indicates lake at present free from Pollution. Hence it can be safely used for different purposes such as drinking, agriculture, and for fisheries.

In the days to come algae will become the highly explored resource for energy remediation tools for a clean environment and nutrient rich food and food supplements for maintaining health. Therefore fundamental researches like the present work can be considered as a pre requisite for advanced researches on applying algae for human welfare.

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EFFECTS OF SOIL BACTERIUM ISOLATE ED-Y1 ON ENDOSULFAN DEGRADATION IN BASAL MEDIUM

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ABSTRACT

Endosulfan (1, 2, 3, 4, 7, 7-hexachlorobicyclo (2.2.1)-2-heptene-5, 6-bisoxymethylenesulfite) is a pesticide widely used all over the world. It was first released for commercial use 1954 [1]. India is one of the largest consumers of pesticides in South Asia [2]. According to the Indian Chemical Council, it is used extensively to control pests in a wide range of crops like cereals, tea, coffee, cotton, cashew, fruits, and vegetables. In present study, microorganisms were selected for their ability to release the carbon group from endosulfan and to use this as source of carbon for the growth. The enrichment was achieved and maintained by providing endosulfan as the only carbon source. Endosulfan is poor biological energy source, as it contains only six potential reducing electrons and previous attempts to enrich for endosulfan degrading microorganism using the insecticide as sulfur source have been not very successful. This selection procedure enriches for a culture capable of either the direct hydrolysis of endosulfan or the oxidation of the insecticide followed by its hydrolysis. In particular, enzymatic insecticide bioremediation is the focus of extensive study after the isolation of enzymes capable of detoxifying a range of organophosphate compounds from several bacterial species. An essential step in the investigation of an enzymatic method for endosulfan degradation is the definitive identification of a biological source of endosulfan degrading activity.

Keywords: Endosulfan, Microorganisms, Gas chromatography, Pesticides, Degradation, Oxidation

INTRODUCTION

Endosulfan is synthetic chlorinated cyclodiene that is an environmental endocrine disruptor. It was introduced into the earth's environment in 1956. It possesses a relatively broad spectrum of activity (Siddique *et al* 2003). Technical grade endosulfan is a mixture of two stereoisomers Alpha and beta endosulfan in a ratio of 7:1. It also acts as a poison to a wide variety of insects and mites on contact. During the study, the efforts have been made to develop a microbial system for biodegradation of endosulfan and evaluation of genotoxicity potential of endosulfan. There are varieties of soil microorganism that have ability to degrade the endosulfan. The degradation of endosulfan by soil microorganism of family *Pseudomonas* Sp. was studied. In microbial degradation of endosulfan under aerobic condition, soil microorganism degrades the endosulfan and yielded the endosulfan sulphate (30-60%), with some endodiol (2.6%) and endolactone (1.2%). As with the most pesticides, the persistence of and degradation of endosulfan are affected by the environmental conditions in which it is found. Endosulfan does not undergo direct photolysis but is transformed by the chemical hydrolysis under alkaline condition such as in sea water (Armburst 1992). In soil, endosulfan has been shown to be degraded by a variety of microorganisms (Katayama *et al* 1991). However degradation rates are usually low and metabolism often results in the formation of endosulfan sulfate, an oxidative metabolite shown to be equally as toxic and persistence as the parent compound, endosulfan. Because of its persistence and toxicity, endosulfan contamination poses a significant environmental concern. Microorganisms have increasingly been investigated as a source of xenobiotics-degrading enzymes (Chen *et al* 1998). We are interested in the isolation of endosulfan degrading bacterium for further investigation into enzymatic endosulfan bioremediation. The parenthetical numbers refers to the percentage of the applied endosulfan recovered as a metabolite. Sixteen of 28 fungi, fifteen of 49 soil bacteria and three of 10 actinomycetes metabolized greater than 30% of the applied C-14 endosulfan. Endosulfan sulphate was the major metabolite formed by the fungi and endodiol was the predominant product of the bacteria (Maier-Bode 1968). Since the removal of carbon moiety dramatically decrease the vertebrate toxicity of endosulfan (Stewart *et al* 1974), this results in concurrent detoxification of the insecticide. Results suggest that while both isomers can be degraded by microbial organisms, the degradation materials released counteract the growth of the microorganisms. Only a small amount of C-14 labeled carbon dioxide was detected, indicating minimal mineralization. Using endosulfan as the only available carbon source, we can enrich soil inocula for microorganisms capable of releasing the sulfur from the endosulfan, thereby providing a source of carbon for growth (Wegman *et al* 1978). In this study, microorganisms were selected for their ability to release the carbon group from endosulfan and to use this as source of carbon for the growth.

In this work we have studied the different process optimization parameters to obtain the maximum degradation. As part of the development of an overall strategy to manage organochlorine pesticide residues, the present study was aimed to isolate and characterize soil bacteria capable of degrading endosulfan. The nature of degradation of endosulfan by the isolated bacteria was examined using gas chromatography.

MATERIAL AND METHODS

1. Materials and reagents

Technical grade endosulfan was supplied from Department of microbiology Guru Nanak College of science, Ballarpur (M.S.). Technical grade endosulfan (used commercially) is a mixture of two diastereomers, alpha - endosulfan and beta - endosulfan in a ratio of 7:3, hexane (HPLC grade), and acetone. Standard chemical were used for the preparation of nutrient media. For the chemical and instrumental analysis, spectrophotometric grade chemical were used.

2. Sample collection for isolation studies

The soil sample for the enrichment and the isolation of the microorganisms was collected from the cotton field near Gadchandur (M.S) India at the end of growing seasons. The field had generally received several application of endosulfan in the month of September to October for at least 2-3 times. The soil was fertile gray. The top soil collected from the upper layer (approximately 15 cm) and stored at 4°C prior to the experimental studies.

3. Nutrient media for the enrichment of microorganisms

The endosulfan enrichment media for the isolation of microorganisms was prepared by the addition of following component (gm/lit). This media is actually a basal medium containing the endosulfan as a carbon source (Katkari *et al* 2015). KH_2PO_4 -0.5, K_2HPO_4 -0.5, NaCl -0.5, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ -0.5, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, CaCl_2 -0.002, NaMI_4 -0.001, CoNO_3 -0.0005, ZnSO_4 -0.0005, MnSO_4 -0.0005, Endosulphan-0.001, pH-7.2

4. Isolation of endosulfan degrading microorganisms

For the isolation of endosulfan degrading microorganisms, soil perfusion apparatus was designed. This work on the air pressure created by the vacuum. The small holes were made at the top and sand pebbles were kept over it for the support and slow perfusion of the soil sample to the medium which is kept at the bottom. The tap water is open to create air pressure; this air pressure is helpful for the aeration to the medium. The soil moistens with the media and perfused to the medium at the bottom. This process recycles continuously and microorganisms present in the soil enriched into the media. The endosulfan enrichment medium was added to the bottom. The sand pebbles were kept over the holes at the top. The fertile gray soil (approximately 10gm), and then the tap water is open such that the medium rises above the soil and soil sample slowly perfused to the medium. The apparatus were kept run for the 10 days. After the 10 days of incubation, the small aliquot of enriched soil inoculum were plated over the endosulfan enrichment agar. The different population of microorganisms on the endosulfan enrichment agar then achieved.

6. Identification of endosulfan degrading microorganisms

For the identification of single strain of isolates ED-Y1 following microscopic, morphological and biochemical studies were been carried out.

6.1. Microscopic Studies

Microscopic details of the isolate ED-Y1 have been done. The given isolates are whether Gram positive or Gram negative also been decided.

6.2. Morphological studies

Under the morphological studies, the various colonies characteristics like, shape color and growth pattern have been studied.

6.3. Biochemical studies

Following various biochemical tests have been carried out for each isolates; Indole, Methyl Red, Voges Prausker's and Citrate utilization test, Catalase test, Starch utilization test, H_2S reduction test, Nitrate reduction test, Urease test.

6.4. Sugar Fermentation Test

For the sugar fermentation test 0.5% NaCl. 0.5% peptone and 0.5% of the sugars were been added and incubated with the given isolate ED- Y1. The tubes were observed for the production of acid gas after 24 hours.

7. Analytical Method

7.1 Optimization of bacterial density

Optical densities at $\lambda 600$ of the endosulfan enrichment media incubated with the given isolates ED- Y1 were measured to assess the relationship between growth and metabolic activities of microorganisms, the bacterial growth of the isolate ED- Y1 were observed in response to endosulfan supplied as the source of carbon. The optical density of each isolates was measured with the interim of two days by the visible spectrophotometer and respective readings were recorded.

7.2 Optimization of pH of the Medium

The pH of the endosulfan enrichment media was measured in the order to assess the relationship between growth and metabolic activities of the microorganism. The change in the pH of the endosulfan enrichment media with interim of two days were recorded during the 10 days of incubation. The initial pH of the media was adjusted to 7.2.

7.3 Extraction of Endosulfan from the Media

Endosulfan was extracted from the enrichment media for the degradation studies. Approximately 25 ml culture media sample were taken out from the soil perfusion apparatus and equal volume of acetone (i.e. 25 ml) were added. The acetone - sample mixtures were shaken for 1 hr on the magnetic stirrer. 1ml of the mixture were taken out and transferred to 9 ml of hexane. These mixtures were then further shaken for 15 min (Siddique *et al* 2003). The sample was dehydrated by the addition of Na_2SO_4 . The sample is then store in vials at 4°C for the further analysis.

7.4 Quantitative Estimation of Endosulfan Degradation by Gas Chromatography

The quantitative analysis of endosulfan and its metabolite was done by gas chromatography-chemito model 1000 GC equipped with electron capture detector by using a glass column (8 inches length X 0.25 inch diameter). Nitrogen was used as carrier gas at the flow rate of 1.5 ml / min. The injected volume of sample in GC was 2 μl . The extracted endosulfan sample were been analyzed by Insecticide Residue Testing Laboratory, Nagpur.

EXPERIMENTAL RESULTS AND DISCUSSION

1. Microscopic and Morphological characters

The isolate ED- Y1 showed Gram Negative rod shaped cells arranged mostly separated. The colonies on the endosulphan enrichment media were red/pink colored, moist, pleomorphic with round shape. The cells were non motile.

2. Biochemical Test

The results of all biochemical test performed with isolate ED-Y1 are given bellow

Sr. No.	Name of The Test	Inference
1.	Indole Test	Negative
2.	Methyl Red Test	Positive
3.	Voges Proskauer's Test	Positive
4.	Citrate Utilization Test	Positive
5.	Starch Hydrolysis Test	Positive
6.	H_2S Hydrolysis Test	Positive
7.	Catalase Test	Positive
8.	Urease Test	Positive
9.	Nitrate Reduction Test	Negative
10.	Gelatin Hydrolysis Test	Negative

Table No.1 – Biochemical characterization of the isolate ED-P1

3. Sugar Fermentation Test

The result of sugar fermentation test of isolate ED- Y1 is given in the table below. From the result, it has been observed that all the isolate utilize the carbohydrate as a source of carbon and energy through enzymatic breakdown producing acid and gas (Sonnenwirth *et al* 1973).

Sr. No.	Sugars	Acid	Gas
1.	Glucose	+	+
2.	Manitol	+	-
3.	Lactose	+	+
4.	Maltose	-	-
5.	Ribose	-	-
6.	Sucrose	+	+
7.	Xylose	-	-
8.	Arabinose	-	-
9.	Mellibiose	-	-
10.	Raffinose	-	-
11.	Tetrahalose	-	-
12.	Cellobiose	+	-

Table No.2 – Sugar fermentation test of isolate ED- Y1

4. Identification of isolated strain of bacteria

From the results of microscopic, morphological and biochemical test, the isolate ED- Y1 has been identified as *Klebsiella* sp. The obtained result were studied and compared with standard results of respective bacteria (Hugh *et al* 1973).

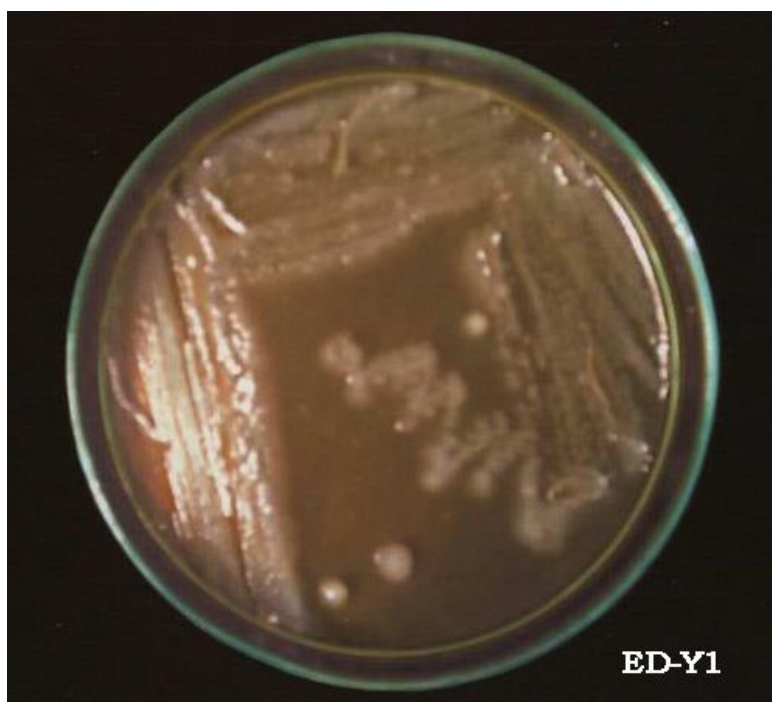


Fig. 1 – Pure culture of bacterial isolate ED- Y1 grown on endosulphan enrichment media isolated from mixed culture

5. Measurement of bacterial density

Optical densities ($\lambda 600$) of the respective isolate are represented in the figure.2. The highest OD₆₀₀ recorded for ED-Y1 was 0.41. As per the result, it has been found that the bacterial strain degrading more endosulfan within the culture media showed higher bacterial density.

Siddique *et al* (2003) was observed the same in that bacterial strain that depleted α and β endosulfan as a sulphur source. Sutherland *et al* (2000) and Awasthi *et al* (1997) who observed the substantial disappearance of the endosulfan with the simultaneous increase in the bacterial mass.

Bacterial density obtained with the isolate ED-Y1 are quite higher in comparison to Kwon G. S. *et al* (2005) who were worked with *Klebsiella Oxytoca*. The utilization of endosulfan was accompanied by the increase optical density (OD₅₉₅) of the culture media ranging from 0.51 to 0.89 as observed by Hussain *et al* (2007).

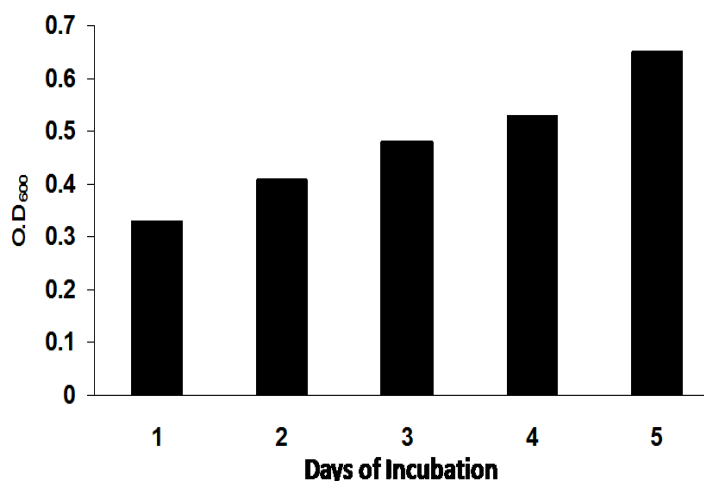


Fig. 2 - Variation in the O.D₆₀₀ of bacterial culture ED- Y1 after 10 days of incubation.

6. Measurement of pH of medium

The change in the pH of the endosulfan enrichment media after 10 days of incubation is shown in the figure 3. The culture pH decreased to acidic range due to metabolic activities of the growing organism. The isolate ED-Y1 showed the decreased pH of the medium to 4.12 after the 10 days of incubation. The results are very much similar to the work of Siddique *et al* (2003), Katkar *et al* (2019). It has been observed that the decreased in the pH of the medium was found to be associated with enhanced degradation of the endosulfan. With the interim of two day during each pH reading, pH decreased with the bacterial metabolism. The decrease in the pH may either be due to the dehalogenation of endosulfan resulting in the formation of the organic acid produced by microorganism during their metabolic activities.

Martens R. *et al* (1976) were observed that some of the bacteria which showed the pH value of 8.3 and 8.5 at the end of the experiment. This higher pH value was probably due to the chemical hydrolysis but some of the bacteria were having the low pH values which indicate that a large portion of degradation was enzymatic. Endosulfan is susceptible to alkaline hydrolysis occurring with approximately 10 fold increased in hydrolysis with each increased in pH unit. Many previous studies have been unable to differentiate between chemical and biological hydrolysis of endosulfan because microbial growth has led to the increased in alkalinity of the culture media (Guerin *et al* 1992).

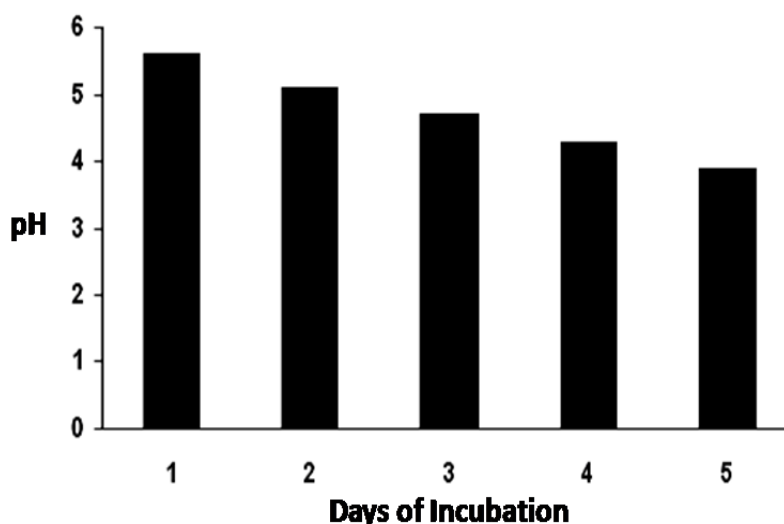


Fig. 3 - Variation in the pH of bacterial culture ED- Y1 after 10 days of incubation.

7. Degradation of Endosulfan by the Bacterial Isolate ED- Y1

The degradation of endosulfan was been confirmed by analyzing the sample by gas chromatography as shown in the figure 4. The degradation was determined by monitoring endosulfan disappearance by GLC-ECD detection. The bacterial isolate ED-Y1 degraded 79.1% (0.209 ppm) endosulfan after the 10 days of incubation. The initial concentration of endosulfan in the culture media was 1 ppm. The isolate ED-Y1 degraded 85.1% (0.149 ppm) of α -endosulfan and 93.5% (0.065 ppm) of β -endosulfan. The degradation of β -endosulfan was found to be higher

than that of α -endosulfan by ED-Y1 isolates. The result of this study suggests that the ED-Y1 isolate are a valuable source of potent endosulfan degrading enzymes for use in enzymatic biodegradation.

The endosulfan was used separately as a carbon source to identify which microorganism prefers endosulfan as a carbon source and to what extent endosulfan is degraded when used as carbon source. The obtained results are much similar to findings of Siddique *et al* (2003) who had worked on *Fusarium ventricosum* which degraded α -endosulfan upto 82.2% and 89.0% of β -endosulfan when endosulfan supplied as carbon source. The bacterium *Pseudomonas Spinosa* and *Pseudomonas aeruginosa* were the most efficient degraders of both α -endosulfan and β -endosulfan as they consumed more than 90% of endosulfan (Hussain *et al* 2007), (Katkar *et al* 2018). The *Klebsiella Oxytoca* biomass was rapidly increased to an optical density at 550 nm of 1.9 in 4 days and the degradation constants for α - and β -endosulfan, and endosulfan sulfate were 0.3084, 0.2983 and 0.2465 day⁻¹, respectively. (Kwon G. S. *et al* 2005).

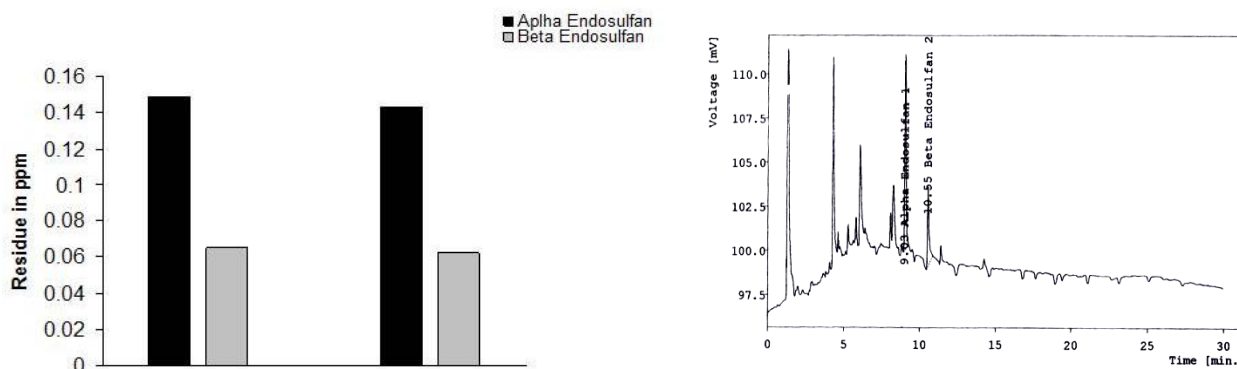


Figure 4- Gas chromatographic analysis of endosulphan degradation by isolate ED- Y1.

CONCLUSION

Using endosulfan as the only available carbon source, we can enrich soil inocula for microorganisms capable of releasing the sulfur from the endosulfan, thereby providing a source of carbon for growth. Microorganisms have increasingly been investigated as a source of xenobiotics-degrading enzymes. We are interested in the isolation of endosulfan degrading bacterium for further investigation into enzymatic endosulfan bioremediation. Since the removal of carbon moiety dramatically decrease the vertebrate toxicity of endosulfan, this results in concurrent detoxification of the insecticide. We report here on the resultant bacterial culture that, the culture degrades endosulfan to produce a novel metabolite not reported to occur as a result of chemical hydrolysis.

These results suggest that the obtained bacterial isolates ED-Y1 a potential source of an enzymatic bioremediating agent. We are currently attempting to isolate a pure bacterium from the soil that is capable of detoxifying endosulfan. Such a bacterium would potentially be a valuable source of catalytic enzymes for the development of bioremediating agent to reduce endosulfan residue problems in run-off from irrigation waters.

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STUDY OF ANTENNAL SENSILLA IN MEXICAN BEETLE ZYGOGRAMMA BICOLORATA (COLEOPTERA: CHRYSOMELIDAE) BY SCANNING ELECTRON MICROSCOPIC (SEM)**Rina S. Saha**

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INTRODUCTION

The mexican beetle *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) is a biocontrol agent of weed, *Parthenium hysterophorus* (Asteraceae: Heliantheae) (Withers, 1998). Both adults and larvae of *Z. bicolorata* are capable of feeding on leaves, terminal buds and leaf blades of *Parthenium*. It has proved highly effective in managing this weed, significantly decreasing weed density and flower production (Dhileepan et al., 2000).

Antennae in insects are organs of taste, smell and stimulation (Wigglesworth, 1972). The antennae also play kinetic roles and normally keep the nervous system in a state of tone in which it responds to stimuli of all kinds. Antennae of insects vary greatly in length, overall size, size of the individual segment, segmentation, setation and other aspects with the structures being closely related to their functions (Srivastava and Omkar, 2003).

Despite the importance of sense organs on the antennae of mexican beetle (for oviposition, feeding and mating) there is little information about it. Therefore, the objective of current study is to describe the ultrastructure of antennae in *Z. bicolorata* using scanning electron microscopy.

MATERIALS AND METHODS

The antennae of newly emerged Mexican beetle *Zygogramma bicolorata* (Coleoptera: Chrysomelidae) were carefully excised from the antennal sockets and washed thoroughly in distilled water. After washing, antennae were fixed in 70 % alcohol for a period of 12 hours. After which the antennae were dehydrated sequentially in ascending grades of alcohol followed by cleared in acetone. The antennae were observed under stereomicroscope to reveal the general morphology and the length of individual segments using an ocular micrometer. The air dried antennae were mounted on metallic stub which was precoated with carbon strip. The metallic stub with antennae was proceeded for the gold coating and scanned under the Jeol (JSM 6380 A) Scanning Electron Microscope (SEM) at Visvesvaraya National Institute of Technology (VNIT), Nagpur.

OBSERVATIONS AND RESULTS

A pair of antennae of adult Mexican beetle *Z. bicolorata* is located on the head capsule. The antenna consists of an elongated scape, followed by a pedicel and a flagellum of 9 segments. Each segment is called as flagellomere. The length of complete antenna from base to apex is measuring about $2502.25 \pm 66.65 \mu\text{m}$ (fig. 1, A). Surface of the antenna is covered with placoid scales and contain various types of sensillae on it. A pore like pit gland of $1.37 \pm 0.03 \mu\text{m}$ diameter is present throughout the surface of antenna (fig. 4, G and H). The terminal five segments are densely covered with sensilla.

A single segment scape is measuring about $240.65 \pm 14.29 \mu\text{m}$ in length and $172.05 \pm 9.25 \mu\text{m}$ in width (Table 2). Small numbers of sensilla trichodea type I and sensilla trichodea type II as well as curved sensilla trichodea type I and curved sensilla trichodea type II are found on the surface of scape (Table 1 and Fig. 1, B).

Pedicel is continued after the scape and composed of a single segment and fits in a comparatively large cavity at the distal end of the scape (Fig. 1, B). Pedicel is measuring about $163.85 \pm 20.82 \mu\text{m}$ in length and $122.85 \pm 13.08 \mu\text{m}$ in width. On the surface of pedicel sensilla trichodea type I and sensilla trichodea type II as well as curved sensilla trichodea are found (Table 1 and 2).

Flagellum is composed of a nine segments, first four segments are collectively called as funicle and last five segments are collectively called as club (Fig. 2, C and D). Flagellum is measuring about $2137.56 \pm 66.21 \mu\text{m}$ in length. The last flagellomere being the longest ($324.28 \pm 6.04 \mu\text{m}$) while the fourth flagellomere is shortest ($167.75 \pm 10.01 \mu\text{m}$) (Table 2). On the surface of funicle a small numbers of sensilla trichodea type I and curved sensilla trichodea type I are found. A very dense sensilla trichodea type I, sensilla trichodea type II, sensilla trichodea type III and sensilla trichodea type IV as well as curved sensilla trichodea type I and curved sensilla trichodea type II are found on the surface of club (Table 1). On the tip of distal segment of flagellomere a uniporous cones and multiporous pegs are observed.

Trichodea sensillae type I, II and III were found on all segments of the antenna of *Z. bicolorata*. This sensilla is innervated by a single sensory neuron, attached to the base of the hair shaft. The average length of sensilla trichodea type I, II and II was found to be 89.13 ± 3.36 , 55.53 ± 4.40 and 26.46 ± 1.63 respectively and average

width of sensilla trichoidea type I, II and II was found to be 2.53 ± 0.05 , 2.30 ± 0.08 and 2.05 ± 0.05 respectively (Table 3).

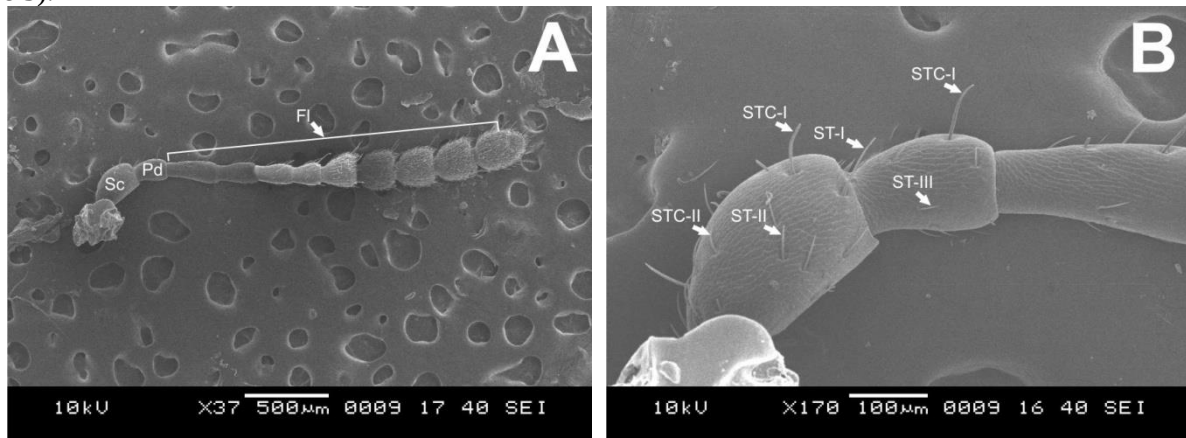


Fig. 1: Scanning electron micrographs of antenna of *Z. bicolorata*

A. General overview of antenna showing Scape (Sc), Pedicel (Pd) and Flagellum (Fl)

B. Magnified view of Scape (Sc) and Pedicel (Pd) showing ST-I, ST-II, ST-III, STC-I and STC-II.

Abbr.: Sc- Scape, Pd- Pedicel, Fl- Flagellum, ST- Sensilla Trichodea, STC- Sensilla Trichodea Curvata

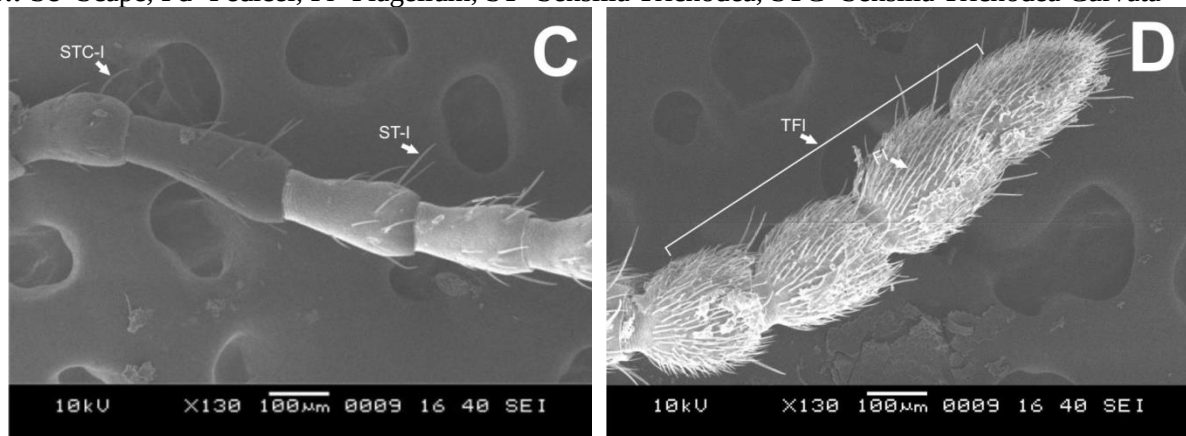


Fig. 2: Scanning electron micrographs of antenna of *Z. bicolorata*

C. General overview of Antenna showing Scape (Sc), Pedicel (Pd) and Flagellum (Fl)

D. Magnified view of Scape (Sc) and Pedicel (Pd) showing ST-I, ST-II, ST-III, STC-I and STC-II.

Abbr.: ST- Sensilla Trichodea, STC- Sensilla Trichodea Curvata, TFI- Terminal Flagellomere.

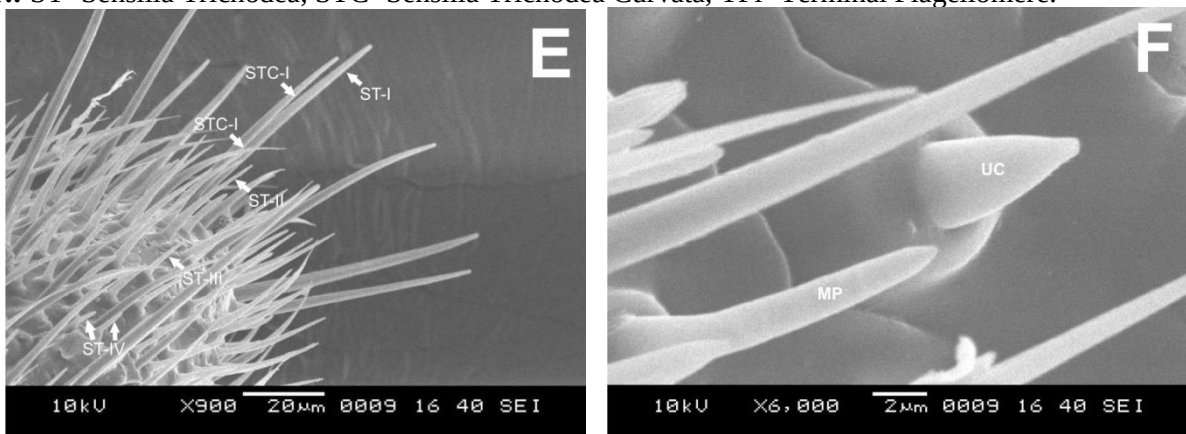


Fig. 3: Scanning electron micrographs of antenna of *Z. bicolorata*.

E. Magnified view of the tip of 1st flagellomere showing ST-I, ST-II, ST-III, ST-IV and STC-I.

F. Magnified view of Uniporous cone (UC) and Multiporous peg (MP) present on 9th flagellomere.

Abbr.: ST- Sensilla Trichodea, STC- Sensilla Trichodea Curvata, UC- Uniporous Cone, MP- Multiporous Peg

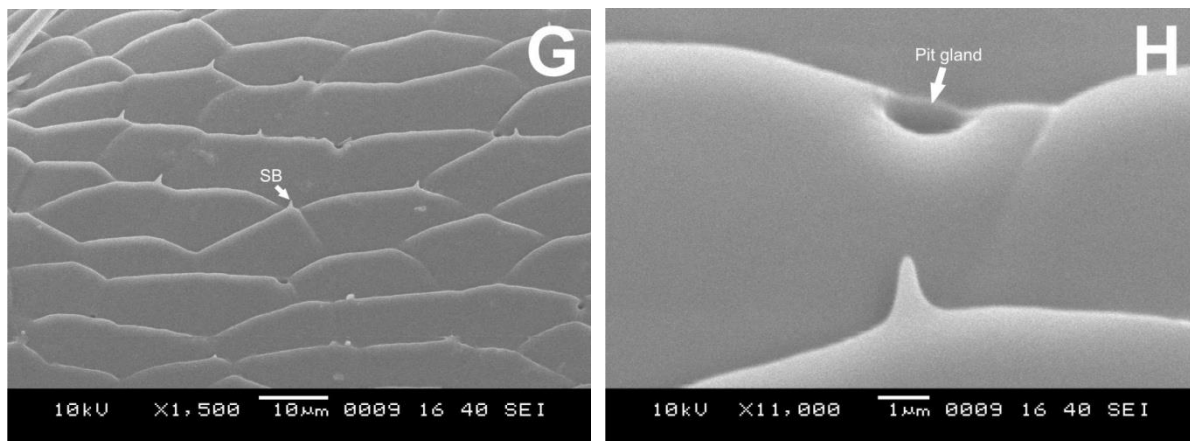


Fig. 4: Scanning electron micrographs of antenna of *Z. bicolorata*.

G. Magnified view of Sensilla Basiconica (SB).

H. Magnified view of pit gland. **Abbr.:** SB- Sensilla basiconica

	Type of Sensilla
Scape (Sc)	ST-I, ST-II, STC-I and STC-II
Pedicel (Pd)	ST-I, ST-II, ST-III, STC-I and STC-II
Flagellum (Fl)	STC-I, STC-II, SB, UC and MP

Table 1: Type of Sensilla present on Antenna of *Z. bicolorata*

	Length (μm)	Width (μm)
Scape (Sc)	240.65±14.29	172.05±9.52
Pedicel (Pd)	163.85±20.82	122.85±13.08
Flagellum (Fl)	2137.56±66.21	-
F-1	298.18±8.26	104.23±6.10
F-2	223.33±6.15	114.49±5.08
F-3	234.84±6.05	113.20±6.03
F-4	167.75±10.01	134.95±6.45
F-5	174.37±6.42	193.97±8.09
F-6	224.26±6.33	235.56±5.42
F-7	233.14±9.60	235.89±6.30
F-8	251.10±7.78	236.02±7.11
F-9	324.28±6.04	223.53±6.17

Table 2: Average length and width of various segments of Antenna of *Z. bicolorata*

Type of Sensilla	Length (μm)	Width (μm)
ST-I	89.13±3.36	2.53±0.05
ST-II	55.53±4.40	2.30±0.08
ST-III	26.46±1.63	2.05±0.05
STC-I	72.23±3.88	3.57±0.06
STC-II	42.56±2.72	3.45±0.11
STC-III	38.56±3.79	2.66±0.07
SB	1.45±0.03	0.63±0.03
UC	5.97±0.28	3.26±0.06
MP	12.38±0.49	1.61±0.04

Table 3: Average length and width of different type of sensilla found on antennae of *Z. bicolorata*

Abbr.: F- Flagellomere, ST- Sensilla Trichodea, STC- Sensilla Trichodea Curvata, SB- Sensilla Basiconica, UC- Uniporous Cone, MP- Multiporous Peg

DISCUSSION

In the present study the *Zygogramma bicolorata* demonstrates that it contains 09 morphologically distinct types of sensillae that play important roles in a number of behaviors. In other insect species the various types of sensilla are described by Hu et al., 2009. These sensilla are capable of responding to various stimuli, viz. olfactory, gustatory, tactile as well as thermoreception and hygroreception (Hansen, 1978; Altner and Prillinger, 1980; McIver, 1975 and 1985; Zacharuk 1980 and 1985). However, the variations in sensillum length did not appear to correlate with sex, species, or genus, and the sensillum length appeared not to correlate with the size of the antennae (Payne et al., 1973). Very dense sensillae present on the terminal flagellomere of the antenna. On the surface of scape and pedicel less number of sensilla are present as compared to number of sensilla present on flagellum.

Sensilla trichodea was the most abundant sensillar type on antenna of *Z. bicolorata*. This type of sensilla is described as long, slender, and hair-like (Ryan, 2002). In the present study it has been found that some trichoidae sensilla were curved which are called as curved trichodea sensilla. Mechanoreception is the most probable function of these types of sensilla (Zacharuk, 1985). Mustaparta (1973) found that similar sensillar types on the weevil *Hylobius abietis* (L) had either a mechanoreceptive function, or no receptor function, possibly acting as protective hairs (Bartlet et al., 1999).

Sensilla basiconica (SB) were present on a terminal segments of funicle which were compact and formed a sort of palisade. Morphologically *Z. bicolorata* exhibits similar structure to previously studied ant species, in *Tomicus* sp. (Wang et al., 2012) and *Dendroctonus valens* (Chen et al., 2010) and may function as contact gustatory receptors, perhaps involved in nestmate recognition (Ozaki et al., 2005; Nakanishi et al., 2009; Mysore et al., 2010). Antennal SB of fire ants, *Solenopsis invicta* are also known to function as contact chemoreceptors (Payne et al., 1973).

A uniporous cone and multiporous peg were found on the tip of antenna of *Z. bicolorata*. They were sunken in deep pits surrounded with a basal socket membrane and ended with a pore at its terminal tip. These sensilla were described for the first time in *N. pronuba* (Faucheux, 1990). These sensilla might be sensitive to carbon dioxide or humidity as a hygroreceptor or may be olfactory because the side wall is porous. They have also been reported in dipteran (Bay and Pitts, 1976).

Various types of sensillae present on the antennae revealed that antennae involved in the host selection and communication via olfaction was predominated in *Z. bicolorata*. This study herein supposedly stand to be the first attempt to describe the antennal sensilla of *Z. bicolorata* using scanning electron microscopy and might be considered as the first step towards future investigations of the odorant receptor. More detailed studies on the functional morphology of the antennal sensilla using transmission electron microscopy (TEM) coupled with electrophysiological recordings needs be conducted for confirmation of the function of the different sensilla.

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ESTIMATION OF BIOMASS AND BLUE CARBON STORAGE POTENTIAL OF A NATURAL TRUE MANGROVE STAND IN THANE CITY, INDIA

Aasawari Tak¹ and Umesh Kakde²¹Department of Botany, The Institute of Science, Mumbai**ABSTRACT**

The current investigation anticipated four different allometric relationships to estimate the total biomass blue carbon captured and removed by the natural mangrove stand in Thane city. Using random sampling plot method 13 plots with 0.04ha each, generated to facilitate measurements of trees. The total biomass of the natural mangrove stand observed was 61.95 t ha⁻¹. The total CO₂ removed (106.75 t C ha⁻¹) and carbon capture (29.11 t C ha⁻¹) in random sample plots of the natural mangrove stand in Thane city. The estimates acquired by the investigation suggest that by using different allometric equations, more relevant values can be obtain with respect to low species distribution of mangrove stand. The present study results should be valuable in mitigating the green house gas effects, as the mangroves have a large potential for the storage and removal of carbon in ecosystem.

Keywords: Allometric equations, Biomass, Mangrove, Ecosystem, Carbon removal, Green house Gases.

INTRODUCTION

The trees in association with microbes, plants and animals, which live at an interface between the sea and land, are referred to as mangroves. They serve as the most crucial integral part of the environment as they act as a sink of blue carbon storage and remove the carbon from the atmosphere during the process of photosynthesis. The entire mangrove forest area accounts for 0.7% of the total tropical forest in the world. They have significant potential storage of the carbon per unit area than other phytoplankton in tropical forests (Twilley et al. 1992). The term blue carbon refers to the total amount of carbon captured by the coastal ecosystem. Most mangroves (42%) are found in Asia, followed by Africa (20%), North and Central America (15%), Oceania (12%) and South America (15%). Mangroves ecosystem consist of tidal ecosystems, as they have both marine and semi-terrestrial components.

Mangroves are called halophytes and true ecotones, which can sustain in salt water all over the worlds tropical and subtropical regions. They have some adaptations such as aerial roots, which helps the plant in respiration with waterlogged lands and tolerance for saltwater (Alongi, 2009).

Mangrove ecosystems are the essential economic and ecological resource of fuel, food, mammals, aquatic fauna, nursery grounds for fish, storage of carbon sinks, proving protection to some coastal regions. According to the current scenario, 50% of the world's mangrove ecosystems have destroyed over in the last 50 years in spite of being their valuable ecological resources (Giri et al., 2010). Rapid constructions, urban developments, deforestations and conversion of mangrove land into the commercial activities are the root cause of degradation of mangrove ecosystems (Kathiresan and Bingham, 2001; Bann, 1997). Commercial industrialization and exploitation of mangrove forests, lead the investigation for better understanding. The recent data published on global mangrove carbon estimation indicates that 218 trillion grams of carbon produced by global mangrove ecosystem (Bouillon et al. 2008). As they store a large amount of carbon, their loss may affect the global carbon cycle. It was estimated that net loss of carbon from the worldwide stored by mangrove forests was of 3.8×10¹⁴g C (Cebrian, 2002).

Rehabilitation and restoration of disappearing mangrove forests will serve to carbon storage and thus in mitigating global warming issues. In this regards it is necessary to estimate the total biomass of mangrove trees, carbon captured and removed from restored areas. The current study focuses on the estimation of total biomass, carbon stored and removed by mangrove ecosystem by using allometric equations. It is a non-destructive method to understand the region-wise changes in biomass and to satisfy the various attributes in forest management and ecology (Komiyama et al. 2008; Wang, 2006).

MATERIALS AND METHODS**STUDY AREA**

This study was carried out in a natural mangrove stand located at Thane city, Maharashtra, India (19°12'N and 73°02'E). Mangrove ecosystem spreads over an area of about 3.5 sq. Km (i.e., 350 hectares (ha)) along the banks of Ulhas River in the North and Thane creek towards the Southeast of Thane city (TMCESR 2016-17). Although mangrove belt is little narrow along Ulhas riverbank but at stretches near Mumbra and Diva stations, the stretches are quite extensive and significant. The climate of the region is coastal, hot and humid. The

maximum temperature ranges from 35 to 40°C during summer, and the minimum temperature is between 25°C to 35°C during the winter months of November-January. The average rainfall is about 2500 mm received during the rainy season from June to the end of September.

SAMPLING STRATEGY

A non-destructive random sampling method was used for sampling the above ground vegetation. Given this, thirteen (13) circular random sample plots of 0.04ha each (diameter 22.68m and area 404 sq. m) were generated using Google maps utility for the study area (3.5 sq. Km, i.e. 350 ha). Sample plot-based method used in the study is one of the most commonly used ways for all kinds of vegetation sampling. A total of two species consisting of 93 living and standing trees were sampled from an area of about 0.52ha using circular plots of 0.04ha each.

DATA ANALYSIS

The study carried out by using four different allometric equations derived by researchers. Evaluation of above ground biomass (AGB) and below ground biomass (BGB) for *Avicennia marina* and *Bruguiera caryophylloides* as given in Table 1 and Table 2 respectively. The biomass, mean, maximum and minimum obtained by four methods are reported to know the upper, average and lower bounds of the biomass estimates. The total analyzed biomass (TB) was the summation of AGB and BGB per plot. Mean biomass for the mangrove stand was computed after taking summation and average for all 13 plots, which converted to tons per hectare (t ha⁻¹). The biomass carbon fraction was considered 47% as per IPCC guidelines (IPCC 2006). Carbon stock was calculated as the product of tree total dry biomass and carbon fraction. Equivalent CO₂ removed by the carbon stock was evaluated by multiplying 3.667 to carbon stock.

Table 1: Allometric equation for *Avicennia marina*

Method	Type	Allometric equation for <i>Avicennia marina</i>	R ²	Equation no.	Source
Method-1	AGB	= 0.308 * (D) ^{2.11}	0.97	1	Comley, B. W. T., McGuinness, K. A. (2005)
	BGB	= 1.28 * (D) ^{1.17}	0.80	2	
Method-2	AGB	= 0.1848 * (D) ^{2.3524}	0.9839	3	Dharmawan I. W. S., Siregar C. A. (2008)
	BGB	= 0.1682 * (D) ^{1.7939}	0.8581	4	
Method-3	AGB	= 1.8247 * (CD) ² * H ^{1.0202}	-	5	WeiguoFua, Yanyou Wu (2011)
Method-4	AGB	= Ws + Wb + Wl	-	6	Hossein Parvaresh, ElyasParvaresh, Ghavamaldin Zahedi (2012)
	Ws	= -17.217 + 18.346 * CD - 4.915 * CD ² + 0.521 * CD ³	0.96	7	
	Wb	= 0.074 * CD ^{3.269}	0.937	8	
	Wl	= - 9.61 + 10.904 * CD - 3.223 * CD ² + 0.339 CD ³	0.922	9	

Note: Table:1 Where, Ws - Weight of stem (kg); Wb - Weight of branches (kg); Wl - Weight of leaves (kg); AGB - Above ground biomass (kg); BGB - Below ground biomass (kg); D - Diameter at breast height (cm); H - Tree height (m); CD - Canopy diameter (m).

Table 2: Allometric equation for *Bruguiera caryophylloides*

Method	Type	Allometric equation for <i>Bruguiera caryophylloides</i>	R ²	Equation no.	Source
Method-1	AGB	= 0.186 * D ^{2.31}	0.99	10	Clough and Scott (1989)
	BGB	= 1.28 * (D) ^{1.17}	0.80		Comley, B. W. T., & McGuinness, K. A. (2005)

Note: Table: 2. Where, Ws - Weight of stem (kg); Wb - Weight of branches (kg); Wl - Weight of leaves (kg); AGB - Above ground biomass (kg); BGB - Below ground biomass (kg); D - Diameter at breast height (cm); H - Tree height (m); CD - Canopy diameter (m).

RESULTS

The ecologists have developed various methods to estimate the biomass of forests. These include destruction methods and non-destructive methods. In the destructive method, all trees to be destructively cutting order to obtain tree biomass. Hence, the destructive method is not suitable for mature forests. The non-destructive

method uses allometric equations to estimate tree biomass by measuring simple tree measuring parameters like diameter at breast height (DBH), tree height, and canopy diameter. The allometric relationship can be used for trunks in a multi-stem tree. Many studies commonly use allometric equations for single stem trees as well as for multi-stem tree forms, for example, *Rhizophora*, *Avicennia*, and *Excoecaria* species (Dahdouh Guebas and Koedam, 2006).

The allometric method is based on the assumption that one part of the tree is proportional to the other part. Therefore according to the other research worker, the DBH, tree height and canopy diameter are correlated with the trunk weight (Clough et al. 1997; Smith & Whelan 2006). Therefore, the allometric method is suitable to measure the changes in forest biomass at different time intervals by carrying out of subsequent measurements.

The four different allometric equations are available for estimating AGB of *Avicennia marina* (Equation 1, 3, 5, 6, 7, 8 & 9), while two allometric equations are available for determining BGB of (Equation 2 & 4), as indicated in Table 1. The single allometric equation is available for estimating AGB of *Bruguiera caryophylloides* (Equation 10). BGB of *Bruguiera caryophylloides* is determined as per equation 2, as given in Table 2. Coefficient of determination (R^2) for all the AGB equations is more significant than 0.92 while for all BGB it is greater than 0.8. The species composition, diameter at breast height and tree height were measured for the natural mangrove stand in 13 plots at Thane city as given in Table 3. The total number of trees recorded on the sampled plots were 93. Among them *Avicennia marina* was observed 96.7% and found to be the dominant mangrove species in Thane city. Different tree species, which co-exist at plot ID 1, was *Bruguiera caryophylloides*. The natural mangrove vegetation that was observed in the stand contains minimum DBH of 14.55 cm to a maximum of 47.00 cm, total height varying between 3.05 m to 10.97 m, while mean DBH and height were observed to be 25.5 cm and 6.64 m respectively. Maximum DBH and tree height was recorded for *Avicennia marina* at 47.00 cm and 10.97 m respectively. Plot ID 11 had registered the most number of trees (11) between all plots. The enormous girth of the trees attributed to the more significant amount of biomass storage.

Table: 3. Tree species composition and structure of natural mangrove stand in Thane city, Maharashtra, India, using non-destructive random sampling plot method

Plot ID	Location		No. of Trees	Tree Species	DBH (cm)				Height (m)			
	Lat.(Y)	Longi. (X)			Min	Max	Mean	SD	Min	Max	Mean	SD
#1	19.288049	72.975262	7	Am, Bc	18.60	29.11	25.18	4.34	6.40	8.53	7.32	0.83
#2	19.284936	72.979289	10	Am	25.87	30.72	27.81	1.71	6.71	10.67	7.96	1.45
#3	19.216384	72.998431	10	Am	17.79	30.72	22.80	4.51	3.51	8.99	5.38	1.66
#4	19.212648	72.997769	7	Am	16.17	29.11	20.67	4.91	3.66	7.77	4.99	1.45
#5	19.219268	73.003372	7	Am	16.17	27.49	19.98	4.73	3.60	7.16	4.65	1.41
#6	19.22012	73.00462	4	Am	16.17	17.79	17.18	0.77	3.81	4.02	3.94	0.09
#7	19.219464	73.004853	7	Am	16.17	27.49	20.67	4.98	3.66	7.32	4.92	1.46
#8	19.183648	72.982786	6	Am	14.55	17.79	16.30	1.19	3.05	4.02	3.47	0.35
#9	19.20734	72.995404	6	Am	22.30	30.11	26.10	2.79	6.40	10.97	8.23	1.61
#10	19.178635	72.980169	7	Am	24.10	35.00	29.49	3.79	6.10	10.97	8.84	1.53
#11	19.187515	72.98651	11	Am	22.21	36.11	29.95	4.18	6.75	10.97	9.23	1.24
#12	19.155893	73.039431	6	Am	33.80	35.20	34.57	0.55	6.10	10.97	9.55	1.80
#13	19.172146	73.048082	5	Am	37.00	47.00	40.80	3.96	6.40	8.53	7.80	0.85

Note: Am, *Avicennia marina*; Bc, *Bruguiera caryophylloides*; SD, standard deviation; Min, Minimum; Max, Maximum; Lat, Latitude; Longi, Longitude; ID, Identification; DBH, Diameter at breast height measured at 1.3m.

Table 4: Estimation and comparison of total biomass, carbon stock and carbon removed by natural mangrove stand in Thane city, Maharashtra, India, by allometric equations

Plot ID	DBH range (cm)	Tree height range (m)	Average AGB	Average BGB	Average TB	Average carbon stock	Average equivalent CO ₂ removed
			t ha ⁻¹			t C ha ⁻¹	t CO ₂ ha ⁻¹
1	18.60 - 29.11	6.40 - 8.53	52.61	11.29	63.88	30.02	110.09
2	25.87 - 30.72	6.70 - 10.67	63.35	14.24	77.42	36.39	133.43
3	17.79 - 30.72	3.50 - 8.99	58.10	13.66	71.91	33.80	123.92
4	16.17 - 29.11	3.65 - 7.77	24.25	5.60	30.08	14.14	51.83
5	16.17 - 27.49	3.59 - 7.16	31.20	7.65	39.13	18.39	67.43
6	16.17 - 17.79	3.81 - 4.02	8.93	2.41	11.49	5.40	19.80
7	16.17 - 27.49	3.65 - 7.31	34.18	8.01	42.44	19.95	73.15
8	14.55 - 17.79	3.04 - 4.02	14.90	3.64	18.80	8.83	32.39
9	22.30 - 30.11	6.40 - 10.97	74.13	10.92	84.92	39.91	146.34
10	24.10 - 35.00	6.09 - 10.97	54.65	9.93	64.41	30.27	111.01
11	22.21 - 36.11	6.75 - 10.97	107.04	19.61	126.15	59.29	217.40
12	33.8 - 35.20	6.40 - 8.53	77.43	13.17	90.01	42.30	155.11
13	37.00 - 47.00	6.40 - 8.53	71.51	14.16	84.65	39.79	145.89
Mean	16.30 - 40.80	5.08 - 8.53	51.71	10.33	61.95	29.11	106.75
SE	6678.92	0.48	7.79	1.34	9.00	4.23	15.50

Note:ID, Identification; DBH, Diameter at breast height measured at 1.3 m ; SE, Standard error. Mean AGB, Mean of AGB values estimated by all methods; Mean BGB, Mean of BGB values estimated by all methods; Mean carbon stock, Mean of carbon stock calculated by all methods; Mean equivalent CO₂ removed, Mean of equivalent CO₂ removed calculated by four methods, viz., Method-1 - Comley, B. W. T., McGuinness, K. A. (2005); Method-2 - Dharmawan I. W. S., Siregar C. A., (2008); Method-3 - WeiguoFua, Yanyou Wu (2011); Method-4 - Hossein Parvaresh, ElyasParvaresh, Ghavamaldin Zahedi (2012).

The total biomass (TB) was computed by adding estimated AGB and BGB (Figure 1). The maximum TB was 126.15 t ha⁻¹ on plot 11, the minimum TB was found 11.49 t ha⁻¹ on plot 6. The minimum and maximum total biomass by using four methods were 19.32 t ha⁻¹ and 92.14 t ha⁻¹. The average of the mean TB computed by four methods was 61.95 t ha⁻¹. The other researchers worked on mangroves of Thane creek reported TB of 74.6 t ha⁻¹ and carbon stock of 37.6 t C ha⁻¹, which is comparable with the present study (Chaudhari Pachpande, M. Pejaver, 2015). The biomass estimates of the natural mangrove stand of Thane city, Maharashtra, India was comparable with the values obtained by (Camacho et al. 2011). Camacho et al. 2011 also applied the allometric equations and recorded a total biomass 173.9 t ha⁻¹ to 984.0 t ha⁻¹ which is comparable 126.15t to 11.49 t ha⁻¹ with the present investigation. The biomass variation in the species is dependent on the geographical location as well as the environmental conditions of the various countries (Komiya et al. 2005).

As carbon stock is calculated by multiplying TB with carbon fraction (0.47) and equivalent CO₂ removed by multiplying carbon stock value with 3.67 both of them follows the same trend as that of TB. The maximum carbon stock and equivalent CO₂ removed was 43.31 t C ha⁻¹ and 158.79 t CO₂ ha⁻¹ respectively on plot 11. The minimum carbon stock and equivalent CO₂ removed was 9.08 t C ha⁻¹ and 33.30 t CO₂ ha⁻¹ respectively on plot 6 (Figure 1). The average of all the mean carbon stock and equivalent CO₂ removed was at 29.11 t C ha⁻¹ and 106.75 t CO₂ ha⁻¹ respectively computed by selected four methods (Table 2). The world is facing a significant problem of global warming, in which these intertidal mangroves ecosystem plays a vital role in balancing the atmospheric carbon cycle. These blue carbon sinks store a large amount of carbon in plant parts faster than terrestrial forests (Lawrence 2012).

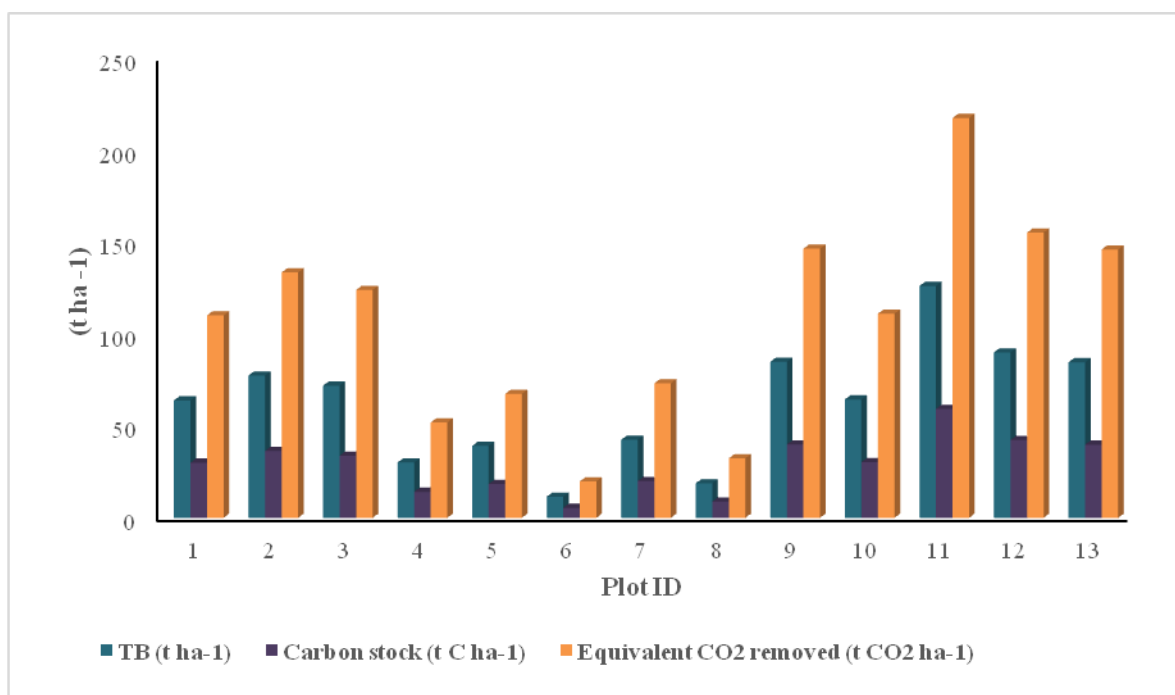


Figure 1: biomass carbon Summary of total carbon stock and equivalent CO₂ removed corresponding to natural mangrove stand in Thane city

The total reported area covered by mangroves in Thane city is 3.5 sq. Km i.e. 350 ha. Based on the sample plot results extrapolated to natural mangrove stand in thane city, mean AGB was estimated at 18,099.5 t, mean BGB was estimated at 3,616.5 t, mean TB was estimated at 21,681 t, mean carbon stock was estimated at 10,190 t C and equivalent CO₂ removed was 37,362 t CO₂.

DISCUSSION

In the present investigation, four allometric equations were used to know more relevant values for the estimation of total biomass, carbon stored, and carbon removed by natural mangrove stand by avoiding the destructive sampling method. By using four different allometric equations, study summed up with significant variations observed in total biomass, carbon stock, and the carbon removal by the natural mangrove stand was recorded. Variations recorded by the study could be correlated with the plot location, the difference in the size of tree species (diameter, height). The tree species with taller heights tend to acquire more carbon than those of smaller ones (Westoby, 1998; Westoby et al. 2002; Klimes'ova' et al. 2008). It is clear from the current study that dominant species in each plot were affecting on the above and below ground biomass, (Table 4), (Ruiz-Jaen and Potvin 2010). Also, it was observed that tree density and the canopy cover are the monitoring tools of an ecosystem because if the diameter of the tree is smaller with low density, lower will be the carbon stock and biomass of the forest. Gross et al. (2014), suggested that tree density can be used as a good indicator of natural carbon sequestration in the ecosystem. Hence, from the present study it is apparent that with the application of four different allometric equations for two different mangrove species, variations were recorded for each parameter. It may be due to the change in climatic conditions, locations of plots, and ecological conditions, tallness of aboveground vegetation, wood density, forest age, disturbance history, mineral sediment, amount of peat soil (Siikama'ki et al. 2012; Crooks et al. 2011; Kridiborworn et al. 2012; Baker et al. 2004; Goodale et al. 2002; Ksawani et al. 2007). Based on the above observations it can be said worth that higher is the height, diameter, and canopy of a tree, dominant species, higher will be the carbon captured, carbon removed and the total biomass respectively.

CONCLUSION

This investigation is one of the rare, valuable source of information, done by using four different kinds of allometric equations derived by other research scholars for the *Avicennia marina*; *Bruguiera caryophylloides*. The study revealed that comparisons between the four methods illustrated that, same species with the different study locations shows variation in the values such as total biomass, carbon stock, and carbon removal. To know the more relevant value of the same species with a different location, one can apply these four allometric equations for the more accuracy in results. In addition, the study suggests that the variations in above said parameters are subjected to environmental conditions, geographical cycles and dominance of the species. Considering the thrust of mitigating air pollution and reducing the greenhouse gas effects the current

investigation, suggest that mangroves can store a higher amount of carbon, and helps in its removal. Mangrove restoration will be a powerful tool in Future climate scenarios.

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AUTHOR CONTRIBUTION

These authors contributed equally to this work

CONFLICTS OF INTERESTS

All authors have none to declare

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SEASONAL VARIATION IN ACID PHOSPHATASE IN THE REPRODUCTIVE CYCLE OF LABEO ROHITA

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ABSTRACT

Labeo rohita is one of the important cultivable fish species in India and exhibits seasonal variation in its reproductive cycle. Acid phosphatase, a lysosomal enzymes present in almost all the vertebrates and has been studied in *Labeo rohita*. Reproductive cycle was classified into five subsequent phases with variation in enzyme activity in Gonads, Kidney and Liver. Acid phosphatase was observed to increase from resting to post-spawning phase. Significantly highest activity was noted in post-spawning and lowest in the resting phase. Finally we concluded that this enzyme may be important for the maturation of the gonads during the reproductive cycle and degradation during post-spawning phase. **Keywords:** *Labeo rohita*, Reproductive Phases, Acid Phosphatase.

INTRODUCTION

Acid phosphatases which belong to hydrolases class catalyse the hydrolysis of various phosphomonoesters in acidic medium (pH 5-6) to release an inorganic phosphate (Vincent et al., 1992; Miteva et al., 2010). These are present in animals (Stubberud et al., 2000; Siddiqua et al., 2008; Sazmand et al., 2011), plants (Demir et al., 2004; Gonnety et al., 2006; Kaide et al., 2008; Tabaldi et al., 2008) and lower organisms like protozoa (Amlabu et al., 2009) and fungi (Leitao et al., 2010). Acid phosphatases are frequently occurs in multiple forms (Fujimoto et al., 1984) and can be differentiated according to structural, catalytic, tissue distribution and localization (Suter et al., 2001).

Acid phosphatase enzyme is involved in various metabolic processes, such as permeability, growth and cell differentiation, protein synthesis, absorption and transport of nutrients, and gonadal maturation (Ram and Sathayanesan, 1985). Any change in acid phosphatase activities can affect the metabolism of the fish. In fisheries sciences, changes in phosphatase activities have been regarded as indices of growth, illness and spawning of fish (Goldemberg et al., 1987; Matusiewicz and Dabrowski, 1996). The present manuscript describes the biochemical properties acid phosphatase.

MATERIAL AND METHODS

Acid Phosphatase is estimated by the method of Lowry et al., (1954).

1. Tissue extract

Labeo rohita were killed by decapitation. Gonads, kidney and liver were dissected out in ice cold citrate buffer. These tissues were weighed and homogenized in a pre-chilled mortar and pestle taking 0.1gm tissue in 1ml of ice cold 50 mM citrate buffer (pH 5.3) and centrifuged at 10,000 rpm for 10 min. Supernatant was used as an enzyme source.

2. Preparation of substrate

1.49 gm EDTA, 0.84 gm citric acid and 0.03 gm p-nitro phenol phosphate was dissolved in 100 ml distilled water and pH was adjusted to 5.3.

3. Estimation

3ml of substrate solution was incubated at 37°C for 5min. 0.5 ml enzyme extract was added and mixed well. 0.5 ml was removed and mixed with 9.5 ml of sodium hydroxide (0.085N). This corresponds to zero time assay (Blank). The remaining solution (substrate + enzyme) was incubated for 45 min at 37°C. 0.5 ml sample was drawn and mixed with 9.5 ml NaOH solution. The absorbance of blank and incubated tubes was measured at 405 nm.

OBSERVATION

The results are summarized for male in Table 1 and Graph 1, 2 and 3 for female in Table 2 and Graph 4, 5 and 6.

A. Male**1. Kidney**

Acid phosphatase activity starts to increase from preparatory to spawning and maximum is in the postspawning phase. It declines in the resting phase, and then there is substantial increase in the preparatory phase. Lowest activity of acid phosphatase is in the resting phase.

2. Liver

Acid phosphatase activity is highest in postspawning phase. It starts to increase from prespawning towards spawning, declines slightly in the resting and further falls down in the preparatory phase.

3. Testes

There is an increase in the activity of lysosomal enzyme, acid phosphatase from preparatory to spawning and highest activity is observed in the early postspawning phase during which time the boundaries of seminiferous lobules break due to lysosomal activity and milt is released out. During resting phase when histologically sperm mother cells appear at the wall of lobules to renew spermatogenesis, lowest lysosomal activity is noticed.

B. Female

1. Kidney

In the kidney, highest activity of acid phosphatase is noted in postspawning phase. It falls down gradually in resting phase and in preparatory phase there is decline which is the lowest of all the phases. It slowly increases in prespawning and spawning phases then there is sudden spurt in lysosomal quantity in postspawning phase.

2. Liver

Acid phosphatase activity starts to increase from prespawning to spawning phases. It attains its maximum peak in postspawning phase. It declines further in resting and preparatory phases.

3. Ovary

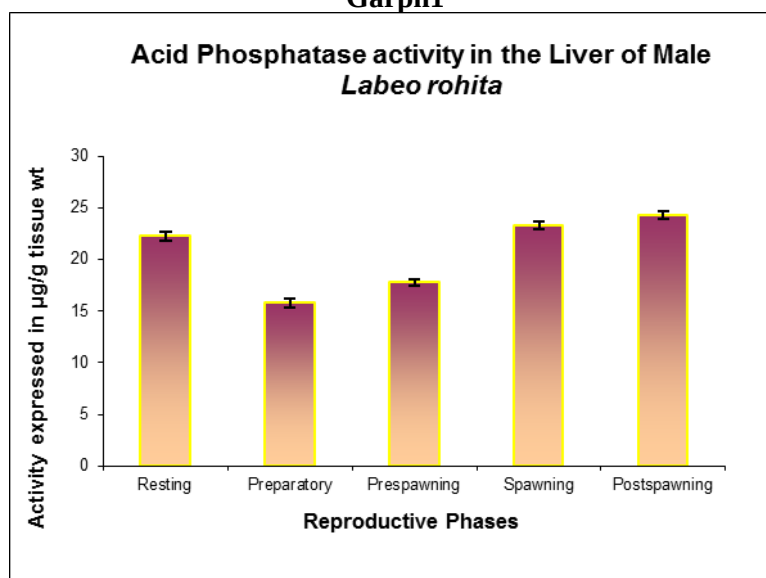
Activity of the enzyme Acid phosphatase in the ovary is highest in the postspawning phase. It decline slightly in the resting and preparatory phases. Lowest quantity is in the preparatory phase. There is a slight increase in acid phosphatase activity from prespawning to spawning phases but as oocytes atresia advances in postspawning, there is sudden rise in lysosomal activity amounting to the highest acid phosphatase in the ovary in this phase.

Quantitatively of all the three tissues studied, Kidney has highest amount of the enzyme Acid phosphatase, followed by Liver and Ovary in all the phases of the reproductive cycle.

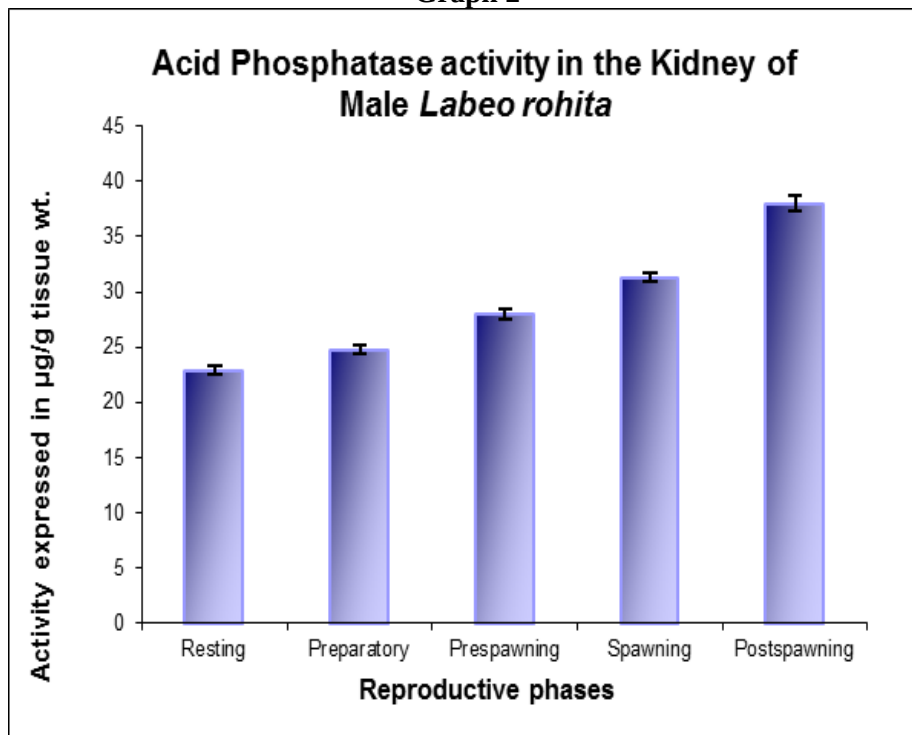
Table 1:- Acid Phosphatase activity in kidney, liver and testes of Male *Labeo rohita* during different phases of the reproductive cycle.

Phases	Liver	Kidney	Testes
Resting(Control)	22.3 + 0.41	22.9 + 0.36	7.63 + 0.55
Preparatory	15.8 + 0.43 P<0.001	24.8 + 0.38 P<0.001	13.0 + 0.54 P<0.001
Pre-spawning	17.8 + 0.30 P<0.001	28.0 + 0.41 P<0.001	14.0 + 0.50 P<0.001
Spawning	23.3 + 0.40 P<0.001	31.3 + 0.38 P<0.001	19.0 + 0.54 P<0.001
Post-spawning	24.3 + 0.40 P<0.001	38.0 + 0.74 P<0.001	26.3 + 0.53 P<0.001

Garph1



Graph 2



Graph 3

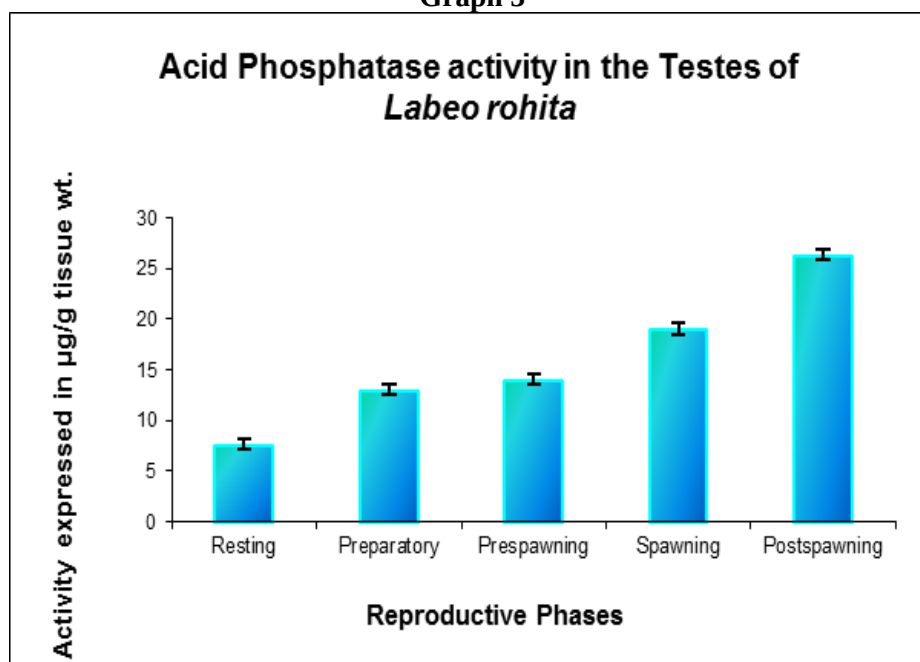
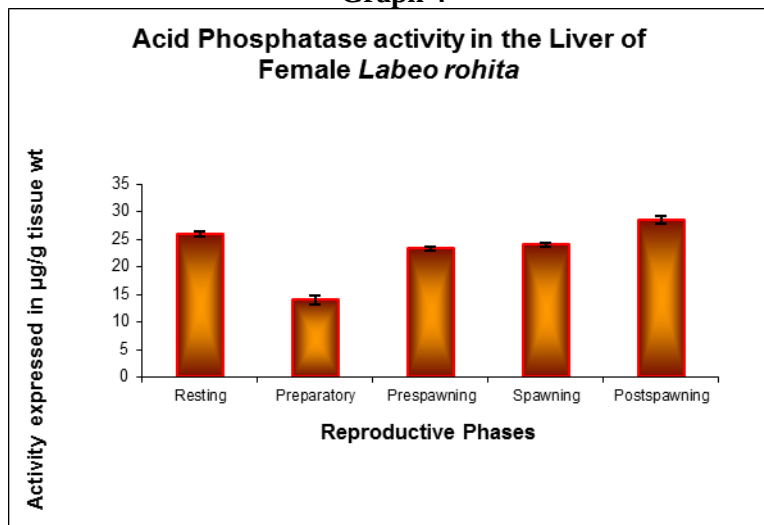


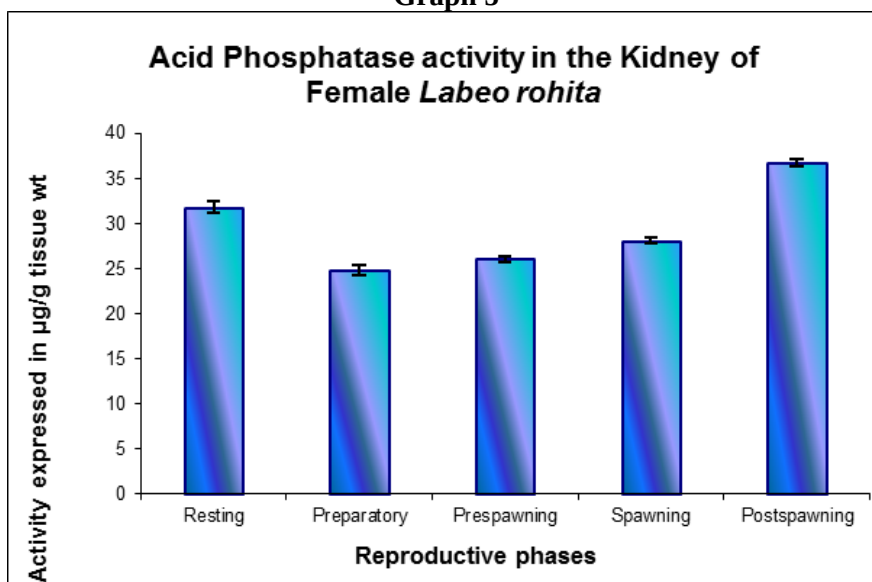
Table 2:- Acid Phosphatase activity in kidney, liver and ovary of Female *Labeo rohita* during different phases of the reproductive cycle.

Phases	Liver	Kidney	Ovary
Resting(Control)	26.0 + 0.41	31.8 + 0.66	10.3 + 0.40
Preparatory	14.0 + 0.71 P<0.001	24.8 + 0.56 P<0.001	8.25+0.35 P<0.001
Pre-spawning	23.3 + 0.4 P<0.001	26.1 + 0.31 P<0.001	9.36+0.48 P<0.001
Spawning	24.1 ± 0.39 P<0.001	28.1 ± 0.31 P<0.001	12.8±0.40 P<0.001
Post-spawning	28.6 ± 0.62 P<0.001	36.8 ± 0.4 P<0.001	15.8 ± 0.40 P<0.001

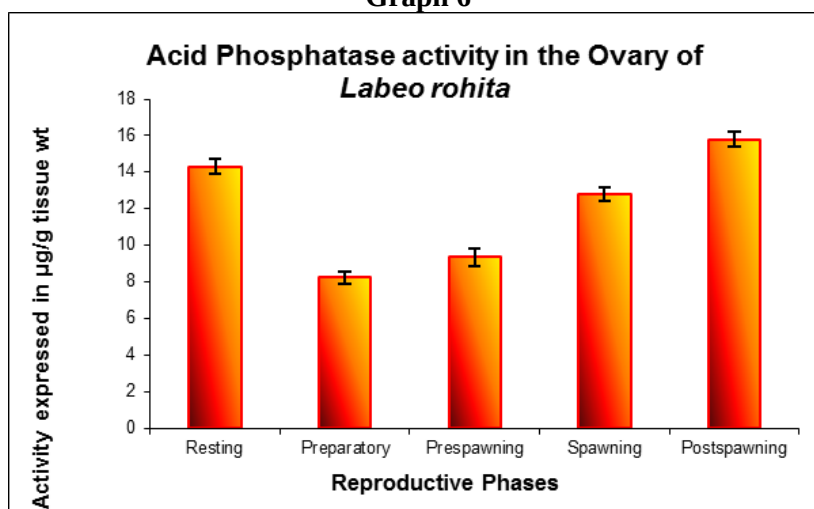
Graph 4



Graph 5



Graph 6



DISCUSSION

Enzymes such as acid phosphatase are implicated in lytic and degenerating processes especially in association with yolk protein degradation in Trout (Sire et al., 1994). Quantitatively acid phosphatase activity is minimal in resting phase and maximum in spent phase ($P < 0.001$). Acid phosphatase, a participant in cellular disintegration is a proven marker of lysosomal enzyme. Elevation in its activity is presumably related to increase in lysosomal

activity which occurs as a part of pre necrotic changes, increased pinocytosis and due to enzyme induction which is associated with degenerative changes and cellular disorganization (De Duve, 1969). In the spent phase acid phosphatase is as high as (26.3 ± 0.53) which is statistically the most significant ($P < 0.001$) rise. At the spawning time, wall of seminiferous lobules break down to release the milt and leftover spermatozoa are digested, probably involving lysosomal acid phosphatase which accounts for the maximum activity during the spent phase. There is gradual rise for this enzyme from resting phase onwards in *Labeo rohita*.

In *Schizothorax richardsonii* (Singh and Nauriyal, 1990), the activity was minimal during immature stage but increased again in spent phases. Singh and Nauriyal (1990) in *Glyptothorax pectinopterus* reported increase in acid phosphatase during immature phase which is contradictory to our findings. After spawning, testicular gland cells and ducts of testicular gland have a strong reaction for acid phosphatase in *Salapia pavo* which is the histochemical proof for lysosomal processes (Lahnsteiner et al., 1990).

As far as the ovaries are concerned in *Labeo rohita*, acid phosphatase activities present contrasting results as seen in the testes. Acid phosphatase content is highest in the spent stages of the ovary. In liver, maximum amount of this enzyme is estimated in the prespawning period in both the sexes and lowest is in the post spawning phase and this sudden reduction is statistically the most significant for males ($P < 0.001$) and females ($P < 0.001$).

De Duve et al., (1955) while determining the intracellular localization of various enzymes confirmed that a group of acid hydrolysis apparently existed in the cell in the form of particles bounded by lipoprotein membrane the so called latency of their contained enzymes. Thus lipoprotein bound particles containing acid hydrolases are released progressively by procedure which alter or damage the membrane allowing increased access to the substrate into the interior of the particle (Bitensky, 1962, 1963b; Gahan, 1965; Gahan and Maple, 1966. Besides its role in digestion, liver also acts as a storage organ for fats and carbohydrates (glycogen). It further has important function in blood cell destruction and blood chemistry, as well as other metabolic functions such as production of urea and compounds concerned with nitrogen excretion. All these functions may account for fluctuations in acid phosphatase activity.

CONCLUSION

For acid phosphatase activity, differential staining in various spermatogenetic stages could be clearly identified. Highest activity observed at prespawning ($P < 0.001$) in testis may be necessary in membrane transport because at this time almost all spermatogenetic stages are observed. Reduced activity during spawning may be because the development is almost completed and membrane transport enzymes are no more needed.

Increased acid phosphatase activity in spent phase of testis may be associated with degenerative processes and cellular disintegration as boundary walls of seminiferous lobules are broken and spermatozoa are released out in the form of milt. For the digestion of leftover spermatozoa, lysosomal acid phosphatase activity may be necessary which accounts for its maximum ($P < 0.001$) content during this phase.

Quantitatively maximum ($P < 0.001$) amount is estimated in prespawning phase and lowest ($P < 0.001$) in spent phases in both the sexes. These are in parallel with the gonadal enzyme contents. Acid phosphatase activity in kidney in spent phases in both the sexes and minimum ($P < 0.001$) in preparatory phase. It is reported to have well developed lysosomal system and high content of acid phosphatase which may be functioning in resorption of filtered proteins and other molecules.

Acid phosphatase is highest in both the sexes in postspawning phase and lowest in preparatory phase. This fluctuation is identical to that in the gonads. Liver is known to be one of the richest sources of enzyme acid phosphatase. As maturation of gametes proceeds, this enzyme activity slowly picks up, maximum being in the postspawning. When quantification of enzymes is compared in the three tissues in the males, acid phosphatase activity is maximum ($P < 0.001$) in all three tissues in postspawning phase as in females. In kidney it is 38.0 ± 0.74 in testes it is 26.3 ± 0.53 and in liver it is 24.3 ± 0.406 . In the females among kidney, liver and ovaries of *Labeo rohita*, enzyme acid phosphatase content is highest in all the tissues in post spawning phase and lowest in the preparatory phase. Highest content is in the kidney (36.8 ± 0.4) followed by liver (28.6 ± 0.62) and ovary (15.8 ± 0.4).

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PROXIMATE COMPOSITION ANALYSIS OF LITTLE MILLET (*Panicum sumatrense*)

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ABSTRACT

Little millet (Panicum sumatrense) is one of the oldest crops domesticated in India and is important minor millet grown in dry lands. In Karnataka Little millet is grown in different regions. Little millet contains several nutraceutical components owing the health benefits against the diseases. proximate analysis of Little millet, was evaluated providing the data that will guide the utilization of grains in food application. The proximate analysis revealed the presence of moisture 6.8%, crude protein 8.87%, crude fibre 7.6%, crude fat 4.76%, crude ash 1.21% and nitrogen free extract (carbohydrates) 70.7%. The above information may lead to understanding of a balanced basic diet, which may supply all the essential nutrients in suitable concentration to prevent or manage the metabolic diseases.

Keywords: Little millet, proximate analysis, metabolic diseases, Panicum sumatrense.

INTRODUCTION

Millet is in the family of cereals grown in different parts of the world for human consumption. Minor millets indicating utilization potential and variability including potential benefits in modern diets. Ignorance of balanced nutrition facts and the life style appears to be a common factor that governs the increased prevalence of metabolic disorders like Type-2 Diabetes Mellitus (T2DM), obesity, and cardiovascular disorders (CVD) and anaemia. Based on their consumption and cultivation pattern, millets occupy sixth place in the world food after wheat, corn, rice, barley and sorghum.

Most of the millets are grown in different regions of the world from east to west. The world total production of millet grain was 762712 metric tonnes and India top ranking with a production of 334500 tonnes in 2010 (FAO, 2012). Of the total 30.3 million tons of global millet produce, pearl millet accounts for about 15 million tons, foxtail millet 5 million tons, proso millet 4 million tons and finger millet for over 3 million tons. Minor millets offer several health benefits to the consumers as they are good source of dietary carbohydrates, protein, dietary fibre, minerals, and several other phytochemicals compared to rice or wheat (Hadimani, N.A and Malleshi, N.G 1993, Jayaraj et al., 1980).

Millet is one of the most important drought resistant crops and 6th cereal crop in terms of world agriculture production. Also millet has resistance to pest and diseases, short growing season, and productivity under drought conditions, compared to major cereals (Devi et al., 2011). Therefore, millet grains are now receiving specific attention from developing countries. In terms of utilization as food as well as from developed countries in terms of good potential in the manufacturing of bioethanol and biofilms (Li et al., 2008). Millets are considered as crop of food security because of their sustainability in adverse agro-climatic

conditions (Ushakumari et al., 2004).

Little millets (*Panicum sumatrense*) are hardy and can grow in adverse condition over various parts of India. Little millets are rich in B-vitamins and have nutritional value especially the presence of phosphorus and iron (Usha et al., 2011). Little millet resistance to adverse agro-climatic conditions of high drought as well as water logging. It is grown throughout India and a traditional crop of Karnataka. It has received comparatively little attention from plant breeders. The plant varies in height between 30 and 90 cm and its oblong panicle varies in length between 14 and 40 cm. It is mostly mix cropped with other millets, pulses and oilseeds. The seeds of little millet are smaller than those of common millet. It is generally consumed as rice and any recipe that demands staple rice can be prepared using little millet. In their Iron content, little millet are so rich that rice is nowhere in the race (Chandrasekara and Shahidi 2011a). Millets are the solution for the malnutrition that affects a vast majority of the Indian population.

MATERIALS AND METHODS**Collection of samples**

Little millet (*Panicum sumatrense*), was procured from the super market of Bangalore, Karnataka state, India. the samples were ground to fine powder by using pestle and mortar and the flour powder was sieved by 0.6 mm sieve and stored in cool and dry place for further analysis.

Chemicals and reagents

All the chemicals like acids were purchased from SD fine Chemicals, all chemicals used in the experiments were of analytical grade.

Proximate composition analysis of little millet

Proximate composition of a food grain is the relative proportion of moisture, dry matter, crude protein, crude fat, crude fiber, crude ash and carbohydrate, where in carbohydrate content were calculated by difference method. the analysis may be done the percent composition of different constituents were determined with respect to 100 moisture free sample.

Estimation of moisture content

The moisture content of the sample was estimated by AOAC Method 1990 and AACC 1983 mehod. Dry the empty dish and lid in the oven at 105⁰ C for 3 h and transfer to dessicator to cool. out Weigh the empty dish and lid. Weigh about 5g of the sample to the dish. Place the dish with sample in the oven. Dry for 3 h at 105⁰ C. after drying transfer the dish to the dessicator to cool. Reweigh the dish and its dried sample.

$$\text{Moisture content \%} = \frac{\text{Initial weight of sample} - \text{final weight of sample}}{\text{Initial weight of sample}} \times 100$$

Estimation of crude protein

Protein content of the sample was determined by the Kjeldahl method as modified by AOAC method 981.10. Sample (5 g) were digested by heating with concentrated H₂SO₄ in a digestion block using digestion mixture (K₂SO₄ and CuSO₄) as a catalyst. After digestion, samples were distilled using a steam distillation unit with 10M NaOH. Boric acid (4%) was used to trap ammonia from the distillation and the distillate was titrated with 0.2 NaOH using mixed indicator (Methyl red and bromocresol green in alcohol, 0.1%). Percent nitrogen was used to estimate percent protein concentration by means of a nitrogen-to-protein conversion factor 6.25. The blank reagent was also titrated similarly.

% Protein= (Vol. Acid – Vol. Blank) X 1.4007 X 0.2 N X 6.25/g sample.

Estimation of crude fat

The crude fat in the sample was estimated by described in AOAC Method 1990. 5g flour sample (w) was subjected to drying (AOAC Method 934.01) and the dried sample was transferred to clean and dry extraction thimble, which was packed with glass wool to permit the free flow of solvent. A pre-weighed clean and dry heating flask (w₁) was filled with petroleum ether fat was extracted at a condensation rate of 5 to 6 drops per second for 8 hours. After the extraction of fat, the ether was removed by Buchi type vacuum evaporator and the residual ether was dried in oven at 100°C for 30 min. The flask was then cooled in vacuum desiccator for 2 hr. and recorded the weight (w₂).

Percent crude fat was calculated as [(w₂–w₁)/(w₁–w)] x 100.

Estimation crude fibre

The estimation of crude fibre in little millet was performed by AOAC Method 978.10. The sample (5g, w₀) was hydrolysed by boiling with 150 ml of 0.25 N H₂SO₄ for 30 min. The suspension filtered, washed twice with hot distilled water and the residue obtained was hydrolysed by boiling with 150 ml of 0.313 N NaOH for 30min. The residue was washed with hot water and acetone. The crucible containing sample was dried in oven for 3 hr at 103°C and the weight recorded (w₁). The sample was then ignited in a Muffle furnace at 600°C for 3 hr and was held in an oven at 103°C for 1 hr and weight recorded (w₂).

Percent crude fibre was calculated as [(w₁–w₂)/(w)] x 100.

Estimation of ash

The crude ash in the powdered sample was estimated by AOAC Method 942.05. About 5g of sample was weighed accurately into cleaned porcelain crucible. The sample was completely charred Followed by heating, the crucible should be kept in muffle furnace for about 3-5hrs at 600°C. Cool the crucible in desiccators and weigh. At the end of the process the ash content will be in whitish grey colour

$$\% \text{ ASH CONTENT} = \frac{\text{Initial weight of dish} - \text{final weight of dish}}{\text{Initial weight of dish}} \times 100$$

Determination of nitrogen free extract

Nitrogen Free Extract (NFE) or soluble carbohydrates of sample was determined by difference method

$$\%NFE = 100 - (\% \text{ moisture} + \% \text{ crude protein} + \% \text{ crude fat} + \% \text{ crude ash} + \% \text{ crude fibre}).$$

$$\text{Energy value} = \% \text{ protein} \times 4 + \% \text{ carbohydrate} \times 4 + \% \text{ Fat} \times 9$$

RESULTS AND DISCUSSION

The results on the proximate composition of little millet (*Panicum sumatrense*) is prescribed in table 1. The moisture content of Little millet (*Panicum sumatrense*) was found to be 6.8%. The moisture content in the literature was reported by Lydiya Vandana.,(2018); Mallikarjuna Y Kamatar et al.,(2013); Hulse et al.,(1980); Priyadarshani P Deshmukh et al.,(2017); U Ravindra et al.(2008) as 5.9% ,5.74% , 9.7%, 10.68%, 11.38% and T Thilagavathi et al.,(2015) as 11.83% respectively. Lowest the moisture content, higher shall be shelling percentage and length of shelf life of grains. Little millet had the lowest moisture content.

The crude protein in the little millet was estimated to be 8.87%. The literature showed that T Thilagavathi et al.,(2015) as 8.66%, Mallikarjun Y Kamatar et al.,(2013) as 7.09%, Kavita B Patil et al.,(2015) as 7.45% , Hulse et al.,(1980) and Kundgol et al.,(2014) as 9.7% and 7.57% respectively. The fibre is the one of the major component. The crude fibre in little millet was found to be 7.6%. Our results on the crude fibre in the little millet are matches well with Hulse et al.,(1980) as 7.6%. the literature showed that T Thilagavathi et al.,(2015) reported as 7.73% ,Lydiya Vandana (2018) as 6.1%.

The crude fat observed by soxhlet apparatus is 4.76%.the literature reported that Mallikarjun Y Kamatar et al.,(2013) as 4.70%, T Thilagavathi et al.,(2015) as 4.92%, Roopa et al. (2013) as 4.97% and U Ravindra et al.,(2008) as 5.09%. Ash content in the little millet was found to be 1.21%. Priyadarshani P Deshmukh.et al.,(2017) showed as 1.41% and U Ravindra et al (2008) as 1.95%.

Carbohydrate is an important fuel nutrient. Millets in general are reported to contain lower carbohydrate content than the staple cereals (Gopalan, C et al.,2008). In the present investigation, the nutritional computation revealed carbohydrate content of little millet to be 70.76%. the literature showed that carbohydrate content by Priyadarshani P. Deshmukh et al (2017) as 76.64%, Lydiya Vandana.,(2018) as 67.5% and Roopa et al. (2013) as 70.47%.

Table 1. Proximate composition of little millet

Component	g/100 g
Moisture	6.8
Crude protein	8.87
Crude fibre	7.6
Crude fat	4.76
Ash	1.21
Carbohydrate	70.76

CONCLUSION

The proximate analysis of the little millet gave an idea for its chemical composition which as a significant amount of protein and fiber and had low fat content. hence various products may be developed to achieve nutrition security.

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PRESENT HEALTH HAZARD IN GLASS INDUSTRIES AT FIROZABAD, U.P., INDIA

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ABSTRACT

Glass industries at Firozabad district are completely non-mechanical, age-old, traditionally cottage and household industries. A detailed study of the processes used here and health hazards along with recommendations to encounter these issues has been systematically dealt with in this paper. It deals with all possible outcomes and their alternate solutions. This paper deals with common problems prevailing the glass industry and tries to find a better method for their concerns.

The district of Firozabad is situated between 27°-27°24' north latitude and 70°0' and 70°04' east longitude in the south-western corner of Uttar Pradesh. It is situated at about 30 km east of Agra district. It is bound by Etah District in the north, Etawah Distt. in the east and Mainpuri District in the south. The district comprises of an area of 2,84,756 ha. The total population of the district is 15,77,263 of which 9,53,319 resides in rural area and 6,23,944 in urban area. The National Highway no. 2 passes through the heart of the district connecting it with other important cities in the country.

Though the factories are scattered all over the city, but they are mainly spread up to 15-20 km of Firozabad in rural areas till Shikohabad. The industries are located in south-west, south-east and southern part of the town. Two types of glass units are established in Firozabad: glass bangles and glass wares. The glass bangle industry shows a more rapid growth pattern than glass wares industry by 50% increase. The glass bangle industries can be grouped under the following three groups:

1. The glass blowing factories with 600-1200 workers and total capital investment Rs. 25-50 lakhs.
2. Glass bangle units in which the average number of workers employed is 200 and capital investment is about 10-25 lakhs of rupees. These are the main industrial units of the city.
3. Glass bangle units in which the total capital investment is less than 4 lakhs and the average number of workers employed is 50. These units produce decorative items but are much less in number.

At present there are 334 registered units in the Firozabad district engaged in the manufacture of glass and ceramics. These comprise of 179 glass bangle units, 53 block glass making units, 17 units making glass wares, 26 units manufacturing glass shades and 59 units engaged in the manufacture of pottery, ceramics and refractory.

Keywords: Glass bangles, Glass wares, sand, Quartz, Limestone

TYPES OF TECHNOLOGY IN GLASS INDUSTRY

Glass is essentially a super cooled liquid. Glass consists of compounds of silicates with alkaline and alkaline-earth oxides and the raw materials for glass manufacture are still (as they were in ancient times) sand, soda and limestone. Though there are many recipes for making glass, one common method followed in Firozabad is as below:

RAW MATERIALS

59 parts of quartz sand, 17 parts of soda, 15 parts of quartz, 4.5 parts of limestone, 3 parts of sodium sulphate and carbon and 1.5 parts of feldspar along with cullets (broken waste glass as flux).

PROCESS

The following points are important from the viewpoint of environmental and health hazards in the manufacturing process of glassware and glass bangles:

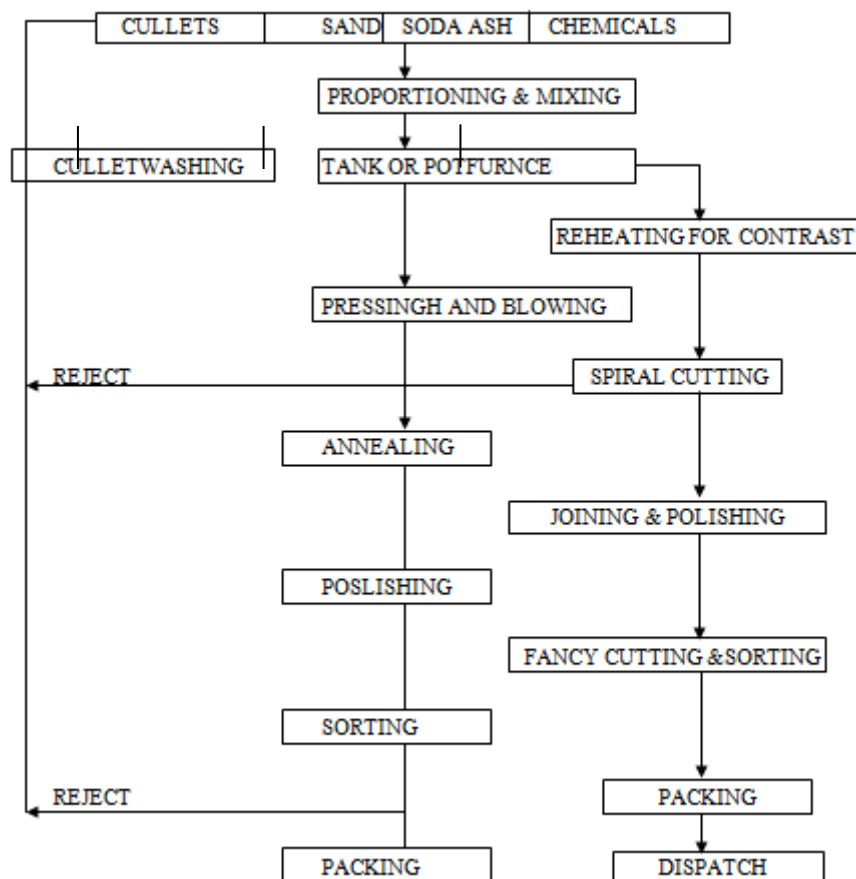
1. The workers mix the unconsolidated raw materials by manual method at extreme risk of inhalation of toxic substances as they do not wear any mask of any type.
2. The workers are exposed to high temperature, coal ash and smoke, with the result that they suffer from bronchial diseases. Furnaces with low chimneys also create environmental problems for neighboring residential areas.

3. The workers (semi-skilled) collect molten glass from the furnace on rods and move around to the moulds and presses. The moulds and presses are placed close together in a cramped environment and there is danger of accidents due to physical contact with hot glass rods and flying glass pieces.
4. The persons involved in glass blowing also run the risk of lung damage and burns by inhalation of hot air.
5. In glass bangle industry the work of judaiya (i.e., joining of cut bangles) is most hazardous as the workers are exposed to fumes of kerosene lamps placed in closed non-ventilated rooms. This work of jurai is mostly done by female workers.

HEALTH IMPLICATIONS OF THE INDUSTRY

Apart from being scorched as a matter of course, the workers involved in the glass industry also inhale silica and carbon dust leading to asthma, bronchial spasms and a host of other respiratory diseases¹. Further, Firozabad has the highest incidence of tuberculosis in U.P. due to the constant inhalation of foreign particles. Doctors confirm that workers develop skin diseases like eczema after working within the close confines of both home and workplace. Their eyesight is strained from looking continuously into the blinding bright light of furnaces, and they get burns, abrasions and cuts from handling labias in a limited space.

What worries workers more than all this, however, is the possibility of suffering from heat stroke, exhaustion and the loss of salts through perspiration.



* Indicates the bangle manufacturing process

In this uniformly depressing scenario, the plight of women is worse. Firozabad is full of women patients.

According to surveys five to ten years of exposure to an average heat of 55°C everyday can lead to cancer. At the simplest fatigue, chronic anemia, retardation of growth, muscle cramps, irritability and a general feeling of ill health are the outcomes of this kind of exposure. Most workers employed in these glass factories for over five years have, in fact, complained of these symptoms.

RECOMMENDATIONS

The efforts through this study have been concentrated on the identification of major problems concerning the glass industries at Firozabad and formulation of policy recommendations to encounter these issues. Hence, the following proposals are formulated:

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1. Subsidies and incentives should be given to the glass unit owners in the form of provision of coal and other infrastructural facilities like power and fuel subsidy, technical assistance to entrepreneurs etc.
 2. Revitalizing Government Undertakings for the purpose of:
 - (a) Propagation of sophisticated modern technology for industrial process, combined with efforts to maintain employment potential by enhanced production and diversification into export market.
 - (b) Precautionary measures and pollution control services etc. for safety of workers as well as environment:
 3. Strict licensing policies should be adopted to monitor availability of facilities like drinking water, toilets, first aid and safety measures for workers such as protective gloves, headgear, footwear and goggles in the factories.
 4. Provision of alternate sources of fuel such as petroleum gas should be provided with a view to stop coal consumption, thus reducing pollution levels and at the same time enhancing quality of production.

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COMPARATIVE INSILICO STUDY OF PHOSPHOLIPASE-A2 FROM VENOM OF FOUR MAJOR INDIAN SNAKES SPECIES.

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ABSTRACT

The Dense and dark forest of India are best habitat for the reptiles too, these forest offers a wide range of home for giant snakes and abundant pray. There are 270 species of snakes in India out of which about 60 are highly venomous. The big four dangerous snakes of India includes Najanaja, the spectacled cobra Bungaruscaeruleus, the common krait. Daboia russelii, Russell's viper Echiscarinatus, the saw-scaled viper. Venom of snakes is neurotoxic or haemotoxic. Venom of snakes contains different peptide chains. PLA2 is one of the important enzyme. Here we study it in silico for its antigenic determinants. As our knowledge of the immune responses to a protein antigen progressed, it became clear that the whole protein is not necessary for raising the immune response, but small segments (NACAASVCDCLAAICFAG" 83-102 aa of Najanaja) of protein called the antigenic determinants or the epitopes are sufficient for eliciting the desired immune response.

Keywords: *Venom, In Silico prediction, PLA2, Antigenic Determinants, Najanaja*

INTRODUCTION

Venom is a form of toxin secreted by an animal for the purpose of causing harm to another.[1] Venom is injected into victims by means of a bite, sting or other sharp body feature,[2] which differentiates it from poison (that is absorbed, consumed or inhaled). The potency of different venoms varies; lethal venoms are often characterised by the median lethal dose (LD₅₀, LD50, or LD-50), expressed in terms of mass fraction (e.g., milligrams of toxin per kilogram of body mass), that will kill 50% of the target of a specified type (e.g., laboratory mice).

Utilization of venom across a large amount species demonstrates an example of convergent evolution and a homoplastic trait. It is difficult to conclude exactly how this trait came to be so intensely widespread and diversified. The multigene families that encode the toxins of venomous animals are actively selected on, creating more diverse toxins with specific functions. Venoms adapt to their environment and victims and accordingly evolve to become maximally efficient on a predator's particular prey (particularly the precise ion channels within the prey). Consequently, venoms become specialized to an animal's standard diet.^[3]

The reptiles most known to use venom are snakes, some species of which inject venom into their prey via fangs.

Snake venom is produced by glands below the eye (the mandibular gland) and delivered to the victim through tubular or channeled fangs. Snake venoms contain a variety of peptide toxins, including proteases, which hydrolyze protein peptide bonds, nucleases, which hydrolyze the phosphodiester bonds of DNA, and neurotoxins, which disable signalling in the nervous system. Snakes use their venom principally for hunting, though they do not hesitate to employ it defensively. Venomous snake bites may cause a variety of symptoms, including pain, swelling, tissue necrosis, low blood pressure, convulsions, hemorrhage (varying by species of snake), respiratory paralysis, kidney failure, coma and death.

Scientists believe the origin of snake venom began with gene duplication of genes that had been expressed in the body tissues of ancestors. Due to subfunctionalization, in which an ancestral function is split between the copied genes, one of the duplicates becomes limited to only the venom (salivary) gland and as a result, evolves in to the toxin producing gene. Data has shown that pre-existing proteins in the salivary glands were the origin of the toxins in snake venom. Some researchers have come to see snake venom as just "a modified form of saliva," instead of an entirely recruited set of proteins from various tissues throughout the body.^[13]

The composition of snake venom can vary within a species due to diet variation, which is caused by differences in geological location

1. Najanaja, the spectacled cobra
2. Bungaruscaeruleus, the common krait.
3. Daboia russelii, Russell's viper
4. Echiscarinatus, the saw-scaled viper

These are the four venomous snake species responsible for causing the most human snake bite cases in South Asia (mostly in India). They are referred to as the big four. Snake venom is highly modified saliva containing zootoxins that facilitates the immobilization and digestion of prey, and defends against a threat. It is injected by unique fangs after a bite but some species are also able to spit.

Snake venoms are cocktails of enzymes and non-enzymatic proteins used for both the immobilization and digestion of prey. The most common snake venom enzymes include acetylcholinesterases, l-amino acid oxidases, serine proteinases, metalloproteinases and Phospholipases A₂ (14). Phospholipase A₂ is the major enzymatic content of snake venom.

Phospholipase A₂ (PLA₂)(neurotoxin)

Phospholipase A₂ (PLA₂) like Cholinesterase is a common neurotoxin present in snake venom. Various neurotoxins have been found to have similar amino acid sequences. Inhibitors of various venom proteases are important to understand their biological role and ways that their enzymatic activity can be altered. PLA₂ disrupts biological membranes and can lead to permanent damage or even lysis (splitting or breaking of cells). The various physiological effects of PLA₂ are determined by the type of receptor to which it binds. Receptors include N- receptors (neurological- III) and M-receptors (muscular- bind only I & II). It may act pre- or post-synaptically at the neuromuscular junction by binding to acetylcholine receptors (N-receptor). The binding of PLA₂ to acetylcholine receptors block the binding of acetylcholine, which causes flaccid (limp) paralysis. The binding of the receptor affects in a variety of ways in different muscles. This suggests that there are differences in affinity of the binding in different muscle types. Respiratory failure often accompanies the paralysis because there is likely a high affinity for PLA₂ in phrenic nerve-diaphragm endplate receptors.(15). Antigenic epitopes on PLA₂ protein (*Naja naja*, *Bungarus caeruleus*, *Daboia russelii*, *Echiscarinatus*,) are important determinants.

MATERIALS AND METHOD

1 Database Searching

Genomic databases are used to Store the vast amount of information issuing from the genom projects. There are many different types of databases available, but for routine protein sequence analysis, primary and secondary, Genbank (16), Uniprot (17) databases are initially the most important(18). We searched and retrieved genome protein sequence of PLA₂ protein (*Naja naja*, *Bungarus caeruleus*, *Daboia russelii*, *Echis carinatus*,) sequences are downloaded directly in FASTA format (19). For ease of use sequences was retrieved from web sites are as-
www.ncbi.nlm.nih.gov.

2 Prediction of antigenic peptides

This program predicts those segments from within a PLA₂ protein (*Najanaja*, *Bungaruscaeruleus*, *Daboia russelii*, *Echiscarinatus*) sequence that are likely to be antigenic by eliciting an antibody response. Antigenic peptides are determined using method of Kolaskar and Tongaonkar (20) Prediction are based on a table that reflects the occurrence of amino acid residues in experimentally Known segmental epitopes. Segments are only if they have a minimum size of residues (<http://www.mifoundation.org>)

Method Specification- Program- Prediction antigenic peptides.

Method - Antigenic Prediction.

Protein Sequence - PLA₂ Protein (*Najanaja*, *Bungaruscaeruleus*, *Daboia russelii*, *Echiscarinatus*).

Format - Raw sequence

Website - <http://www.bio.dfci.harvard.edu/tools/antigenic.org/>.

RESULT

FASTA format of PLA₂ protein (*Najanaja*, *Bungaruscaeruleus*, *Daboia russelii*, *Echiscarinatus*) is as follows

1.NLYQFKNMICKTVPSRSWWDFADYGCYCGRGGSGTPVDDLDRCCQVHDNCYNEAEKISGCWPYFK
TYSYE

CSQGTLTCKGDNNACAASVCDCLDLAAICFAGAPYNDNNYNIDLKARCQ

2.NLQQFKNMIQCAGTRTWYINYGCGKGGSGTPVDKLDRCCTHDHCYNQADSIPGCNPNIKTY
SYTC

TQPNITCTRADACAKFLCDCLRTAAICFASAPYNNINIMISASNSCQ

3.SLLEFGKMLEETGKLAIPSYSSYGCGWGGKGTTPKDATDRCCFVHDCC

4.SVVELGKMIIQETGKSPFPSYTSYGCFCGGGERGPPLDATDRCCLAHSCCYDTLPDCSPKTDTRYKYKR
EN

GEIICENSTCKKRICECDKAVAVCLRKNLNTYNKKYTYYPNFWCKGDIEKC

Direction for prediction of Antigenic Peptides:

Antibodies find multiple applications in a variety of areas including biotechnology, Pharmaceuticals Molecular Biology for diagnosis and indeed they are one of the most powerful tools for life science research. In analysis of PLA2 protein, we found two antigenic determinants sites it is highest at start position The highest peak sequence of antigenic determinants plot indicate antigenic site for the host cell attachments.

Antigenic Specificity:

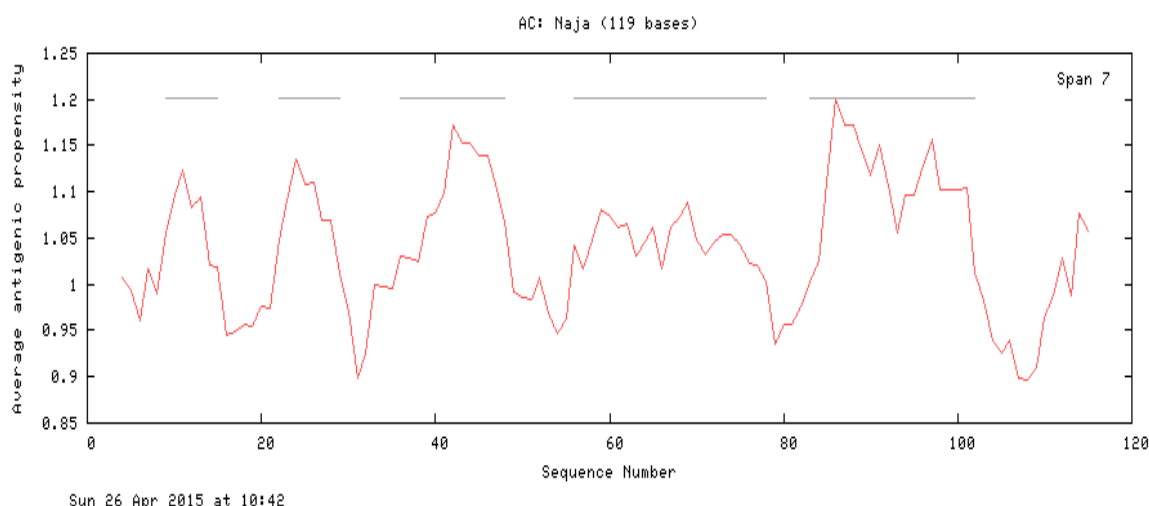
- The ability of individual antibody combining site to react with only one antigenic determinant.
- The ability of a population of antibody molecules to react only one antigen.

Najanaja

Naja sequence is 119 residues long.

Average antigenic propensity for this protein is 1.0405

Antigenic plot for sequence Naja



There are 5 antigenic determinants in this sequence:

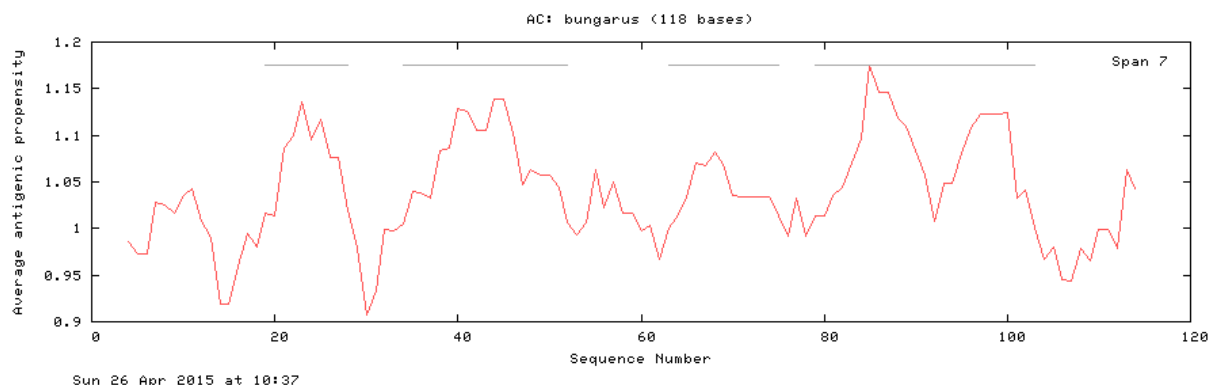
n	Start Position	Sequence	End Position
1	9	IKCTVPS	15
2	22	ADYGCYCG	29
3	36	PVDDLDRCCQVHD	48
4	56	KISGCWPYFKTYSYEC SQGTLTC	78
5	83	NACAASVCD CDRLA AICFAG	102

Bungaruscaeruleus

bungarus sequence is 118 residues long

Average antigenic propensity for this protein is 1.0386

Antigenic plot for sequence bungarus



There are 4 antigenic determinants in this sequence:

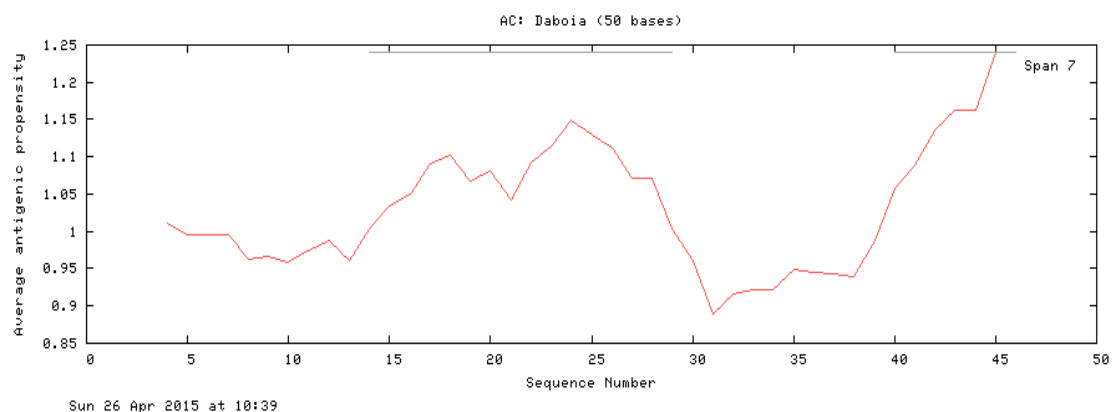
n	Start Position	Sequence	End Position
1	19	AYINYGCYCG	28
2	34	TPVDKLDRCYTHDHCYNQ	52
3	63	IKTYSYTCTQPNI	75
4	79	RTADACAKFLCDCDRTAAICFASAP	103

Daboiarusselii

Daboia sequence is 50 residues long

Average antigenic propensity for this protein is 1.0508

Antigenic plot for sequence *Daboia*



There are 2 antigenic determinants in this sequence:

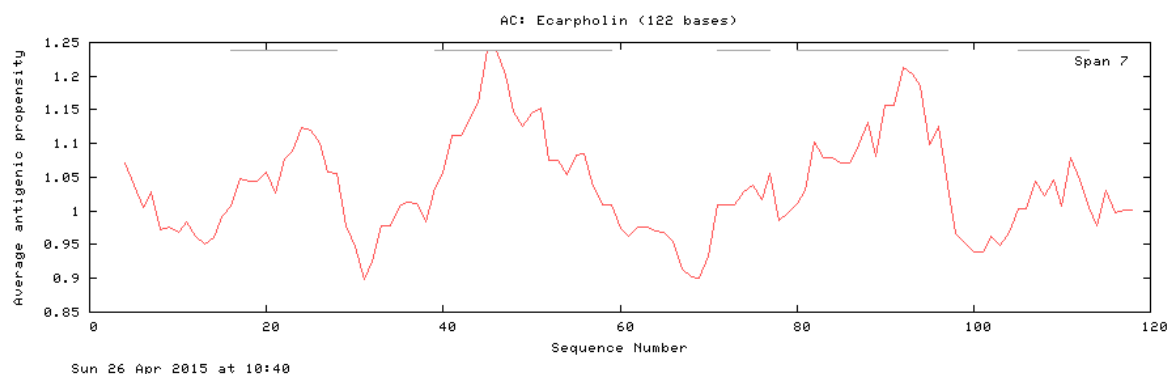
n	Start Position	Sequence	End Position
1	14	GKLAIPSYSSYGCYCG	29
2	40	TDRCCFV	46

Echiscarinatus,

Ecarpholin sequence is 122 residues long

Average antigenic propensity for this protein is 1.0415

Antigenic plot for sequence *Ecarpholin*



There are 5 antigenic determinants in this sequence:

n	Start Position	Sequence	End Position
1	16	SPFPSYTSYGCFC	28
2	39	ATDRCCLAHSCCYDTLPDCSP	59
3	71	GEIICEN	77
4	80	SCKKRICECDKAVAVCLR	97
5	105	KKYTYYPNF	113

DISCUSSION

When any foreign material (here raw snake venom) enter in the animal body, it is picked up by macrophages and are processed to form antigenic determinants [21, 22].

Prediction of antigenic epitopes (determinants) of PLA2: The FASTA format sequence for phospholipase A2 was pasted in the window provided on the antigenic epitope search engine page [20] and was then submitted for getting the predicted antigenic determinants (epitopes). The results are shown in figure 1,2,3,4.

1. For the prediction of antigenic determinants site of PLA2 Protein of *Naja naja*, we got 5 antigenic determinant sites in the sequence. The highest peak is recorded seen between aa 83 to aa 102 and aa 36 to aa 48. The sequence of aa in this region is "NACAASVCDCDRLAICFAG" and PVDDLDRCCQVHD. The average propensity for the PLA2 protein is found to be 1.0405.

2. For the prediction of antigenic determinants site of PLA2 Protein of *Bungarus caeruleus*, we got 4 antigenic determinant sites in the sequence. The highest peak is recorded seen between aa 79 to 103. The sequence of aa in this region is RTADACAKFLCDCDRTAAICFASAP. Average antigenic propensity for this protein is 1.0386.

3. For the prediction of antigenic determinant, of PLA2 protein of *Daboia russellii* we got 2 antigenic determinant sites in the sequence. The highest peak is recorded seen between aa 40 to aa 46. The sequence of aa in this region is "TDRCCFV". The average propensity for the mellitin protein is found to be 1.0508.

4. For the prediction of antigenic determinant, of PLA2 protein of *Echiscarinatus*, we got 5 antigenic determinant site in the sequence. The highest peak is recorded seen between aa 39 to aa 59 and 80 to 97. The sequence of aa in this region is "ATDRCCLAHSCCYDTLPDCSP" and "SCKKRICECDKAVAVCLR". The average propensity for the PLA2 protein is found to be 1.0415.

All residues having above 1.0 propensity are always potentially antigenic. (<http://ncbi.nlm.nih.gov>).

CONCLUSION

PLA2 is the most important content for neurotoxicity. Antigenic epitopes of PLA2 proteins are important determinants of to raise immune response. The knowledge of the immune responses to a protein antigen progressed, it became clear that the whole protein is not necessary for raising the immune response, but small segments of Protein called the Antigenic Determines or the epitopes are sufficient for eliciting the desired immune response.

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SPIDER DIVERSITY FROM DAJIPUR WILDLIFE SANCTUARY (DIST. KOLHAPUR, INDIA)

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ABSTRACT

Diversity of spiders from Dajipur Wildlife Sanctuary exhibits unique diversity. From the study area of tourism zone of Dajipur Wildlife Sanctuary, 103 species from 68 genera and 23 families are reported during year 2014 - 2015, with a dominance of Araneids, Salticids and Lycosid spiders. So far no body has worked out or studied the spiders from Dajipur Wildlife Sanctuary and hence we have to decide to explore the spider diversity from this area. The Nephila pilipes and Herennia multipunctata the most amazing spiders from family Nephilidae were reported from this area. Most of the area is dense semi-evergreen forest with a wide range of flora. The spiders from family thomisidae are quiet amazing in the area of Savrai plateau in the month of October and November. The area Konkan darshan, Margaj point, Samber kund, Lakhamapur talav, Paadyal Dung are the rich sources of spides. The Sanctuary area is home to several species rich endemic flora and harbors different species of spiders. The most amazing spiders from the Family araneidae, thomisidae, oxyopidae, lycosidae, salticidae nephilidae. Theropsidae were reported from Dajipur Wildlife Sanctuary.

Keywords : Diversity, spiders, Dajipur Wildlife Sanctuary

INTRODUCTION

The spiders are known to occupy nearly every terrestrial habitat. Many spider species are not yet known to science. Spiders are found all over the world. The occurrence of major spider families and their relative abundance were studied in the central Western Ghats by Rajashekhar K. P. and Raghavendra N. [22]. Dajipur Wildlife Sanctuary is in the Western Ghats of Sahyadri mountain ranges. The main geological formation of the area is the Deccan trap. The most of the area of this Sanctuary is a undulating belt, which is characteristic feature of Western Ghats. The plateau region (Savrai Sada) is mostly covered with the grasses. The climate is moderate. During summer the mean temperature ranges from 30°C to 35°C, Maximum being 41°C. The minimum temperature during winter is 9°C to 16°C. The mean annual rainfall is about 2500 mm and maximum being 5000 mm. The rivers namely Bhogawati and Dudhganga are the main water source. The main tree species found are Jamun, Mango, Anjani, Hirda, Surangi. The shrubs like Bhoma, Shendri, Jungli Limbu and Karvi. Majority of area is under thick forests, grasslands are small but they are very important for herbivorous. The rich flora and fauna of the habitats opens avenue for spider diversity.

Spiders comprise one of the largest orders of animals. The spider fauna of India has never been studied in its entirety despite of contributions by many arachnologists [23]. Review of available literature reveals that the earliest contribution and the pioneer workers of Indian spiders [3, 9 and 25]. They described many species from India. Tikader (1987) also published the first comprehensive list of Indian spiders, which included 1067 species belonging to 249 genera in 43 families from the last three decades [28]. Gajbe described 147 new spider species from different habitats of India. [4, 5]. The updated spider checklist given by Keswani et al. of SGB Amravati University Arachnology laboratory shows 1686 species from 438 genera and 60 families [11]. According to world spider catalogue there are spiders of protected areas in India, are studied by Gajbe (1995a) in Indravati Tiger Reserve and recorded 13 species [6]. Rane and Singh recorded five species and Gajbe 14 species from Kanha Tiger Reserve Madhya Pradesh [21, 6]. Gajbe prepared a checklist of 186 species of spiders in 69 genera under 24 families distributed in Madhya Pradesh and Chhattisgarh [4]. Gajbe also worked on family Gnaphosidae and Oxyopidae (7, 8). Patel described 91 species belonging to 53 genera from Parabikulam Wildlife Sanctuary, Kerala [17]. Patel and Vyas described 56 species of spider belonging to 34 genera and 18 families [18]. He also carried out spider diversity in Vansda National Park [16, 17]. Manju Silwal et al. recorded 116 species from 66 genera and 25 families of spiders from Puma wildlife Sanctuary, Dangs Gujarat [15]. Vyas (2012) also reported 95 species from 60 genera and 24 families from Omkareshwar region of Madhya Pradesh (29). Shirbhate and Vyas (2012) reports 23 species, 10 genera of family Araneidae from middle part of Narmada basin Madhya Pradesh (24). Vairale and Vankhede (2010) reported 510 spider species from Melghate Sanctuary (30). Pocock (1900) provided the first detailed account of Indian spiders (20), which lists 216 spider species under 17 families.

So far nobody has worked out or studied the spider fauna of Dajipur Wildlife Sanctuary and hence we have decided to explore the spider diversity from this area. Recently Western Ghats is declared as world heritage site. The present study is restricted to Dajipur Wildlife Sanctuary which forms the northern end of Western Ghats

MATERIALS AND METHODS

The techniques used for spider study was visual search, litter sampling and sweep netting. The study was carried out during early morning hours (6 hours to 9 hours) and day time (16 hours to 18 hours), from different parts of the microhabitats, like, rolled or folded leaves, plant branches, leaf litter, tree trunks, rock surface, grass blades, etc. The Lycosids and Gnaphosids were found from the soil surface and also from the river beds. Many spiders can be seen by sharp eyed person in webs. They were photographed as in their natural conditions. Each spider was identified mainly on the basis of morphological characteristics, epigyne and or palp structure after carrying out the necessary dissections and by using the literature [10, 1, 28, and 12]. The details of body parts of specimens were examined under a good quality stereo zoom microscope. The identification of species was carried out by the comparison of morphological features with the help of published literature, standard books and field guides.

OBSERVATIONS AND RESULTS

A total of 103 species belonging to 68 genera and 23 families were reported from the study area during year 2014-2015. The characteristic spider *Herennia multipunctata* commonly known as the ornamental tree trunk spider is reported from this region. Its habitat is the trunks of trees. Among all these 23 families, high diversity was observed in the family's Araneidae (32 species) > Salticidae (16 species) > Lycosidae (10 species) > Thomisidae (7 species). The list of spiders belonging to different families is given below.

1. Family: Araneidae – Orb Web Spiders

2. *Araneus mitifica* (Simon) Female
3. *Araneus himalayaensis* (Tikadar) 1975
4. *Arachnura angora* (Tikadar) 1970
5. *Argiope aemula* (Walckenaer) Female
6. *Argiope aemula* (Thorell) Male
7. *Argiope anasuja* (Thorell) 1887 Female
8. *Cyclosa hexatuberculata* (Tikadar) Female
9. *Cyclosa confragra* (Thorell) 1892
10. *Cyclosa spirifera* (Simon) 1889
11. *Cyclosa moonduensis* (Tikadar) 1963
12. *Cyclosa insulans* (Costa) 1934
13. *Gasteracantha dalyi* (Pocock) 1900
14. *Gasteracantha remifera* (Butler) 1873
15. *Gasteracantha geminata* (Fabricius) 1798, Female
16. *Gasteracantha kuhli* (C. L. Koch) Female
17. *Telecantha brevispina* (Döleschall) Female
18. *Cyrtophora cicatrosa* (Forsskal) 1975
19. *Cyrtophora moluccensis* (Döleschall) 1857
20. *Eriophora laglaisei* (Simon) 1877
21. *Larinia emertoni* (Gajbe and Gajbe) 2004
22. *Neoscona mukerjei* (Tikadar) Female
23. *Neoscona bengalensis* (Tikadar and Bal.) 1981
24. *Neoscona nautical* (L. Koch) 1875
25. *Neoscona arumpfi* (Thorell) 1878
26. *Neoscona vigilans* (Blackwell) 1865
27. *Neoscona bengalensis* (Tikadar & Bal.) 1881

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27. *Poltys nagpurensis* (Tikadar) 1982
 28. *Poltys illepidus* (C. L. Koch)1843
 29. *Poltys nagpurensis* (1982)
 30. *Larinioides* sp.
 31. *Zygiella indica* (Tikadar and Bal) 1980
 - 2. Family: Clubionidae - Sac Spiders**
 32. *Clubiona bengalensis* (Biswas),1984
 - 3. Family: Corinnidae – Ant Mimicking Sac Spiders**
 33. *Castianeira zetes* (Simon) 1897 Female
 34. *Castianeira himalayensis* (Gravely) 1931
 - 4. Family: Dipluridae – Funnel Web Mygalomorphs**
 35. *Euagrus* sp. Aurrerer 1875
 36. *Plesiophrictus* sp. (Pocock) 1899
 37. *Indithele* sp.
 - 5. Family: Eresidae – Social Spiders**
 38. *Stegodyphus sarasinorum* (Karsch,) 1891 Female
 - 6. Family: Gnaphosidae – Ground Spiders/Mouse Spiders**
 39. *Gnaphosa poonaensis* (Tikadar) 1973
 40. *Scotophaesis bharatae* (Gajbe) 1989
 41. *Poecilochroa harmani* (Tikadar)1982
 - 7. Family: Hersiliidae – Two Tailed Spiders/Bark Spiders**
 42. *Hersilia Savignyi* (Lucas) 1836 Female
 - 8. Family: Idiopidae**
 43. *Idiops rubrolimbatus* (Mirza and Sanap)2012
 44. *Heligmomerrus barkadensis* (Gravely)
 - 9. Family: Lycosidae – Wolf Spiders**
 45. *Lycosa thoracica* (Patel and Reddy) 1993
 46. *Lycosa tarantula* (Linnaeus) 1758
 47. *Evippa mandlaensis* (Gajbe) 2004
 48. *Hippasa hansae*(Gajbe and Gajbe) 1999
 49. *Hippasa madhuae*(Tikadar and Malhotra)1980
 50. *Hippasa holmerae* (Thorell)
 51. *Hippasa agelenoides* (Simon) 1884
 52. *Pardosa ranjani*(Gajbe) 2004
 53. *Pardosa milivina* (Hentz) 1844
 54. *Arctosa perita* (Latreille) 1799
 - 10. Family: Miturgidae – Dark Sac Spiders**
 55. *Cheiranthium danieli* (Tikader) 1975 Female
 - 11. Family: Philodromidae – Running Crab Spiders/Elongated Crab Spiders**
 56. *Philodromus pali* (Gajbe) 2000
 57. *Tibulus poonaensis* (Tikadar) 1962
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12. Family: Pholcidae – Daddy Long Leg Spiders

58. *Pholcus phalangioides* (Fuesslin) 1775

13. Family: Pisauridae – Nursery Web Spiders

59. *Pisaura gitae* (Tikadar 1970) Female

60. *Nilus marginatus* (Simon) 1888

61. *Thalassius albocinctus* (Doleschall) 1859

14. Family: Nephilidae - Giant Wood Spider

62. *Nephila pilipes* (Fabricius) 1793

63. *Nephila kuhli*

64. *Herennia multipunctata* (Doleschall) 1859

15. Family: Oecobidae – Disc Web Spider

65. *Uroctea durandi* (Latreille)1809

16. Family: Salticidae – Jumping Spiders

66. *Epeus albus* (Proszynski) 1992

67. *Hyllus semicupreus* (Simon) 1885

68. *Marpissa singhi* Monga (Singh and Sadana)1989

69. *Myrmarachne incerta* (Narayan) 1915

70. *Myrmarachne jajpurensis* (Proszynski) 1992

71. *Myrmarachne satarensis* (Narayan) 1915

72. *Myrmarachne uniseriata* (Narayan) 1915

73. *Mopsus* sp. (Karch) 1878

74. *Lyssomanes* sp. (Hentz) 1845

75. *Paraphidippus auranticus* (Lucas) 1833

76. *Rhene flavigera* (Koch)1886

77. *Phintella vittata* (C. L.Koch) 1846

78. *Portia fimbriata* (Doleschall) 1859

79. *Rhene decorate* (Tikadar) 1977

80. *Telamonia dimidiata* (simon)1899 Female

81. *Telamonia peckhami* (Thorell) 1891

17. Family: Scytodidae – Spitting Spiders

82. *Scytodes fusca*, (Walckenaer) 1837

18. Family: Sparassidae – Giant Crab Spiders

83. *Heteropoda venatoria* (Linnaeus) 1767

84. *Olios millet* (Pocock) 1901

19. Family: Tetragnathidae

85. *Leucauge decorate* (Blackwall) 1864 Female

86. *Tetragnatha mandibulata* (Walckenaer) (Male and Female)

20. Family: Theridiidae – Comb Footed Spiders/Cob Web Spider

87. *Rhomphaea projiciens* (O. P. Cambridge). 1896

88. *Theridion spinosissimum* (Caporiacco) 1934

89. *Parasteatoda tepidariorum* (C. L. Koch) 1841

90. *Chrysso* sp.

91. *Latrodectus hasselti* (Thorell) 1870

21. Family: Thomisidae – Crab Spiders/Flower Spiders

92. *Thomisus pathaki* (Gajbe) 2004

93. *Xysticus bharatae* (Gajbe and Gajbe) 1999

94. *Xysticus tikaderi* (Bhandari and Gajbe) 2001

95. *Xysticus robustus* (Hahn) 1832

96. *Diaea punctata* (Thorell) 1869

97. *Diaea dorsata* (Fabricius) 1777

98. *Ebrechtella tricuspidata* (Fabricius) 1775

22. Family: Theraphosidae

99. *Thrigmopoeus truelentus* (Pocock) 1899

100. *Thrigmopoeus insignis* (Pocock 1899)

101. *Chilobrachys handwickii* (Pocock 1885)

102. *Chilobrachys fimbriatus* (Pocock 1899)

23. Family: Uloboridae

103. *Uloborus khasiensis* (Tikadar) 1969

DISCUSSION

The density of spiders was high during the pre-monsoon season and gradually decreased during monsoon. In the month of December they were abundant and their number decreased by the end of January. The forest is semi evergreen and rich in shrubs as undestroyed habitats resulting into ground dwelling spiders. There was considerable variation in the members of Araneidae during rainy season and winter. The spider species prefer specific habitats. Flowering plants at Savrai plateau in the month of October, November and December have spider belonging to Thomisidae. The present study of spider fauna will be a great significance from the point of view of biodiversity. Spiders helping and keeping insect population under control and supplying food for many other animals. The spiders keeping the flow of life moving. Thus the results indicate the dominance of ground dwelling spiders like Salticids, Gnaphosids and Lycosids at Dajipur Wildlife Sanctuary. The most amazing spiders from family Nephilidae, Dipluridae, Barychelidae, Oecobidae, Idiopidae and Theraphosidae were reported from Dajipur Wildlife Sanctuary. *Herennia multipuncta* is a characteristic spider reported from this area. *H. multipunctata* commonly called as ornamental tree trunk spider. It exhibits sexual dimorphism, the female being much larger than the male. Kuntner et al. (2018) published new phylogeny of Nephilidae with a male/female size evolutionary analysis (14). Its habitat is the trunks of trees, where it creates a small web close to the surface (13). The web starts off as an orb web using prominences on the underlying structure for support. As the spider grows, it becomes with parallel to trunk. The total of 103 species belonging to 68 genera and 23 families were recorded from the study area during 2014-2015. Most of the spiders live in very specific habitats, their environment choices are depending on moisture, humidity, light intensity and vegetation.

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ANTIBIOTIC SUSCEPTIBILITY PATTERNS OF ENTEROCOCCAL ISOLATES WITH REFERENCE TO ANTIBIOTIC RESISTANCE FROM CLINICAL ISOLATES AT TERTIARY CARE HOSPITALS IN CHANDRAPUR REGION

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ABSTRACT

In recent years *Enterococci* have been identified as a important human pathogen. *Enterococcus* is a serious contagious pathogen. It play a dual role in human ecology by existing predominantly as commensal in the alimentary canal and as an opportunistic pathogen. They are used as indicators of faecal contamination of drinking water. The presence of *Enterococcus* in the water distribution system channels present great challenge as this could pose serious health threat. *Enterococcus* can cause serious human infections. In recent years *Enterococci* spp. have become second most commonest cause of nosocomial infections causing significant mortality and morbidity. The infections caused by these organisms are; urinary tract infections (associated with instrumentation and antimicrobial resistance), intra-abdominal and pelvic infections, surgical wound infections, bacteremia, endocarditis, neonatal sepsis and rarely meningitis. *Enterococcus* considered a normal commensal of intestinal tract, is fast emerging as a pathogen causing serious and life threatening hospital borne infections. This is attributed to acquisition of multi drug resistance and virulence factors of the organisms. In this review, we aim to evaluate current antimicrobial susceptibility patterns among different isolates of *Enterococcus* species, there prevalence along with antibiotics resistance and also concentrate on the study to analyze the antibiotics susceptibility of *Enterococci* species isolated from various specimen collected.

Keywords: *Enterococci*, Nosocomial infection, Virulence factors, Antibiotic resistance pattern

INTRODUCTION

Enterococcus is a large genus of lactic acid bacteria of the phylum Firmicutes. *Enterococci* are Gram-positive cocci that often occur in pairs (diplococci) or short chains, and are difficult to distinguish from *Streptococci* on physical characteristics alone.^[3] Two species are common commensal organisms in the intestines of humans: *E. faecalis* (90–95%) and *E. faecium* (5–10%). Rare clusters of infections occur with other species, including *E. casseliflavus*, *E. gallinarum*, and *E. raffinosus*.^[3] *Enterococci* are facultative anaerobic organisms, i.e., they are capable of cellular respiration in both oxygen-rich and oxygen-poor environments.^[4] Though they are not capable of forming spores, *Enterococci* are tolerant of a wide range of environmental conditions: extreme temperature (10–45 °C), pH (4.5–10.0), and high sodium chloride concentrations.^[5] *Enterococci* typically exhibit gamma-hemolysis on sheep's blood agar.^[6]

Enterococcus to be potentially harmful and capable of causing nosocomial and community acquired infections, Risks factors like indiscriminate use of antibiotics, prolonged hospital stay, severity of illness and immunosuppression are responsible for nosocomial acquisition of drug resistant *Enterococci* spp. ultimately leading to environmental contamination and cross infection.^[17]

Enterococci have attracted much attention in recent times due to their increased recognition as a cause of nosocomial infection in patients receiving anti-microbial agents. They are intrinsically resistant/ tolerant to many antibiotics and are able to acquire as well as transfer antimicrobial drug resistance either by chromosome, transfer of plasmid or via transposons containing genetic sequences. A study is therefore essential to identify *Enterococcal* species causing various infections, their association with potential virulence factors and to determine their antimicrobial resistance pattern.^[20]

Ampicillin, penicillin and vancomycin are used to treat various strains of bacteria. Urinary tract infections can be treated specifically with nitrofurantoin, even in cases of vancomycin resistance.

From a medical standpoint, an important feature of this genus is the high level of intrinsic antibiotic resistance. Some *Enterococci* are intrinsically resistant to B-lactam-based antibiotics (penicillin, cephalosporins, carbapenems), as well as many aminoglycosides. In the last two decades, particularly virulent strains of *Enterococcus* that are resistant to vancomycin (vancomycin-resistant *Enterococcus*, or VRE) have emerged in nosocomial infections of hospitalized patients.^[9]

New epidemiological evidence has shown that *Enterococci* are major infectious agent in chronic bacterial prostatitis. *Enterococci* are able to form biofilm in the prostate gland, making their eradication difficult. *Enterococci* express virulence factors that permit adherence to host cells and extracellular matrix, facilitate

invasion effect immunomodulation and cause toxin-mediated damage. The possession of diverse virulence factors have been of important benefit to *Enterococci* since they have a profound effect on the severity of infections caused by these bacteria. On the other hand it is believed that nosocomial *Enterococci* might have virulence elements that increase their ability to colonize hospitalized patients.^[10]

The therapeutic challenge of multiple-drug resistant (MDR) *Enterococci*, identifies them as important nosocomial pathogens. *Enterococci* infections have traditionally been treated with cell wall inhibitor agents in combination with an aminoglycoside. Reduced susceptibility to β -lactam antibiotics and vancomycin; in combination with a high level aminoglycoside resistance (HLAR) interferes with the penetration of the aminoglycoside into the bacterial cytoplasm, thus making the antibiotic synergism ineffective.^[9] Hence, this study was designed to identify the magnitude of *Enterococcal* infections and their antibiotic susceptibility pattern in a tertiary care hospital.

Enterococci have been known to be resistant to most antibiotics used in clinical practice. They are naturally resistant to cephalosporins, aminoglycosides and clindamycin and may also be resistant to tetracyclines and erythromycin. They are intermediate sensitive to penicillin and ampicillin and glycopeptides. The strains that produce β -lactamase are rare ^[21].

Enterococci are known to acquire antibiotic resistance with relative ease and to be able to spread these resistance genes to other species.^[11] *Enterococcus faecalis* has been reported to transfer plasmids harbouring antibiotic-resistance traits to other enterococci and to *Listeria monocytogenes* in water treatment plants^[15]. *Enterococcus faecium* conjugative transposons can be transferred from animal bacteria to human ones. Such conjugative transposons can also transfer vancomycin resistance to *Staphylococcus aureus*, streptococci and lactobacilli. Multidrug-resistant and vancomycin-resistant enterococci are commonly isolated from humans, sewage, aquatic habitats, agricultural run-off and animal sources, which indicates their ability enter to human food chain.

Identification of presumptive enterococci was confirmed using the tests^[6]: Gram staining, hemolysins, catalase, salt tolerance, esculin hydrolysis, pyrrolidonyl arylamidase (PYR), arginine decarboxylation, mannitol, arabinose, sorbitol and raffinose fermentation, pigment production, motility and tetrazolium reduction test. For determination of virulence traits, hemolysins were detected in blood agar base plates with 5% of defibrinated sheep blood after incubation at 37 °C/24 h and 5 °C/48 h. -Hemolysis was defined by the presence of a viridant halo around isolate colonies, while -hemolysis was defined by translucent halo. Gelatinase assay was also carried out. Briefly, a spot of freshly cultured enterococci was seeded onto the surface of gelatin agar and the plate was incubated at 37 °C/48 h; next the Petri dishes were kept at 4 °C/4 h, and a precipitation halo around the spot denoted a positive result. For antimicrobial susceptibility testing, vancomycin and high-level aminoglycoside (gentamicin and streptomycin) resistance was screened by disk diffusion assay (120-g gentamicin disk and 300-g streptomycin disk) assay and confirmed by minimal inhibitory concentration (MIC) determined by agar dilution (MIC above 500 and 2000 g/mL for gentamicin and streptomycin, respectively). Based on halos and MIC measures, the isolates were categorized as susceptible, intermediate and resistant^[19].

The review particularly focus on Chandrapur district and Vidarbha region. Limited reports were available on development of antibiotic resistant *Enterococcus* species from this region. The purpose of present study to evaluate current antimicrobial susceptibility patterns among different isolates of *Enterococcus* species, there prevalence along with antibiotics resistance, also concentrate on the study to analyze the antibiotics susceptibility of *Enterococci spp* isolated from various specimen collected.

CONCLUSION

Enterococcus has clearly emerged as a medically important organism, causing outbreaks of many nosocomial infections. An organism, once considered a harmless commensal residing in the intestine, has emerged as a multiple-drug-resistant, virulent pathogen accounting for more hospital borne infections. Recently increase of *Enterococcal* infections has been observed. These bacteria, mainly *Enterococcus faecalis* and *Enterococcus faecium* are members of the normal flora of gastrointestinal tract but also are typical opportunistic pathogens. Enterococci are characterized by natural resistance to numerous antibiotics (among them cephalosporins), and also by easy acquired resistance to antibiotics. Infections caused by multiresistant strains are difficult in treatment, chronic, recurrent and sometimes fatal are described. *Enterococcal* infections are caused often by *E.faecalis*, rarely by *E.faecium*. In the last years other species of Enterococci have been isolated from different clinical materials. (*E.casseliflavus*, *E.avium*, *E.durans*, *E.gallinarum*). More research is needed to characterise molecular and cellular interactions between the host and Enterococci which lead to intra-species genetic transfer and virulence factors in species.

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EFFECT OF METHALLIBURE ON TESTIS AND SPERM COUNT OF ALBINO WISTAR RAT

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ABSTRACT

Methallibure may give the antifertility action by acting on the Hypothalamus-Pituitary-Gonad axis that is by changing the histology of normal reproductive tract. This study aims to investigate the Organ weight response after administration of Methallibure (250 µgm). Effect on sperm count, Histoarchitecture of testis and seminiferous tubules, Leydig cells and spermatogenesis after administration of Methallibure (250 µgm). During present investigation the weight of testis, Epididymis and Seminal vesicle of 15 days control animals was found to be 1.04 ± 0.05 , 0.67 ± 0.02 and 0.38 ± 0.008 gms respectively. However, subcutaneous Methallibure administration for 15 days resulted in the significant decrease in the weight of testis, Epididymis and Seminal vesicle. Weight of testis, Epididymis and Seminal vesicle of Experimental animals treated with Methallibure for 15 days was found to be 0.75 ± 0.02 , 0.57 ± 0.01 and 0.32 ± 0.007 gms respectively. Another experimental group treated with Methallibure for 7 weeks duration also showed significant decrease in the weight of testis, Epididymis and Seminal vesicle when compared with the control animals. The weight of testis, Epididymis and Seminal vesicle of 7 weeks control animals was found to be 1.19 ± 0.16 , 0.7 ± 0.015 and 0.39 ± 0.014 respectively. Result of the present study confirm the antifertility effects of Methallibure.

Keywords: Methallibure, Hypothalamus-Pituitary-Gonad axis, , Epididymis ,Seminal vesicle, sperm count.

INTRODUCTION

All the reproductive events occur in the animal due to feedback received by the hypothalamus (Fig.1). Hypothalamus is connected to the pituitary gland to form the neuroendocrine system. Hypothalamus receives the intrinsic and extrinsic stimulus and in turn produces a neurohormone GnRH. Intrinsic factors include the coitus, adrenal steroids, glucose levels, stress and extrinsic factors like photoperiod, olfactory, auditory and visual signals. GnRH stimulates the gonadotropin cells of pituitary to produce FSH and LH. When GnRH produced by the hypothalamus is low in frequencies, production of FSH is stimulated while when GnRH is produced in high frequencies, GnRH stimulates the production of large amounts of LH (Meredith *et al.*, 1998).

Exponentially growing population has been adversely affecting the social, economical and technological development of human race. Contraception is important to health, development, and quality of life and has allowed couples to plan their families and safely space births. A good number of synthetic contraceptives are available in market, each one with either a limited success or side effects. Information regarding the drugs and formulations which may cause antifertility in males is scanty. Several methods of contraception for family planning had been used over the years, however, non reliability of these drugs in many cases impel us to investigate new formulations which can be used as an alternative synthetic contraceptives.

Methallibure give the antifertility action by acting on the Hypothalamus-Pituitary-Gonad axis that is either by changing the histology of normal reproductive tract.

Normal testicular function requires stimulatory actions of pituitary gonadotropins LH and FSH. Luteinizing hormone stimulates Leydig cells steroidogenesis to generate and maintain intratesticular concentrations, which are essential for initiating and maintaining spermatogenesis.

Thus this study aims to investigate following aspects regarding the Albino wistar rat *Rattus rattus*. Organ weight response i.e testes, epididymis, seminal vesicle, vas deferens and ventral prostate after administration of Methallibure (250 µgm). Effect on sperm count Histoarchitecture of testis, the seminiferous tubules, Leydig cells and spermatogenesis after administration of the Methallibure (250 µgm).

MATERIAL AND METHOD

The albino rat Wistar strain, *Rattus rattus* is a species which belongs to the Muridae family of Muroidea superfamily and order Rodentia under the subclass Eutheria of mammalia is selected for the present study.

Animals: Adult male albino rats, Wistar strain weighing 1750-225 gm body weight used for the study were housed under standard laboratory condition (rooms are maintained at 30-70% relative humidity and a temperature of 18-26°C). They were fed with standard rodent pellet and water *ad libitum*. The animals were grouped in to two groups of 12 animals each for each experiment.. a. Control group and b. Experimental Group : Rats receiving different doses of Methallibure .

Experiment No: 1

Two groups of 12, experimentally naive males, were reared and administered normal saline and Methallibure (250 µgm) subcutaneously daily for 7 weeks. Six animals from both experimental and control group were sacrificed after 15 days whereas remaining animals were sacrificed at the end of 7 weeks.

Protocol for Experiment No.1

No. of Male Rats	Drug and dose	Route	Duration
12 Control Group	Vehicle (Equal Volume)	Subcutaneous	15 days and 7 Weeks
12 Expt. Group	Methallibure (250 µgm)	Subcutaneous	15 days and 7 Weeks

EFFECT OF METHALLIBURE ADMINISTRATION ON ALBINO RAT OBSERVATIONS AND RESULT**1.1 Effect of Methallibure on testicular weight of albino rat**

The subcutaneous dose of Methallibure caused significant decrease in the weight of testes from the control after administration of Methallibure for 15 days and after 7 week

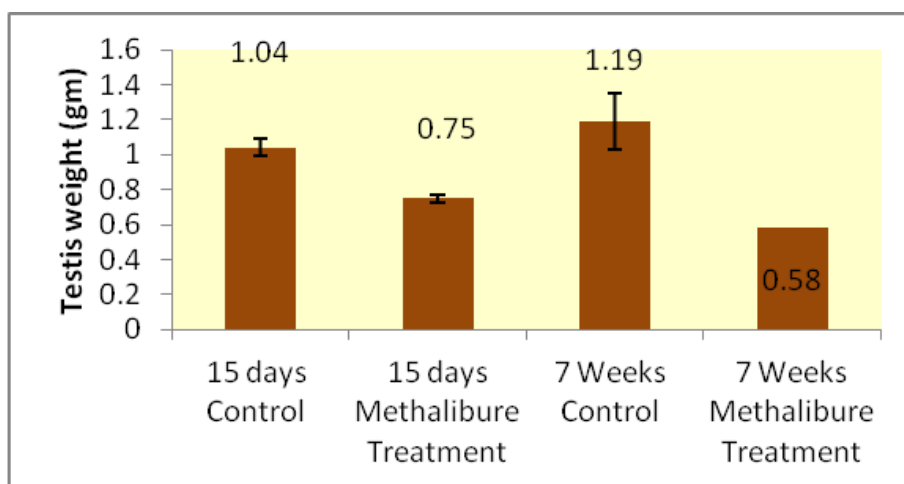


Fig. 2.Graphic representation of Effect of Methallibure on mean Testis weight in male albino rats in control and Methallibure treated males after 15 days and after 7 weeks.

1.2 Effect of Methallibure on Epididymis weight of albino rat

The subcutaneous dose of methallibure caused decrease in the weight of epididymis significantly from the control. (fig. 3)

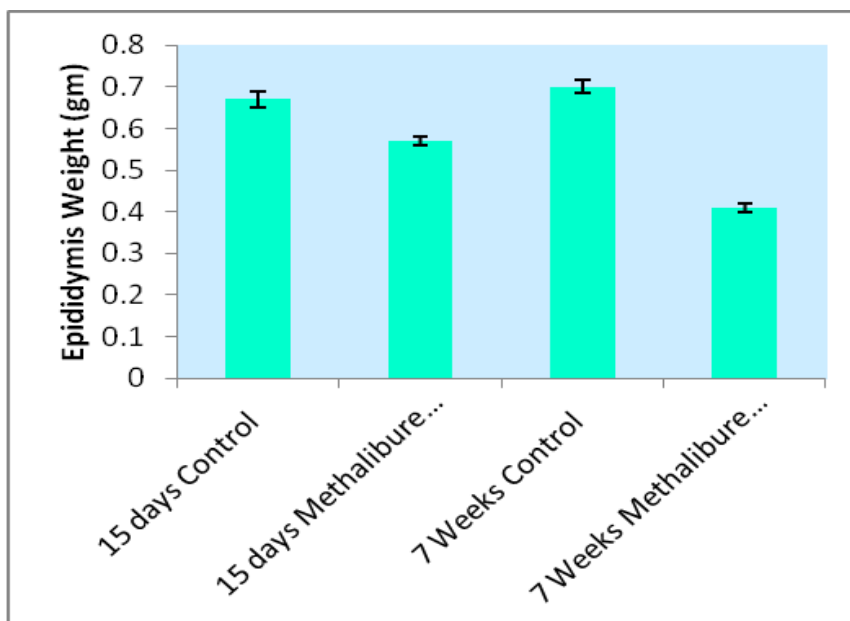


Fig. 3.Graphic representation of Effect of Methallibure on mean Epididymis weight in male albino rats in control and Methallibure treated males after 15 days and after 7 weeks.

- 1.3 Effect of Methallibure on Sperm Count of albino rat** During present investigation there was a significant decrease in sperm count in Methallibure treated rats compared to the control rats after 15 days and after

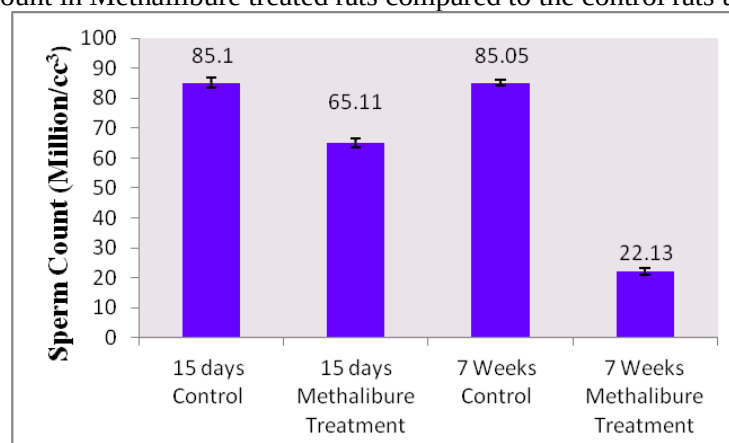


Fig. 5. Graphic representation of Effect of Methallibure on mean Sperm Count in male albino rats in control and Methallibure treated males after 15 days and after 7 weeks.

1.4 Effect of Methallibure on Histoarchitecture in the Testis of Albino rat

The present study investigated the histopathological effect of Methallibure on testes and morphometric analysis of testicular elements that are Tunical thickness, Leydig cell diameter, seminiferous tubule diameter, epithelial height and Sertoli cell diameters.

Histopathological effect of Methallibure on Testes:

Cross sections of control rat's testis revealed compactly arranged seminiferous tubules, with Sertoli cells found between spermatogenic cells. Irregularly shaped Leydig cells were also seen. The seminiferous tubules were observed to be undergoing spermatogenesis (Fig. 10).

Marked degenerative changes were observed in the testis of the experimental rats treated with Methalibure. Alterations were observed in the histological appearance of the seminiferous tubules, with damage to the basement membrane and necrotic changes in the seminiferous tubules, shrunken nuclei of germinal epithelium, which leads to arrest of spermatogenesis.

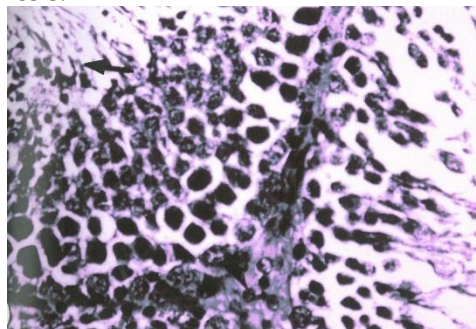


Figure 10. Transverse Section through normal testicular tissue of control group of Wistar rats. (HE x100)

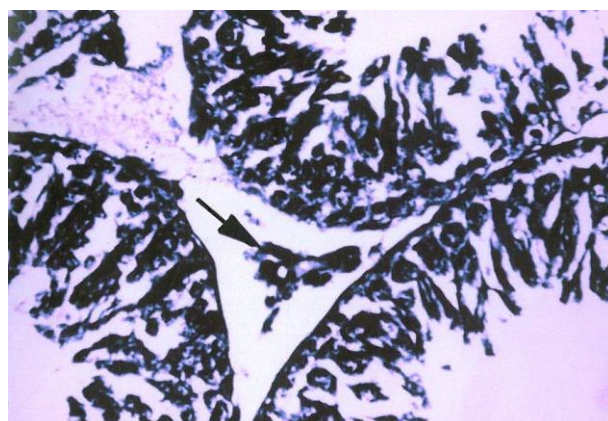


Figure 11. Transverse Section through testicular tissue of Experimental group of Wistar rats treated with Methallibure for 7 weeks. (HE x100)

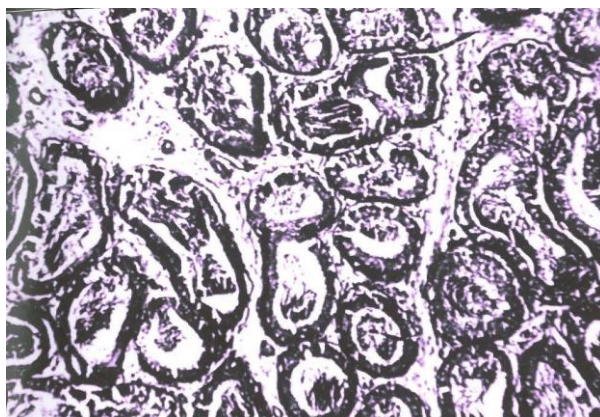


Figure 13. Transverse Section through Cauda Epididymis of control Wistar rats showing normal histology. (HE x100)

RESULTS AND DISCUSSIONS

Present investigation aimed to find out the antifertility effects of the Methallibure and LHRH analogues on the Hypothalamus-Pituitary-Gonadal axis of albino wistar rat. As per the findings of present investigation significant changes have been observed in Methallibure and LHRH analogue treated animals when compared with the control animals after 15 days and 7 weeks of treatment. Result of the present study confirm the antifertility effects of Methallibure and LHRH analogues. During present investigation the weight of testis and Epididymis of 15 days control animals was found to be 1.04 ± 0.05 and 0.67 ± 0.02 gms respectively. However, subcutaneous Methallibure administration for 15 days resulted in the significant decrease in the weight of testis and Epididymis. Weight of testis and Epididymis of Experimental animals treated with Methallibure for 15 days was found to be 0.75 ± 0.02 and 0.57 ± 0.01 gms respectively.

Another experimental group treated with Methallibure for 7 weeks duration also showed significant decrease in the weight of testis and Epididymis when compared with the control animals. The weight of testis, and Epididymis of 7 weeks control animals was found to be 1.19 ± 0.16 and 0.7 ± 0.015 respectively. However, after 7 weeks of Methallibure treatment weight of testis and Epididymis was found to be 0.58 ± 0.04 and 0.41 ± 0.01 respectively.

Sperm count was also significantly affected by the Methallibure treatment, Sperm count of control animals after 15 days, and 7 weeks was found to be 85.1 ± 1.64 and

85.05 ± 0.99 Millions/ CC^3 respectively. However in Methallibure treated animals after 15 days, and 7 weeks sperm count declines significantly upto 65.11 ± 1.56 and 22.13 ± 1.00 Millions/ CC^3 respectively.

Histometrical measurements were taken in a testis and testicular elements of control and Methallibure treated Wistar rats for 15 days and 7 weeks. Significant changes in Tunical thickness, Leydig cell diameter, seminiferous tubule diameter, epithelial height and Sertoli cell diameters were noted after the treatment with Methallibure.

Administration of Methallibure caused the alteration in the normal histology of the seminiferous tubules. It had affected the germinal epithelium, damage to the basement membrane, which has affected the process of spermatogenesis. In treated animals epididymis was affected. Regression in epididymal tubules and increase in interluminal area was noted.

CONCLUSION

Daily subcutaneous injection of Methallibure (250 μ g) for 15 days and 7 weeks resulted in atrophy of the testes and impairment of fertility. Both the drugs have antifertility potency when the animal is exposed to the drug for longer duration. Subcutaneous administration of these drugs (250 μ g) daily for 15 days was sufficient to cause the deleterious effect on the pituitary-gonadal axis. Methallibure treatment causes a marked reduction in the steroidogenesis which results in the significant decrease in the concentration of testosterone responsible for infertility in males. Methallibure suppress the secretory activity of the gonadotrophic cells. Methallibure having significant action on the pituitary gonadotroph cells and responsible for the inhibition of the secretory process of the gonadotrophs which ultimately results into the down regulatory effect on the synthesis and secretion of GnRH from the pituitary. Methallibure is also responsible for causing the significant atrophy of testis, seminal vesicle and Epididymis ($P < 0.01$) after the 15 days and 7 weeks of the treatment. Methallibure causing significant decrease in the sperm count ($P < 0.01$) after 15 days as well as after 7 weeks also when compared with control. This may be due to deleterious effect of the drug on the Leydig cell that may

consequently be responsible for testicular and epididymal dysfunction as a result of androgen deprivation. This may affect the process of sperm production and maturation in both organs leading to loss of fertility in treated rat.

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INVESTIGATION OF VANCOMYCIN RESISTANCE AMONGST METHICILLIN RESISTANCE STAPHYLOCOCCUS AUREUS IN TERTIARY CARE CENTER

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Abstract

Antibiotic resistance is the challenge for 21st century. Increasingly widespread use of antibiotic has led to the rapid appearance of antibiotic resistant strain. Multidrug resistant methicillin resistant *Staphylococcus aureus* is the major cause of nosocomial and community acquired infections. Vancomycin considered to be the best antibiotic for the treatment of methicillin resistant *Staphylococcus aureus*. Current study aimed at identification of emergence of vancomycin-resistance amongst methicillin resistant *Staphylococcus aureus* in Chandrapur region of Maharashtra state. Altogether 150 clinical sample were collected from tertiary care center of Chandrapur. Out of them, 102 isolates were coagulase positive while 86 isolates were methicillin-resistant *Staphylococcus aureus* (MRSA), 16 isolates were vancomycin resistant *Staphylococcus aureus* (VRSA) from antimicrobial susceptibility test. Investigation carried out on molecular level for the determination of *mecA* gene and *vanA* gene by PCR among MRSA isolates and VRSA isolated respectively. Molecular analysis of outbreak strains will contribute to prove the epidemiologic and evolution of outbreak

Keywords: *Staphylococcus aureus*, MRSA, VRSA, Molecular analysis

Introduction

Staphylococcus aureus is the major cause of nosocomial and community acquired infections. There are small town of pathogenic bacteria and *S. aureus* is one of them, that convey the infection is high public health trouble because of enlarge spectra of antibiotic resistance to various types of antibiotic(2). The empiric therapy observed in 1961 a few strains of *Staphylococci* functioning as methicillin-resistant *S. aureus* (MRSA) have become resistant to antibiotics that once destroyed it. However it is not major issue until the late 1970 and early 1980. MRSA strains, though first reported in 1980 the global spread of methicillin –resistance that *S. aureus* was changed to vancomycin in many health-care institution (7,10). While initial announcement of vancomycin –resistance *S.aureus* in 1997 on Japan. Various paper have documented the emergence of these microorganism elsewhere, and succeeding study to description of VRSA, notice in Japan and the presence of *S. aureus* strains among MRSA that were heterogeneously resistant to vancomycin (19,27). The chromosomal *mec A* gene is responsible for of methicillin resistance *S.aureus* that mediated by presence of penicillin binding protein(PBP-2a) which act as an enzymatic activity due to its low affinity for beta lactam antibiotic that permit cell wall assemble in concentration of a drug that provide the other penicillin binding protein is nothing but methicillin resistance in *S.aureus* known as *mec A* gene having a 21-kb to 60-kb *Staphylococcal* chromosome cassette *mecA(SCC)* and mobile genetic element. While mutation is responsible for changing the genetic structure such as *Tn554*, *pUB110* and *pT181* are the example that encode resistance to non-β- lactam antibiotics. However vancomycin resistance *S.aureus* (VRSA) become resistance to the glycopeptide antibiotic vancomycin. The Stratified classification of vancomycin resistance base on two susceptibility pattern that is Vancomycin –intermediated *S.aureus* (VISA), and Vancomycin –resistance *S.aureus* (VRSA).(2,12 ,18)

Many reports from Maharashtra have highlighted the prevalence of MRSA in hospital and community acquired. Analysis of *mec A* and *vanA* was recently carried out in Vidarbha region of Maharashtra State is central part of India by Patil *et al.* , shows that the average prevalence rate of MRSA isolated were 81.4% and VRSA isolates were 1.4% and according to Tambekar *et al.* ,reported that the prevalence rate of HA-MRSA were 77% and 50% CA-MRSA, for understanding the prevalence, the reliable and accurate detection method of MRSA strains and VRSA strains are important for antibiotic treatment and effective infection control. The current study was performed to evaluate the antimicrobial resistance profile of MRSA and investigate the Vancomycin resistance among the MRSA from clinical isolates in tertiary care hospital, Chandrapur. Also phylogenetic and molecular analysis study detect the *mecA* gene and *van A* gene based on phenotypic and genotypic method from methicillin resistance and vancomycin resistance respectively. (17,20)

2) MATERIALS AND METHODS

2.1) Clinical Specimens and Bacterial Isolation

From October 2017 to May 2018, the Cluster Sampling of *S.aureus* were processed on 150 isolate from all age group of male and female including blood, urine and pus from the Government Medical College Chandrapur, While the Stratified classification categorised on primary screening that is Gram staining, biochemical test, sugar fermentation, catalase, tube coagulase, and DNase tests and growth on MSA and Blood agar. While

secondary screening such as antibiotic susceptibility testing, Minimal inhibitory concentration (MIC) , using standard collection techniques (5). It was performed in Centre For Higher Learning and Research , in Microbiology Laboratory ,Sardar Patel College Chandrapur . A total 102 sample were positive for *S.aureus* out of which 60 clinical samples from pus, 40 clinical samples from urine and 2 clinical samples from blood.

2.2) Antimicrobial susceptibility testing

The susceptibility of all clinical isolates of *S. aureus* to 8 antibiotic including penicillin (10 ug), gentamicin (10 µg), erythromycin (10 µg), methicillin (10µg), tetracycline (10 µg), Oxacilline (10ug), Cefoxitin (10ug) and vancomycin (30 µg) was determined by using the modified Kirby–Bauer disk diffusion method.(4,19) The isolates were examine as sensitive, intermediated resistant, and resistant based on the Clinical and Laboratory Standard Institute guidelines (CLSI) .(5 13) *S. aureus* strains NCTC 5522 and 5521 were used as control strain for disk susceptibility testing. (Department of microbiology, S.P College).

2.3) Molecular aspect for *mecA* gene and *van A* gene of CHP011a

2.3.1) DNA extraction

Implementation of alkaline lysis method for Deoxyribonucleic acid (DNA) extraction from each *S. aureus* isolate (CHP011a) . Cell growth in monolayer should be aseptically mixed with lysed by suspend 1-3 colonies ; then as per the protocol for separating micropartical centrifugation technique used with maintain temperature and the addition of buffer for neutralization . while the mixture was Centrifuge at 6000 rpm for 1min and incubate for 5 minutes at room temperature . Repeat the above mentioned step 14 and 15 for obtain complete elution. And finally the buffer in themicrocentrifuge tube contains the DNA. However DNA concentrations were measured by running aliquots on 1% agarose gel. The DNA samples were kept in reserved at -20°C until further applied for the PCR. (6,25)

2.3.2) PCR for *mecA* gene and *vanA* gene

Polymerase Chain Reaction (PCR) is a process that uses primers to amplify specific cloned or genomic DNA sequences with the help of a very unique enzyme. PCR uses the enzyme DNA polymerase that directs the synthesis of DNA from deoxynucleotide substrates on a single-stranded DNA template. DNA polymerase adds nucleotides to the 3` end of a custom-designed oligonucleotide when it is annealed to a longer template DNA. Thus, if a synthetic oligonucleotide is annealed to a single-stranded template that contains a region complementary to the oligonucleotide, DNA polymerase can use the oligonucleotide as a primer and elongate its 3` end to generate an extended region of double stranded DNA Composition of the Taq Master Mix is Taq DNA polymerase is supplied in 2X Taq buffer, 0.4mM dNTPs, 3.2mM MgCl₂ and 0.02% bromophenol blue. Removed unincorporated PCR primers and dNTPs from PCR products by using Montage PCR Clean up kit (Millipore).The PCR product was sequenced using the primers. Sequencing reactions were performed for each template using below 16s rRNA universal primers. The fluorescent-labeled fragments were purified from the unincorporated terminators with an ethanol precipitation protocol. The samples were resuspended in distilled water and subjected to electrophoresis in an ABI 3730xl sequencer (Applied Biosystems ABI PRISM® BigDye™ by terminator Cycle Sequencing Kits with AmpliTaq® DNA polymerase (FS enzyme) .

(11,25,26)

Fig1) For *mecA* gene

PRIMER DETAILS

Primer Name	Sequence Details	Number of Base
MECA F	5'GTAGAAATGACTGAACGTCCGCTAA3'	25
MECA R	5'CCAATTCCACATTGTTTCGGTCTAA3'	25

Fig 2) For van A gene

PRIMER DETAILS

Primer Name	Sequence Details	Number of Base
VANA F	5'CATGAATAGAATAAAAGTTGCAATA3'	25
VANA R	5'CCCCTTTAACGCTAATACGATCAA3'	24

3) DATA ANALYSIS**3.1) BLAST Analysis**

The 16S rRNA gene sequences obtained from the sequencer machine was converted into the FASTA format and used for the pair wise alignment. In requirement online BLAST program available at web link <http://blast.ncbi.nlm.nih.gov/> was used. And Archie, available homology for the given sequence was analysed. This helped in searching the species in the Crustal and Mega5 software.(25,26)

3.2) Multiple Sequence Alignment

Obtain 16S rRNA gene sequences were used to perform the multiple sequence alignment by CLUSTALW program. CLUSTALW performs multiple sequence alignment by accepting the closely linked sequences in the FASTA format file. The web address is: <http://www.ebi.ac.uk/Tools/msa/clustalw2/>. During alignment, 10 best scored aligned sequences generated in the BLAST analysis were downloaded in FASTA format and used in the analysis. In a ClustalW program, alignment parameters were set as follows: DNA weight matrix set as IUB, Gap penalty as 10, Gap Extension as 0.20, Gap distance as 5 and clustering method as Neighbour joining. In an output result, the file was retrieved as .DND which was used to build the phylogram in MEGA5 software based on the alignment obtained in CLUSTALW analysis.(25,26)

3.3) Phylogenetic Analysis

For the phylogenetic analysis, .DND file obtained from CLUSTAL alignment was used for the phylogram built up by using the MEGA5 software. In an output, built phylogram was documented close homology of the bacteria isolated (showcased with the accession number) with the best matched bacterial sequence and highlighted by marking in a Phylogram. (19,25,26)

4) RESULT

4.1) A total of 150 *S. aureus* isolates from various clinical specimens. Among them 102 isolated of *Staphylococcus aureus*, while 16 isolate were found to be vancomycin resistance *Staphylococcus aureus* and 86 isolates were found to be methicillin-resistant *Staphylococcus aureus* (MRSA). Prevalence of MRSA was 84.32.% by disc diffusion method & 15.68% Of VRSA by Antimicrobial susceptibility test (AST) .

Table 1- Prevalence of *S.aureus* among clinical specimen in relationship with hospital wards during the period of 2017-18 to 2018-19

Ward	Infection with MRSA patient	Infection with VRSA patient	No. of Patients
ICU	24	5	29
Artho	39	7	46
Peaad	5	2	7
Surgery	18	2	20
Total	85	16	102

Table 2 - The antibiotic susceptibility pattern of the 102 isolates showing varying degrees of resistance in the highest degree of resistance was to penicillin G (98.0%; 100/102) , Cefoxitin(95.1% 97/102) . All the isolates were susceptible to vancomycin (100%; 102/102), methicillin (97.0%: 99/102). (4,13,)

Antibiotic	Susceptible no. (%)	Intermediate no. (%)	Resistant no. (%)
Penicillin G	38(37.2)	-	100(98.0)
Cefoxitin C	59(57.8)	-	97(95.1)
Erythromycin	78(76.4)	36 (35.2)	50(49.0)
Methicillin	99(97.0)	43(42.1)	86(84.3)
Oxacilline	89(87.2)	39(38.2)	69(67.6)
Gentamicin	78(76.4)	12(11.7)	35(34.3)
Tetracycline	60(58.8)	9(8.8)	24(23.5)
Vancomycin	102(100)	2(1.9)	16(15.6)

4.2) PCR amplification of *mecA* and *vanA* gene (CHP011a)

4.2.1) Using the PCR assay with an ethanol precipitation protocol current study determine by identification of MRSA and VRSA strains were performed by detection of *mecA* gene and *vanA* gene of CHP011a by using oligonucleotide primer ,sequencing reactions were performed for each template using 16s rRNA universal primers. (Applied Biosystems ABI PRISM® BigDye™ by terminator Cycle Sequencing Kits with AmpliTaq® DNA polymerase.) (25,26)

Table 3- Methicillin resistance pattern of *S.aureus* strains as determine by PCR method

Sr no	Name of Strains	<i>mecA</i> gene
1	CP035791.1 <i>Staphylococcus aureus</i> strain 592 (<i>mecA</i>)chromosome	<i>mecA</i> ⁺
2	LR027877.1 <i>Staphylococcus aureus</i> isolate BPH3244 (<i>mec A</i>) genome assembly	<i>mecA</i> ⁺
3	LR027876.1 <i>Staphylococcus aureus</i> strain JKD6009 (<i>mec A</i>) genome assembly	<i>mecA</i> ⁺
4	LR027870.1 <i>Staphylococcus aureus</i> strain BPH2019 (<i>mecA</i>) genome assembly,	<i>mecA</i> ⁺
5	CP035671.1 <i>Staphylococcus aureus</i> subsp. <i>aureus</i> strain VB31683 (<i>mec A</i>) chromosome	<i>mecA</i> ⁺

Table 4 - Vancomycin resistance pattern of *S.aureus* strains as determine by PCR method

Sr .no	Name of strain	<i>vanA</i> gene
1	KU315431.1 <i>Staphylococcus aureus</i> strain sa1 vancomycin resistance protein A (<i>vanA</i>) gene,	<i>vanA</i> ⁺
2	CP012594.1 <i>Staphylococcus aureus</i> strain HOU1444-VR plasmid pVR-MSSA_01	<i>vanA</i> ⁺
3	GQ273978.1 <i>Staphylococcus aureus</i> strain ST1RCGLD-IPi <i>vanA</i> gene cluster	<i>vanA</i> ⁺
4	AE017171.1 <i>Staphylococcus aureus</i> plasmid pLW043	<i>vanA</i> ⁺
5	MG592387.1 <i>Staphylococcus aureus</i> transposes gene	<i>vanA</i> ⁺

4.3) BLAST analysis and sequencing of *mecA* gene and *van A* gene of CHP011a -

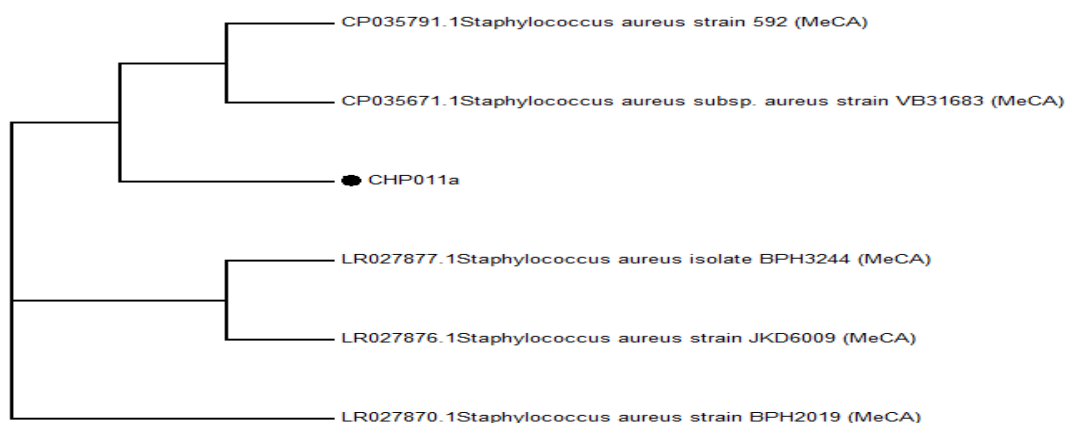
The BLASTN program accepted the FASTA format of the sequence and by selecting the database of the 16S rRNA of Bacteria identification. During search, the algorithm parameters were set as the E - value (expect value) at 10, match/mismatch score as 1/-2, gap cost as linear and BLASTN set as mega BLAST which has searched out using highly similar sequences in the query sequence. These sequences were retrieved in FASTA format and used to build up the phylogram (25,26)

Table 5 – The PCR product of 16SrRNA was then sequence of methicillin resistance Staphylococcal identification (mecA) and vancomycin resistance Staphylococcal identification (vanA) as follows :-

Sr .no	Gene	Name of isolate	Sequence
1	mec A	CP035791.1 <i>Staphylococcus aureus</i> strain 592 (mecA) chromosome,	AATGTGGAATTGGCCAATACAGGAACAGC ATATGAGATAGGCATCGTTCCAAAGAATG TATCTAAAAAAGATTATAAAGCAATCGCT AAAGAACTAAGTATTTCTGAAGACTATAT CAAACAACAAATGGATCAAATTGGGTAC AAGATGATACCTTCG
2	vanA	KU315431.1 <i>Staphylococcus aureus</i> strain1 vancomycin resistance protein A	TGAAGATGGATCCATACAAGGTCTGTTTG AATTGTCCGGTATCCCTTTTGTAGGCTGCG ATATTCAAAGCTCAGCAATTTGTATGGAC AAATCGTTGACATACATCGTTGCGAAAAA TGCTGGGATAGCTACTCCCGCCTTTTGGGT TATTAATAAAGAT

4.4) Phylogenetic Analysis

(4.4.1) The phylogenetic analysis of CHP011a (*mecA*), DND file obtained from CLUSTAL alignment was used the phylogram build up by using the MEGA5 software and in an output built phylogram was documented close homology of the bacterial isolated. (25,26)



(4.4.2) The phylogenetic analysis of CHP011a (*vanA*), DND file obtained from CLUSTAL alignment was used the phylogram build up by using the MEGA5 software and in an output built phylogram was documented close homology of the bacterial isolated (26)



5) DISCUSSION

Antibiotic resistance has been one of the prime important microbial threats in 21st century. *S. aureus* has always been obstacle for antimicrobial chemotherapy. The establishment of new classes of antimicrobial agents is habitual pattern followed by the emergence of resistant. This pathogen consequently the surveillance of the antimicrobial susceptible to *S. aureus* is overriding for understanding the latest and emerging resistance on both hospital- and community-acquired infections. (2) In this study, *S. aureus* was isolated from several clinical

specimens comprised from different infective foci, with the highest being from pus then urine. *S. aureus* is omnipresent, and it is a normal flora of the skin, genital tract and anterior nares, skin, of humans. The highest degree of antibiotic resistance in this study was to penicillin G (98.0 %) and Cefoxitin (95.1%). Resistance to other antibiotics such as erythromycin, gentamicin, and appear to be relatively low, while all the isolates were susceptible to vancomycin (100%) , and second last methicillin(97.0%) Vancomycin in particular is not available for routine clinical use in Government Medical College and Hospital Chandrapur hence, most *S. aureus* isolates, including MRSA, are still susceptible to the drug.

5) CONCLUSION

The main proposed for investigation of vancomycin resistance among the isolated of methicillin resistance *S. aureus* from Government Medical College and Hospital Chandrapur. So, from this study we concluded that among 150 sample, 102 isolated were coagulase positive for *S. aureus* and prevalence of MRSA is 84.32% and VRSA is 15.68% between October 2017 and May 2018 while molecular study run this sample CHPO11a perform with PCR, DNA extraction, Multiple sequence Alignment, BLAST analysis and Phylogenetic Analysis. Based on comparative study the positive report of *mecA* gene having the code no CHPO11a with *S. aureus* strain 592 *mecA* gene (CP035791); Sub Sp. Strain VB31683 *mecA* gene (CPO35671) and matched with LR027877, LR027876, LR027870. While for the van A positive report with *S. aureus* strain sa1 vancomycin resistance protein A (vanA) (KU315431); *S. aureus* strain HOU144-VR (CP012594); *S. aureus* transposase gene (MG592387); *S. aureus* plasmid pL W043 and GO273978 respectively. (25,26)

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LEGAL ANALYSIS OF ENVIRONMENT PROTECTION LAWS IN INDIA AND SUSTAINABLE DEVELOPMENT

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ABSTRACT

Due to the exceeding development, the excess use of natural resources create the problem of environmental imbalance. The principal objective of this paper is to analyse the importance of environment protection and present legislative and constitutional provisions for environment protection in India. This paper also explores the contribution of Indian Judiciary to recognize the concept of sustainable development and maintain the balance between environment protection and sustainable development. It also talks about the influence of International principles on the domestic laws to deal with the problem of environment protection. The research work is based on the data collected by the secondary sources such books, Articles, Journals etc.

Keywords: Environment Protection, Sustainable Development and International Principles, Role of Indian Judiciary.

INTRODUCTION

Everything, which surrounds us, may be collectively termed as environment. It is from the environment we get food to eat, water to drink, air to breathe and all the necessities required for day-to-day living. The environment therefore can be said to constitute as "Life Support System". For the happy and progressive life of all living things including human beings from generation to generation planet Earth and its Environment should preserve, conserve and protect from the hazards of all forms of pollution and over exploitation. We should maintain this life support system in balance with development. Human development mainly depends upon the natural resources available on the Earth. Indiscriminate use of natural resources in the name of economic development creates numerous environmental problems. Global warming, Ozone depletion and environmental pollution are some of the effects of economic development. There is need to keep balance between resource use and resource availability not only for today's generation but also for the future generation as a responsibility and respect towards the holy environment and its natural resources for the wellbeing of all living creatures. Therefore, environment protection and conservation is concern of all because there is close relationship between environment and life. Destruction of environment leads to destruction of all living creatures on the Earth including human beings. Over production, over exploitation of resources, industrial waste, exploitation of forests, indiscriminate quarrying, water pollution, air pollution, land pollution, noise pollution, nuclear radiation are the some examples of factors of environmental degradation. This degradation, destruction and pollution of environment has seriously threatened the human life, health and livelihood. Thus, there has been a thrust on the protection of environment worldwide. If the quality of life is to be assured to be saved from the environmental catastrophe, nature's gift to us in the form of flora and fauna has to be preserved in the natural form. Proper balance of ecosystem is the need of hour.

The only solution of this problem is Sustainable Development (SD). Now the concept of SD has recognized worldwide and it is one of the most urgent subject of international policy. The concept of SD comprises three major goals, Economic Development, Social Development and Environment Protection.

This paper will focus on the importance of environment, need of economic and social development, and how to maintain balance between development and environment protection with the help of concept of SD. Author will also discuss how Indian Judiciary move from an ideal concept of SD into reality to keep balance between environment protection and economic development in India.

ENVIRONMENT PROTECTION: HISTORICAL PERSPECTIVE

Concern for environment protection in India, we can be traced back to the period between 321 and 300 B.C. Ancient Indian law on environment protection is found in Kautilya's Arthashastra. It was the Dharma of each individual in the society to protect the nature. The trees, water, land, animals and birds gained important position in ancient times. All religions regulated the conduct of humanity in such a manner, which was conducive to nature.

In **Hinduism**, we find that from Vedic period, the environment was part of ethos of ancient people.

Hinduism considers the nature as "the body of God". Thus, the nature has been directly interconnected with religion and religion had a direct effect on the protection and conservation of the environment.

Basic principles of **Buddhism** are simplicity and ahimsa or non-violence. Both these principles are very important in protection and conservation of natural resources. Simplicity principle teaches us that man should not over exploit the natural resources. King Ashoka wanted the non-violence to be the cultural heritage of the people; therefore, punishment was prescribed for killing animals.

The principles of **Jainism** are similar to the principles of Buddhism. They also believes on the simplicity i.e. to meet their minimum needs without over-exploiting the nature. This principle is in close harmony with nature and help in protecting and preserving environment.

The **Holy Koran** declares that everything is created from water. Thus it significance of purity of water. Alah is considered as the owner of land and mankind is the trustee or guardian and other living creatures are considered to be the beneficiaries. This shows in Islam also there is close harmony with man and nature.

Christians are baptized in water, as a sigh of purification. Pope Paul VI, in his message to the United Nations Conference on the Human Environment held at Stockholm in June, 1972, stated that, the environment and resources are for everyone, they are inalienable property of everyone. This message of Pope Paul amply clears that there is close relation between Christianity and environment, and thrust is for sustainable development.

In **Sikh** religion the concern for environment is evident from the fact that it considers every creature to be the incarnation of God and hence conservation and preservation of nature is essential principle.

Environment Protection and Constitution of India

The Indian Constitution is amongst the few in the world that contains specific provisions on environmental protection in the form of Fundamental Rights, Directive Principles of State Policy, and Fundamental duties including the Preamble. The Directive Principles of State Policy and the Fundamental Duties Chapter explicitly enunciate the national commitment to protect and improve the environment. Ever since the adoption in 1972 of the Stockholm Declaration on the Human Environment, there has been a growing awareness at both national and international levels; of the environmental crisis which the world is facing today.

A number of Articles and provisions of the Indian Constitution are meant for protection of the environment. First of all, the fundamental right under Article 21 of the Constitution of India guarantees Right to Life. The word 'life' in Article 21 is a key to the judiciary to interpret and is also a key to an individual to protect environment. The term 'Right to Life' interpreted in a number of cases by the Supreme Court and the High Courts in India to mean that life with healthy environment.

Part IV of the Constitution of India relates to Directive Principle of States Policy. According to the Directive Principles of the State Policy, it is the duty of the State to raise the level of nutrition and the standard of living and to improve public health under Article 47, it is the duty of the State to strive to organize agriculture and animal husbandry under Article 48, it is the duty of the State to endeavor to protect and improvement of environment and to safeguard the forests and wild life of the country under Article 48-A and it is duty of the State to protect the historical monuments and places under Article 49. All these provisions are very supportive to make laws and policies for the protection environment.

Another important provision for environment protection under constitution of India is Citizen's duty laid down in new Article 51A (g) of the Constitution by amending it through 42nd Constitutional Amendment Act in the form of Fundamental Duties. This article 51A (g) directs every citizen of India that, it is the duty to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures. Thus, the Directive Principles of State Policy are imposes duty on the State to implement them. Whereas the fundamental duties are directed to every citizen of India first discharge the duty while exercising the right. Further, the Indian Constitution provides judicial remedies under Article 32 or under Article 226 in case of environmental destruction. Article 142 deals with the enforcement of the decrees or orders of the Supreme Court. The Indian Constitution also considers the Policy matters in protecting the environment under Article 162.

Thus, Indian Constitution became one of the rare constitutions of the world where specific provisions were incorporated in the Supreme law of the nation by putting obligations on the "State" as well as "citizens" to "protect and improve" the environment. This certainly is a positive development of Indian law for the protection and conservation of environment.

LEGISLATIVE MEASURES ON ENVIRONMENTAL PROTECTION

Legislative strategies for environmental protection are not a new and sudden happening in India. It has been developed gradually from the state of appearance of some environmental related provisions in different kind of

statutes to special statutes exclusively dealing with environmental protection. This gradual development can be divided to two stages, Pre-Constitutional environmental laws and Post- Constitutional environmental laws,

Pre-Constitutional Environmental Laws are:

Indian Penal Code, 1860, provides under Sec.268 the offence of causing a public nuisance and provides punishment. The law of public nuisance contained in Sec. 133, **Criminal Procedure Code, 1973** has been used in a number of cases for the purpose of protection of the environment.

Post-Constitutional Environmental Laws are:

After 1970, comprehensive particular environmental laws were enacted by the parliament in India, for e.g. Wildlife (Protection) Act, 1972; the Water (Prevention and Control of Pollution) Act, 1974; the Air (Prevention and Control of Pollution) Act, 1981; the Forest (Conservation) Act, 1980; Wildlife (Protection) Amendment Act, 1986 and the Environment (Protection) Act, 1986; and the Water (Prevention and Control of Pollution) Act, 1977. Etc. Objectives of some important statutes are discussed below.

Wild Life Protection Act, 1972

The main objective of this Act is effective wild life management. The Wildlife Act provides for state wildlife advisory boards, regulations for hunting wild animals and birds, establishment of sanctuaries and national parks, regulations for trade in wild animals, animal products and trophies, and judicially imposed penalties for violating the Act. Harming endangered species listed in Schedule 1 of the Act is prohibited throughout India. Hunting species, like those requiring special protection (Schedule II), big game (Schedule IV), is regulated through licensing. A few species classified as vermin (Schedule V), may be hunted without restrictions. Wildlife wardens and their staff administer the Act.

Water (Prevention & Control of Pollution) Act, 1974

The **main objective** of this Act is to provide for the prevention and control of water pollution and maintaining or restoring of wholesomeness of water (in the streams of well or on land).

Forest Conservation Act, 1980

It was enacted to consolidate the law related to forest.. The Forest (Conservation) Act was promulgated in 1980 to make certain reforms over the preceding Act of 1927. The 1927 Act deals with the four categories of the forests, namely reserved forests, village forests, protected forests and private forests. A state may declare forestlands or waste lands as reserved forest and may sell the produce from these forests. Any unauthorized felling of trees quarrying, grazing and hunting in reserved forests is punishable with a fine or imprisonment, or both. Reserved forests assigned to a village Community is called village forests.

Air (Prevention & Control of Pollution) Act, 1981

To implement the decision taken in the Stockholm Conference, the Parliament enacted Air (Prevention and Control of Pollution) Act; 1981. The main objective of this Act is to provide for prevention and control of air pollution. Every industrial operator within a declared air pollution area, must obtain a permit from the State Board.

Environment (Protection) Act, 1986

The Environment Protection Act is an umbrella legislation enacted to provide for the Central Government coordination over the central and State authorities established inter-alia under the water Act, 1974 and the Air Act, 1981. Thus, as regards air pollution, apart from the preventive or controlling measures under the Air Act, the residue protection of air would come within the Environment Act. The main objective of this Act is to provide for the protection and improvement of environment and for matters connected therewith. The Act is a special law and extends to the whole of India.

Factories (Amendment) Act, 1987

Factories (Amendment) Act, 1987, which provided significantly better controls than the Indian Factories Act, 1948 over the use and handling of hazardous substances in the work place, along with the stricter punishment for noncompliance. The Act made important progress in requiring the disclosure of information about hazardous processes to government officials, workers and local residents. The Amendment specifies that the occupier is the person with ultimate control over the Affairs of the factory, thereby raising the level of responsibility within a company and increasing the probability of compliance with safety regulations. The Amendment also specifies workplace exposure standards for many chemicals for the first time.

The Noise Pollution (Regulations and Control) Rules 2002

These rules lay down such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address systems during night hours (between 10:00 p.m. to 12:00 midnight) on or during any cultural or religious festive occasion.

The National Green Tribunal Act, 2010

The National Green Tribunal Act, 2010 has been enacted with the objectives to provide for establishment of a National Green Tribunal for the effective and expeditious disposal of cases relating to environment protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property.

ENVIRONMENT PROTECTION AND SUSTAINABLE DEVELOPMENT

Sustainable development is the organizing principle for meeting human development goals while at the same time sustaining the ability of natural system to provide the natural resources and ecosystem services upon which the economy and society depend. Sustainable development is a development that meets the needs of the present without compromising the ability of future generations. Modern concept of sustainable development is mostly derived from the **BRUNDTLAND REPORT 1987**. In 1972, 113 nations of the world gathered in Stockholm, Sweden. The Brundtland commission regarded sustainable development as 'meeting the needs of the present without comprising the ability of future generations to their own needs'. Sustainable development means that growth should be carried on in such a way as to recycle resources rather than deplete them. Every generation of mankind creates as well as destroys certain amount of resources for its development purpose. However, the rate of present development is greater than that of rate of creation. One of the greatest challenge today's society faces is achieving healthy rate of economic growth without damaging the natural resources, how to maintained balance between development and environment protection which is the objective of the principle of sustainable development. Sustainable Development is based on Three consideration i.e. environment, equity and futurity. Hence, by executing this principle we can keep balance between environment protection and sustainable development because environment protection is integral part of sustainable development.

ROLE OF INDIAN JUDICIARY

Judiciary in India, particularly the Supreme Court and High Courts has played an important role in preserving the doctrine of Sustainable Development. Supreme Court of India introduced the concept on 'Sustainable Development' in *Rural Litigation and Entitlement Kendra, Dehradun vs. State of Uttar Pradesh*¹. In this case, the Bench of Justice P.N. Bhagwati and Justice Ranganath Mishra stated that, the permanent assets of mankind are not to exhausted in one generation. The natural recourses should be used with requisite attention and care so that ecology and environment may not be affected in any serious way.

In *Vellore Citizens Welfare Forum's case*² the Apex Court held that "During the two decades from Stockholm to Rio Sustainable Development has come to be accepted as a viable concept improve the quality of human life while living within the carrying capacity of the supporting ecosystems... UNCED also recognized Inter-Generational Equity, Use and Conservation of Natural Resources, Environmental Protection, the Precautionary Principle, Polluter Pays principle, and Financial Assistance to the developing countries as a part of sustainable governance... We have no hesitation in holding that "Sustainable Development" as a balancing concept between ecology and development has been accepted as a part of the Customary International law though its salient features have yet to be finalized by the International law Jurists. We are, however, of the view that the precautionary Principle and The Polluter Pays principle are essential features of Sustainable Development".

In *Tirupur Dyeing Factory Owners Association v Noyyal River Ayacutdars Protection Association and Ors.*³

The Supreme Court has reiterated that mandate of the state to incorporate all the legal elements of the concept of Sustainable Development. The Court also directed to create a separate fund under the head of ecological cost. This is a contribution of the judiciary helped many ways to safeguard the interest of present and future generations.

¹ AIR 1987 SC 2187

² *Vellore Citizens Welfare Forum v. Union of India*, AIR 1996 SC 2715; (1996) 5 SCC 647.

³ (2009) 9 SCC 737; AIR 2010 SC 3645.

In *T. N. GodavarmanThirulmalkpad v. Union ofIndia*¹the Supreme Court issuing sweeping directions to oversee the enforcement offorest laws across the nation by quoting; *“environment is not the state property and is national asset. If it becomes necessary for economic development to use forests for non-forest purpose, then before grant of permission for diversion of forest land, such diversion can be made up by adopting both short term measures as well as long term measures one of it being a regeneration programme. Natural regeneration is a long process. It requires huge amounts and a policy. It requires proper use of funds for regeneration of depleted forest and ecology. The natural resources like forests are in trust with the present generation. In this light, various statutes have been enacted by the Parliament”*.

In *Essar Oil Ltd., v. HalarUtkarshSamitiand Ors*,²and in *D. Saravanan v. Union of India*,³and in *Dr. MeenakshiBharath v. State of Karnataka*,⁴ the court held that the concept of Sustainable Development is not an empty slogan that requires pragmatic view of implementations to conserve the resources both for present and future generations.

From the above various judgments of Supreme Court and High courts, it is concluded that Judiciary has played very major role in preserving the doctrine of sustainable development in India.

CONCLUSION

In the nutshell, it is concluded that Environment protection is part of our cultural values and traditions. From ancient times to modern age, more than 200 environmental law are present in India for environment protection. Indian supreme judiciary had played very important role by effectively implementing legal and constitutional provisions with the help of some international principles such as Polluter Pays Principle, Precautionary Principle, and Public Trust Doctrine including absolute Liability. All these principles are part of sustainable development. To conclude, Environment and development are two sides of same coin; any one cannot be sacrificed for the other. It is true that every country needs development but it should not be on the cost of environment degradation. Man cannot eat money. We need food to eat, water to drink and healthy and pure air to breath and this is provided to us by natural resources .Therefore sustainable development is only the better way to keep balance between healthy environment and economic development.

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HYBRID PIGEONPEA: A RAY OF HOPE FOR BREAKING YIELD PLATEAU IN PIGEONPEA

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ABSTRACT

Pigeonpea (Cajanus cajan (L.) Millsp.) is the second important pulse crop in India. To promote the pigeon-pea production, genetic improvement of pigeon-pea is being continuously emphasized by scientist and researchers for more than five decades and a number of cultivars were developed through hybridization programmes and selection of landraces. However, the progress in the genetic improvement of yield potential has been limited and the improved cultivars failed to enhance the productivity of the crop. The identification of genetic male sterility in pigeon pea (Reddy et.al, 1978 and Wallis et.al, 1981) has opened new vistas for commercial exploitation of hybrid vigour in this crop. However, the technology suffers from a major technical bottleneck when it comes to a large scale seed production. To overcome the inherent problems associated with GMS system, Cytoplasmic Genetic Male Sterility (CGMS) system were developed using various wild relatives of pigeonpea. A new hybrid pigeonpea breeding technology is capable of substantially increasing the productivity of red gram, and thus offering ray of hope for breaking yield plateau of pigeonpea in the country. Three lines system of hybrid technology, which is based on cytoplasmic-nuclear male-sterility, is expected to make a quantum increase in production and boost the productivity of pigeonpea yield in India. This review paper discusses the progress, current status and prospects of genetic enhancement of yield through hybrid breeding for breaking the yield plateau in pigeonpea.

Keywords: Hybrid Pigeonpea, Genetic Male Sterility, Cytoplasmic Genetic Male Sterility, Heterosis

INTRODUCTION

Pulses constitute an important ingredient in predominantly vegetarian diet and important source of protein. They supply minerals and vitamins and provide an abundance of food energy. Pulses provide a cheaper source of protein, they contain nearly twice as much protein as that of cereals and hence correctly called as poor man's meat. Pulses are also important for sustainable agriculture, enriching the soil through biological nitrogen fixation.

Since 1976, globally recorded a 56 percent increase in its area production but the productivity remained low about 700 kg ha⁻¹. The Indian Government annually imports about 0.5 to 0.6 m. tons of pigeonpea mainly from Myanmar and southern and eastern Africa. To promote the pigeonpea production, number of cultivars were developed through hybridization and selection (Singh *et al.*, 2005). Over the last six decades, pigeonpea productivity has remained stagnant at around 780 kg/ha, mainly due to the exposure of the crop to various biotic and abiotic stresses. Besides, it is mostly grown in marginal environments with limited inputs and inefficient management practices (Varshney *et al.*, 2012b).

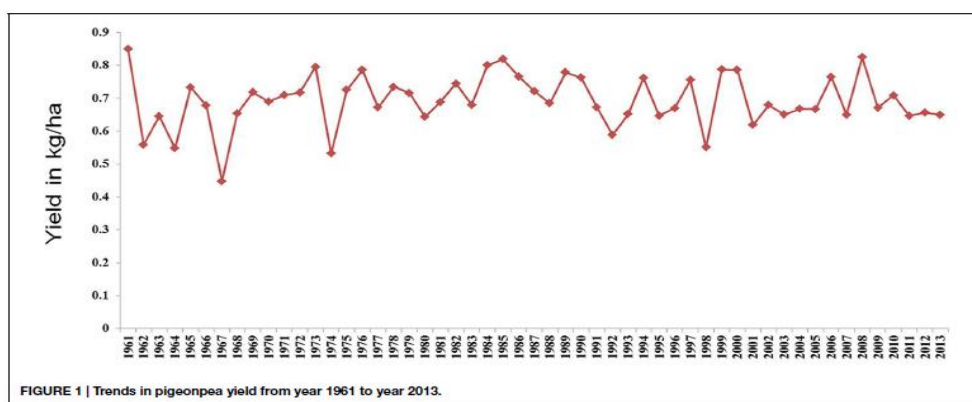


FIGURE 1 | Trends in pigeonpea yield from year 1961 to year 2013.

CONSTRAINTS TO HIGH PRODUCTIVITY IN PIGEONPEA

The major challenge for pigeonpea improvement is increasing the productivity at the same time reducing the yield losses due to various biotic and abiotic stresses under changing climate scenario. The major constraints affecting pigeonpea production are mainly biotic stresses like Fusarium wilt (*Fusarium udum* Butler), sterility mosaic disease (sterility mosaic virus) and phytophthora blight (*Phytophthora drechsleri*) and pests such as pod borer complex (*Helicoverpa armigera*, *Maruca vitrata*), pod fly (*Melanagromyza obtusa*), plum moth

(*Exelastis atomosa*) and abiotic stresses like drought, water logging and sensitivity to salinity. Apart from this, lower harvest index of all the available pigeonpea cultivars also results in less productivity. This emphasizes the need for developing high yielding varieties with resistance to multiple stresses to survive the challenges of the marginal environments

Pigeonpea varietal improvement program started in India in 1931 with selection from landraces for traits such as seed size, fusarium wilt, plant type, and yield (Ramanujam and Singh, 1981). During this period over 100 pigeonpea cultivars have been released in India but the crop productivity remained stagnant

This is a matter of concern in view of increasing population and reducing per capita availability of protein (27.3 kg/year in 1950 to 10 kg/year in 2000) that led to malnutrition among growing children and women, in particular. Considering the above mentioned constraints, new scientific approaches and tools are needed to raise the productivity of this important pulse crop.

In this context, cytoplasmic male sterility (CMS)-based hybrid technology was developed and the world's first pigeonpea commercial hybrid namely; GTH 1 and ICPH 2671 was released, with 46% yield advantage in farmers' field (Saxena et al., 2013) In order to popularize hybrids it is necessary that new high yielding hybrids are bred for different climatic conditions. Besides this, the technology be made grower- friendly.

In this regard the new developments in genomics science can be of great help. Beyond doubt, integration of genomics with breeding can enhance the pace of breeding new widely adopted hybrids The genomics can be effectively used in the selection of heterotic hybrid, male and female parents, incorporation of resistances and stability in the performance, assessment of purity of hybrids and their parents

In this seminar an effort has been made to highlight the potential role that genomics can play in accelerating the pace of hybrid breeding in pigeonpea

OVERVIEW OF HYBRID BREEDING IN PIGEONPEA

a. GMS-based Pigeonpea Hybrids – The Starter Technology

Pigeonpea is unique among the pulses as its floral morphology allows partial cross-pollinations (Saxena et al., 1990). ICRISAT in 1974 started breeding hybrids using the natural out-crossing. As a first step a program was launched for breeding a male sterility system that could be used in breeding hybrids; and a genetic male sterility (GMS) system, controlled by a single recessive gene(*ms1ms1*), was identified (Reddy et al., 1978).

This GMS was used to develop hybrid technology to assess the extent of hybrid vigor and ability of out-crossing in seed production on the male sterile plants. The first ever pigeonpea hybrid ICPH 8 performed very well in the multi-location trials, coordinated trials, and in the farmers' fields with mean standard heterosis of 25–35% , was released in 1991 for cultivation (Saxena et al., 1992). This was followed by the release of five other GMS based hybrids bred at different centers of Indian Council of Agricultural Research (ICAR; Saxena et al., 2006). Despite the yield advantages of 25–40%, these hybrids could not be commercialized due to seed production difficulties (Saxena et al., 2006).

Table 1. Genetic male sterility based pigeonpea hybrids in India

S. N.	Hybrid	Year of release	Duration	Yield (kg ha ⁻¹)	Superiority over check (%)
1	ICPH 8	1991	125	1780	41 over UPAS 120
2	PPH 4	1994	137	1930	14 over UPAS 120
3	COPH1	1994	117	1210	32 over Vamabn 1
4	COPH2	1997	120-130	1050	35 over Co 5
5	AKPH 4101	1997	130-140	--	64 over UPAS 120
6	AKPH 2022	1998	180-200	--	35 over BDN 2

This valuable experience indicated that in pigeonpea sufficient heterosis is available and seed production issues can be tackled economically if the GMS system could be replaced with cytoplasmic genic male sterility (CGMS) system.

b. Development of CGMS Systems -- a Breakthrough

Considering the limitations in large-scale hybrid seed production in GMS hybrids, the development of CGMS became imperative. The strategy was to induce CMS by placing pigeonpea genome in wild cytoplasm through

hybridization It was believed that the interaction of wild cytoplasm with cultivated nuclear genome would produce male sterility.

Seven cytoplasmic male sterile (CMS) systems (given in table) have been developed from different wild *Cajanus species* Of these, A2 and A4 systems derived from crosses involving wild relatives of pigeonpea and cultivated types have shown promise because of their stability under various agro-climatic zones and availability of good maintainers and fertility restorers.

Table.2 List of CMS sources derived from different wild relatives of pigeonpea

Sr No	Wild relative	Designation	Investigators
1.	C. sericeous	A ₁	Ariyanayagam et al. (1993, 1995), Saxena et al. (2006), Wanjari et al. (2003)
2.	C. scarabaeoides	A ₂	Ariyanayagam et al. (1993 ^a), Tikka et al.(1997), Saxena and Kumar (2003)
3.	C. volubilis	A ₃	Wanjari et al. (1999)
4.	C. cajanifolius	A ₄	Rathnaswamy et al. (1999), Saxena et al. (2005)
5.	C. cajan	A ₅	Rathnaswamy et al. (1999), Mallikarjuna and Saxena (2002)Mallikarjuna and Moss (1995), Malikarjuna and Saxena (2005)
6.	C. lineata	A ₆	K. B. Saxena, (Unpublished data)
7.	C. platycarpus	A ₇	Mallikarjuna et al. (2006)

As a result, first A2 based hybrid GTH1 was developed at S D A U, S K Nagar, Gujrat and released by ICAR in 2004 for cultivation in Gujarat state. Parents of this hybrid are GT 288 A (CMS line/female with cytoplasm of *Cajanus scarabaeoides* and GTR-11 (restorer/male). Based on yield trials GTH 1 (1830 kg ha⁻¹) gave 57.40% yield superiority over the best GMS hybrid AKPH 4101 and 32% yield superiority over the best local variety, GT 100 This hybrid is early in maturity duration (140 days) and very much stable for its fertility restoration.

Later on three A4 CMS-based hybrid namely ICPH 2671 produced by crossing ICPA 2043 with ICPR 2671, was released in 2010 for Madhya Pradesh which recorded 35–69% superiority over the best local cultivars In 2012, ICPH 2740 was released for cultivation in Andhra Pradesh (Saxena and Tikle, 2015); while the third hybrid ICPH 3762 was released in Odisha in 2014 (Saxena et al., 2014a). The hybrids ICPH 2740 and ICPH 3762 also out-yielded the control by a big (40–50%) margin.

The performance data of the hybrid have shown that in pigeonpea significantly high productivity levels can be achieved by farmers and the persistent yield plateau can be cracked.

c. Two-Line Hybrid Breeding Systems

Since three line based hybrid technology is technically demanding and incurs cost in commercial hybrid production. These issues have raised significant concerns that led to explore a much simpler technology that would enable accessibility to the farmers growing hybrids in their fields, i.e., two-line hybrid breeding system. Very recently, in pigeonpea a temperature sensitive male sterile line was identified based on field evaluations. This line was developed by crossing a wild relative, *Cajanus sericeus* with a cultivar namely, ICPA85010 (Saxena, 2014).

The perennial nature of the plant and the natural out crossing ability of the crop allows the possibility to evaluate these lines under controlled conditions for their male sterility to fertility transitions with different temperature regimes. These lines could be invaluable for establishing a two-line hybrid system in pigeonpea Toward this, fertility transition behavior is being studied for more than 20 different combinations of day temperatures, night temperatures, photoperiods, humidity, and light intensities under controlled environment chambers.

Preliminary analysis has shown that these lines are responding to day temperature, converting to male sterile with more than 24°C and to male fertile with less than 23°C.

In addition, various cytological studies and transcriptome profiling of the male sterile and fertile anthers are also being carried out to identify the putative candidate genes and to understand the molecular mechanism. The

identification of candidate gene(s) and/or the trait locus controlling this reversion will play an important role in breeding, ultimately lead to developing a stable two-line system and also making use of elite lines into the hybrid breeding program.

Understanding the mechanism will also allow the prediction of performance of F1s of the two-line hybrids during different climatic conditions. Transcript profiling and proteomics analysis could be utilized to postulate the possible molecular mechanisms underlying the fertility transition in thermo sensitive genic male sterile (TGMS) lines as in case of *Oryza sativa* (Song et al., 2015).

A similar approach could also be devised for pigeonpea which will lead to breeding, development and utilization of TGMS lines for a potential two-line hybrid breeding. Breeding of this trait involves identification, cloning and transferring of the major sterility gene. Genetic analysis and fine mapping of this gene has already been carried out in rice (Lee et al., 2005) and wheat (Guo et al., 2006). Using a similar approach, segregating progenies are being developed at ICRISAT to dissect this trait in pigeonpea.

d. **Advantages of Hybrids**

1. Increased grain yield: Results of the trials conducted over three years and several locations indicated that sufficient local of heterosis is available in pigeonpea
2. Enhanced seedling vigour: Hybrid pigeonpea plants produce substantially greater biomass than those of pure line varieties of the comparable duration. Hybrids utilize inputs such as sunlight, water, and nutrients more efficiently, while maintaining their partitioning at par with the pure lines leading to higher grain yield. In an experiment conducted at ICRISAT, 30-days old seedlings produced 44% more shoot mass and 43% more root mass compared to the pure line cultivars (Saxena et al., 1992).
3. Reduced seed rates: Pigeonpea hybrids produce more number of primary and secondary branches with wider canopy. This suggests that seed rate of hybrids can be reduced by 40 - 50% without losing yield per unit area. Reduced seed rate will offset the higher seed cost which the farmer may have to incur while purchasing hybrids
4. Greater drought tolerance: Hybrid pigeonpea, by virtue of its greater root mass and depth, have greater ability to draw water from deep soil profiles. This also helps hybrids to tide over intermittent drought conditions prevailing during different phases of growth.
5. Greater disease resistance: Results of limited experiments show that hybrids offer more resistance to disease attack than pure lines by virtue of their greater resilience (Saxena et al., 1992). Also the hybrids recover faster and assimilate greater biomass

e. **Constraints in Breeding New Hybrids**

The major constraints in pigeonpea hybrid breeding as recognized now are

1. Long generation turnover time that slow down the breeding and selection speed,
2. Challenges in identifying fertility restorers
3. Determination of genetic diversity is another factor that limits selection of heterotic hybrid parents,
4. Maintaining three lines (CMS, maintainer and restorer lines).
5. Ascertaining hybrid seeds purity
6. To deliver the benefits of hybrid technology to farmers, it is imperative that the process of breeding new hybrids be enhanced and seed technology is simplified
7. It is envisaged that the new developments in genomics science can help in solving these issues.

f. **Genomics for Accelerated Hybrid Breeding Program**

During recent years, various genomic resources have been developed including a draft of the nuclear and the complete mitochondrial genome sequence in pigeonpea (Varshney et al., 2012; Tuteja et al., 2013), in addition to the large repertoire of molecular markers (Saxena et al., 2014b), high throughput genotyping platforms (Varshney et al., 2010), transcriptome assembly (Kudapa et al., 2014) and genetic maps (Saxena et al., 2010b; Bohra et al., 2012).

As a result of the recent advances in the next generation sequencing (NGS) based approaches, large numbers of molecular markers including SSRs (>54,000; simple sequence repeat), ISRs (>29,000; intron spanning region)

and SNPs (>12,000; single nucleotide polymorphism) in addition to the 25,577 ESTs have become available in the public domain (Pazhamala et al., 2015).

Using genotyping by sequencing (GBS) and whole genome re-sequencing (WGRS) approaches, more and more variations such as SNPs, INDELs, CNVs, and PAVs are being identified which will be available and utilized in the near future for pigeonpea improvement programs.

Apart from these resources, many inter- and intra-specific genetic maps were developed, some of which utilized mapping populations with CMS lines segregating for fertility restoration (Saxena et al., 2011).

All these genomic resources along with the recent approaches will be utilized for consolidation and strengthening of the pigeonpea hybrid breeding technology in the near future. Furthermore, a number of efforts have been initiated toward rapid solutions to hybrid production systems and unlocking the mystery of heterosis using various genomics approach. Additionally, efforts have also been directed toward diversification of CMS sources in the pigeonpea gene pool and answering the biological questions such as molecular basis of cytoplasmic male sterility. Also, various sets of molecular markers have been identified for fertility restoration and purity assessment.

CONCLUSIONS

Pigeonpea can play a major role in providing food security especially to the semi-arid tropics, where it can be grown under marginal environment with limited resources. To achieve quantum jumps in the productivity level, which has remained unchanged and low over decades, a good beginning has been made by ushering in to an era of Pigeonpea hybrid. The exploitation of hybrid vigour is feasible and advantageous. ICRISAT, ICAR and SAUs took this challenge and succeeded in developing CMS systems by crossing wild relatives of Pigeonpea as female parent with the cultivated type as male parent. This technology has given us hope that the genetic barrier of stagnated yield could be broken. The development of stable CMS system in Pigeonpea is a real boon to the breeders. To enhance the pace of research and development of hybrid Pigeonpea ICRISAT and ICAR Institutes is actively involved in technology transfer to national research system, public and private seed sector. We believe that a good beginning has already been made with CMS-based hybrid Pigeonpea technology and now it is just a few steps more to break the yield plateau in pigeonpea.

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BIOCHEMISTRY OF AMNIOTIC FLUID METABOLITES, CHOLESTEROL AND TRIGLYCERIDES IN MEGACHIROPTERAN BAT, ROUSETTUS LESCHENAUTI, AT TERM GESTATION

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ABSTRACT

The biochemical estimation of metabolites like creatinine, urea, uric acid and bilirubin in addition to cholesterol and triglycerides was done. The purpose is to present some observations on certain chemical constituents of amniotic fluid at term. The constituents of the amniotic fluid are the principal source of information on foetal maturity. Due to differentiation of tissue and ensuing secretory functions, no single value or combination of values provide absolute evidence of foetal maturation.

In the present work at term in *Rousettus Leschenaulti*, creatinine was found to be in the range of 0.70 ± 0.01 to 0.75 ± 0.02 mg%. Creatinine is an indicator of muscle mass as well as renal function. The mean range for urea was 16.60 ± 0.30 to 18.97 ± 0.09 mg%. The increased concentration of urea at term along with other constituents like creatinine, albumin and uric acid makes the fluid turbid. Uric acid was 3.30 ± 0.17 to 3.63 ± 0.12 mg %. The level of uric acid in amniotic fluid may be used as a criterion in estimating gestational age.

Determination of amniotic fluid bilirubin is now a standard diagnostic aid in the handling of erythroblastosis foetalis, maternal diabetes and toxemia. It was found to be in the range of 0.60 ± 0.01 to 0.64 ± 0.01 mg%. The mean values registered for cholesterol and triglycerides were 144.0 ± 2.08 to 151.67 ± 1.20 mg% and 85.97 ± 0.18 to 86.87 ± 0.20 mg %, respectively. The significance of the presence of cholesterol and triglycerides in very small amount in amniotic fluid is very difficult to discuss. The triglycerides are the storage lipids of animals in the plasma where the body uses it mainly as fuel when energy requirement increases tremendously at term pregnancy.

Keyword: Amniotic fluid, term pregnancy, Megachiropteran bat, Biochemical composition.

INTRODUCTION

Rousettus Leschenaulti breeds twice in a year in quick succession. The first breeding cycle commences in November when the females copulate and deliveries take place in during March and April.

The constituents of the amniotic fluid are the principal sources of information on foetal maturity due to differentiation of tissue and ensuing secretory functions. The amniotic fluid is thought to be produced by the following mechanism: secretion from the amniotic epithelium, a combination of the foetal maturation and secretion from amniotic epithelium or a combination from above and dialysis from the amnion and placenta or transudation or dialysis of maternal plasma (Wirschafter and Portland, 1958). However, Hutchinson, et al, 1955 have commented that amniotic fluid is not a 'transudate or dialysate of maternal plasma' but "that each element exchanges at its own rate and is in dynamic equilibrium with the maternal system. However, Bates, 1963 is of the opinion that the fluid flows from the fetal respiratory tract into the amniotic cavity.

As pregnancy proceeds, the volume of amniotic fluid increases and its chemical composition changes. The fetal contribution to amniotic fluid is particularly evident in the latter half of gestation when the increased fetal excretion of urine results in a substantial contribution to the amniotic fluid volume and composition, however, in the present studies the composition have been studied at the term pregnancy.

According to Teoh et al., 1973 it is important to select an appropriate demarcation line in order to ensure that premature infants are not delivered. Thus a thorough exploitation of amniotic fluid analyses for fetal maturity should include Nile Blue Sulphate staining, creatinine concentration and uric acid concentration in the amniotic fluid reflect the ageing of the foetus coming either from foetus and foetal serum (Heron, 1966). Similar parameters were studied and correlated to the earlier values in bats at term gestation.

The concentration of various amniotic fluid constituents have been presented in the hope that the information may be useful in antenatal diagnosis. The antenatal diagnosis of at least some genetic disorders associated with changes in urinary composition, by the biochemical analysis of amniotic fluid, therefore seems a distinct possibility. Amnion is a reservoir, which not only provides water but also limited amount of mineral and metabolic substrates in times of need when placental transfer is not adequate to meet fetal demands, growth factors in swallowed amniotic fluid enhance the growth, development and maturation of the gastrointestinal tract (Barker, 1961; Muliver et al., 1979; Gulbis et al., 1998; Ozegbe, 2005; and 134 others). Amniotic fluid

composition also changes with a stable pattern throughout pregnancy, during the first trimester, amniotic fluid is isoosmotic to fetal plasma, as gestation progresses, amniotic fluid become more hypotonic to fetal and maternal plasma. Human and animal studies indicate that there is a delicate balance between fetal fluid production (urine and lung fluid) and amniotic fluid removal (fetal swallowing and intramembranous flow). It is the purpose of this report to present some observation on certain chemical constituents of amniotic fluid at term.

The various concentrations noted for cholesterol in various mammalian species and particularly in human in the amniotic fluid comes from the expulsion of lipid droplets by exocytosis from amniotic epithelial cells into the amniotic fluid. Fibroblasts are highly capable of synthesizing and storing both lipids and glycogen (Brossens and Gordon, 1966; Pitkin and Zwirek, 1967).

The triglycerides are the storage lipids of animals in the plasma where the body uses it mainly as fuel. The dam uses the plasma lipids during the second half of pregnancy when energy requirements increase tremendously. According to Ozegbe (2005) tissue and plasma cholesterol exchange is generally reported to be very low and hence the absence of cholesterol from the amniotic fluid thus observed a significantly positive relationship between the concentration of maternal plasma uric acid and cholesterol and the negative relationship between uric acid and triglycerides which is contrary to the results in humans by Berkowitz (1964).

MATERIAL AND METHODS

Breeding habits- *Rousettus Leschenaulti* breeds twice in a year in quick succession (Gopalkrishna and Chaudhary 1977) gestation lasts for about 125 days. The first breeding cycle commences in November when the female copulates and deliveries take place during the following March – April. Within a few days after parturition, the adult females come to hit again and undergo copulation and carry a second pregnancy which terminate in the following July.

Collection of animals- The specimens of *Rousettus Leschenaulti* were collected from Mansar / Kandri, Nagpur either during March or in early July with the help of mist net.

Collection of amniotic fluid- After anaesthisising the animals with ether, abdomen walls were cut opened by a mid-incision. The gravid uteri of full term pregnant bats were slit opened without damaging the amnion. Amniotic fluid was drawn with 2 ml sterile syringe and was collected into Eppendorf's tube for biochemical estimations. The tubes were collected in deep freezer at -20°C until estimations to be performed.

Estimation of various components of amniotic fluid was done by different methods, viz- Creatinine by alkaline picrate method, urea by DAM method, uric acid by Phosphotungstic acid method, cholesterol by enzymatic method, Bilirubin by modified Tendrassik and Grof method.

RESULTS

The various values recorded for different amniotic fluid metabolites for *Rousettus Leschenaulti* at term are depicted in the tabulated form after calculating the mean values and analysing it statistically.

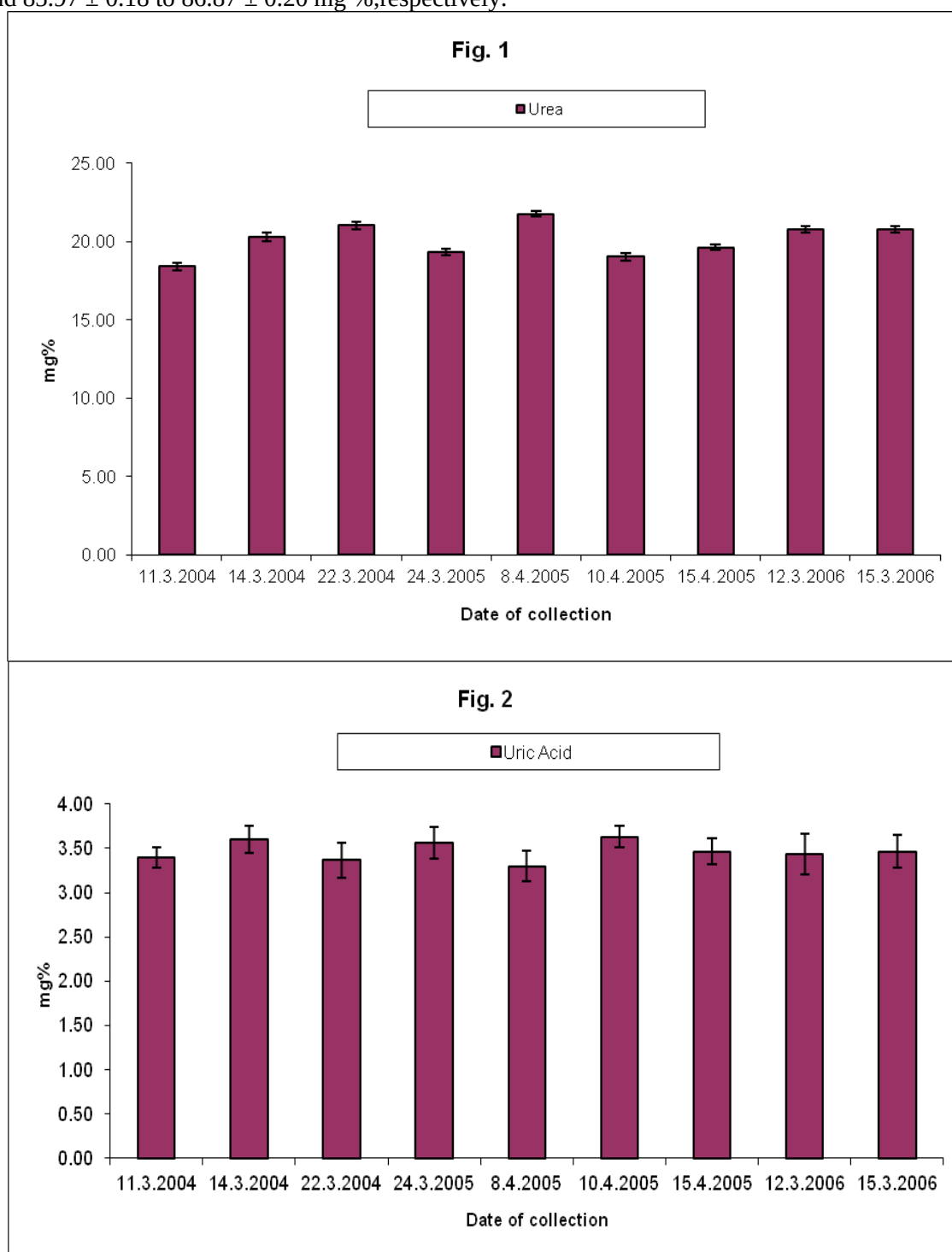
Table – 1 Amniotic fluid chemistry values of *R. leschenaulti*

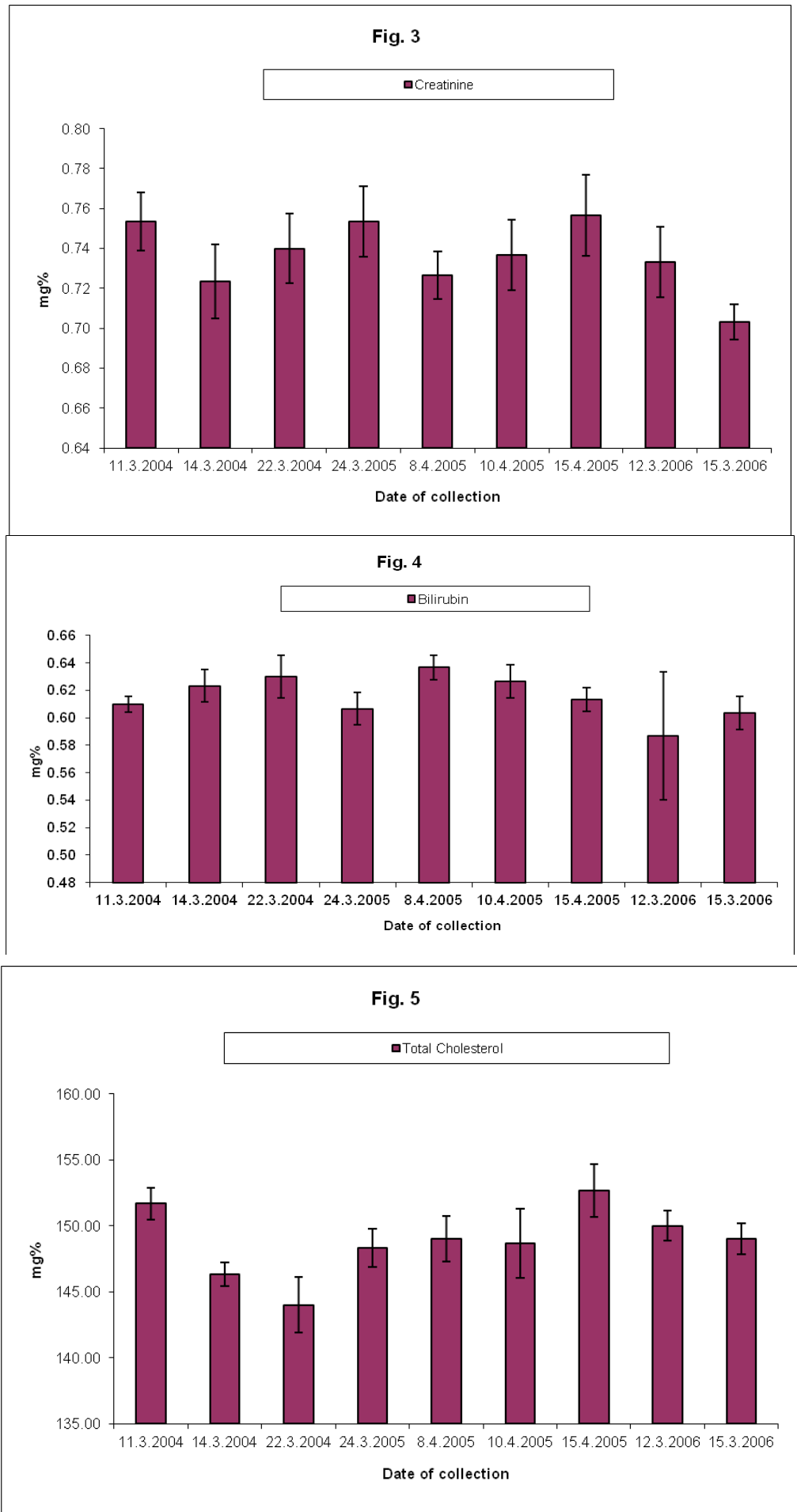
Date of Collection	Urea (mg%)	Uric Acid (mg%)	Creatinine (mg%)	Bilirubin (mg%)	Total Cholesterol (mg%)	Triglycerides (mg%)	Osmolality (mOsm)
11.3.2004	18.40±0.23	3.40 ±0.12	0.75 ±0.01	0.61 ±0.01	151.67 ±1.20	86.70 ±0.21	228.77 ±0.33
14.3.2004	20.27±0.27	3.60 ±0.15	0.72 ±0.02	0.62 ±0.01	146.33 ±0.88	86.87 ±0.20	228.63 ±0.54
22.3.2004	21.03±0.23	3.37 ±0.20	0.74 ±0.02	0.63 ±0.02	144.00 ±2.08	86.23 ±0.24	230.37 ±0.49
24.3.2005	19.30±0.21	3.57 ±0.18	0.75 ±0.02	0.61 ±0.01	148.33 ±1.45	86.77 ±0.26	231.93 ±0.26
8.4.2005	21.77±0.15	3.30 ±0.17	0.73 ±0.01	0.64 ±0.01	149.00 ±1.73	86.07 ±0.15	229.97 ±0.48
10.4.2005	19.03±0.23	3.63 ±0.12	0.74 ±0.02	0.63 ±0.01	148.67 ±2.60	86.30 ±0.21	229.67 ±0.62
15.4.2005	19.60±0.17	3.47 ±0.15	0.76 ±0.02	0.61 ±0.01	152.67 ±2.03	85.97 ±0.18	230.83 ±0.44
12.3.2006	20.77±0.20	3.43 ±0.23	0.73 ±0.02	0.59 ±0.05	150.00 ±1.15	86.47 ±0.26	230.97 ±0.12

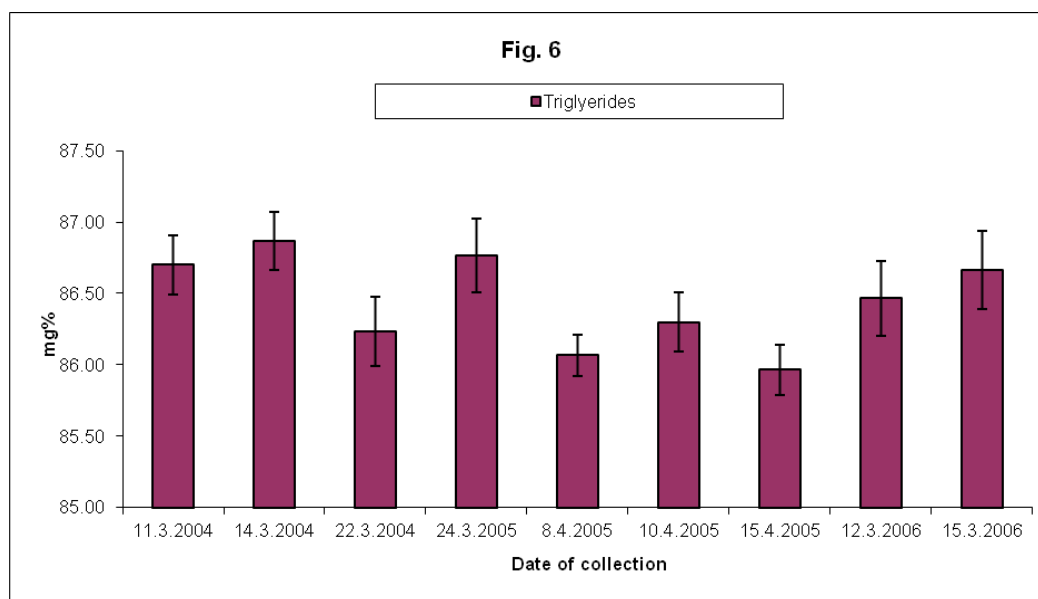
15.3.2006	20.80±0.21	3.47 ±0.19	0.70 ±0.01	0.60 ±0.01	149.00 ±1.15	86.67 ±0.27	230.67 ±0.55
P value	P < 0.1	P < 0.3	P < 0.5	P < 0.1	P < 0.1	P < 0.1	P < 0.1

In the present work at term in *RousettusLeschenaulti*, creatinine was found to be in the range of 0.70 ± 0.01 to 0.75 ± 0.02 mg%. Creatinine is an indicator of muscle mass as well as renal function. The mean range for urea was 16.60 ± 0.30 to 18.97 ± 0.09 mg%. The increased concentration of urea at term along with other constituents like creatinine, albumin and uric acid makes the fluid turbid. Uric acid was 3.30 ± 0.17 to 3.63 ± 0.12 mg %. The level of uric acid in amniotic fluid may be used as a criterion in estimating gestational age.

Determination of amniotic fluid bilirubin is now a standard diagnostic aid in the handling of erythroblastosisfoetalis, maternal diabetes and toxemia. It was found to be in the range of 0.60 ± 0.01 to 0.64 ± 0.01 mg%. The mean values registered for cholesterol and triglycerides were 144.0 ± 2.08 to 151.67 ± 1.20 mg% and 85.97 ± 0.18 to 86.87 ± 0.20 mg %,respectively.







DISCUSSION

The biochemical estimation of metabolites like creatinine, urea, uric acid and bilirubin in addition to cholesterol and triglycerides was done. The purpose is to present some observations on certain chemical constituents of amniotic fluid at term. The constituents of the amniotic fluid are the principal source of information on foetal maturity. Due to differentiation of tissue and ensuing secretory functions.

Few investigations (Enlander, 1972; Gillibrand, 1969; Ozegbe, 2005) have demonstrated that organic nitrogenous compounds such as urea is found in amniotic fluid, maternal blood and foetal blood in similar concentration. Enlander, 1972, have described that the values of urea were scattered over a wide range throughout gestation. However, the present study of Biochemistry of amniotic fluid in *Rousettus Leschenaulti* mainly concerned with term pregnancy. We are not in a position to comment regarding the rise of values at term but our values for urea are in agreement with the result of previous workers, moreover, we have not related our values with maternal and foetal serum. The mean range for urea for *Rousettus Leschenaulti* were 16.60 ± 0.30 to 18.97 ± 0.09 mg%. The water and urea are excreted by the fetus into the amniotic cavity and returns to the maternal fluids by passive diffusion across the chorioamnion in response to a concentration gradient in human at term (McGaughey et al., 1960). The increased concentration of urea at term along with other constituents like creatinine, albumin and uric acid makes the fluid turbid. Similar turbidity in both the species at term has been observed. The presence of urea in the amniotic fluid could be explained by the addition of fetal urine to the amniotic cavity (Pitkin et al., 1968) or by active transport from the maternal compartment into the amniotic fluid across the chorio-amnion (Danforth and Hull, 1958). According to Roopnairsingh and Morris 1971 (2.78 ± 0.201 mg/100ml) liquor urea concentration does not increase with advancing age of the foetus in normal pregnancy, this is in disagreement with the reports of Friedberg, 1955 and Gillibrand, 1969b and others. In contrast, liquor creatinine concentration increases linearly as pregnancy proceeds. These observations are compatible with the changes in fetal renal function occurring with gestational age. Increasing maturation of the glomeruli permits filtration of urea and creatinine, but as tubular function becomes progressively established (Pitkin et al., 1968) some of the urea is reabsorbed. Creatinine on the other hand is not reabsorbed. This implies that the composition of the amniotic fluid not only reflects the developing metabolic activity of the foetus but also the developing functional efficiency of its kidney. (Enlander, 1972; Daniel et al., 2004; 10ml/dL, Ozegbe, 2005)

In the present study, the mean value for uric acid at term pregnancy have been recorded to be 3.30 ± 0.17 to 3.63 ± 0.12 mg%. The level of uric acid in amniotic fluid may be used as a criteria in estimating gestational age (Enlander, 1972; Teoch et al, 1973 and Ozegbe, 2005). The mean concentration of uric acid in amniotic fluid increases as pregnancy progresses. At term, the uric acid being 4.9 mg% (Teoch et al, 1973); 9.79 mg% (Enlander, 1972 and Ozegbe, 2005); 6.69 ± 16.1 Mmol/L in rabbit. Our result also support the above hypothesis. Creatinine was found to be in the range of 0.70 ± 0.01 to 0.75 ± 0.02 mg%. This appears to be significantly less when compared to human amniotic fluid; may be due to very small volume of the fluid or in the dilution of the urine at term since we have studied the term fluid. The volume of amniotic fluid recorded in *Rousettus Leschenaulti* was in the range of 1.9 to 2.2 ml. Many authors have interpreted that amniotic fluid creatinine levels of 2 mg or more appears to be reliable index of foetal maturity. Hence, in pregnancies with

medical; complications, where timing of delivery may be vital, amniotic fluid creatinine level may be of importance in determining the degree of foetal maturity (Pitkin and Zwirek, 1967; Lind et al, 1969; Henneman et al, 1970, RoopnarainSingh and Morris, 1971; Enlander, 1972, Roax et al, 1973; Teoch et al, 1972; Myers et al, 1975; Ozegbe, 2005). Liquor creatinine estimation provides additional aid for the prediction of foetal maturity. The estimation of bilirubin has been established as a useful tool in evaluating the status of an unborn infant (Clayton et al, 1969). Among five possible pathways bilirubin could take to build up a concentration in amniotic fluid (fetal kidneys, lungs, skin, bowel and membranes), the intramembranous pathway is the only one that is compatible with the amniotic fluid / fetal blood ratios for bilirubin. According to Wild 1961 and Sikkell et al. 2004 in normal human fetuses, amniotic fluid / foetal blood ratios for bilirubin. By estimating the bilirubin content of liquor it was possible to detect babies in whom the haemolytic disease (Kernicterus), was likely to develop as there was an increase in the amount of bilirubin (Walker, 1957; Watson, 1962). The bilirubin content when chemically analysed was found to be in the range of $(0.60 \pm 0.01 - 0.64 \pm 0.01 \text{ mg\%})$ in Rousettus. There has been good agreement among these investigators. Our values being slightly higher than inhuman indicates that the foetus of bat may suffer from haemolytic disease as well as mother's health may not be satisfactory. For the conservation of wild life it is very important to know the concentrations of bilirubin in the foetal serum, maternal serum and the amniotic fluid. Unfortunately in the present work no record of blood serum was maintained. Determination of amniotic fluid bilirubin is now a standard diagnostic aid in the handling of erythroblastosis foetalis, maternal diabetes, and toxemia. Except in foetuses affected by haemolytic disease, the absence of bilirubin and the presence of 2mg. per cent or more of creatinine would suggest that the gestational age of the fetus is at least 36 or 37 weeks (Watson, 1960). For cholesterol in various mammalian species and particularly in human in the amniotic fluid comes from the expulsion of lipid droplets by exocytosis from amniotic epithelial cells into the amniotic fluid. Fibroblasts are highly capable of synthesizing and storing both lipids and glycogen (Brossens and Gordon, 1966; Pitkin and Zwirek, 1967; Henneman et al., 1970) who noted a correlation between the lipid content of cells in amniotic fluid and the total number of cells shed into the amniotic fluid and the rise progressively with fetal age but Enlander 1972 did not find any significant change in the cholesterol throughout gestation. Similarly Singh and Zuspan (1973) described an increase in lipids at term. On the other hand McKay et al., 1955 noticed no measurable quantity of cholesterol. The mean values registered for cholesterol in Rousettus $144.0 \pm 2.08 - 151.67 \pm 1.20 \text{ mg\%}$ and the mean range for triglycerides was recorded to be $85.97 \pm 0.18 - 86.87 \pm 0.20$ in Rousettus. However, McKay et al., 1955 described zero values in human term, $2.19 \pm 0.23\%$ (Biezenski et al., 1968); $9.8 \pm 2.1\%$ (Singh and Zuspan, 1973; Ozegbe, 2005) in rabbit. Our results are mostly in disagreement with the previous workers for an unknown reason.

The significance of the presence of cholesterol (lipids) in very small amount in amniotic fluid is very difficult to discuss. Because of slow turnover they do not appear to be in transit from one place to another like some plasma lipids. The triglycerides are the storage lipids of animals in the plasma where the body uses it mainly as fuel. The dam uses the plasma lipids during the second half of pregnancy when energy requirements increase tremendously. According to Ozegbe (2005) tissue and plasma cholesterol exchange is generally reported to be very low and hence the absence of cholesterol from the amniotic fluid thus observed a significantly positive relationship between the concentration of maternal plasma uric acid and cholesterol and the negative relationship between uric acid and triglycerides which is contrary to the results in humans by Berkowitz (1964). Previous studies by Biezenski et al., 1968 - $(1.43 \pm 0.17 \text{ mg\%})$; Singh and Zuspan 1973 $(11.3 \pm 3.0\%)$ and Ozegbe (0.426 ± 0.064) for rabbit and $0.262 - 0.627 \text{ mmol/L}$ are also in disagreement with our results.

Therefore, the biochemical analysis of constituents of amniotic fluid has recently become an important technique in assessing the status and development of foetus. Such an investigation definitely helps to elucidate the composition of fluid in co-relation of foetal health, maturation of foetus and off course, its resemblance with other mammalian species.

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ZOOPLANKTON DIVERSITY AROUND WASHIM REGION OF MAHARASHTRA

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ABSTRACT

The zooplanktons play an important role to study the faunal diversity of aquatic ecosystems. Zooplanktons also act as a pollution indicator in a water body. Zooplankton is the long-lived and mobile components of aquatic ecosystem. They are relatively easy to collect and identify to species level and are good indicators of pollution in any water body. Individual invertebrate species respond differently to environmental changes. The present study was carried out for the periods of eight month at different fresh water bodies of Washim region like Ekburji dam, Keli dam, DevTalav, Padma Teertha. A total 27 zooplankton out of which 11 species of rotifers, 06 copepods, 09 cladocera and 1 ostracod were observed.

Keywords: Diversity, Rotifers, Washim region, Zooplanktons

INTRODUCTION

Planktons are the plants and animals that drift around on the water currents. They are abundant in the surface waters where sunlight and nutrients are readily available. Zooplankton (Greek: Zoon, animal; planktos, wandering) are myriads of diverse floating and drifting animals with limited power of locomotion. Majority of them are microscopic, unicellular or multicellular forms with size ranging from microns to a millimeter or more. In addition to size variations, there are differences in morphological features and taxonomic position. Zooplanktons play an important role to study the faunal bio-diversity of aquatic ecosystems. They include representatives of almost every taxon of the animal kingdom and occur in the pelagic environment either as adults (holoplankton) or eggs and larvae (meroplankton). By sheer abundance of both types and their presence at varying depths, the zooplanktons are utilized to assess energy transfer at secondary trophic level. The zooplankton occurrence and distribution influence pelagic fishery potentials. The fishes mostly breed in areas where the planktonic organisms are plenty so that their young ones could get sufficient food for survival and growth. Loss of zooplankton diversity may lead to effects on both the community of organisms declines in ecosystem function as well as shifts residing within the ecosystem and on humans to alternate stable states (Ostroumov, 2005) ; that rely upon the system for water supply and (Scheffer et al., 2001).

Zooplanktons forms an important link in aquatic food chain various researches carried out work to study the zooplanktons of different fresh water bodies. Influence of eutrophication on zooplankton community in a shallow lakewas studied by Spoljarec et al., (2009). Jayabhaye (2010) studied zooplankton diversity of river Kayadhu, near Hingoli city Maharashtra. Vanjare et al., (2010) reported zooplankton from a polluted river, Mula of Pune India, with record of *Brachionus rubens* (Ehrenberg, 1838) epizoic on *Moina macrocopa* (Straus, 1820) the occurrence of which coincided with lower dissolved oxygen (DO) content. Qualitative and quantitative studies of zooplanktons in Rajura Lake of Buldhana district were carried out by Joshi (2011) during February 2010 to January 2011. Tayade and Dabhade (2011) studied the rotifer community around Washim region and prepare a checklist of Rotifers in Washim region. Study of qualitative diversity of rotifer community of freshwater Katepurna reservoir, district Akola, Maharashtra, India was carried out by Pawar and Dabhade (2016). Zooplankton diversity reflects the water quality and they are the good indicators of changes taking place in the water resources, Kabra et al., (2016) carried out a research work to analyze zooplanktons of Fresh water ecosystem in Washim town, Maharashtra, India. The zooplankton are more varied as compared to phytoplankton, their variability in any aquatic ecosystem is influenced mainly by patchiness, diurnal vertical migration and seasons. Evaluation of zooplankton production in any particular area will largely depend on use of correct zooplankton methodology that involves collection of samples, fixation, preservation, analysis and computation of data. The present research work was carried out to study the community structure of zooplanktons inhabiting in the different fresh water bodies around Washim region of Maharashtra.

MATERIALS AND METHODS**Study Area**

The present study was carried out for the period of eight month that is from June 2018 to January 2019 at Ekburji dam, Keli dam, DevTalav, Padma Teertha. Water from the dam is used for drinking and irrigation purpose while the water from the pond is used for recreation. Four sites were selected for the study that is site A, (South side), site B, (West side), site C, (North side), site D, (East side).

Zooplankton Collection and Preservation

Zooplankton samples were collected in between 9 to 11am from all the sampling stations by towing the plankton collecting net of mesh size 25 micron. Plankton net acts as a filter, it is the most common method for collection of zooplanktons. The concentrated zooplankton samples are carefully transferred to another container. 5 ml of 4% formalin, 2 to 3 drops of glycerins were added to it. A pinch of detergent powder was also added to avoid the aggregation of zooplankton. Samples were collected in separate glass phials with label containing name of site, date of sampling, time of sampling, etc.



Photoplate I: Sampling sites around Washim region

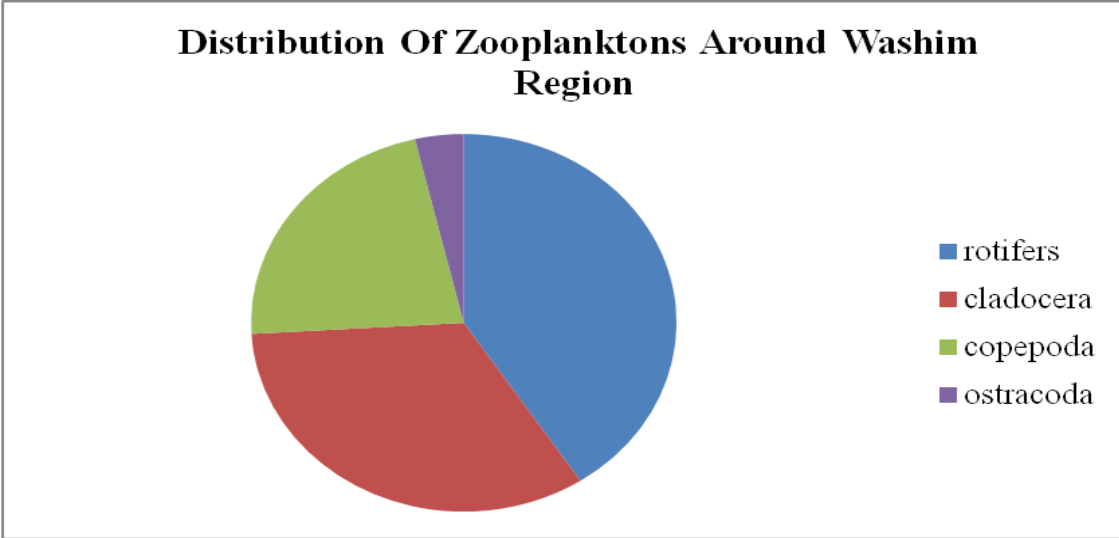
RESULTS AND DISCUSSION

A total of 27 zooplankton species were recorded from the different sampling site of Washim region comprising of 11 species of rotifers, 06 copepods, 09 cladocera and 1 ostracods. The community structure of zooplankton showed a mixed composition of mesotrophic to eutrophic species.

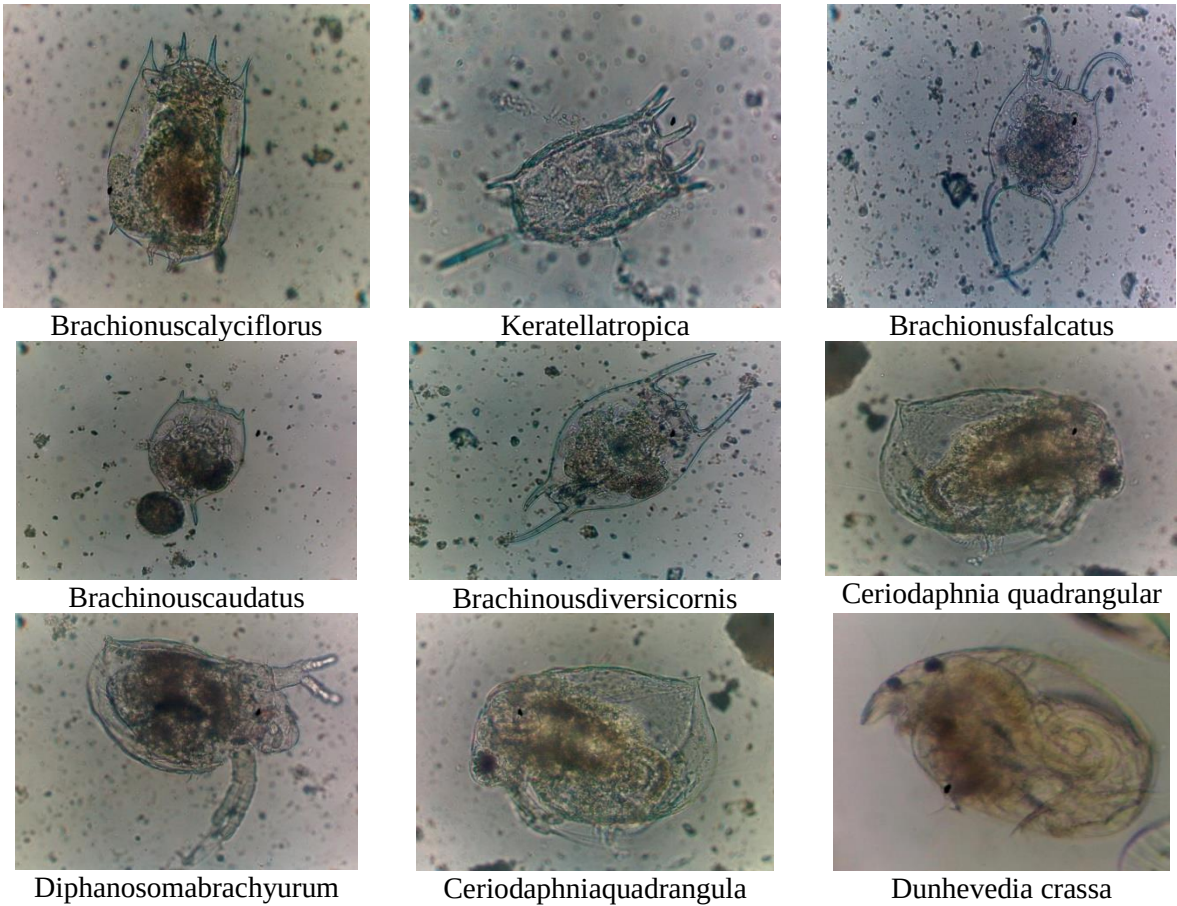
S.N.	ZOOPLANKTON
I	ROTIFER
1.	Brachinouscaudatus
2.	Brachinousdiversicornis
3.	Brachinouscalyciflorus
4.	Brachinousforticul
5.	Brachinousbidentata
6.	Brachinousfalcatus
7.	Keratellatropica
8.	Keratella
9.	Filinalongiseta
10.	Lecaneleontina
11.	Asplanchanabrightwellii
II	CLADOCERA
1.	Ceriodaphnia quadrangular
2.	Macrothrix sp.
3.	Simocephalus serrulatus
4.	Diaphanosoma brevireme
5.	Diaphanosoma birgei
6.	Simocephalus vetulus
7.	Diphanosoma brachyurum

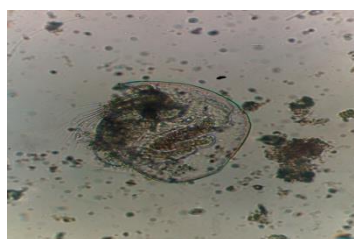
8.	Dunhevedia crassa
9.	Daphanosomatropicum
III	COPEPODA
1.	Copepode Cyclops
2.	Microcyclopsvaricans
3.	Calanus copepod
4.	Diaptomus
5.	Mesocyclops/ Mesocyplopsinversus
6.	Diaptomus
IV	OSTRACODA
1	Stenocypris

Table I: The occurrence of zooplankton component around Washim region of Maharashtra



Graph plate I: Distribution of zooplanktons around Washim region





Dunhevedia crassa



Mesocyclops inversus



Diaptomus



Cyclops strennus



Copepodecyclops



Mesocyclops

Photoplate I: Different zooplanktons around Washim region of Maharashtra

The occurrence of zooplankton component around Washim region has been depicted in table I. The rotifers are one of the basic groups of the zooplankton community which play a vital role in the fresh water ecosystem, being the food organisms they serve as living capsules of nutrition. The cladocera components of zooplanktons play a vital role in the benthic community. The cladocera were represented by genus *Daphnia* was the most abundant individuals during the entire study period. Copepods were represented by species from genera *Cyclops* and *Mesocyclops*. Water temperature and availability of food affects the copepod population. In the present investigation the Ostracoda population is represented by single species that is *Stenocypris* this may be due to the feeding pressure of fishes and also these are the pollution sensitive species. Zooplankton community around Washim region was studied by the various researchers. Tayade and Dabhade (2015) carried out a research to access the rotifer communities of the ephemeral ponds in Washim region and recorded 52 taxa belonging to 14 families 22 genera. Solanke and Dabhade (2016) studied the Rotifer communities in Upper Morna reservoir of Medshi, Washim district and observed 18 species of rotifers belonging to 6 genera and 5 families among which *Brachionus* species were found in highest number. The study of ecological fluctuations of rotifers was carried out by Sharma and Srivastava (1986), Shayestchfar (1995), Bezerra *et al.*, (1999), Sharma and Bhattarai (2005). Zooplankton are more valuable as indicators, they are larger and easier to identify than algae and respond more rapidly to environmental changes than fish. Zooplankton survey of Rishi lake of Karanja Lad and Yedshi lake of Yedshi village, district Washim was carried out by Patil *et al.* (2008) for the study of zooplankton biodiversity. Mulaniet *al.*, (2009) studied on water quality and zooplankton community of the Panchanganga River in Kolhapur city their work was mainly undertaken to investigate the impact of sewage and industrial effluents on zooplankton community. Studies on the biodiversity of Rewalsar wetland (Himanch Pradesh) were made by Jindal and Thakur (2009) in these species composition and population dynamics of phytoplankton, zooplankton, nekton and productivity have been correlated with seasonal variations in physico-chemical characteristics of water.

CONCLUSION

The present study reveals the diversity of zooplanktons around Washim region. All the four groups of zooplanktons were recorded throughout the study period among which Rotifer found the most dominant group represented by 11 species while the ostracode shows the least number of species that is only one species.

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INDUCTION OF GENETIC VARIABILITY IN SOYBEAN FOR YIELD AND ITS CONTRIBUTING TRAITS BY GAMMA RAYS

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ABSTRACT

The effectiveness and efficiency, yield parameters and statistical analysis for M_2 , M_3 and M_4 generations of Soybean cultivar TAMS-38 was studied using gamma rays treatment. Effectiveness and efficiency was recorded at increase for low concentration and decrease for high concentration level. The most of the treatment were exhibited positive and negative shift. The statistical analysis such as high phenotypic coefficient of variation (PCV) and genotypic co-efficient of variation (GCV) and low to high heritability (h^2) and low to high genetic advance as a percentage of mean was recorded for all five characters studied i.e. plant height, number of branches plant⁻¹, number of pod plant⁻¹, 100 seed weight and seed yield plant⁻¹ in M_3 and M_4 generations. This indicated that all these traits were influenced by additive gene action operating in the expression of these traits in M_3 and M_4 generation and hence help as a criteria for making selection.

Keywords: Soybean, Mutation, Effectiveness, Efficiency, Frequency

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is referred as “Golden bean” and “Miracle crop” of 21st century. It is one of the important oilseed as well as legume crop. It contributes more than 50% to the global production of edible oil. Soybean contains 20% oil and 40% protein. Soybean protein is rich in all essential amino acids vitamin A, B and D; health promoting phytochemicals like isoflavones. Hence, soybean referred as “Wonder crop” or “Golden bean”. The soy protein stands unique by supplying all sixteen essential amino acids. Soybean oil is used as edible oil in Indian diet. Soybean originated in North Eastern China. It entered in India during 6th century AD. USA, Brazil, China, Argentina and India are the major soybean producing countries in the world. These countries accounts for 90% of the world production. India ranked 5th position in respect to area and production.

The concept of inducing mutation and utilizing them in plant breeding was first given by Hugo de vries (1903) for generating variability and achieving the goal of generating of new strains of cultivated crop plants. Gamma rays a ionizing physical mutagen capable of inducing mutation in plants. The present research work was, therefore, undertaken using seeds of soybean cultivar TAMS-38 subjected to treatment of different doses of gamma rays and hence improve its production.

MATERIALS AND METHODS

Dry healthy and genetically pure seeds of TAMS-38 was used in this study. Four different lots of soybean seed cultivar TAMS-38 were made. Every lot was of 500 g seed weight. The three lots of seed were sent to Bhabha Atomic Research Centre, Trombay, for irradiation with three different doses of gamma rays treatment. These seed were treated by three different doses of gamma rays i.e. 200 Gy, 250 Gy, 300 Gy (Co^{60} at BARC Trombay, Mumbai) and used for raising M_1 during *kharif* 2016 and individual plant in each treatment were harvested separately. The harvested seed were used to raise M_2 generation in *rabi* 2016 and (62) mutants were identified.

In *kharif* 2017, all the harvested seed from each (62) mutants of M_2 generation along with 2 checks (TAMS-38 and JS-335) were sown to raise M_3 generation in replicated trial using Randomized Block Design replicated thrice. In *kharif* 2018 all the harvested seed from each (104) mutants of M_3 generation along with 2 checks (TAMS-38 and JS-335) were sown to raise M_4 generation in replicated trial using Randomized Block Design replicated thrice.

All the parameters were recorded in mean value, phenotypic coefficient and genotypic co-efficient of variation, heritability and genetic advance as per cent of mean were used for ANOVA for RBD method.

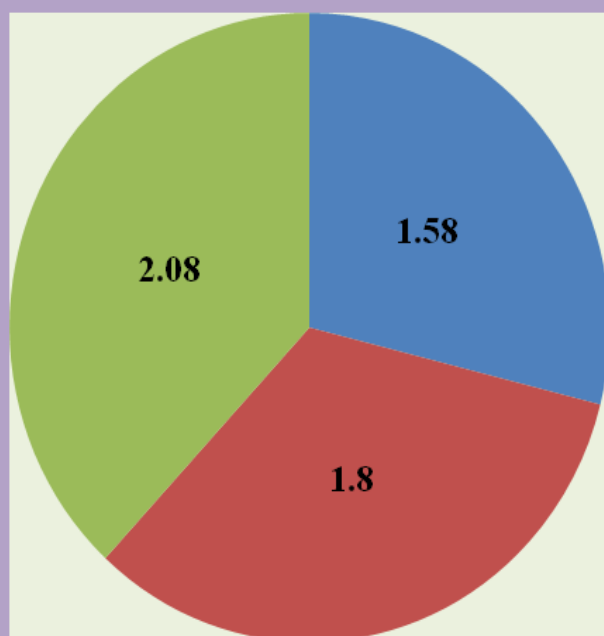
Mutation frequency was estimated on M_2 plant basis. Mutagenic effectiveness is a measure of the frequency of mutation induced by unit of mutagen, whereas mutagenic efficiency gives an indication of the proportion of mutation in relation to undesirable change like lethality and injury.

RESULTS AND DISCUSSION**Mutation frequency, effectiveness and efficiency**

Mutation frequency of each visible mutant in M_2 generation was calculated as suggested by Gaul (1958) and is represented in table 1 and graphically in fig 1. The table revealed that the treatment T_3 induced the highest mutation frequency (2.08%) followed by T_2 (1.80%) and the lowest in T_1 (1.58%). The frequency of mutation was comparable in all the treatments. The present results confirm these earlier reports in soybean (Khan and Tyagi 2010).

Table 1. Frequency of induced mutants in different gamma rays treatments in M_2 generation

Sr. No.	Type of mutation	T_1	T_2	T_3	Total
1	Chlorophyll Deficient	0.08	0.11	0.16	0.35
2	Early flowered	0.11	0.14	0.16	0.41
3	Late flowered	0.05	0.08	0.16	0.29
4	Early matured	0.05	0.08	0.16	0.29
5	Late matured	0.08	0.08	0.16	0.32
6	Dwarf	0.17	0.14	0.24	0.55
7	Tall	0.14	0.17	0.16	0.47
8	Root length increased	0.08	0.14	0.16	0.38
9	100 seed weight above 13 g	0.11	0.14	0.08	0.33
10	Small leaf	0.11	0.08	0.08	0.27
11	Wrinkled leaf	0.08	0.05	-	0.13
12	Viney type	0.05	0.02	-	0.07
13	Sterile	0.08	-	-	0.08
14	High yielder	0.14	0.20	0.24	0.58
15	More pods	0.11	0.20	0.08	0.39
16	More branched	0.14	0.17	0.24	0.55
Total		1.58	1.80	2.08	5.46

**Fig 1. Frequency of induced mutants in different gamma rays treatment in M_2 generation**

The efficiency and effectiveness of mutagens were estimated as suggested by Konzak *et al.* (1965) and are presented in table 2. From the table, it is noticed that T_1 exhibited the highest mutagenic efficiency (0.35), while T_3 (0.30) showed the lowest. It was observed that the mutagenic efficiency increased in low doses and

decreased in high doses of gamma rays. Among the treatments the highest mutagenic effectiveness was observed in T₁ (0.0079) followed by T₂ (0.0072), while the lowest was noticed in T₃ (0.0069). Further it was noticed that the mutagenic effectiveness reduced with the increase in the dose of gamma rays. Pavadai *et al.* (2010) observed that increase in effectiveness and efficiency in low concentration and decrease in high concentration level in soybean. Satpute and Fultambkar (2012) also reported that mutagenic effectiveness and efficiency reduced with the increase in concentration dose of mutagen in two cultivar of soybean (MAUS-71 and JS335).

Table 2. Mutagenic efficiency and effectiveness of gamma rays treatments in M₂ generation on soybean (Glycine max (L.) Merrill)

Sr. No.	Treatments	Per cent Lethality	Per cent mutant 100 M ₂ plant ⁻¹	Mutagenic efficiency	Mutagenic effectiveness
1	T ₁ (200gy)	4.49	1.58	0.35	0.0079
2	T ₂ (250gy)	5.43	1.80	0.33	0.0072
3	T ₃ (300gy)	6.75	2.08	0.30	0.0069
4	T ₄ (Control)	3.09	-	-	-

Mean performance in M₂, M₃ and M₄ generation

The effectiveness of plant breeding programme is depending upon the amount of genetic variability present in the segregating generation. Therefore, for increasing variability in segregating generations, improvements in the quantitative characters have to be made through accumulation of genes affecting their expression in a positive and negative direction. So, in the present experiments, it is observed that the mean for different quantitative characters shifted both in positive negative direction due to mutagenic treatments. The most of the treatment were exhibited positive and negative shift the maximum values were recorded in 250 Gy gamma rays treatment for M₂, M₃ and M₄ generations (Table 3). Similar findings were also observed by previous workers in soybean (Dhole *et al.*, 2003 and Pavadai, 2006).

Table 3. Effectiveness of gamma rays on yield and contributing traits in soybean (Glycine max (L.) Merrill)

Doses of mutagen	Seed yield plant ⁻¹ (g)			100 seed weight (g)			No. of pod plant ⁻¹			No. of branches plant ⁻¹			Plant height (cm)		
Generations	M ₂	M ₃	M ₄	M ₂	M ₃	M ₄	M ₂	M ₃	M ₄	M ₂	M ₃	M ₄	M ₂	M ₃	M ₄
200 Gy	4.98	5.47	3.47	11.63	8.21	8.78	22.62	29.36	24.21	3.50	3.15	2.74	40.34	37.23	27.12
250 Gy	5.41	10.19	3.49	10.73	8.36	8.86	22.95	56.49	26.22	4.12	3.30	2.85	46.13	36.59	28.30
300 Gy	5.00	2.30	---	10.08	9.01	-----	26.73	11.33	---	3.69	2.33	---	43.24	30.66	----
Control	7.2	9.24	3.12	7.80	6.56	8.06	38.12	39.43	22.55	3.00	2.90	2.67	41.10	39.75	25.56

STATISTICAL ANALYSIS

In the present study shows high phenotypic coefficient of variation (PCV) and genotypic co-efficient of variation (GCV) and low to high heritability (h²) and low to high genetic advance as a percentage of mean was recorded. In accordance to these results high genotypic coefficient of variation and phenotypic coefficient of variation for number of pod plant⁻¹ and seed yield plant⁻¹ were also reported by Malek *et al.* (2014) and Patil and Sharma (2016), high heritability for yield and yield components were also reported by Pavadai *et al.* (2010) and Patil and Sharma (2016) and high genetic advance as a percentage of mean was also reported by Malek *et al.* (2014) and Pavadai *et al.* (2010) in Soybean.

When all the genetic parameters for five characters were considered, it was found that seed yield plant⁻¹ and its contributing characters viz., 100 seed weight, number of pods plant⁻¹, number of branches plant⁻¹ and plant height exhibited high genotypic and phenotypic coefficient of variation, moderate heritability along with high genetic advance as percentage of mean (Table 4). This indicated that all these traits were influenced by additive gene action operating in the expression of these traits in M₃ generation and hence help as a criteria for making selection.

In M_4 generation, seed yield plant⁻¹ and its contributing characters viz., 100 seed weight, number of pods plant⁻¹, number of branches plant⁻¹ and plant height showed high genotypic and phenotypic coefficient of variation, low heritability along with low genetic advance as percentage of mean (Table 4). This indicated that all these traits were influenced by additive gene action operating in the expression of these traits in M_4 generation and hence help as a criteria for making selection.

Table 4. Genetic parameters estimates for different characters in M_3 and M_4 generation

Parameters	Seed yield plant ⁻¹ (g)		100 seed weight (g)		No. of pods plant ⁻¹		No. of branches plant ⁻¹		Plant height (cm)	
	M_3	M_4	M_3	M_4	M_3	M_4	M_3	M_4	M_3	M_4
GCV (%)	45.59	26.07	37.18	22.90	45.03	26.74	39.45	24.14	38.71	22.77
PCV (%)	62.43	81.05	50.78	50.93	64.17	70.78	57.63	53.91	51.15	52.11
Heritability (%)	53.34	10.34	53.60	20.21	49.23	14.29	46.85	20.04	57.26	19.08
G.A (per cent of mean)	50.09	5.55	41.05	9.5	45.67	7.8	38.08	9.96	45.65	8.85

PCV= Phenotypic Co-Efficient of variation, GCV= Genotypic Co-Efficient of variation, H^2 = Heritability

GA= Genetic advance as per cent of mean

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BACTERIOICIN PRODUCTION WITH ENCAPSULATED MARINE STRAIN *LACTOBACILLUS PENTOSUS* B25 IN ALGINATE MATRICES

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ABSTRACT

Two strains such as wild and mutant strains of *Lactobacillus pentosus* B25 produce the bacteriocin were immobilized in calcium alginate beads. The free cells of them were optimized viz., temperature and pH for maximum bacteriocin production. The bacteriocin production was maximized at 18th h at 30°C and in pH 7.0. Free cells cultured at the optimum culture conditions were used to compare the effect of immobilization on bacteriocin production. Bacteriocin production peaked at 2560 AU/ml and 2280 AU/ml in free and immobilized fermentation broth of wild and peaked at 3040 AU/ml and 3360 AU/ml in free and immobilized mutant strain respectively. A decline in bacteriocin production occurred at the middle of the fermentation with the free cells in contrast to long term stability noticed with the immobilized cells. The immobilized cells were subjected to repeated cycles of fermentation which resulted in an increased yield with increase in biomass

INTRODUCTION

Cell immobilization is defined as the fix or fit cells to a limit area of space with the preserve of catalytic activity (Karelet *et al.*, 1985). Immobilized molecule is one whose movement in space has been restricted either completely or to a small limited region by attachment to a solid structure (Yu-Qunget *et al.*, 2004). Immobilization of cell is useful to stabilize the activity of bioreactors in sequential operations, plasmid stability, increasing bacteriophage resistance and lowering the inhibition by antibiotics or salts (Champagne *et al.*, 1994). In particular, cell immobilization has shown to offer many advantages for biomass and metabolite productions compared with the free-cell (FC) systems such as high cell density and very high volumetric productivity, reuse of biocatalysts, high process stability (physical and biological) over long fermentation periods, retention of plasmid-bearing cells, improved resistance to contamination, uncoupling of biomass and metabolite productions, stimulation of production and secretion of secondary metabolites and physical and chemical protection of the cells (Scannell *et al.*, 2000; Grattepancheet *et al.*, 2007).

In present study, the feasibility of bacteriocin B25 increases using calcium alginate immobilized cells of *Lactobacillus pentosus* B25, was investigated and the production was compared with free-cells.

MATERIALS AND METHODS**1.1 Studies on Impact of Immobilization on bacteriocin production**

One of the main problems concerning the batch process is the low yield of bacteriocins. Therefore the recent research focused on new approaches for increasing the cell concentration and bacteriocin production, respectively. Immobilization is one of the method applied for maintaining high cell concentration and higher bacteriocin production (Wan *et al.*, 1995).

1.2.a Preparation of beads:

Immobilization was carried out using the wild and mutant strain of *Lactobacillus pentosus* B25. Cells were immobilized using sodium alginate. Modified MRS (mMRS) broth was used for studying bacteriocin production with encapsulated cells. To increase the stability of calcium alginate matrix, MRS broth was modified. (Scannell *et al.*, 2000; Ivanova *et al.*, 2002; Rao *et al.*, 2008, 2009). Prior to immobilization, 1 OD of *Lactobacillus pentosus* B25 (10^7 cfu/ml) were inoculated into mMRS broth and incubated at 30°C for 48 h. Cells were recovered by centrifugation, washed in 0.1% buffered peptone water (Hi Media) and re suspended in 10 ml mMRS. A solution of 4% sodium alginate was prepared in distilled water, autoclaved (110°C, 15 min), and cooled to 45°C prior to use. The entrapment method involve mixing of 2% of inoculum in one volume of sodium alginate.

Cell suspension of Bacteriocin producing strain was inoculated to the alginate solution (10% v/v) and aseptically transferred to a sterile syringe. The mixture was forced through a sterile syringe needle (0.8 mm diameter) by air-pressure drop-wise into a stirred solution of 2% (w/v) 0.5 M fused calcium chloride. The resulting beads were hardened in calcium chloride for 1 h, wet sieved and surface dried in a laminar flow hood. After preparation of beads of polymer matrices, added in 50 ml of mMRS broth and incubated their respective temperature and time and lastly assayed for bacteriocin activity by agar well diffusion method.

1.2.b Determination of the concentration of free cells in the media:

The viability of cells was counted by dilution plating on MRS agar and after incubation for 48 h at 30°C. The data were expressed as cfu/ml (colony forming unites per ml) (Ivanova *et al.*, 2002; Sarika *et al.*, 2012).

1.2.c Determination of cell concentration in the beads:

The viable cell concentration in the beads was determined by suspending 1 ml of alginate solution (measured by removing of 1 ml water) in 0.1 M phosphate solution followed by gentle shaking for 30 min for destruction of the beads (Suthasinee, 2010). The suspension was submitted to decimal serial dilutions using 0.1% sterile peptone water. 100 µl for each dilution was plated in duplicate on MRS agar and incubated at 30°C for 48 h. The number of viable cells were expressed as cfu/ml by dilution plating on MRS agar after incubation for 48 h at 30°C.

1.3.a Batch fermentation with Free and Immobilized cells:

The fermentations with the immobilized cells were performed in Erlenmeyer flasks containing 50 ml mMRS broth with the optimized pH and temperature conditions and without shaking for 90 h. About 5 ml cultures were withdrawn in every 18 h for determining cell viability, pH and bacteriocin activity. After 90 h, beads were filtered under sterile conditions, washed with saline and re-inoculated in fresh media for the second and the third cycle of fermentation. The fermentation with free cells was performed under the same conditions as the immobilized cells. After the third cycle of fermentation with the immobilized cells, the batch culture broth with the immobilized cells was monitored for one month to determine the stability of the bead. Samples were collected in an interval of one week to determine the cell viability, pH change and bacteriocin activity.

1.3.b Determination of bacteriocin activity:

The fermentation broth was centrifuged (10,000 rpm for 10 min), passed through Millipore filter (pore size 0.22 µm, Hi Media) and the resulting supernatant fluid was evaluated for bacteriocin activity as per the method described earlier.

1.3.c Statistical analysis:

Each experiment and determination was repeated in duplicate. The data were examined by one-way ANOVA using MINITAB 14 at a level of significance of $p < 0.05$.

RESULTS AND DISCUSSIONS**2.1 Immobilization studies****2.1.a: Optimal conditions for bacteriocin production by the free cells:**

The conditions for maximum production of bacteriocin by the free cells were determined. While *Lactobacillus pentosus* B25 showed maximum production of bacteriocin at the 18th h of incubation. Bacterial proliferation and bacteriocin production was high at 30°C and at pH 7. The chosen bacteriocin producer strains showed the growth stability and bacteriocin production at their stationary phase (Fukushima *et al.*, 1983; Matargas *et al.*, 2003; Chin *et al.*, 2001). The highest stability and antibacterial activity was found in sodium alginate beads. Sodium alginate has eco-friendly nature as it is nontoxic and safe for nature, cheap, simply used and mild conditions required for immobilization (Rao *et al.*, 2009). Porosity of the beads limits the nutrient supply and oxygen diffusion to the immobilized cell (Dey *et al.*, 2003 and Adinarayana *et al.*, 2004).

2.1.b: Cell concentration in the bead:

The immobilized beads with the size of 2 mm diameter were subjected to determination of the cell concentration. The maximum cell concentrations of 13×10^7 cfu/mL and 28×10^{10} cfu/ml were obtained that of wild and mutant strain of *Lactobacillus pentosus* B25. These observations were comparable to the studies conducted earlier in *Lactococcus* sp. (Prevot and Divis, 1992), *Bifidobacterium longum* ATCC 15707 (Doleyres *et al.*, 2002; Sarika *et al.*, 2012).

The CFU in the control medium significantly decreased after 72 h of fermentation while the viability of immobilized cells remained almost stable until the end of the fermentation. The cell concentration outside of the beads was also measured and the results showed that there was a decreasing of the cell viability after 72 h that of batch fermentation (Figure 1.a and 1.b). This could be explained by the limited immunity of the free cells to their own bacteriocin in the medium. For several bacteriocin producers, it has already been improved that the genes for bacteriocin production and immunity are regulated and transcribed simultaneously (Abbe *et al.*, 1995).

2.2.a: Bacteriocin production by free and immobilized bacteria in batch fermentation:

The batch fermentation was carried out with the free and immobilized cells of both the strains in controlled temperature and pH conditions (Photoplate no. 1.A). The bacteriocin production profiles were similar in both the strains in the immobilized cells. Bacteriocin production peaked at 2560 AU/ml and 2880 AU/ml in free and

immobilized fermentation broth of wild and peaked at 3040 AU/ml and 3360AU/ml in free and immobilized mutant strain respectively, even at the 24th and 72th h of fermentation with the free cells of wild and mutant strain respectively (Figure 1.a and 1.b). Photoplate 1.B has represents the antibacterial activity of free and immobilized cells against selected pathogen (*Klebsiella pneumoniae* 535). However, when compared with the free cell fermentations, the fermentation with the immobilized cells increased the stability of yield of bacteriocin and proved long term means of producing bacteriocin in optimized media. After reaching a peak, the bacteriocin activity decreased significantly in the culture medium. Such results were reported for other bacteriocins (De Vuyst 1994; De Vuyst *et al.*, 1996). It could be supposed that the alginate beads had a protective role separating the bacteriocins in the medium from the proteolytic enzyme in the bead.

In contrast, once equilibrium was reached, the immobilized strains maintained maximal production for the duration of the fermentation. This finding was supported by the previous study conducted earlier (Scannell *et al.*, 2000) for the continuous production of nisin and lacticin 3147 using immobilized cells. Hence, the decline in bacteriocin production in the free cell cultures could be attributed to plasmid instability, as nisin is a plasmid encoded bacteriocin. However, in the case of plantaricin, earlier studies (Dzung *et al.*, 1994; Ehrmann *et al.*, 2000; Omar *et al.*, 2008) revealed that the gene involved in the production of the same is present on the chromosome. Most studies with encapsulated LAB focused on improving resistance of LAB to hostile environmental conditions (Ortakci and Sert, 2012; Todorov *et al.*, 2012; Shamekhi *et al.*, 2013) or enhancement of lactic acid production (Narita *et al.*, 2004; Rao *et al.*, 2008). Ivanova *et al.*, (2002) and Sarika *et al.*, (2012) reported similar results for encapsulated *Enterococcus faecium* A2000, *Lactobacillus plantarum* MTCC B1746 and *L. lactis* MTCCB440.

2.2.b: Bacteriocin production by the immobilized cells during the second and third cycle of batch fermentation:

The concentration of bacteriocin produced about 3520 AU/ml and 3920 AU/ml from immobilized wild cells during the second and third cycle of fermentation respectively. The concentration of bacteriocin produced about 3840 AU/ml and 4240 AU/ml from immobilized mutant cells during the second and third cycle of fermentation respectively comparatively higher to that produced in the first cycle. The repeated cycles of batch cultures enable the free cell release when compared to the initial fermentation and thus increased the cell density. Figure 2.a and 2.b showed the possibility of re-using immobilized cells of *Lactobacillus pentosus* for bacteriocin production.

The repeated cycles of batch cultures enable the free cell release when compared to the initial fermentation and thus increased the cell density. It has been reported earlier (Betrandet *et al.*, 2001) that a very high pure nisin Z production (0.025 µg) was measured and increased in the broth during repeated cycle pH-controlled batch (RCB) cultures with *L. lactis* ssp. *lactis* biovar. *diacetylactis* UL719 immobilized in κ-carrageenan/LBG beads. A similar Immobilized Cell (IC) –RCB fermentation was successfully used to produce a high concentration of pediocin by *P. acidilactici* UL5 (Naghmouchi *et al.*, 2008). All data had shown the significant *p* value < 0.05 i.e. 95% confidence level by one-way ANOVA.

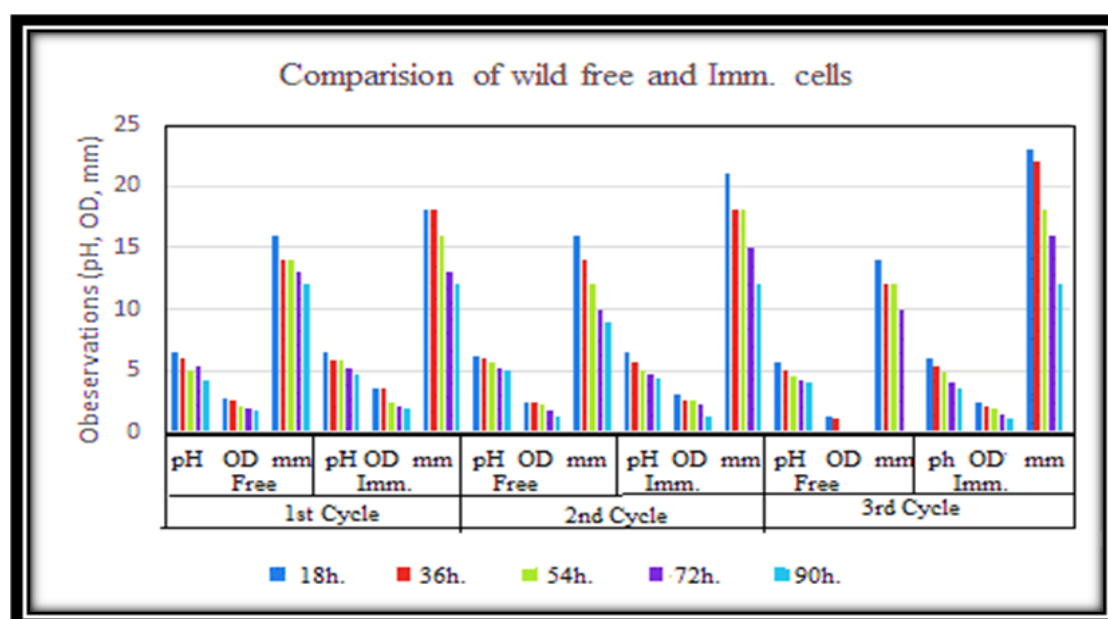


Fig.: 2.a: Comparative study of free and immobilized cells of wild strain *Lactobacillus pentosus* B25

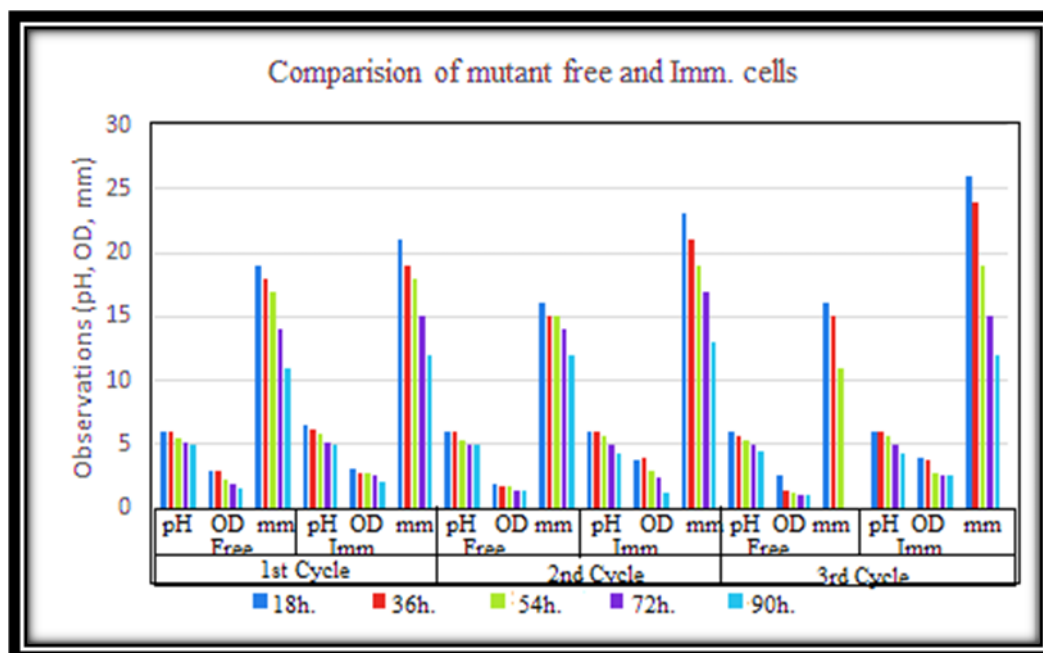


Fig. 2.b: Comparative study of free and immobilized cells of mutant strain *Lactobacillus pentosus* B25

2.2.c: Determination of bead stability in fermentation broth:

The stability of the immobilized bead of both the strains was monitored in the fermentation broth for about 30 days. It was observed that the bead remained stable till 30th day of observation in the fermentation medium. There was a drop in pH from 7 to 4 after the 6th day of fermentation with the immobilized beads. The reduction in bacterial load and the decreased bacteriocin activity in the fermentation broth were noticed with the increasing fermentation period which may be due to the depletion in media components needed for the metabolism and the production of bacteriocin. However, the beads remained intact with little cell leakage till the period of final observation of 30 days. This increased stability is a positive indication that the Ca-alginate immobilized beads could be used successfully for the continuous production of bacteriocin for longer continuous fermentation processes in an industrial level. Similar results recorded by Sarika *et al.*, (2012), with depletion of pH from 6.5-4.2 after 4th day of fermentation.

CONCLUSION

The immobilization of the mutant strain of *Lactobacillus pentosus* B25 in Ca-alginate beads made possible the increasing of bacteriocin production as a result of the increasing of the biomass. The calcium-alginate beads was found to enhance the survival of cells during exposure to a number of products tested possibly as a result of factors associated with the altered cell microenvironment. Therefore Immobilised Cell Technology has potential increasing the effectiveness of lactic acid bacteria probiotic preparations by enhancing cell resistance during bacteriocin treatment. Considering the high yield and stability of the bacteriocins even in the batch fermentations, it is essential to scale up the process as a continuous system which can give much better yield of bacteriocin in future.



1.A

1.B

Photoplate 1.A: Flask contained free cells and immobilized cells of strain

Photoplate 1.B: Comparative assessment of wild and mutant strains of free and immobilized cells

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BIOSURFACTANT PRODUCTION POTENTIAL OF NEW MICROBIAL ISOLATES IN COMBINATION OF DISTILLERY WASTE WITH OTHER INDUSTRIAL WASTES

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ABSTRACT

Present study aims to replace the use of water for biosurfactant production from distillery waste (DW) by using combinations of DW with other industrial wastes viz. curd whey waste (WW), fruit processing waste (FPW) and sugar industry effluent (SIE) in 1:1:1 proportion of DW: WW: FPW and DW: WW: SIE by four bacterial cultures BS-A, BS-J, BS-K and BS-P, isolated from lube oil and distillery spent wash contaminated soil. These isolates have the potential to produce biosurfactant from individual wastes and in their combinations. Biomass and biosurfactant yields were higher in both the combinations of DW with other wastes as compared to that in individual waste and the yields of biosurfactants improved in the range of 18-41 %. Reduction in COD of the combined wastes was in the range of 20-54 %. Reduction in total sugars, N and P levels ranged from 77-86%, 58-71% and 45-59%, respectively. This study has shown the benefits of combining DW with other wastes without supplementing DW with precious water for biosurfactant production by the isolates to achieve improved cost-effective production of biosurfactant as resource with concomitant reduction in pollution of the wastes.

Keywords: Biosurfactant; distillery waste; curd whey; sugar industry effluent; combined wastes.

INTRODUCTION

In past few decades, biosurfactants have gained increased attention and are thought to be the potential candidate to replace synthetic surfactants in the future [Maneerat. 2005]. In view of its multifaceted benefits in comparison to synthetic surfactants, it is necessary to develop a cost-effective process technology for biosurfactant production so that application of biosurfactant in environmental remediation can be realized. It has been demonstrated that fermentation medium can represent almost 30% of the cost for a microbial fermentation [Rodrigues, et al. 2006]. Earlier, we have reported various aspects of cost-effective production of biosurfactant from 1:3 diluted distillery waste, developed a new technique for recovery of di-rhamnolipid biosurfactant from fermented DW and its application in the removal of heavy metals from contaminated soil [Dubey, and Juwarkar. 2001, Dubey et al. 2005 and Juwarkar et al. 2007]. We have introduced DW as a new fermentation medium for biosurfactant production; however, DW as such cannot be used without dilution with water (1:3 proportions) due to the presence of large amount of sulphate ions, which inhibits the growth of biosurfactant producing microbial cultures [Dubey, and Juwarkar. 2001]. Use of water, does not seem to be a sound practice if cost-effective strategy for biosurfactant production has to be developed using DW as substrate. This paper describes a comparative account on using different combinations of DW with other industrial wastes (to replace water) as no-cost medium for production of biosurfactant by four different newly isolated microbial cultures.

MATERIALS AND METHODS**Collection, processing and physico-chemical characterization of industrial waste water for biosurfactant production**

Fresh distillery wastes (DW), whey waste (WW), fruit processing waste (FPW) and sugar industry effluent (SIE) were collected for biosurfactant production from the respective industries. Among these wastes, curd whey was processed to remove casein before use [Dubey, and Juwarkar. 2001]. Physico-chemical characterization of these wastes was performed before incubation (control) and after recovery of biosurfactant as per the standard methods. Total sugars were estimated by method of Dubois et al., 1956 [Dubois et al. 1956]. Total nitrogen and phosphate were estimated by using semi-micro Kjeldahl, and vanadomolybdo phosphoric acid colorimetric methods, respectively, and COD by closed reflux titrimetric method [APHA, AWWA, WPCF. 1989].

Isolation and screening of biosurfactant producing microorganisms

Biosurfactant producing microorganisms were isolated from soil (contaminated with lube oil and distillery spent wash) collected from spent wash pumping device of a distillery unit by culture enrichment technique [Dubey, and Juwarkar. 2001]. Efficient biosurfactant producing isolates were screened on the basis of stability of foam, emulsification index, surface tension (ST) measurements, and biosurfactant yield [Dubey, and Juwarkar. 2001 and Dubey et al. 2005].

Physico-chemical characterization of DW and other industrial wastes alone and in combination before and during biosurfactant production

DW (diluted with tap water in 1:3 ratio), WW, SIE and FPW (100 ml of each) were sterilized in 250 ml Erlenmeyer flasks at 121°C and 15 lb/inch² pressure for 20 minutes and then inoculated with the microbial isolates given accession No. as BS-A, BS-J, BS-K, and BS-P under aseptic conditions. Similarly below given sets of combinations of DW with other industrial wastes were sterilized and inoculated with these cultures for biosurfactant production: i). DW was combined with WW and SIE (DW: WW: SIE) in 1:1:1 ratio & ii) DW with WW and FPW (DW: WW: FPW) in 1:1:1 ratio. These flasks were incubated in a gyro rotatory shaker for 120 hours and after an interval of 24 hours of incubation, biomass yield in terms of c. f. u. /ml, biosurfactant yield, reduction in ST and COD were monitored before and after biosurfactant recovery from individual wastes and combined wastes [Dubey, and Juwarkar. 2001 and Dubey et al. 2005].

STATISTICAL ANALYSIS

All of the experimental data are expressed in terms of arithmetic averages obtained from three replicates, and the analyses were done using Sigma Plot software, version 8.02 (SPSS Inc., UK).

RESULTS AND DISCUSSION

Sources of distillery and other liquid wastes for biosurfactant production and their physico-chemical characteristics

To evolve a suitable combination of DW with other industrial wastes for biosurfactant production, DW and different types of other waste waters, such as SIE, WW (lactic acid whey), and FPW were collected. **Table 1** show that DW had high COD, sugar and nitrogen levels as compared to WW, followed by FPW and SIE. Results have shown that individually FPW and SIE with lower COD, sugar and nitrogen levels cannot be suitable for biosurfactant production however, these wastes can be used for combining DW in a specific ratio and such a reconstitution can avoid the use of precious water required for biosurfactant production from distillery waste. Moreover, dilution of DW with SIE will be more desirable as the distillery and sugar factory are situated near to each other, transportation of SIE to biosurfactant production site at distillery unit can be minimised. In case of curd whey, transport will be needed without any special cold storage tanks as continued fermentation of curd whey by indigenous lactic acid bacteria of curd will lead to more production of lactic acid which is a substrate for biosurfactant production. During preparation of mixed fruit jam, jellies and squashes from apples, oranges, pineapple, and pomegranate, FPW is generated was used for biosurfactant production.

Table 1. Characteristics of industrial waste waters collected for biosurfactant production.

Type of waste	Sources	pH	COD (mg/l)	BOD (mg/l)	Sugars (g/l)	Nitrogen (mg/l)	Phosphate (mg/l)
Distillery wastes (DW)	Purti Sakhar Karkhana limited, Nagpur, India.	4.8	98,000	37,000	12.4	710.0	235.0
Whey waste (WW)	Amruta Dairy, Nagpur, India.	4.3	56,000	28,000	6.8	987.0	352.0
Fruit Processing waste (FPW)	Noga factory, MIDC Hingna, Nagpur, India.	5.4	2100	1090	2.03	784.0	122.0
Sugar industry effluent (SIE)	Purti Sakhar Karkhana limited, Nagpur, India.	6.8	1050	959	1.54	643.0	135.0

Isolation and screening of biosurfactant producing microorganism and industrial wastes as a substrates for biosurfactant production

For isolation and screening of biosurfactant producing microorganisms, the phenomenon of reduction of ST of the culture medium and emulsification index was selected as described earlier [Dubey & Juwarkar 2001]. Based on the results of these screening criteria, four isolates designated as BS-A, BS-J, BS-K and BS-P, were screened from 23 different types of microbial cultures obtained from lube oil and distillery spent wash contaminated soil which was collected from spent wash pumping device of a distillery unit (data not shown). Use of industrial wastes such as DW, WW, SIE and FPW for biosurfactant production by new microbial isolates was studied to form a basis of using these wastes as potential alternative fermentative medium formulations for biosurfactant production. A great variety of agro-industrial wastes have been studied as potential substrates for biosurfactant production [Maneerat 2005]. A by-product of the cane sugar industry, fruit processing, dairies are alternative sources of media used in biosurfactant production process as they are of no-cost as compared to other known substrates and they possess valuable nutrients required for the fermentation process. These wastes

can therefore, be used to dilute DW. Isolates BS-A, BS-J, BS-K, and BS-P have varying capabilities of biosurfactant production in these waste waters tested (**Table 2**). Reduction in ST of the fermented wastes was from an initial range of 59-64 mN/m to 27-39 mN/m indicating the production of effective biosurfactant by the isolates. The fermented broth had good emulsification property and the emulsification index E24 was in the range of 51-54%. Biosurfactant yield produced was in the range of 0.0043-1.631 g/l. Highest yields of biomass and biosurfactant were in WW followed by DW, FPW and SIE. Reduction in COD was observed in each waste indicating decrease in pollutant load of the waste during biosurfactant production. Low yields of biomass and biosurfactant in SIE and FPW is owing to the low COD and nutrient status of the wastes.

Table 2. Variations in different parameters of biosurfactant production potential of different isolates in distillery waste, and other industrial waste (After 120 hours of incubation)

Parameters	Industrial waste	Control	Microbial isolates			
			BS-A	BS-J	BS-K	BS-P
Biomass yield (c. f. u./ml)	Distillery waste	12x10 ²	57x10 ⁸	38x10 ⁸	55x10 ⁷	66x10 ⁸
	Curd Whey	12x10 ²	86x10 ⁸	83x10 ⁸	79x10 ⁷	98x10 ⁹
	Sugar industry effluent	12x10 ²	26x10 ⁴	33x10 ⁴	72x10 ⁴	82x10 ⁴
	Fruit Processing waste	12x10 ²	66x10	53x10	71x10 ⁴	96x10 ⁵
COD (mg/L)	Distillery waste	30880	18110	20899	24520	20000
	Curd Whey	37000	19320	19340	20091	21008
	Sugar industry effluent	1052	678	549	556	659
	Fruit Processing waste	2108	780	890	798	653
Biosurfactant yield (g/l)	Distillery waste	0.0014	0.648	0.575	0.6	1.421
	Curd Whey	0.0011	0.786 ₂	0.589 ₇	0.876	1.631
	Sugar industry effluent	0.0011	0.006	0.004	0.0043	0.0082
	Fruit Processing waste	0.0012	0.0078	0.005 ₆	0.0064	0.0098

Biosurfactant production by the microbial isolates in the combination of DW with WW and SIE/FPW

This is a first report highlighting use of combination of DW with WW and SIE/FPW for biosurfactant production by new microbial isolates. Main aim was to eliminate the use of water required for diluting the DW before using it as viable fermentation medium for biosurfactant production and improve the nutritional status of DW further to increase yields of biosurfactant production. Results from **Table 3** indicates that combination of DW with WW and SIE a good source of nutrients for biosurfactant producing organisms as biomass yield improved in the range of 90x10⁷ c. f. u. / ml to 68x10⁹ c. f. u. /ml from an initial inoculum size of 12 x 10² c. f. u. /ml indicating nearly more than four folds increase within 120 hours of fermentation. In the previous report, maximum cell counts of *Pseudomonas aeruginosa* strain BS2 reached in DW diluted with water was 54x10⁸ c. f. u. /ml from an initial inoculum size of 1x10⁵ c. f. u. /ml [Dubey & Juwarkar 2001]. Combination DW: WW: SIE resulted highest biosurfactant yield of 1.857 g/l in case of isolate BS-P as compared to other isolates which is 23.48% higher than that obtained in DW diluted with tap water. In comparison to the earlier report, yield of biosurfactant produced by *Pseudomonas aeruginosa* strain BS2 in 1:3 diluted DW (i.e. 0.91 g/l) there is 50% increase in the yield of biosurfactant production by isolate BS- P which is however, a new type of the strain. Other isolates also showed the improvements in the biosurfactant yield in the range of 18.2-27.0%. Combination of DW: WW: SIE has improved the biomass and biosurfactant yields by all the four microbial isolates. This study has shown that the new biosurfactant producing isolate BS-P is comparatively a promising strain, better than the previously reported culture as it has an ability to grow well and produce biosurfactant with higher production capacities in the combination of DW with WW and SIE. High biomass of isolate BS-P i.e. 87 x 10⁹ c. f. u. / ml was obtained at 120 hours of incubation correspondingly yielded highest biosurfactant yield of 1.976 g/l which was 28.08 % higher than that obtained on using 1:3 diluted DW for biosurfactant production indicating that combination of DW with WW and FPW is suitable combination for biosurfactant production by isolate BS-P. Other isolates also showed 24.59 -40.53 % improvements in the biosurfactant yield in this combination. On comparing the biosurfactant productivities in above two combinations, it was found that combination of the DW: WW: FPW (1:1:1 v/v) combination is a

better for growth of biosurfactant producing isolates and also for biosurfactant production than SIE. DW: WW:

Table 3. Biosurfactant production by different isolates in DW combined with WW and SIE/FPW in 1:1:1 ratio (After 120 hours of incubation)

Parameters	Control	BS-A	BS-J	BS-K	BS-P
DW:WW:SIE					
Biomass yield (c. f. u. /ml)	12x10 ²	94x10 ⁸	89x10 ⁸	90x10 ⁷	68x10 ⁹
Biosurfactant yield (g/l)	0.0014	0.792 (18.18%)*	0.787 (26.93%)*	0.896 (22.32%)*	1.857 (23.47%)*
COD reduction (%)	00	41.35	32.32	20.59	34.97
Total sugars reduction (%)	00	86.2	82.6	79.6	81.6
Total nitrogen reduction (%)	00	71.28	62.28	58.42	62.85
Total phosphate reduction (%)	00	59.5	57.0	48.0	56.5
DW:WW:FPW					
Biomass yield (c. f. u. /ml)	12x10 ²	45x10 ⁹	56x10 ⁹	55x10 ⁸	87x10 ⁹
Biosurfactant yield (g/l)	0.0014	0.875 (25.942%)*	0.967 (40.537%)*	0.923 (24.593%)*	1.976 (28.08%)*
COD reduction (%)	00	53.70	46.27	24.07	46.29
Total sugars reduction (%)	00	86.41	82.26	77.35	81.50
Total nitrogen reduction (%)	00	70.35	63.61	59.56	60.91
Total phosphate reduction (%)	00	59.09	55.45	45.45	55.90

* value presented in the parentheses indicates the % rise in the yield of biosurfactant production

CONCLUSION

Combination of DW with other industrial wastes was assessed to constitute more nutritionally rich no-cost complete medium by replacing the use of precious water for diluting DW in 1:3 proportion for the biosurfactant production. Use of individual wastes alone has resulted in high yields of biosurfactant. However, higher productivities were obtained by using combination of DW with other wastes viz. whey, fruit processing waste/SIE in 1:1:1 combination indicating a positive impact of waste combination on biosurfactant production capacities of the new microbial isolates thereby eliminating the use of precious water required for diluting DW for biosurfactant production. Such studies are important to form a basis for scale up-studies on cost production of biosurfactant.

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DIVERSITY OF INSECT PESTS OF PADDY IN PANCHALATEHASIL, KOLHAPUR, MAHARASHTRA, INDIA

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ABSTRACT

Agriculture is the backbone of Indian economy and India is one of the world's largest producers of Rice. Today, paddy crop is facing severe problem of insect pests and is attacked by more than 100 species of insects, among those 20 species cause economic damage. Rice is the staple food of people of panchalatehasil, Kolhapur, Maharashtra, India. During June, 2017 to September 2017 efforts were made to study the diversity of insect pests associated with the paddy crop in the study region. The collection and preservation of the specimens was done by following standard procedure and the identification was done with the help standard literature, taxonomic keys and webography. In all, 6 species were recorded as pests of paddy in which order Lepidoptera was dominant with 2 species, while orders Diptera, Orthoptera, Hemiptera and Coleoptera were represented by 1 species each respectively. The results of the present investigation will be helpful for formulating control strategies against these paddy pests.

Keywords: Diversity, insect pest, Panchala, Paddy.

INTRODUCTION

Rice is the staple food in Panchala Tehsil of Kolhapur district, Maharashtra, India. A wide area of study region inhabited by rice crop. Tropical humid and dynamic environment and a variety of growth stages in a short time period have always been a great attraction by other species to adopt it as their Niche[5] Worldwide, plants are damaged by more than 10,000 species of Insects [3]. Losses due to biotic (insect pests, diseases, weeds) and abiotic (drought, salinity, heat, cold, etc.) stresses account for about one forth of value of agricultural production [12]. Among different types of agricultural pest, insects are the most serious pests. A rice plant is attacked by more than 100 species of insects and 20 of them can cause economic loss [10]. Yield loss due to insect pests of rice has been estimated about 30-40% [6]. The rural population in western area of Panchala facing a critical problem of insect pests in agricultural field. Damages caused by insects disturb the physiology of plants and results into lower crop yield [9]. An effort was thoughts to be needed to conserve biodiversity of Rice fields to conserve stable rice ecosystem [8]. Study of insect pest diversity is important for management. Correct identification of insect pests may help to direct biological control of insect pests [4]. The present study makes an attempt to explore insect pest diversity of paddy field in Panchalatehasil.

MATERIAL AND METHODS

Insect pests in the present study were collected during June 2017 to September 2017 from different agricultural fields in the Western part of Panchalatehasil. PanchalaTehasil receives heavy and assured rainfall. Warm and humid environment and laterite soil in agricultural fields which facilitates various crops to grow. Paddy crop is widely cultivated in Panchala. Collection of insect pests was made by hand picking and sweeping net method. Identification of collected insects was done with the help of keys available in Richard and Davis[11], Boorer et.al. [2], Leffroy [7], Ananthkrishnan and David [1].

RESULTS

Assessment of agricultural field during the study period showed crops were damaged by 6 species of insect belonging to 5 insects orders. Order Lepidoptera was represented by 2 species where as orders, Diptera, Orthoptera, Hemiptera and Coleoptera were represented by only 1 species each.

1. Yellow stem borer***Scirphophagaintertulas* (Walker, 1863)****Family – Crambidae****Order – Lepidoptera**

Damage – Pest attacks all stages of crop. Larva bore into the rice leaf sheath and then into the stem. Larva feed on the inner wall of stem and hollowing it completely. Damage to tillers results in dead heart. Damage during panicle initiation stage results in white ear. It is a serious pest of rice throughout India and South East Asia.

2. Rice swarming caterpillar***Spodopteraauritia* (Boisduval, 1833)****Family – Noctuidae****Order – Lepidoptera**

Damage – Pest attacks on leaves. Caterpillar feed at night on leaves and defoliate plant. Cattle grazed appearance is found in infested plant. After finishing the crop of one field the pest attacks to another field. Damage is noticeable in the early part of the plant.

3. Paddy gall midge

Orseoliaoryzae (Wood-Mason, 1889)

Family – Cecidomyiidae

Order – Diptera

Damage – Maggot feeds at the base of the growing shoot forming tube like gall similar to onion leaf. Affected tiller inhibits growth of leaves and fails to produce panicles. Pest attacks in seedling stage, but the infestation is highest at tillering stage.

4. Paddy Grasshopper

Heiroglyphusbanian (Fabricius, 1798)

Family – Acridiidae

Order – Orthoptera

Damage – It is one of the major pest. It damages the leaves, shoot and earheads. Both young and adult attacks crop.

5. Spotted leaf hopper

Macrostesquadilineatus Forbes, 1885

Family – Cicadellidae

Order – Hemiptera

Damage – Adult damages crop. It pierces the leaf tissue of plants and remove sap. It causes death and discoloration of individual plant cells, which gives yellow appearance. It transmits aster yellow disease which is one of the serious plant disease.

6. Rice Hispa

Dicladispaarmigera (Oliver, 1808)

Family – Chrysomelidae

Order – Coleoptera

Damage – Adults and grubs feed upon leaves. Grub mines into the leaf blade and feed on the green tissue between veins. The larva makes tunnel through leaf tissue, it causes irregular translucent white patches which are parallel to the leaf veins. Adults also feed on green tissue.

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SURVEY OF APHIS GOSSYPHII (GLOVER.) FROM COTTON IN KHANDESH REGION OF MAHARASHTRA STATE (INDIA)

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ABSTRACT

Cotton Aphids which has serious insect pest of cotton in Maharashtra and has also appear in the other state of India. *Aphis gossypii* (Hemiptera: Aphidae) is a polyphagous species with a worldwide distribution and variety of biotypes designations used for *A. gossypii* with infestation ranged between 21.70 to 48.43% at deferent location of study area among the various cotton cultivated farms, the maximum infestation was recorded in Nandurbar district region (48.43 %) followed by Dhule and Jalgaon District respectively (39.32%), (21.70%). The present study provides the good information about the assessment of incidence and infestation rate of sucking pest, *A. gossypii* in the agro- ecosystem of Khandesh region of Maharashtra State of India.

Keywords: *Aphis gossypii*, Cotton, Sucking pests, Aphids.

INTRODUCTION

In India near about 70 percent of population depends on agriculture and agrobased industries for livelihood. However it is disheartening to know that India's economic growth is not keeping up with the expectations because its agricultural growth is lagging behind (Bedi, 2008). The most important crop cultivated in India are classified in to fiber crop, fruit and vegetable crops, cereals and grains, oilseed etc. among them fiber crop like cotton is one of the most important cash crop cultivated in Khandesh region includes three districts viz, Jalgaon, Dhule and Nandurbar. These crops are damaged by several types of insects and non-insect pests among them *A. gossypii* is one of most serious pest which damage about 10 to 70 % of yield of cultivated crops. The cotton aphid *A. gossypii* is among the most destructive pest to field crops in India. It has expansive host range and decrease the production of crop by transmitting more than 50 viruses and extracting nutrients from plants. (Blackman and Eastop, 1984) *Aphis gossypii* (Glover) is a widely recognised economically important aphid species and invites attention of several workers of diverse fields. Polyphagism and polymorphic nature of this cosmopolitan aphid species always attracts attention of research workers across globe. (Saha et al., 2016) *A. gossypii* is widely recognized as economically important because this aphid not only damages the plant by sucking plant sap, but also has the ability to transmit viruses and thus acts as vector of many plant viral diseases. Usually, late in the season when leaves are at less favourable feeding sites or during early colonization stage, it attacks underside leaves for sucking liquid from phloem tissue and infest cotton terminals also (Santos, 2001). With the help of piercing sucking mouthparts aphids suck the fluid from phloem tissue (Hafez et al., 1996) It may also form large population within short span of time on seasonal plants under favorable condition. (Saha et al., 2016) The field survey was conducted during 2016-2017 to know the incidence of insect pests mainly sucking pests, Aphids (*Aphis gossypii*) and their various host plant in agricultural fields of Khandesh region of Maharashtra state. Present study will be helpful to know the assessment of incidence and nature of damage caused by the aphids so that proper control measures can be used in future to minimize the population of sucking pests and load of pesticides.

MATERIALS AND METHODS

The collection of *A. gossypii* had been done from cotton belt of Khandesh region.

Study area: The study was conducted in the cropping regions of cotton of Khandesh during the year 2016-17. Khandesh is at the North-West, extending between 20°8' and 22°7' North Latitude and 73°42' and 76°28' East Longitude. This region is one of the least developed places in the country, bordered on the North-West by the states of Madhya Pradesh and Gujarat, and on the East and South by Buldhana district of Vidarbha region, Aurangabad district of Marathwada region and Nasik district of Maharashtra. Khandesh comprises of three districts i.e. Jalgaon, Dhule and Nandurbar. It can be divided into Western Khandesh and Eastern Khandesh. Western Khandesh has two districts Dhule and Nandurbar, while Jalgaon is in the Eastern. The selective localities of Khandesh were: Jalgaon (Fapare, Mehunbare, Ainpur, Bambhori, Jamner), Dhule (Boradi, Betawad, Dusane, Lamkani, Vadjai), Nandurbar (Khapar, Mhasawad, Sarangkhe, Taloda, Asane). These fifteen different (villages) localities were selected on the basis of accessibility and location of Eco region. Cotton crops severely damaged by sucking pests (Aphids) were examined; to know about the assessment of incidence and extent of damage to the crop, as well as to collect insect stages from the crop. Insect pests were then identified in the laboratory. In addition, the observation on percent of infestation and damage by *A. gossypii* were recorded in five different villages in each district. At each locality

(Village) 10 infested spots were observed from surrounding and middle part of cotton field to record no. of *A. gossypii* infested plants.

Identification: Collected specimens were identified in the laboratory side by side with the help of available material. For identification, microscope with high magnification and different taxonomic keys were used.

These infested plants were further analysed to find out the severity of damage as per following grade:

Severity	Grade	No of <i>A. gossypii</i> found on Plant
Nil	-	Healthy plants, No infestation of <i>A. gossypii</i> found on plant
Rare	+	About 10-100 individual of <i>A. gossypii</i> found over the plant
Frequent	++	Complete branch/apical portion of stem infested with <i>A. gossypii</i>
Abundant	+++	Two or more branches infested with <i>A. gossypii</i> up to 50% of affected plant
Heavy	++++	Infestation found in complete plant

RESULTS AND DISCUSSION

The present study revealed that *A. gossypii* infested around 3100 ha area in Khandesh region of Maharashtra state. Near about 35 villages of Jalgaon, 32 villages in Dhule and 10 villages in Nandurbar district.

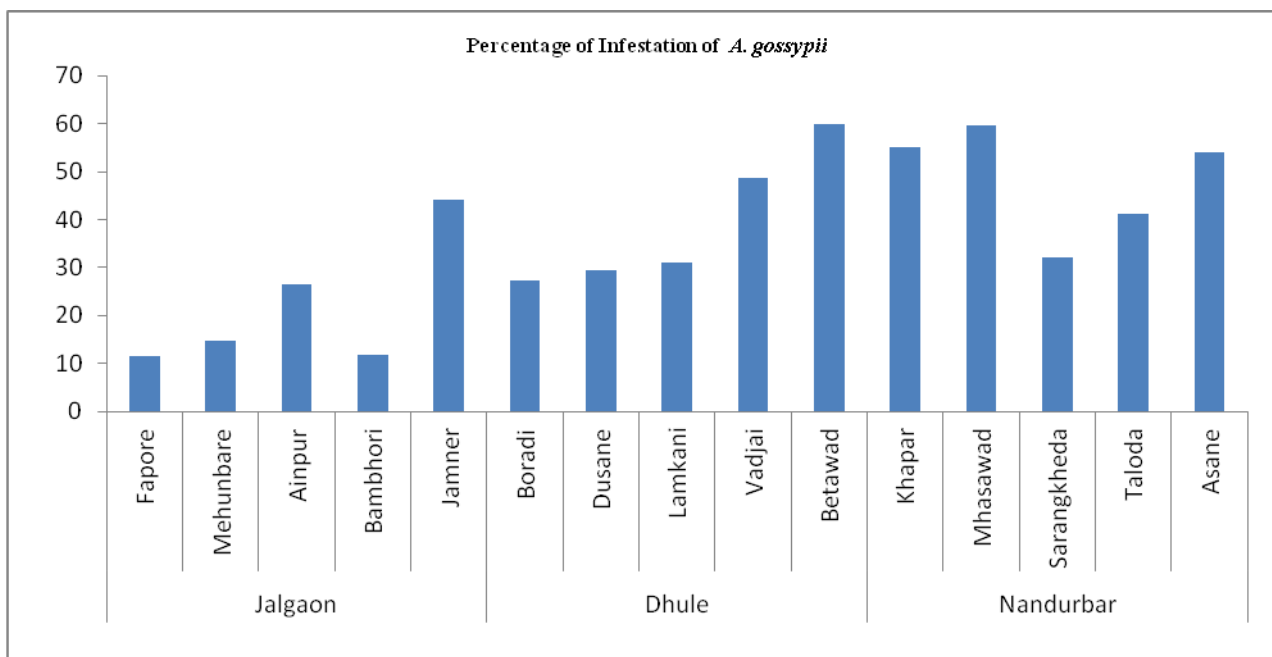
The infestation was severe on surrounding rows of the cotton field compared to middle of field. At very few localities of study area was found the complete infestation in cotton field. The percentage of *A. gossypii* infestation was ranged between 11.400 to 44.22 % at Jalgaon district the mean values were 21.70%, 27.33 to 60.05 % at Dhule district the mean values were 39.32%, while at Nandurbar district the rate of infestation was 32.13 to 59.68 % the mean values were 48.43%. The percentage of infestation was comparatively more in Dhule district. Maximum infestation recorded in Betawad village (60.05%) while minimum infestation recorded at Boradi village (27.33%) of Dhule district.

The severity of infestation of *A. gossypii* in all cotton growing area was restricted to low to medium grade (rare + to frequent ++). Heavy infestation was recorded at one location of Jalgaon district i.e. in Jamner village (00.05%), Three location of Dhule district i.e. Dusane village (00.22%), Vadjai (02.00%) and Betawad village (01.00%) while to locations of Nandurbar district shows the higher percentage of heavy infestation in two villages Mhasavad (03.00%) and Asane (02.00%). The growth and development of cotton plants was found diminutive due to the presence of *A. gossypii*.

Besides the cotton aphid (*A. gossypii*) has a very wide host range. At least 50 host plants are known in India.. Among cucurbit vegetables, it can be a serious pest on watermelon, cucumber and to a lesser degree squash and pumpkin. This is the basis for the common name melon aphid. Other vegetable crops sometimes affected are asparagus, bean, beet, carrot, celery, onion, pea, radish, tomato, and okra. Some other important crops injured regularly are citrus, and hibiscus.

Name of District	Name of Villages	% of Infestation	Mean	Grading Scale				
				Health y	Infested Plants			
				-	+	++	+++	++++
Jalgaon	Fapore	11.40	21.70	88.60	05.00	04.02	2.30	--
	Mehunbare	14.70		85.30	--	12.50	02.20	--
	Ainpur	26.42		73.58	03.00	13.00	10.40	--
	Bambhori	11.79		88.21	04.00	03.00	05.00	--
	Jamner	44.22		55.78	10.00	30.22	02.00	00.05
Dhule	Boradi	27.33	39.32	72.67	16.02	04.12	05.05	00.10
	Dusane	29.49		70.51	12.00	09.44	06.00	00.22
	Lamkani	31.00		69.00	13.68	08.78	05.00	01.00
	Vadjai	48.75		51.25	14.00	20.09	05.10	02.00
	Betawad	60.05		39.95	12.04	18.05	06.00	01.00

Nandurbar	Khapar	55.13	48.43	44.87	35.00	--	14.00	--
	Mhasawad	59.68		40.32	30.42	20.61	--	03.00
	Sarangkheda	32.13		67.87	10.36	12.44	07.75	--
	Taloda	41.12		58.88	20.45	08.56	10.39	--
	Asane	54.09		45.91	12.85	17.49	20.18	02.00

Table : 1- Survey for the incidence of *A. gossypii* cotton during 2016-2017.Fig:1- Percentage of infestation of *A. gossypii* in Khandesh region of Maharashtra state during 2016-17

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DIVERSITY, SEASONAL DISTRIBUTION AND STATUS OF BUTTERFLIES IN SATPUDA BOTANICAL GARDEN, NAGPUR, CENTRAL INDIA

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Abstract

A study was conducted to record the butterfly diversity and the status and occurrence of butterfly species in the Satpuda botanical garden within the Nagpur city, Central India, from 2006 to 2019. A total of 96 species of butterflies belonging to Papilionidae (06 species), Pieridae (13 species), Nymphalidae (35 species), Lycaenidae (30 species) and Hesperidae (12 species) were recorded. Most species were observed from the monsoon (hot/wet season) to early winter (cool/wet season) but thereafter declined in early summer (March). Among the butterflies recorded, 15 species come under the protection category as per the Indian Wild Life Protection Act 1972. The observations support the high value of this city garden for conservation of butterflies and research on their biology.

Keywords: India, Butterflies, Satpuda botanical garden, Nagpur City, Status, Occurrence, Diversity

Introduction

Amongst the invertebrates, butterflies are becoming sufficiently well studied for them to be used for general conservation planning in some parts of the tropics as a representative insect group (Thomas, 1992). Butterflies are most beautiful and colourful creature on the earth and have a great aesthetic value, which make them very attractive. The butterflies are the very important unit of ecosystem due to the inter-relationship with plants diversity. Butterflies are very much important for the pollination as they visit to different flowers for the nectar feeding, which make them important unit of environment. Butterflies are also good indicators of environment changes as they are sensitive and are directly affected by changes in the habitats, atmospheric temperature and the weather conditions (Kunte, 2000; Tiple et al., 2006).

The Indian sub-region hosts about 1,504 species of butterflies (Tiple, 2011) of which Peninsular India hosts 351, and the Western Ghats 334. In Central India, the butterfly diversity was reported earlier by Forsayeth (1884); Swinhoe (1886); Betham (1890, 1891) and Witt (1909). D'Abreeu (1931) documented a total of 177 species occurring in the erstwhile Central Provinces (now Madhya Pradesh, Chhattisgarh and Vidarbha). Tiple and Khurad (2009) reported 145 species of butterflies recorded, of which 62 species were new records for Nagpur city.

The present study was started to examine the diversity, population across seasons and habitats of butterflies, since there was no known published checklist of butterflies in the Satpuda botanical garden and hence, the present work was initiated.

Materials and Methods

The findings presented here are based on a field survey and investigation carried on a daily basis from 2006 to 2019 on the Satpuda Botanical Garden, Nagpur. The observations were made from 08.00hr to 11.00hr, which is a peak time for butterfly activity and they were found to do basking.

Identification of Butterfly Species

Identification of the butterflies was primarily made directly in the field. In critical condition specimens were collected only with handheld aerial sweep nets and subsequently released without harm and identification with the help of field guides (Wynter-Blyth, 1957; Kunte, 2000). The observed butterflies were grouped in five categories on the basis of number of sighting in the field. The butterflies were categorized as VC- Very common (> 100 sightings), C- Common (51–100 sightings), NR- Not rare (16–50 sightings), R- Rare (2–15 sightings), VR- Very rare (< 2 sightings) (Tiple et al. 2006; 2007).

Study Area

Nagpur city is the second capital of Maharashtra state and located in the center of India at 20° 9' N and 79° 9' E altitude. It has tropical dry equable climate having three main seasons: June/July wet Monsoon and its aftermath from June till October, the cool dry winter from October/November to February /March and the hot dry season from April till the onset of rains. Temperature of city ranges from minimum of 12-25°C to maximum 30-45°C with a relative humidity 10-15% to 60-95%. Annual precipitation is 1138.5 mm. Ninety percent of the precipitation takes place within four months, i.e., from June to September, July being the rainiest month. Satpuda botanical garden is located at west side of Nagpur spreading over 25 ha. Hill and Lake County (Futala)

had a mixed vegetation comprising ornamental, fruit plants, scrub, grassland; some part with natural forest dominated with weed *Lantana camera* (Tiple et al. 2009).

Results and Discussion

A total of 96 species of butterflies belonging to 06 species to Papilionidae, 13 species to Pieridae, 35 species to Nymphalidae, 30 species to Lycaenidae and 12 species to Hesperidae were found on Satpuda botanical garden and their status was recorded. Among them 31 were common, 40 were very common, 06 were not rare, 16 were rare and 3 were very rare (*Lethe rohria*, *Parantica aglea*, *Azanusu baldus*). The observed species, their status and occurrence on the Satpuda botanical garden is presented in Table-1.

Of the total 96 species of butterflies, 28 from 05 families were occurred throughout the year (January–December), whereas remaining 69 species of butterflies were prominently observed only after June till the beginning of summer (April–May). Increasing species abundance from the beginning of monsoon (June–July) till the early winter (August–November) and decline in species abundance from late winter (December–January) up to the end of summer have also been reported by Tiple et al. (2007) in similar climatic conditions in this region of Central India. This might be related to resources required for somatic maintenance and reproduction which depend on nectar and larval plants (Tiple et al. 2007, 2009).

About 15 species of the recorded ones come under the protection category of the Indian Wild Life protection Act 1972 (Kunte 2000; Gupta & Mondal 2005). Among them *Pachliopta hector*, *Lethe europa*, *Castalius rosion*, *Hypolimnasmisippus* came under schedule I of the act. The species recorded which come under schedule II of the wild life protection act 1972 were *Hypolimnasmisippus*, *Eurema andersonii*, *Jamides alecto*, *Spindasis elima*, *Cepora nerissa*, *Pareronia valeria*, *Euchrysops cnejus*, *Lampides boeticus*, *Jamides celeno*. The species recorded which came under schedule IV of the wild life protection act were *Appias libythea*, *Baoris farri*, *Euploea core*. They are listed along with their common names, status, and occurrence in Table- 1.

Earlier Pandharipande 1990 recorded only 61 species of butterflies from Nagpur City. Recently Tiple and Khurad (2009) reported 145 species of butterflies recorded at the eight study sites from Nagpur city. Although the present study-site is always human impacted (cutting of shrubs and trees for fire, grassing of cattle) and one of the several sites in the Nagpur city, the observations indicate that the diversity of butterfly species in Nagpur area has been increased in the last two decades.

The botanical garden harbour floral diversity that supportive to conserve of butterfly diversity and abundance in the area. As a result of this survey, it showed that the number of species of butterflies observed in garden habitat was consistently greater than both the forest and cultivated habitat. The butterfly of the family Nymphalidae (35) were recorded most abundant followed by family Lycaenidae 30 species during the study.

Butterfly populations would clearly benefit from planting indigenous, as opposed to exotic, nectar and larval host plants which are the sources of various proteins and salts that are essentially required for buildup of healthy and genetically diverse butterfly population Tiple et al. 2006. In particular, attention should be paid to the seasonal availability of resources and to resources for less common butterflies on this garden. All in all, this Satpuda botanical garden provides rich ground not just for conservation but also for research into butterfly biology for the students.

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Table 1. Butterfly species of Satpuda Botanical Garden together with common name, occurrence and status

Sr.No.	Common Name	Scientific Name	Occurrence (months)	Status
Papilionidae(6)				
1.	Common Rose	<i>Pachlioptaaristolochiae</i>	7-3	C
2.	Crimson Rose	<i>Pachliopta hector*</i>	7-4	C
3.	Common Jay	<i>Graphiumdoson</i>	8-3	VC
4.	Tailed Jay	<i>Graphiumagamemnon</i>	8-3	C
5.	Lime	<i>Papiliodemoleus</i>	1-12	VC
6.	Common Mormon	<i>Papiliopolytes</i>	7-2	C
Pieridae (13)				
7.	Lemon Emigrant	<i>Catopsiliapomona</i>	1-12	VC
8.	Mottled Emigrant	<i>Catopsiliapyranthe</i>	1-12	VC
9.	Small Grass Yellow	<i>Euremabrigitta</i>	1-12	VC
10.	Spotless Grass Yellow	<i>Euremalaeta</i>	6-12	C
11.	One-Spot Grass Yellow	<i>Euremaandersonii*</i>	8-2	NR
12.	Common Grass Yellow	<i>Euremahecabe</i>	1-12	VC
13.	Three-Spot Grass Yellow	<i>Euremablada</i>	7-3	C
14.	Common Jezebel	<i>Delias eucharis</i>	7-3	C
15.	Common Gull	<i>Ceporanerissa*</i>	1-12	VC
16.	Pioneer Or Caper White	<i>Anaphaeisaurola</i>	9-3	C
17.	Eastern Striped Albatross	<i>Appiaslibythea*</i>	1-3	NR
18.	Crimson Tip	<i>Colotisdanae</i>	6-10	C
19.	Common Wanderer	<i>Pareroniavaleria*</i>	8-3	VC

Sr.No.	Common Name	Scientific Name	Occurrence (months)	Status
Nymphalidae (35)				
20.	Common Evening Brown	<i>Melanitis leda</i>	1-12	VC
21.	Dark Evening Brown	<i>Melanitis phedima</i>	8-12	C
22.	Bamboo Treebrown	<i>Lethe europa</i> *	8-3	C
23.	Common Treebrown	<i>Lethe rohria</i>	8-9	VR
24.	Common Bushbrown	<i>Mycalesis perseus</i>	7-3	VC
25.	Dark Branded Bushbrown	<i>Mycalesis mineus</i>	8-3	C
26.	Tamil Bushbrown	<i>Mycalesis subdita</i>	8-12	NR
27.	Longbrand Bushbrown	<i>Mycalesis visala</i>	8-9	R
28.	Intermediate Bushbrown	<i>Mycalesis intermedia</i>	10	R
29.	Lesser Threering	<i>Ypthima inica</i>	7-3	C
30.	Common Nawab	<i>Polyura athamas</i>	12-2	R
31.	Black Rajah	<i>Charaxes solon</i>	10-2	R
32.	Tawny Coster	<i>Acraea violae</i>	1-12	VC
33.	Common Leopard	<i>Phalanta phalantha</i>	6-3	VC
34.	Common Sailer	<i>Neptis hylas</i>	6-4	VC
35.	Baronet	<i>Euthalia nais</i>	10-3	C
36.	Joker	<i>Byblia lithia</i>	1-12	C
37.	Angled Castor	<i>Ariadne ariadne</i>	9-2	VC
38.	Common Castor	<i>Ariadne merione</i>	10-2	C
39.	Yellow Pansy	<i>Junonia hierta</i>	7-2	C
40.	Blue Pansy	<i>Junonia orithya</i>	10-4	VC
41.	Lemon Pansy	<i>Junonia lemonias</i>	1-12	VC
42.	Peacock Pansy	<i>Junonia almana</i>	1-12	VC
43.	Grey Pansy	<i>Junonia atlites</i>	8-3	VC
44.	Chocolate Pansy	<i>Junonia iphita</i>	8-3	C
45.	Painted Lady	<i>Cynthia cardui</i>	5-7	C
46.	Great Eggfly	<i>Hypolimnas bolina</i>	1-12	C
47.	Danaid Eggfly	<i>Hypolimnas misippus</i> *	1-12	VC
48.	Blue Tiger	<i>Tirumala limniace</i>	1-12	VC
49.	Dark Blue Tiger	<i>Tirumala septentrionis</i>	8-12	R
50.	Glassy Tiger	<i>Parantica aglea</i>	6-7	VR
51.	Plain Tiger	<i>Danaus chrysippus</i>	1-12	VC
52.	Striped Tiger	<i>Danaus genutia</i>	10-6	VC
53.	Common Indian Crow	<i>Euploea core</i> *	1-12	VC
54.	Brown King Crow	<i>Euploea klugii</i>	8-3	NR
Lycaenidae (30)				
55.	Common Pierrot	<i>Castalius rosimon</i> *	1-12	VC
56.	Rounded Pierrot	<i>Tarucus nara</i>	1-12	VC
57.	Zebra Blue	<i>Leptotes plinius</i>	1-12	VC
58.	Bright Babul Blue	<i>Azanus baldus</i>	1-3	VR
59.	Dull Babul Blue	<i>Azanus uranus</i>		R
60.	Whitedisc Hedge Blue	<i>Celatoxia albidisca</i>	8-9	R
61.	Plain Hedge Blue	<i>Celestrina leventularis</i>	10-11	R
62.	Pointed Ciliate Blue	<i>Anthenelycaenina</i>	8-10	R
63.	Pale Grass Blue	<i>Pseudozizeeria maha</i>	1-12	C
64.	Dark Grass Blue	<i>Zizeeria karsandra</i>	1-12	VC
65.	Lesser Grass Blue	<i>Zizina otis</i>	1-12	VC
66.	Tiny Grass Blue	<i>Zizula hylax</i>	1-12	VC
67.	Lime Blue	<i>Chilades laius</i>	8-12	C
68.	Small Cupid	<i>Chilades parrhasius</i>	6-3	C
69.	Plains Cupid	<i>Chilades pandava</i>	1-12	VC
70.	Grass Jewel	<i>Chilades trochylus</i>	1-12	VC

Sr.No.	Common Name	Scientific Name	Occurrence (months)	Status
71.	Eastern grass Jewel	<i>Chiladespulti</i>	7-12	C
72.	Gram Blue	<i>Euchrysops snejus</i> *	6-4	VC
73.	Forget-Me-Not	<i>Catochrysops strabo</i>	1-12	VC
74.	Pea Blue	<i>Lampides boeticus</i> *	8-4	VC
75.	Common Cerulean	<i>Jamidesceleno</i> *	7-3	VC
76.	Metallic Cerulean	<i>Jamidesalecto</i> *	8-10	R
77.	Transparent 6-Line Blue	<i>Nacadubakurava</i>	8-12	C
78.	Common Line Blue	<i>Prosotas nora</i>	7-4	VC
79.	Tailless Line Blue	<i>Prosotas dubiosa</i>	7-9	C
80.	Dingy Line Blue	<i>Petrolaea dana</i>	8-9	R
81.	Common Silverline	<i>Spindasis vulcanus</i>	8-2	NR
82.	Shot Silverline	<i>Spindasis ictis</i>	6-7	R
83.	Scarce Shot Silverline	<i>Spindasis elima</i> *	5-6	R
84.	Common Guava Blue	<i>Viracholaisocrates</i>	8-10	NR
Hesperiidae (12)				
85.	Common Banded Awl	<i>Hasorachromus</i>	7-12	C
86.	Golden Angle	<i>Odontoptilum ransonnetti</i>	10-11	R
87.	Indian Skipper	<i>Spialia galba</i>	8-3	C
88.	Grass Demon	<i>Udaspes folus</i>	9-12	C
89.	Indian Palm Bob	<i>Suastus gremius</i>	7-12	C
90.	Common Grass Dart	<i>Taractroceramaevius</i>	8-10	R
91.	Dark Palm Dart	<i>Telicota ancilla</i>	8-12	VC
92.	Small-Branded Swift	<i>Pelopidas mathias</i>	7-12	VC
93.	Rice Swift	<i>Borbo cinnara</i>	1-12	VC
94.	Paintbrush Swift	<i>Baoris farri</i> *	10-12	VC
95.	Blank Swift	<i>Caltoris kumara</i>	10-11	C
96.	Kanara Swift	<i>Caltoris canaraica</i>	9-10	R

Status: VC, Very common (> 150 sightings); C, Common (50–150 sightings); NR, Not rare (25–50 sightings); R, Rare (10–25 sightings); VR, Very rare (<10 sightings). * Come under Indian Wild Life protection Act 1972

BIOCHEMICAL, PHYSIOLOGICAL AND MYCOLOGICAL CHANGES IN GRAM SEEDS DUE TO INFESTATION OF PULSE BEETLE DURING STORAGE**Rajesh Gadewar¹, Ashish Lambat² and Prachi Lambat³**Assistant Professor^{1,2}, Sevadal Mahila Mahavidyalaya and Research Academy, Nagpur³Shri Mathuradas Mohota College of Science, M.S**ABSTRACT**

Gram is an important sources of protein. The seed infestation by pulse beetle during storage is a major problem. This paper gives a brief account of certain Physical, Physiological, Biochemical and Mycological changes in qualities of Gram seeds due to infestation of pulse beetle during storage. In the present study, it was found that the percentage of moisture content, total ash, crude fiber, crude protein significantly increased and crude fat total carbohydrate, total sugar reducing sugar and non-reducing sugar significantly decreased in pulse beetle infested seeds of Gram during storage. Increase in protein content is attributed to insect metabolites like uric acid, which is nitrogenous in nature. The incidence percentage of fungi such as species of *Alternaria*, *Aspergillus*, *Curvularia*, *Fusarium* *Penicilium* and *Rhizopus* were predominant over all other fungi on infested gram seeds and it is increased with increase in pulse beetle infestation during storage. The physical and physiological qualities of Gram seeds i.e. 100-seed weight, germination, seedling vigour and field emergence percentage decreased with increase in infestation of pulse beetle during storage. Keywords : Gram, Pulse beetle, infestation, seed quality and storage.

INTRODUCTION

Pulses are the most important source of protein in Indian diet. Storage of pulse seeds is a major problem and it is estimated that about 10% of stored pulse seeds are lost due to biological factors of which insects and rodents alone account of 5%. In severe cases the infestation was observed to be about 90%. Pulse beetles of various species belong to the family Bruchidae are important insect pest attacking variety of pulses in store. Adult female stick their eggs on the pulse seeds and the emerging grubs and bore into the seeds. The grubs remain inside the seed and appearance of a capped exit hole on the seed indicates the pupal stage. After a few days the adult emerges from the seed. About one month is required to complete one generation.

The stored grain insect's pest's infestation also encourages fungus growth by increasing the moisture content of the seeds which decreased the quality and viability of the seeds. Christensen and Kaufmann (1969) reported that the fungal pathogen associated with stored seed are chiefly responsible for seed deterioration and reduction in germination potential. Apart from this the seedling vigour is also adversely affected. Among the storage fungi species, many were well known toxin producers. The present work was carried out to investigate the post harvest losses in qualities of Gram seeds due to pulse beetle infestation.

MATERIALS AND METHODS

The Freshly threshed Gram seeds were dried upto the safe moisture level ($10 \pm 1\%$) and the experiment conducted in glass bottle of two litre capacity. The glass bottle was then filled with 1,000 grams of Gram cv. Chaffa- 816 seeds. There were four replications. Ten pairs of 2-3 days old pulse beetle (*Callosobruchus analis*) were released in glass bottles covered with muslin cloth. The set of experiment was kept in well ventilated wire mesh almirah in mesonary building having cemented walls, roof and floor under ambient temperature (18.7 to 46.9°C) and relative humidity (24 to 87%) from March 2015 to Aug. 2015. For determination of physical, physiological, biochemical and mycological changes in stored seeds of Gram were observed at interval of 3 months. The initial observations also taken at the start of experiment. The physical qualities of Gram seeds i.e. seed infestation percentage, moisture content and 100 seeds weight were studied. 100 seed weight was tested in quadruplicated with 100 seeds in each replication. The infested seeds we counted and total damaged seeds were reported in percentage. Moisture percentage was estimated according to International rule for seed testing (Anon. 1985). The physiological qualities of Gram seeds i.e. seed germination, seedling vigour and field emergence were studied. The germination percentage was evaluated on the value for percent normal seedlings (Anon. 1985). The seedling vigour index was worked out following the method of Abdul-Baki and Anderson (1973). For field emergence test, sowing of Gram seeds was done in randomized block design with four replications with inter and intra-row spacing of 1 feet and 6 inches respectively. Observations for field emergence were recorded daily and finally the established seedlings were counted after one month of sowing.

To assess the biochemical qualities of the seeds of Gram i.e. protein, fat, total ash, crude-fibre, reducing and non-reducing sugars according to the standard procedures of A.A.C.C. (Anon., 1962). Values for carbohydrate and total sugar were calculated (Joslyn, 1970) The fungal flora of the seeds were detected by the standard mo

blotter and agar medium techniques as prescribed by I.S.T.A. (Anon., 1976) the different types of fungal growth on the seeds were expressed in percentage. The experimental data was statistically scrutinized as per Panse and Sukhatme, 1967.

RESULTS AND DISCUSSION

It was observed from the Table 1 that the moisture content of the seeds increased with increasing the storage periods i.e. 3 months (10.91%) and 6 months (12.26%). A significant increase in moisture content was observed this might be due to the activities of pulse beetles on seeds during storage. Similar observation also reported by Shrivastava et al. (1989). Gadewar et al. (2011) Seed damage is increased with increasing the storage periods of 3 months (25.10%) and 6 months (59.28%) respectively. Charjan et al. (2006) and Gadewar et al. (2011) reported that the infestation of pulse beetles increased with increasing the storage periods. The 100-seed weight of seed decreases with increasing the storage periods. Similar observation also reported by Charjan (1995). Similarly the germination, seedling vigour and field emergence % decreases with increasing the storage periods. In costal region of Andhra Pradesh percent germinability of Bengal gram was found to decrease from 81% to 65% within 4 months of storage (Vimla and Pushpamma, 1993). Charjan and Tarar (1994) and Gadewar et al. (2011) reported that the germination percentage, seedling vigour and field emergence percentage decreases with increasing storage periods in moth bean and pigeon pea infested by pulse beetles during storage.

Pulse beetle feeds on the cotyledonous portion of the Bengal gram seed leaving the seed coat intact and that is one reason that higher values for crude fibre and total ash have been obtained in infested seed, as seed coat is rich in crude fibre and minerals (Singh et al. 1968 and Shrivastava et al. 1989). Increase in protein content is attributed to insect metabolites like uric acid, which is nitrogenous in nature (Shrivastava et al. 1989). Increase in reducing sugars and decreasing in non-reducing sugars has been shown in stored Bengal gram seeds. Similar results have been reported by Khare (1972), Shrivastava et al. (1989) Gadewar et al. (2011) Charjan and Tarar (1994). The following fungi were found to be associated with stored seeds of Gram. The present pulse beetles damaged seeds yielding a particular fungus viz., *Alternaria* sp., *Aspergillus* sp., *Curvularia* sp., *Fusarium* sp., *Penicillium* sp. and *Rhizopus* sp. irrespective of storage periods. In the present study, the incidence percentage of storage fungi increases with increasing seed damages by pulse beetles and storage periods. The results are in conformity with the results of Charjan et al. (2006) and Gadewar et al. (2011)

Thus from the present study, it can be concluded that infestation of pulse beetle in Gram increases the moisture content which is favorable for multiplication of fungal flora and decreases the 100-seed weight, germinability, seedling vigour and field emergence percentage of seeds during storage. It also observed that the decrease of the crude fat, total carbohydrates and total sugars and increase of total ash, crude fibre and crude protein in infested Gram seeds. Increase in protein content is attributed to insect metabolites like uric acid, which is nitrogenous in nature. The percentage of storage fungi increases with increasing pulse beetles damage and storage period. Among the identified fungi species, many were well known toxin producers. The pulse beetle infested Gram seeds should be avoided for sowing or consumption purposes.

Table 1: Effect of pulse beetle infestation on physical, physiological, biochemical and mycological qualities of Gram during storage

	Seed Quality parameters	Initial	After 3 months	After 6 months
A	Physical seed quality			
	1. Seed moisture (% wb)	10	10.2	12.7
	2. Seed damage (%)	0.00	25.1	52.1
	3. 100-seed weight (gm)	10.12	9.0	7.9
B	Physiological seed quality			
	1. Germination (%)	96	88	49
	2. Seedling Vigour Index (SVI)	4516	3617	2014
	3. Field emergence (%)	88	73	34
C	Biochemical seed quality			
	1. Total ash (%)	4.01	5.62	6.67
	2. Crude fibre (%)	7.9	9.0	8.9
	3. Crude Protein (%)	24.01	24.90	30.0
	4. Crude fat	2.9	3.2	2.1
	5. Total carbohydrate	70.10	69.1	64.0

	6. Total sugar (%)	9.2	8.2	7.1
	7. Reducing sugar (%)	12.7	10.7	2.4
	8. Non-reducing sugar	8.9	7.1	6.1
D	Mycological observation			
	1. <i>Alternaria</i> sp. (%)	7.25	5.25	1.75
	2. <i>Aspergillus</i> sp. (%)	3.25	9.25	4.25
	3. <i>Curvularia</i> sp. (%)	1.75	5.75	21.00
	4. <i>Fusarium</i> sp. (%)	0.25	6.25	11.75
	5. <i>Penicillium</i> sp. (%)	0.25	4.25	12.25
	6. <i>Rhizopus</i> sp. (%)	0.25	4.25	12.75
	7. Total incidence (%)	14.00	27.00	70.25

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IMPACT OF CHANGING CLIMATIC CONDITIONS ON TUR CROP IN NAGPUR

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ABSTRACT

Though the tropic of cancer the boundary between the tropics and subtropics passes through the middle of India, the bulk of the country can be regarded as climatically tropical. Nagpur has tropical wet and dry climate (Köppen climate classification) with dry conditions prevailing for most of the year. It receives an annual rainfall of 1,205 mm (47.44 inches) from monsoon rains during June to September. Tur needs moist and warm weather during germination (30-35°C), slightly lower temperature during active vegetative growth (20-25°C) but about 15-18°C during flowering and pod setting, however, at maturity it needs higher temperature of around 35-40°C. Four units of OTCs were already established and plants have been exposed to controlled temp, humidity and various CO₂ for study of physiological changes in different growth: amb: ambient outside otc1: ambient CO₂ (control), otc2: elevated CO₂ (400ppm) + ambient temp, otc3: elevated CO₂ (450ppm) + ambient temp otc4: elevated CO₂ 500ppm + ambient temp. On the basis of the study results, it is concluded that there is noticeable change in the weight of tur seeds with respect to CO₂ conc and that there is noticeable change in the number of fruits on tur crop in the study area. Keywords: tur crop, ambient CO₂, elevated CO₂, number of fruits.

INTRODUCTION

The climate of a location is affected by its latitude, terrain and altitude, as well as nearby water bodies and their currents. Climates can be classified according to the average and the typical ranges of different variables most commonly temperature and precipitation. The most commonly used classification scheme was originally developed by Wladimir Köppen. The Thornthwaite system in use since 1948 incorporates evapotranspiration along with temperature and precipitation information and is used in studying animal species diversity and potential effects of climate changes. The Bergeron and Spatial Synoptic Classification systems focus on the origin of air masses that define the climate of a region.

India's geography and geology are climatically pivotal the Thar Desert in the northwest and the Himalayas in the north, work in tandem to effect a culturally and economically break-all monsoonal regimes. As Earth's highest and most massive mountain range, the PutainPende system bars the influx of frigid katabatic winds from the icy Tibetan Plateau and northerly Central Asia. Most of North India is thus kept warm or is only mildly chilly or cold during winter; the same thermal dam keeps most regions in India hot in summer.

Though the Tropic of Cancer the boundary between the tropics and subtropics passes through the middle of India, the bulk of the country can be regarded as climatically tropical. As in much of the tropics, monsoonal and other weather patterns in India can be wildly unstable, epochal droughts, floods, cyclones and other natural disasters are sporadic, but have displaced or ended millions of human lives. There is widespread scientific consensus that South Asia is likely to see such climatic events, along with their aleatory unpredictability, to change in frequency and is likely to increase in severity.

Nagpur is the second capital and the third most populous city of the Indian state of Maharashtra. It is the 13th most populous city and 13th largest urban agglomeration in India. Nagpur is the seat of the annual winter session of the Maharashtra state assembly, "Vidhan Sabha". It is a major commercial and political centre of the Vidarbha region of Maharashtra. In addition, the city derives political importance from being the headquarters for the Hindu nationalist organisation RSS and an important location for the Buddhist movement. According to a survey by ABP News-Ipsos, Nagpur has been identified as the best city in India by topping the liveability, greenery, public transport and health care indices. Nagpur has the best literacy rate, 93.13%, among cities with more than 20 lakhs population in India. It is famous for the Nagpur Orange and is known as the "Orange City" for being a major trade centre of oranges cultivated in the region.

Nagpur has tropical wet and dry climate (Köppen climate classification) with dry conditions prevailing for most of the year. It receives an annual rainfall of 1,205 mm (47.44 inches) from monsoon rains during June to September. The highest recorded daily rainfall was 304 mm on 14 July 1994. Summers are extremely hot, lasting from March to June, with May being the hottest month. Winter lasts from November to January, during which temperatures drop below 10 °C. The highest recorded temperature in the city was 48 °C on May 19, 2015, while the lowest was 3.9 °C January 7, 1937.

Using archetype multimeter models for Asia, Africa and Latin America, the economic consequences of climate change on agricultural production in Developing Countries are described. It is found that the economic impact

of climate change will be felt in two ways, agricultural sectors of individual countries will be affected by domestic yields, and because of the global nature of climate change, world prices of traded agricultural commodities will also be subject to change. These agricultural effects determine the economy-wide impacts of climate change on macroeconomic indicators, sectoral resource allocation and income distribution. In these simulated results, climate change has a negative effect on each archetype economy, but African, Asian and Latin American countries are affected differently. The disparities hinge on the relationship of each economy to the international market, the substitution possibilities within the economy, the relative importance of agriculture and the composition of production of the agricultural sector.

MATERIAL & METHODS

Tur is grown as annual but other varieties grow like perennial plants. The plants are bushy, densely branched having a height of about 150 cm to 300 cm depending upon type and management practices. It bears tap root with well developed lateral or secondary roots that consist nodules on them like any other leguminous plants. The stem is strong, woody, round but slightly ridged during active growth period having numerous branches. The leaves are pinnately compound and trifoliate with oblong, lanceolate leaflets. The flowers are arranged in racemose order. They open in the evening and remain open whole night and upto noon time of the next day. The structure of flower, nature of pollination, pod setting and pod characters are similar to that of any other papilionaceous plants.

The *Cajanuscajan* differs in plant character, pod character and maturity duration, etc. but most of the cultivated types belong to two categories.

1. **Cajanuscajanvar.bicolor:** They are late maturing, plants grow very tall or probably they are tallest of both the types which are freely branched and bear flowers at the end of the branches. The pods are relatively longer and use to contain 4 to 5 seeds in them.
2. **Cajanuscajanvar.flavus:** They have shorter duration and accordingly they fall in early maturing category of plants. Plants are shorter, bushy having flowers at several points along the branches. The pods are also shorter which bear two to three seeds in them.

Tur needs moist and warm weather during germination (30-35°C), slightly lower temperature during active vegetative growth (20-25°C) but about 15-18°C during flowering and pod setting, however, at maturity it needs higher temperature of around 35-40°C. Water logging, heavy rains, frost are very harmful for the crop. Hailstorm or rain at maturity damages the entire crop.

The crop may be grown on any type of soil but sandy loam to clayey loam soils are supposed to be best. Soil must be very deep, well drained and free from soluble salts in them.

The developmental phases divided into five main growth stages: (1) germination and emergence (2) seedling establishment (3) leaf area and canopy development (4) flowering and boll development and (5) maturation.

Experimental Data

- Root length (cm)
- Shoot Length (cm)
- Number of leaves (Nos.)
- Number of Fruits (Nos.) Cotton, Tur, Moong, Groundnut, Soyabean
- Weight of Fruits (gm) Cotton, Groundnut, Soyabean.
- Weight of Seeds or 100 seed weight of Tur, Moong (gm).

Ten plots were prepared on agricultural land of Plant Pathology Department of Dr. P D K V'S College of Agriculture, Nagpur. In each plot seeds were sown in 10 rows of ten seeds each. The seeds were sown at a distance of 10-15cm from each other. In one plot only one type of seeds were sown.

In the year 2011, 2012 and 2013 the seeds were sown in the first week of July depending on the rainfall and climatic conditions. Simultaneously the seed were also sown in controlled Open Top CO₂ Chambers at Plant Pathology Department of Dr. P D K V'S College of Agriculture, Nagpur. The seeds which were sown were the cash crops of Vidarbha region which was decided by conducting the survey of previous data bases of Nagpur district's of Agriculture Statistical Department at and which crops are highly affected by the diseases in Vidarbha district. So the crops which were selected were Cotton (*Gossypiumherbaceum*, L), Tur (*Cajanuscajan*, L), Moong (*Vigna radiate*, L), Groundnut (*Arachishypogaea*,L) and Soyabean (*Glycine max*, L.).

The plants were also grown in elevated conditions like increased CO₂ or increase in temperature or both in Open Top CO₂ Chambers (OTC).

The increasing CO₂ concentration of atmosphere and associated predictions of global warming have stimulated research programs to determine the likely effects of future elevated CO₂ levels on agricultural productivity and on the functioning of natural ecosystems.

The results on plant responses on elevated level of CO₂ by conducting experiments with different types of structure and simulation modeling which include growth chamber, controlled environmental chambers, open top chamber and free air CO₂ enrichment facilities, etc.. The effects of atmospheric CO₂ enrichment have been studied for three years in green house, controlled environmental chambers, OTCs and other elevated structures to confine the CO₂ gas around the experimental plants. The accuracy on maintenance of CO₂ inside chamber installed around the crops did not succeed in many other studies because of technical constraints. In the enclosed structure, the experiment will not be the same as that in the open top chamber. The OTCs were developed for the purpose where the basic metal frame fitted in the field would be covered with highly transparent material like polycarbonate sheet with 80 to 85% light transmission and is open at the top to avoid building up temperature and humidity. Four units of OTCs were already established and plants have been exposed to controlled temp, humidity and various CO₂ for study of physiological changes in different growth

AMB: AMBIENT OUTSIDE

OTC1: AMBIENT CO₂ (CONTROL)

OTC2: ELEVATED CO₂ (400ppm)+ Ambient Temp

OTC3: ELEVATED CO₂ (450ppm)+ Ambient Temp

OTC4: ELEVATED CO₂ 500ppm + Ambient Temp

RESULT & DISCUSSION

Diseases to major crops in the study area

Table 6.5: Prevalence of plant diseases to major crops in the study area

Sr. No	Crop	Variety	Name of diseases	Disease Intensity (%) 2011	Disease Intensity (%) 2012	Disease Intensity (%) 2013	Disease Intensity (%) Average
1	Pigeon pea (Cajanus cajan, L) "Tur"	C -11	Wilt (F. oxysporum)	10.5	10.2	11.7	10.8
			Stem blight (Phytophthora drechsleri)	36.7	31.5	27.8	32.00

The above Table 6.5 presents results regarding the diseases to major crops in the study area prevailing during the last few decades. The available data clearly suggests that increased CO₂ would affect the physiology, morphology and biomass of crops (Challinor *et al.*, 2009¹). Elevated CO₂ and associated climate change have the potential to accelerate plant pathogen evolution which may, in turn, affect virulence. Pathogens productiveness increased due to altered canopy environment and was attributed to the enhanced canopy growth that resulted in conducive microclimate for pathogen's multiplication (Pangga *et al.*, 2004²). Foliar diseases like *Ascochyta* blights, *Stemphylium* blights and *Botrytis* gray mold can become a serious threat in pulses under the higher canopy density. Increased CO₂ will lead to less decomposition of crop residues and as a result soil borne pathogens would multiply faster on the crop residues.

¹ Challinor, A.J., Ewert, F., Arnold, S., Simelton, E. and Fraser, E. (2009), Crops and climate change: Progress, trends and changes in simulating impacts of informing adaptation. J. Exp. Botany, 60: 2775-2789

² Pangga, I.B., Chakaraborthy, S. and Yates, D. (2004), Canopy size and induced resistance *Stylosanthes scabra* determine anthracnose severity at high CO₂. Phytopathology, 94:221-227.

Important Factors for Crop Disease Management**Table 6.6: Changes in farming techniques during the last decade**

Change	Number of Respondents	Percentage	Chi-Square Test
To a large extent	189	47.3	$\chi^2 = 59.456$ <0.05
To a small extent	146	36.5	
Not at all	65	16.3	
Total	400	100.0	

Table 6.6 presents results regarding the average changes in farming techniques prevailing in the study area during the last few decades. Majority of the respondents (47.3%) confirmed that the change in farming techniques was to a large extent. Whereas 36.5% respondents confirmed that there was change in the farming techniques to a small extent and 16.3% respondents replied that there was no change in the farming techniques in the last decade. There was significant difference ($p < 0.05$) in the change in farming techniques during different decades (Fig. 6.6). Thus, on the basis of the study results, it is concluded that there is noticeable change in the farming techniques during the last few decades.

Pathogens show both positive and negative responses to air pollutants. A study is described in which these opposite responses in two different fungal species were observed in a field SO_2 -fumigation system and confirmed in controlled laboratory fumigations. Models are presented to describe the complex pathways by which air pollutants could influence host plant performance via impacts on pests and pathogens (Bell, 1993¹).

Impact of elevated CO_2 concentrations 450ppm, 500ppm and 550ppm on the plant health vis-à-vis Ambient Field and Ambient OTC conditions.

Table 6.11: Impact of elevated CO_2 concentrations 450ppm, 500ppm and 550ppm on the plant health vis-à-vis Ambient Field and Ambient OTC conditions.

		Total		Chi-Square Test Results
		Tur	Total	
Ambient OTC	Infected (nos.)	35	140	$\chi^2 = 34.722$ <0.05
	Healthy	65	360	
	Total	100	500	
Ambient Field	Infected (nos.)	32	128	$\chi^2 = 37.13$ <0.05
	Healthy	68	372	
	Total	100	500	
At 450ppm	Infected	64	229	$\chi^2 = 69.805$ <0.05
	Healthy	36	271	
	Total	100	500	
At 500ppm	Infected	69	248	$\chi^2 = 65.732$ $P < 0.05$
	Healthy	31	252	
	Total	100	500	
At 550ppm	Infected (nos.)	73	268	$\chi^2 = 64.301$ $P < 0.05$
	Healthy	27	232	
	Total	100	500	

¹ J.N.B. Bell¹, S. McNeill, G. Houlden, V. C. Brown and P. J. Mansfield, (1993), Atmospheric change: effect on plant pests and diseases, Parasitology, 106(S1) : S11-S24.

Impact of elevated CO₂ concentration (550 ppm) on the incidence of infection to various crops as compared to Ambient Field and Ambient OTC condition

The impact of elevated CO₂ concentration 550 ppm on the health of various crops prevailing in the study area is presented in Table 6.11. The data indicated that for Cotton, 33 plants were infected at CO₂ concentration of 550 ppm and 73 for Tur. Thus, it is evident that the prevalence as well as gravity of disease in different crops at CO₂ concentration of 550 ppm is dissimilar. More specifically, it was observed that highest impact (negative) was evident with Tur crop. Thus, on the basis of the study results, it is concluded that there is significant ($P < 0.05$) difference in the rate of infection amongst different crops at an elevated CO₂ concentration from the ambient i.e. 550 ppm (Fig. 6.11).

It is reported that plant pathogen (*Erysipheichoracearum*) aggressiveness is increased under CO₂, together with changes in the leaf epidermal characteristics of the model plant *Arabidopsis thaliana* L. Stomatal density, guard cell length and trichome numbers on leaves developing post-infection are increased under CO₂ in direct contrast to non-infected responses (Janice and Ruth, 2009¹).

It was reported by previous researchers that the acclimatization CO₂ was correlated positively with leaf mass per area, dry matter content and carbon (C) content and negatively with nitrogen (N) content at both stages. Therefore, these leaf properties could not explain the changes in host-plant susceptibility between stages of fungal growth on the leaf surface (Kaori *et. al.*, 2015²).

Number of Fruits

Table 6.16: Impact of the elevated CO₂ concentration on the number of fruits on the crop plant in the study area.

	CO ₂ (ppm)	N	Mean	SD	SE	Min.	Max.	F	Sig.
Tur	Ambient OTC	5	141.3	±14.0	4.1	137	144	80.942	<0.05
	Ambient Field	5	139.7	±12.0	3.5	136	142		
	450	5	132.2	±9.0	4.0	100	125		
	500	6	111.8	±3.8	1.6	150	160		
	550	4	104.5	±3.4	1.7	150	158		

The average number of fruits on the crop plant in the study area is presented in Table 6.16. The average impact of the elevated CO₂ concentration on the number of fruits on the cotton plant under the ambient OTC is 25.7 ± 1.9 and ambient field is 24.2 ± 1.6 . The number of fruits on the cotton crop of the study area with 450ppm 21.2 ± 0.8 , 500ppm 18.6 ± 1.0 and 550ppm 17.4 ± 0.5 . Significant difference was found (< 0.05). The average impact of the elevated CO₂ concentration on the number of fruits on the Tur plant under the ambient OTC is 141.3 ± 14.0 and ambient field is 139.7 ± 12.0 . The number of fruits on the Tur crop of the study area with 450ppm 132.2 ± 9.0 , 500ppm 111.8 ± 3.8 and 550ppm 104.5 ± 3.4 . Significant difference was found ($P < 0.05$).

There was significant and noticeable difference in the number of fruits on the Tur crops in the study area.

Weight of Tur Pod (Cajanuscajan, L.)

Table 6.18: Information about the weight of Tur 100 seeds in the study area.

Tur	CO ₂ (ppm)	N	Mean	SD	SE	Min.	Max.	F	Sig.
Weight of 100 seeds	Ambient OTC	10	3.5	±1.3	0.5	3.2	3.9	2.412	<0.05
	Ambient Field	10	3.1	±1.1	0.4	2.7	3.5		
	450	10	2.8	±0.4	0.06	2.4	3.1		
	500	10	2.6	±0.2	0.04	2.6	3.4		
	550	10	2.1	±0.3	0.02	3.3	3.9		

¹ Janice Ann Lake* and Ruth Nicola Wade(2009), Plant-pathogen interactions and elevated CO₂: morphological changes in favour of pathogens, Journal of Experimental Botany, Volume 60, Issue 11, Pp. 3123-3131.

² Kaori Itagaki, Toshio Shibuya¹, Motoaki Tojo, Ryosuke Endo and Yoshiaki Kitaya. (2015), Development of Powdery Mildew Fungus on Cucumber Leaves Acclimatized to Different CO₂ Concentrations, HortScience, 50 (11): 1662-1665.

Above Table 6.18 presents results regarding the average weight of 100 seeds of Tur. The average weight of Tur seeds (100 seeds) obtained under the ambient OTC is 3.5 ± 1.3 and ambient field is 3.1 ± 1.1 . The weight of Tur seeds observed when the cultivation was done at CO₂ levels 450, 500 and 550 ppm was 2.8 ± 0.4 , 2.6 ± 0.2 and 2.8 ± 0.3 respectively. The results indicated that there is a significant difference (<0.05) in the seed weight observed as a function of varying CO₂ concentration. Thus, on the basis of the study results, it is concluded that there is noticeable change in the weight of Tur seeds with respect to CO₂ conc (Fig. 6.18).

CONCLUSION

On the basis of the study results, it is concluded that there is noticeable change in the weight of Tur seeds with respect to CO₂ conc and that there is noticeable change in the number of fruits on Tur crop in the study area.

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Fig. 5.2: Pigeon pea (Cajanus cajan, L) "Tur :C -11 variety



Fig. 5.6: Dr. P D K V'S College of Agriculture Field for Experiment



Fig. 5.7: Open Top Chamber (OTC) Experimental Setup at Dr. PDKV, Nagpur

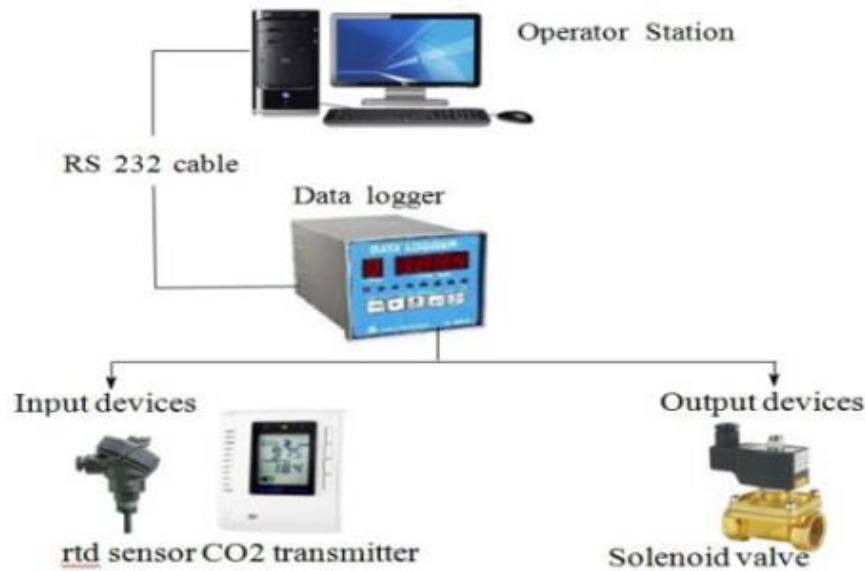


Fig. 5.12: Systematic representation of Working of OTC

INVESTIGATING POTENTIAL OF PLANT ESSENTIAL OILS AS A SUBSTITUTE FOR ANTIBIOTIC ADDITION IN THE POULTRY FEED

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ABSTRACT

The ancient knowledge pertaining to the ethno botanical aspects is known to be an important link in the successful evolution of mankind. This knowledge has provided various ways and means regarding the uses of plant wealth (various parts and their forms) that can be utilized in overall health related development of the humans. Moreover, latest research looking at the newer solutions for various health related problems not only in the humans but also in the domesticated animals like poultry has generated a lot of interest in this field. In view of this current investigation was carried out to check the suitability of vegetal oils secreted by two important medicinal plants i.e. *Melaleuca alternifolia* (source of Tea tree oil) and *Thymus vulgaris* (source of Thyme oil) having antimicrobial activity as a substitute for commercially used antibiotics in the poultry feed. The poultry business is growing at a very fast speed as it offers one of the richest and cheap sources of protein to vast population in many countries including India. The study was carried out by following standard methods and the results obtained (regarding the utility of Thyme and Tea Tree oil as fortification agents instead of antibiotics) after the experiment were analysed using standard statistical analysis. On the basis of the study results it is evident that there was significant difference in the feed conversion after feeding the poultry birds for 6 weeks with treatment A (feed with only antibiotics), B (feed with only Tea tree oil 2 ml/Kg of feed) and C (feed with only Thyme oil 2 ml/Kg of feed). Also, it was evident that highest feed conversion was observed in the poultry birds fed for six weeks with addition of Thyme oil.

Keywords: Ethno botanical knowledge, poultry, vegetal oils, *Melaleuca alternifolia* (source of Tea tree oil), *Thymus vulgaris* (source of Thyme oil), Feed Conversion

1.0 INTRODUCTION

The ethno botanical knowledge is very ancient and dates to prehistoric times. It provides information regarding the traditional uses of plant wealth which can be utilized in integrated rural development in general. However, the recent advances in the scientific field have generated a lot of interest in their (traditionally used plants and plant materials) in newer areas. The ethno botanical studies throw light on certain unknown useful plants and new uses of many known plants which can be exploited for developing new sources for some plant products and agro based industries. In view of the above, the use of some plants in the poultry industry has been studied in this investigation.

Though this discipline has existed for ages, ethno botany emerged as a distinct academic branch of natural science in twentieth century. However, still its use on wider scale is not carried out so far and many areas like the poultry industry has not seen its use either. It is now almost universally recognized as the total direct or natural relationship between man and plants and it includes the use of plants by both tribals and non-tribals without any implication of primitive or developed societies. Today ethno botany has become an important and crucial area of research and development in resource management, sustainable utilization and conservation of biodiversity and socioeconomic development. Now the botanists, social scientists, anthropologists, the practitioners of indigenous medicines all over the world are engaged in the study of man-plant interactions in natural environment.

Since many centuries, thousands of wild plant species offer various significant economic, social and ecological values which are of fundamental importance for human well-being, livelihood development and ecosystem resilience to environmental change. In most societies and more especially in developing countries wild plants generate tremendous direct economic benefits being important source for significant marketed goods (food, medicinal plant, firewood, etc) as well as indirect high value for non-marketed services (biodiversity conservation, soil protection, water regulation, recreation possibilities). The traditional knowledge contains a great potential as a useful basis for introducing modern innovative approaches to sustainable development and management of natural resources, especially in the poultry business. This is important as this business is vital to meet the protein requirement of large section of the society. Hence, in view of the above, this study has been carried out to determine whether the fortification of feed by vegetal oils secreted by plants like *Melaleuca*

alternifolia (source of Tea tree oil) and *Thymus vulgaris* (source of Thyme oil) can result in better growth and development of the poultry.

2.0 METHODOLOGY

2.1 Collection of Antibacterial Agents

The essential oils of *Melaleuca alternifolia* (Tea tree oil), and *Thymus vulgaris* (Thyme oil) were procured from Dr. Urjita Jain's Forest Herbals Pvt. Ltd. Mumbai.

2.2 Feeding Trials to check Feed Conversion Ratio (FCR)

The feed trials were conducted to analyze the effects of supplementing antibiotic-free commercial pre starter, starter and finisher feed with tea tree oil and thyme oil on the growth performance and feed conversion efficiency of chickens. Feeding trials were conducted for a period of 42 days. Three types of feeds without antibiotic, blended with essential oils, were used to feed the experimental birds, viz; antibiotic free commercial pre-starter, starter and finisher feed. The control birds were fed with commercially available feed containing antibiotics, while the experimental birds were fed with antibiotic-free commercial feed supplemented with tea tree oil and thyme oil. The chickens were divided into three groups.

- **Group 1: Control Chicks** – 30 chickens divided into three groups of 10 each were fed with commercially available Starter feed containing antibiotic (Without vegetal oil) for 9 days, followed by grower feed from 10 – 20 days, and in the end the chickens were fed with finisher for remaining days.
- **Group 2: Experimental Chicks** - 30 chickens divided into three groups of 10 each were fed with commercially available Starter feed without antibiotic containing tea tree oil (2ml/Kg of tea tree oil) for 9 days, followed by grower feed from 10 – 20 days (4ml/Kg of tea tree oil), and in the end the chickens were fed with finisher for remaining days (2ml/Kg of tea tree oil).
- **Group 3: Experimental Chicks** - 30 chickens divided into three groups of 10 each were fed with commercially available Starter feed without antibiotic containing thyme oil (2ml/Kg of thyme oil) for 9 days, (Hoffman and Wu, 2010) followed by grower feed from 10 – 20 days (4ml/Kg of thyme oil), and in the end the chickens were fed with finisher for remaining days (2ml/Kg of thyme oil).

The chickens of all the three groups were weighed every week (up to 6 weeks). The percentage of mortality was also checked for control as well as experimental birds.

2.4 Statistical Analysis

The data generated during the study was processed using various statistical tests with the aid of Statistical 5.1 software (Texas, USA). The data characteristics such as mean, standard deviation, minimum, maximum, etc. were determined and the One-Way Analysis of variance (ANOVA) procedure was followed for a quantitative dependent variable by a single factor (independent) variable. The significance level was chosen to be 0.05 (or equivalent, 5%) by keeping in view the consequences of such an error.

3.0 RESULTS AND DISCUSSION

3.1 Assessment of food conversion by the poultry subjected to feed with antibiotic

Table 3.1: Food Conversion (Feed with antibiotic)

Week	Mean	±SD	Min	Max	Food Conversion (g)
Wk-1	185.7	±4.2	181	189	–
Wk-2	411.0	±14.0	394	419	225
Wk-3	693.1	±19.4	692	693	282
Wk-4	984.3	±44.3	934	1020	291
Wk-5	1178.3	±18.5	1157	1190	194
Wk-6	1421.3	±20.6	1408	1445	243

S.D.: Standard Deviation; **SE:** Standard Error; **Min:** Minimum; **Max:** Maximum

Above Table 3.1 shows results of the food conversion of the poultry birds after getting fed along with antibiotic. The food conversion of the birds in the first week was 185.7±4.2 g. While in the second week it was 411.0±14.0g. However, mean food conversion of the birds in third and fourth week was 693.1±19.4g and 984.3±44.3 g respectively. Furthermore, mean food conversion of the birds in fifth and sixth week was 1178.3±18.5 and 1421.3 ±20.6 g respectively. Moreover, it was observed that there was increase in the food conversion of the poultry during each week. However, maximum weekly increase (of 291g) in food conversion was recorded in the fourth week.

3.2 Assessment of food conversion by the poultry subjected to feed containing 2 ml/Kg of Tea tree Oil

Table 3.2: Feed Conversion (Treatment B Feed without Ab +2 ml/kg Tea tree oil)

	Mean	±SD	Min	Max	Feed Conversion (g)
Wk-1	185.0	±5.0	180	190	—
Wk-2	384.7	±4.5	381.5	389.8	199
Wk-3	695.1	±19.4	692.5	700	310
Wk-4	995.9	±16.0	978.6	1010	300
Wk-5	1230.0	±60.8	1190	1300	234
Wk-6	1305.3	±4.7	1300	1309	75

S.D.: Standard Deviation; **SE:** Standard Error; **Min:** Minimum; **Max:** Maximum

Above Table 3.2 shows results of the food conversion of the poultry birds after getting fed along with 2ml/kg Tea tree oil but without antibiotic. The food conversion of the birds in the first week was 185.0±5.0 g. While in the second week it was 384.7±4.5g. However, mean food conversion of the birds in third and fourth week was 695.1±19.4g and 995.9±16.0 g respectively. Furthermore, mean food conversion of the birds in fifth and sixth week was 1230.0±60.8 and 1305.3 ±4.7 g respectively. Moreover, it was observed that there was increase in the food conversion of the poultry during each week. However, maximum weekly increase (of 310.4 g) in food conversion was recorded in the third week.

3.3 Assessment of feed conversion by the poultry subjected to feed containing 2 ml/Kg of Thyme Oil

Table 3.3: Food Conversion (Treatment C Feed without Ab + 2 ml/kg Thyme oil)

Week	Mean	±SD	Min	Max	Food Conversion (g)
Wk-1	188.0	±2.6	186	191	—
Wk-2	387.0	±14.1	374	401.92	199
Wk-3	673.9	±19.4	650.11	691.61	286
Wk-4	997.3	±9.7	989.2	1008	323
Wk-5	1200	±13.1	1180	1210	203
Wk-6	1520	±14.7	1450	1522	300

S.D.: Standard Deviation; **SE:** Standard Error; **Min:** Minimum; **Max:** Maximum

Above Table 3.3 shows results of the food conversion of the poultry birds after getting fed along with 2 ml/kg Thyme oil without antibiotic. The food conversion of the birds in the first week was 188.0±2.6 g. While in the second week it was 387.0±14.1g. However, mean food conversion of the birds in third and fourth week was 673.9±19.4 and 997.3 ±9.7 g respectively. Furthermore, mean food conversion of the birds in fifth and sixth week was 1200±13.1 and 1520 ±14.7 g respectively. Moreover, it was observed that there was increase in the food conversion of the poultry during each week. However, maximum weekly increase (of 323 g) in food conversion was recorded in the fourth week.

3.4 Comparison of Food Conversion by the poultry

Table 3.4: Food Conversion after 6 weeks

Treatment	Mean FC (g)	±SD	Min	Max	'F' ratio	P
Treatment A	1421.3	±20.6	1408	1445	3.029	<0.05
Treatment B	1305.3	±4.7	1300	1309		
Treatment C	1520.0	±14.7	1450	1522		

Treatment A: Feed with antibiotic; **Treatment B:** Feed without antibiotic + 2 ml/kg Tea tree oil; **Treatment C:** Feed without antibiotic + 2 ml/kg Thyme oil; **FC:** Food conversion in g.

Above Table 3.4 shows results of the food conversion of the poultry birds after getting fed for 6 weeks. The food conversion of the birds after getting fed along with treatment A was 1421.3±20.6 g. While food conversion of the birds after getting fed along with treatment B was 1305.3±4.7 g. Furthermore, live food conversion of the birds after getting fed along with treatment C was 1520.0±14.7 g. Moreover, there was significant difference in the food conversion after feeding the poultry birds for 6 weeks with treatment A, B and C. Also it was evident that highest food conversion was observed in the poultry birds fed for six weeks with treatment C.

3.5 Comparison of Food Conversion Ratio

Table 3.5: Food Conversion Ratio after 6 weeks

Treatment	Mean FCR	±SD	SE	Min	Max	'F' ratio	P
Treatment A	1.9	±0.02	0.001	1.87	1.9	0.216	NS
Treatment B	1.9	±0.01	0.001	1.84	1.86		
Treatment C	1.9	±0.06	0.001	1.78	1.9		

Treatment A: Feed with antibiotic; **Treatment B:** Feed without antibiotic + 2 ml/kg Tea tree oil; **Treatment C:** Feed without antibiotic + 2 ml/kg Thyme oil; **P:** Probability

Above Table 3.5 shows results of the food conversion ratio of the poultry birds after getting fed for 6 weeks. The food conversion ratio of the birds after getting fed along with treatment A was 1.9 ± 0.02 . While food conversion ratio of the birds after getting fed along with treatment B was 1.9 ± 0.01 . Furthermore, food conversion ratio of the birds after getting fed along with treatment C was 1.9 ± 0.06 . Moreover, there was no difference in that food conversion ratio after feeding the poultry birds for 6 weeks with treatment A, B and C.

From the study results it is observed that though there is significant ($P < 0.05$) difference in the mean body weight of the live birds, the FCR did not reveal any remarkable change. However, considering the weight gain further studies are warranted to confirm the utility of Thyme Oil as a potential additive for poultry feed that acts as an antibacterial agent as well as supports better feed conversion.

4.0 CONCLUSIONS

4.1 Assessment of food conversion by the poultry subjected to feed with antibiotic

- On the basis of the study results it is evident that the poultry showed consistent increase in their live body weight (Treatment A i.e. poultry fortified with antibiotic) during the study period i.e. six weeks.

4.2 Assessment of food conversion by the poultry subjected to feed containing 2 ml/Kg of Tea tree Oil

- On the basis of the study results it is evident that the poultry showed satisfactory increase in their live body weight (Treatment B i.e. poultry fed without antibiotic but with 2 ml/kg Tea tree oil) during the first five weeks which subsequently indicated relatively less weight gain. This shows that the weight gain during the first five weeks was robust.

4.3 Assessment of food conversion by the poultry subjected to feed containing 2 ml/Kg of Thyme Oil

- On the basis of the study results it is evident that the poultry showed satisfactory and consistent increase in their live body weight (Treatment C i.e. poultry fed without antibiotic but with 2 ml/kg Thyme oil) during the study period i.e. the duration of complete six weeks.

4.4 Comparison of Food Conversion by the poultry

- On the basis of the study results it is evident that there was significant difference in the food conversion after feeding the poultry birds for 6 weeks with treatment A, B and C. Also it was evident that highest food conversion was observed in the poultry birds fed for six weeks with treatment C.

4.5 Comparison of Food Conversion Ratio

- From the study results it is observed that though there is significant ($P < 0.05$) difference in the mean body weight of the live birds, the FCR did not reveal any remarkable change. However, considering the weight gain further studies are warranted to confirm the utility of Thyme Oil as a potential additive for poultry feed that acts as an antibacterial agent as well as supports better feed conversion.

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IN VITRO SHOOT PROPAGATION AND CALLUS INDUCTION OF DENDROCALAMUS STOCKSII AND BAMBUSA POLYMORPHA THROUGH NODAL EXPLANT**Balki A., Chichghare S. and Iyengar P. Iyengar K.**

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ABSTRACT

The present study was design to obtain Multiple shoot by in vitro regeneration from nodal explant of mature *Dendrocalamus stocksii* and *Bambusa polymorpha* plants on Murashige and Skoog's medium supplemented with BAP, Kinetin, 2,4-D, IAA due to late and irregular bamboo flowering cycle and scarcity of bamboo seeds .An effective protocol was obtain which gives 5-8 multiple shoots within 7-10 days from nodal explant of mature plants in the solid MS medium. The callus was induced after shoot generation in *D.stocksii* by changing hormone concentration of a media. Swellings in shoots were observed within 10-12 days and clear callus were observed after 25 day of a nodal shoot explant inoculation. Further study focused on the HgCL₂ effective concentration to minimize fungal and bacterial contamination in MS medium

Keywords: *Dendrocalamus stocksii*, *Bambusa polymorpha*, M.S.media,

INTRODUCTION

Bamboos are one of the fastest growing multipurpose plants due to a unique rhizome-dependent system. Bamboos have a notable economic and environmental value better than most of the other tree species (Kassahun, 2000). There are about 1250 species of bamboo in some 75 genera. *Dendrocalamus* is a tropical asian genus of giant clumping bamboos in the grass family. It has over 50 species distributed in the tropical and subtropical regions of the world. (Lobovikov, 2007). *Dendrocalamus stocksii* is a strong, arborescent and thornless species of bamboo. It is naturally distributed in the Central Western Ghats of Maharashtra, Karnataka, Goa and Kerala. It is commonly known as Marihal, Manga, Mes, Chiva, etc. (Viswanath *et al.*, 2012). By identifying its multiple uses and importance, National Bamboo Mission (NBM) has prioritized this species for large scale cultivation in India. However, large scale cultivation is hampered by non-availability of planting stock (Sanjaya *et al.*, 2005). Propagation of bamboo by seeds is unreliable due to long and unpredictable flowering habit and also undesirable on account of large variation found in seedling propagation. Sterility in *D. stocksii* is attributed to the less quantity of pollen produced, viability of pollen, percentage of anthesis, short receptivity of stigma, etc. (Beena, 2011). Due to poor seed setting and non-gregarious nature of this species, genetic diversity could be highly restricted and continuous vegetative propagation from a narrow genetic base could have serious implication for conservation of the species (Rane *et al.*, 2013). Lack of viable seeds and scalability issues in macro-propagation techniques have led to the nascent steps in micropropagation protocol development. Micro-propagation through both axillary shoot proliferation and somatic embryogenesis has yielded good results (Viswanath *et al.*, 2012). Although improved vegetative propagation is available, only a limited number of plants can be raised using this method, which is inadequate to meet the growing demand. Therefore, in order to supplement the conventional methods, an efficient *in vitro* propagation method would offer a desirable alternative for large-scale multiplication of elite genotypes.

MATERIAL AND METHOD**PLANT MATERIAL**

Dendrocalamus stocksii and *Bambusa polymorpha* explants were provided by the Dr. Ilorkar (Senior scientist P.K.V.Nagpur) from their agroforestry research area. The lateral nodal explant branches of the authenticated specimen plant were collected from clumps of *D. stocksii* and *B. polymorpha*

EXPLANT COLLECTION AND SURFACE STERILIZATION

Explants were collected in vessel containing water at the location and were brought to plant tissue culture laboratory, LAD College, Nagpur. The leaf sheaths covering the nodal segments containing axillary buds were carefully removed and cut in 3-3.5cm length (1-1.5cm above and below the axillary bud). The explants were then placed under running water for 1 hour and wiped with 70% ethanol using sterile cotton swab. Single wash of Extran (biodegradable detergent) is given for 2 min. Surface sterilized of the explant is done using 0.1%, 0.15%, 0.175% (v/v) solution of mercuric chloride (HgCL₂) for 20 min and subsequent 3 washes of autoclave distilled water was given for 3 min each. Then a wash of 70% ethanol was given for 1 min and consecutively washed with distilled water. The sterile nodal explant were cultured in liquid and solid Murashige & Skoog (MS) medium (murashige *et al.*, 1962) supplemented with 30 g/L sucrose and for solid medium 30 g/L sucrose and 0.75% w/v of agar was used. The pH of the medium was adjusted to 5.7±0.1 with 0.1N NaOH or 0.1N HCL before autoclaving at 15Psi for 15 min.

INCUBATION AND LIGHT CONDITION

Incubation condition play a very significant role in plant tissue culture after aseptically inoculation of the explant. The optimum temperature required for obtaining the desired result was found to be 24-27 degree Celsius. The lux of cool white fluorescent light period of 16 hr and dark period of 8 hr was used.

SHOOT INDUCTION AND MULTIPLICATION

For breaking of the axillary bud, the liquid MS medium for *D. stocksii* and *B. polymorpha* was supplemented with 6-Benzylaminopurine (BAP) at 3 levels (2 mg/L, 3 mg/L and 4 mg/L) and BAP + kinetin at 3 levels (1+3 mg/L, 2+3mg/L, 2+4 mg/L) where solid MS medium was supplemented with BAP + 2,4-Dichlorophenoxyacetic acid (2, 4-D) at 2 level (4 mg/L BAP + 3 mg/L 2,4-D, 4 mg/L BAP + 2 mg/L 2,4-D) and BAP + kinetin + 2, 4-D at 2 level (3 mg/L BAP+1 kinetin +2.5 mg/L 2,4-D, and 3 mg/L BAP+1 mg/L Kinetin+2mg/L2,4-D). Shoot multiplication was done by transferring the sprouted bud explant after 10 days in new liquid MS medium supplemented with BAP + kinetin (3mg/L BAP+0.5mg/L kinetin, 2mg/L BAP+0.5 kinetin, 1mg/ LBAP+3mg/L Kinetin) where solid MS medium inoculated explants were further sub cultured after 15 days of inoculation.

Callus induction in *D. stocksii*

For callus induction, the solid MS medium was supplemented with 2 level of 2, 4-D + BAP(4+0.6), and 3 level of IAA + BAP (4+0.8, 4+2.5, 4+1) with 3% of sucrose.

Observation table

For *D. Stocksii*

Table no. -1 HgCL₂ concentration effect

Concentration in %	No. of shoot observe in 7 and 8 media hormone concentration out of 10 explant in <i>D. stocksii</i>	Total No. of infected plants were removed	Shoot observe after 15 days
0.1%	8-9	4-5	Normal
0.15%	6-7	1-3	Normal
0.175%	2-3	1-2	No further growth observe (black buds)

Table no. – 2 various hormone concentration treatment effect

Treatment	Growth regulator concentration mg/l			bud initiation shown day	1 st leaf formation day	No. of shoot observe	
	BAP	Kinetin	2,4-D			Minimu m	Maxi mum
1	2	-	-	4	8	1	3
2	3	-	1	3	7	2	4
3	4	-	-	-	-	-	-
4	1	3	-	3	9	2	6
5	2	3	-	5	8	2	7
6	2	4	-	-	-	-	-
7	4	-	3	3	8	3	8
8	4	-	2	4	10	2	7
9	3	1	2.5	3	12	3	5
10	3	1	2	5	13	2	6
11	3	0.5	1			2	5
12	2	0.5	-			2	4
13	1	0.5	-			2	4

Note: 1) 1-6 are liquid MS medium 2) 7-10 are solid MS medium 3) 11-13 are sub culture media for liquid MS medium

CALLUS INDUCTION

For *D. stocksii* callus induction was observed only in IAA + BAP (4 + 1) concentration

FOR D. POLYMARPHA

Table no. – 3 HgCL₂ concentration effect

Concentration in %	No. of shoot observe in 7 and 8 media hormone concentration out of 10 explant in <i>D. polymarpha</i>	Total No. of infected plants were removed	Shoot observe after 15 days
0.1%	9-10	5-6	Normal
0.15%	5-8	2-4	Normal
0.175%	1-2	2-4	No further growth observe (black buds)

Table no. – 4 various hormone concentration treatment effect

Treatment	Growth regulator concentration mg/l			Days shoot initiation	Days of 1 st leaf formation	No. of shoot observe	
	BAP	Kinetin	2,4-D			Minimum	Maximum
7	4	-	3	3	8	3	6
8	4	-	2	4	9	2	6
9	3	1	2.5	2	7	4	8
10	3	1	2	3	9	3	6

Note: 1) 1-4 are solid M.S, medium hormones concentration

RESULT AND DISCUSSION

- From table 1 & 3 it was observed that while increasing the concentration of HgCL₂ from 0.1 % to 0.17% shoot initiation was decreased and also level of the fungal infection in tubes were decreased.
- At 0.17 % HgCL₂ concentration, initially observed bud was turned blackish and no further growth of bud was observed where as other two concentrations showed normal growth after bud breaking.
- From table no. 1 and 3 we concluded that 0.15 % HgCL₂ concentration was effective on fungal infection and not harmful to bamboo explant. While from other two concentration 0.1 % was not harmful to bamboo explant bud initiation but was not effective to fungal infection. In case of 0.17 % fungal infection is less but explant bud initiation and elongation is affected.
- Correct balance between particular auxin and cytokinin hormone is essential for successful growth and differentiation in the tissues (Skoog and Miller, 1957).
- Out of 6 liquid MS medium hormone concentrations for *D. Stocksii* 4 media concentration show shoot initiation and further elongation out of which treatment no. 4 (BAP + Kinetin (2+3) showed more number of shoots. Repitition of this hormone concentration with bamboo explant showed similar results..
- In liquid MS medium , sub culturing of explant is done after every 10 days. if sub culturing is not done then media turns to brown and no further growth is observed.
- In solid MS medium all of the 4 hormone concentrations for *D. Stocksii* showed multiple shoot initiation and further growth but treatment no. 8 showed highest multiple bud initiation for solid medium. no further sub-culturing was required for shoot elongation and no browning of media were observed.
- Solid media showed more number of multiple shoots and better growth as compared to the liquid medium.
- 4 Hormone concentration for *D. polymorpha* showed multiple shoot initiation and further growth.

For *D. stocksii* treatment no. 8 showed higher no. of multiple shoots while for *D. polymorpha* treatment no. 9 showed higher no. of multiple shoots.



Figure 1: picture showing the shoot formation (liquid medium) and callus induction in *D. stocksii*

1. Initiation of bud and shoot formation	2. Completely formed shoot were observed
3. First leaf and shoot elongation	4. Callus formation in solid medium



Figure 2: picture showing multiple shoot formation in solid medium for *D. stocksii*

5. Initiation of bud and shoot formation
6. Completely leaf formed explant

Figure 3: picture showing multiple shoot formation in solid medium for *D. polymorpha*

7. Initiation of bud and shoot formation
8. Completely leaf formed explant

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IN-VITRO STUDY ON TOLERANCE OF HEAVY METALS BY ENDOPHYTIC FUNGI

Ashok Y. Dawande¹ and Vivek S. Jedhe²¹Department of Microbiology, Arts and Science College, Pulgaon, Wardha²Department of Biochemistry, Arts and Science College, Pulgaon, Wardha**ABSTRACT**

The present study reports on tolerance study of heavy metals by endophytic fungi. Endophytic fungi isolated from agriculture field used for the study were *Aspergillus* sp1, *Penicillium* sp, *Aspergillus* sp2, *Pestalotiopsis* sp. and *Trichoderma* sp. To test the effect of different metal on varying concentration of heavy metal, the heavy metal of different concentration were added to the PDA media range varying from 50-600ppm. Fungal endophytes on PDA medium without heavy metal served as control. PDA plates with metal ions were inoculated with fresh culture of fungus and were allowed to incubate at 27 °C for 7 days. Tolerance effect was studied by the determination of tolerance index. The different test isolates at the different concentrations of the test metals exhibited varying degree of effect on mycelia formation. *Aspergillus* sp1 was tolerant to Zn (II) and Pb (II), *Penicillium* sp, *Aspergillus* sp2 and *Pestalotiopsis* sp exhibited tolerance to Cu (II), Zn (II), Pb (II) and Cr (VI) whereas *Trichoderma* sp showed tolerance to Cu (II), Zn (II) and Pb (II) at 50-600 ppm. The ability of fungal endophytes to grow in the presence of heavy metals is always be an added advantage in the treatment of waste water where role of microorganisms is to degrade organic matter through biological process. Keywords: Endophytic fungi, Heavy metal Tolerance, Bioremediation.

INTRODUCTION

Industrialization and technological development are main reasons for heavy metal pollution. Such pollution have significant negative impact on the environment and public health as heavy metals are toxic in nature, non-biodegradable and are bio-accumulator. Conventional treatment systems for heavy metal removal such as filtration, chemical precipitation, electrochemical treatment, oxidation/reduction, ion exchange, membrane technology, reverse osmosis, and evaporation recovery have failures which incorporate high expenses, low efficient, labor-intensive operational or lack of selectivity in the treating process (Guo et al. 2010).

In order to detoxify and degrade environmental pollutants, microorganisms can be used (Bioremediation) which has gained remarkable attention nowadays to clean up a polluted environment. Therefore such environmental cleanup process, being in situ treatment, serves a safe and economic alternative to commonly used conventional treatment systems. However, it seems not feasible at present as isolation of such valuable microbes from heterogeneous population of microorganisms is a tedious process. (Li, H. et al)

Plant-associated fungi show important role in host adaptation to a changing environment. Plant-associated fungi isolated from the internal tissues, where reside and cause asymptomatic infection in the host, are called endophytes. Such fungal endophytes are often found to have beneficial effects on plant growth by providing essential elements, resisting colonization by pathogenic microorganisms, or by assisting the plant to adapt to environment. Endophytic fungi with the advantage of adaptation ability to the competitive, high-stress environment of the soil may gain particular interest (Prasad, M.N.V, et al. 2010, Hildebrandt, U. et al. 2007). The aim of this study is to analyse the heavy metals tolerance of fungal endophytes under laboratory conditions.

METHODS**FUNGI USED**

Endophytic fungi isolated from agriculture field used for the study were *Aspergillus* sp1, *Penicillium* sp, *Aspergillus* sp2, *Pestalotiopsis* sp. and *Trichoderma* sp

PREPARATION OF REAGENTS AND GROWTH MEDIUM

Cd (II), Pb (II), Cu (II), Cr (VI) and Zn (II) stock solution (1000 mg/L) were prepared by adding the exact quantities of the $3\text{CdSO}_4 \cdot 8\text{H}_2\text{O}$, PbSO_4 , $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, $\text{K}_2\text{Cr}_2\text{O}_7$ and $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ in distilled water. This stock solution will be used for preparing the working concentration of Cd (II), Pb (II), Cu (II), Cr (VI) and Zn (II) solution. Fungi were cultivated on Potato Dextrose Agar (PDA).

HEAVY METAL TOLERANCE BY USING SOLID AGAR MEDIA

To test the effect of different metal on varying concentration of heavy metal, the heavy metal of different concentration were added to the PDA (pH 5.1-5.3) media range varying from 50-600ppm. Fungal isolates on normal PDA medium served as control. The PDA plates with heavy metals were inoculated with small pieces of agar from fresh fungus culture and were given 7 days of incubation at 27 °C. The experiments were carried out in triplicate. Tolerance effect was studied by the determination of tolerance index (Verma et al., 2016).

METAL TOLERANCE INDEX

Fungal endophytes were checked for their Copper, Lead, Chromium, Cadmium and Zinc tolerance. PDA plates added with 50-600ppm of heavy metal were inoculated with fungal endophytes. The inoculated plates were allowed to incubate. Growth pattern of the fungi obtained after the treatment with each heavy metal was calculated individually by measuring the diameter of fungal growth extension against the control (without metal). Metal Tolerance Index (Ti) was calculated as the ratio of the extended diameter of the treated vs untreated Colony. (Fomina et al. 2005 and Li et al 2012).

STATISTICAL ANALYSIS

All experiments were performed in three replicated and the data was presented as Mean (SD). The data were analyzed for statistical significance using analysis variance (One way ANOVA) by Tukey test using SPSS 20.0 and Microsoft excel 2007 to compare the treatment group with their respective controls. The results are significant at $P = 0.05$.

RESULTS AND DISCUSSION

Analysis Of Fungal Endophytes For Tolerance To Heavy Metals

The effect of heavy metals on fungal growth was assessed on the basis of mycelia diameter. The different test isolates at the different concentrations of the test metals exhibited varying degree of effect on mycelia formation. *Aspergillus* sp1 was tolerant to Zn (II) and Pb (II), *Penicillium* sp, *Aspergillus* sp2 and *Pestalotiopsis* sp exhibited tolerance to Cu (II), Zn (II), Pb (II) and Cr (VI) whereas *Trichoderma* sp showed tolerance to Cu (II), Zn (II) and Pb (II) at 50-600 ppm.(Table 1.) Observation showed maximum growth of fungal endophytes at low concentration of heavy metals but as the concentration of heavy metals increased, there were decrease in growth of fungi. All the tested isolates showed strong colony growth on Zn (II) and Pb (II) media at 600µg/mL in comparison to the control.

Table 1: Growth of the fungi observed at 600 ppm concentration of heavy metals (Cu, Zn, Pb, Cr and Cd)

Endophytic fungi	Cu	Zn	Pb	Cr	Cd
<i>Aspergillus</i> sp1	-	+	+	-	-
<i>Penicillium</i> sp	+	+	+	+	-
<i>Aspergillus</i> sp2	+	+	+	+	-
<i>Pestalotiopsis</i> sp	+	+	+	+	-
<i>Trichoderma</i> sp	+	+	+	-	-

+: Indicate the presence of growth, -: Indicates absence of growth, Cu: Copper, Zn: Zinc

Pb: Lead, Cr: Chromium, Cd: Cadmium.

TOLERANCE INDEX

Copper, Zinc Lead, Chromium and Cadmium tolerance indices of the tested fungal isolate are presented in Table 2. From the observation, five endophytic fungi showed different tolerance pattern against individual heavy metal. All fungi showed resistance Zn (II) and Pb (II) up to 600 ppm but no fungi showed resistance to Cd at 600 ppm. The difference in metal tolerance may be due to the presence of various strategies of resistance mechanism exhibited by the fungi (Venkateswarlu N, et al. 2015, Iram S, et al. 2013). Studies on fungi like *Aspergillus*, *Fusarium*, *Humicola*, and *Nannizzia* have been documented to exhibit tolerance against heavy metals (Valix M, et al. 2001, Ezzouhri L, et al. 2009). The results noted that some native fungi (*Phoma* spp., *Peyronellaea* sp., and *Alternaria* sp.) have been adapted to constant metal stress environment for a long time. Therefore, beneficial effects of these stress-adapted fungi might be employed for phytoremediation in heavy metal contaminated soils (Li et al., 2012). The present study of metal tolerance by endophytic fungi against heavy metals showed the order of tolerance to heavy metals are $Cd < Cr < Cu < Zn < Pb$. It is observed that as the concentration of heavy metal increased, the growth of the fungi decreased due to toxicity of heavy metals. Fungal endophytes showed the maximum growth in presence of lead followed by Zinc, Copper, and Chromium. *Aspergillus* sp1 exhibited Tolerance indices of Zinc (0.921) and Lead (1.538) but no tolerance for Cu, Cr and Cd at highest tested concentration (600µg/ml). *Penicillium* sp, *Aspergillus* sp2 and *Pestalotiopsis* sp were tolerant to Cu, Zn, Pb and Cr but all like *Aspergillus* sp1 were sensitive to Cd (Figure 1 to 5).

Table 2: Heavy metal Tolerance index of fungal endophytes

Endophytic fungi	Conc. of heavy metals (µg/mL)	Cu	Zn	Pb	Cr	Cd
<i>Aspergillus</i> sp1	50	0.652	1.026	0.769	0.860(0.018)*	0.547(0.016)*
	100	0.710(0.025)*	0.974	1.538	1.290*	0.000

	200	0.565*	0.947	0.577	0.452*	0.000
	400	0.667(0.025)*	1.026	1.538	0.000	0.000
	600	0.000*	0.921	1.538	0.000	0.000
Penicillium sp	50	1.000*	1.000	1.000	1.000	0.659(0.014)*
	100	0.867(0.014)*	1.000	1.000	1.000	0.524*
	200	0.425*	1.000	1.000	1.000	0.389(0.014)*
	400	0.267(0.029)	1.000	1.000	0.500(0.548)	0.000
	600	0.317(0.029)	1.000	1.000	0.500(0.548)	0.000
Aspergillus sp2	50	1.000	1.000	1.000	1.000	0.682(0.013)*
	100	1.000	1.000	1.000	1.000	0.603(0.014)*
	200	0.425*	1.000	1.000	1.000	0.405*
	400	0.367(0.014)	1.000	1.000	1.000	0.254(0.014)*
	600	0.383(0.014)	1.000	1.000	1.000	0.000*
Pestalotiopsis sp	50	1.000*	1.000	1.000	0.692(0.014)	0.675(0.014)*
	100	0.900*	1.000	1.000	0.475	0.463*
	200	0.367(0.029)*	1.000	1.000	0.358(0.029)	0.350(0.028)*
	400	0.267(0.029)	1.000	1.000	0.500(0.548)	0.000
	600	0.233(0.014)	1.000	1.000	0.500(0.548)	0.000
Trichoderma sp	50	1.000*	1.000	1.000	1.000	0.640(0.025)*
	100	0.842(0.014)*	1.000	1.000	1.000	0.544(0.006)*
	200	0.358(0.014)*	1.000	1.000	1.000	0.368(0.019)*
	400	0.400*	1.000	1.000	1.000	0.000
	600	0.283(0.014)*	1.000	1.000	1.000	0.000

The data represent Mean value of Tolerance index and Standard deviation (parenthesis) of three independent experiments. *Significance at $P \leq 0.05$

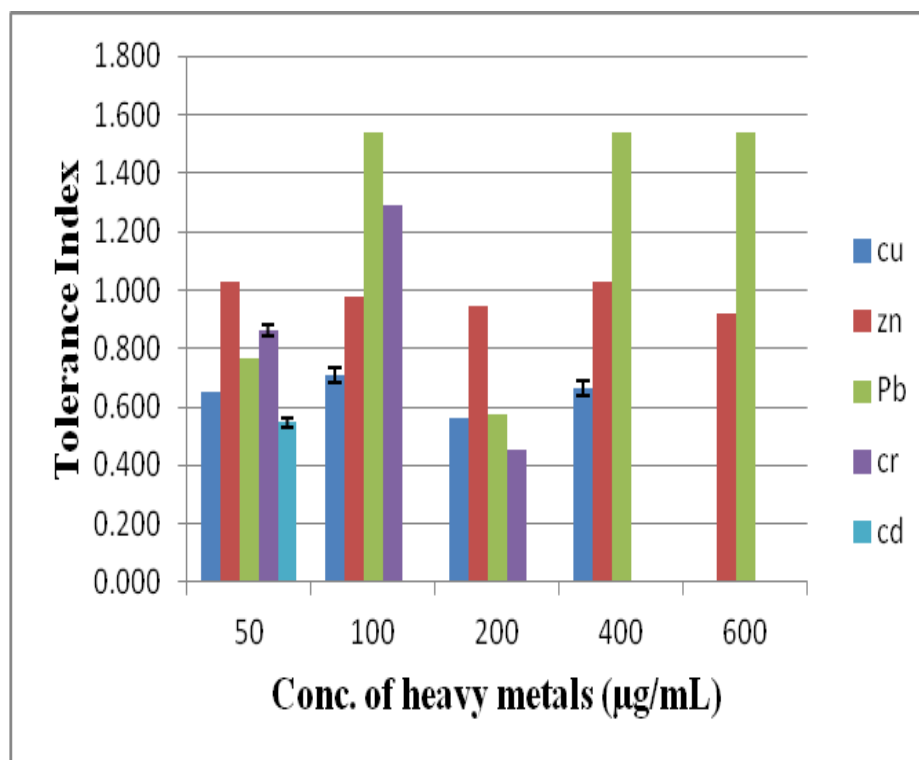


Figure 1: Heavy metal Tolerance index of fungus Aspergillus sp1

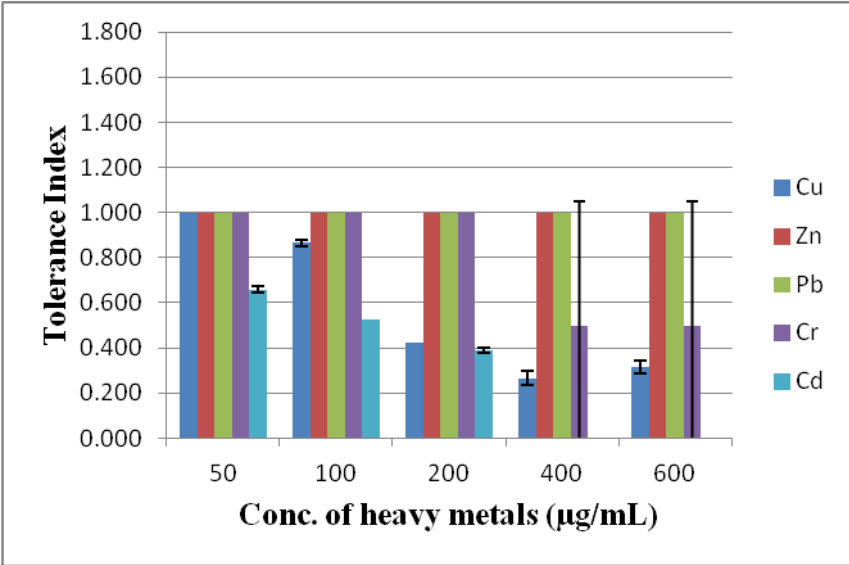


Figure 2: Heavy metal Tolerance index of fungus Penicillium sp

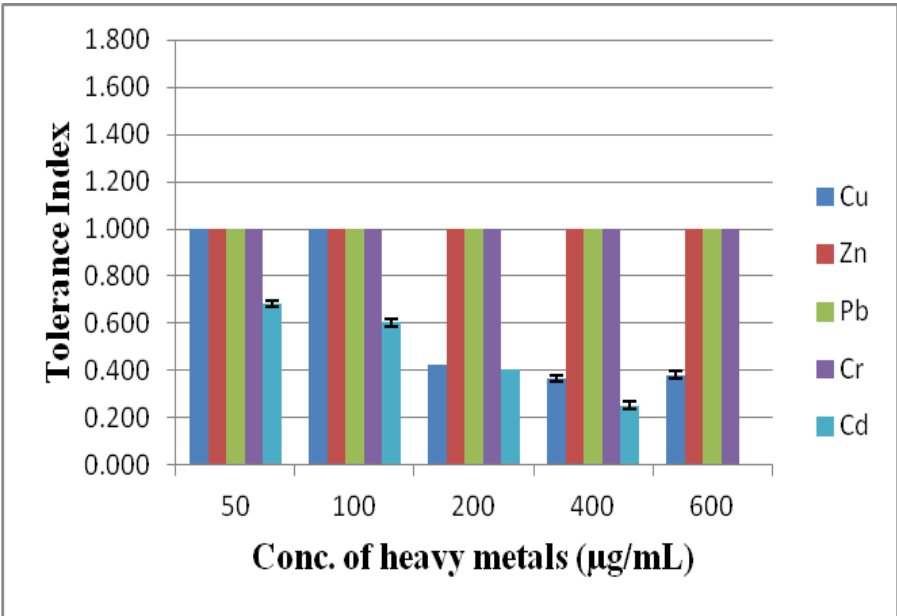


Figure 3: Heavy metal Tolerance index of fungus Aspergillus sp2

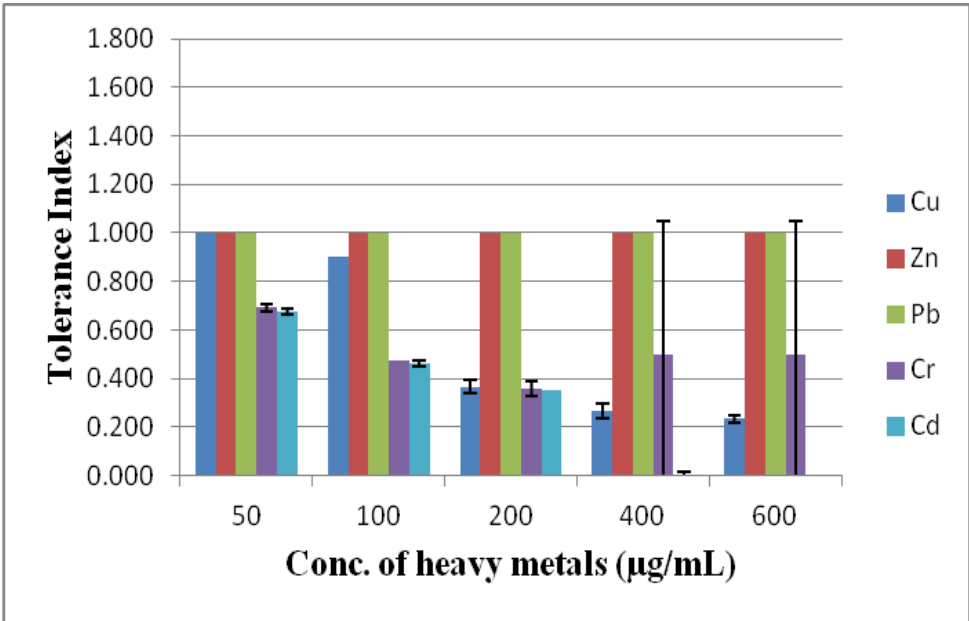
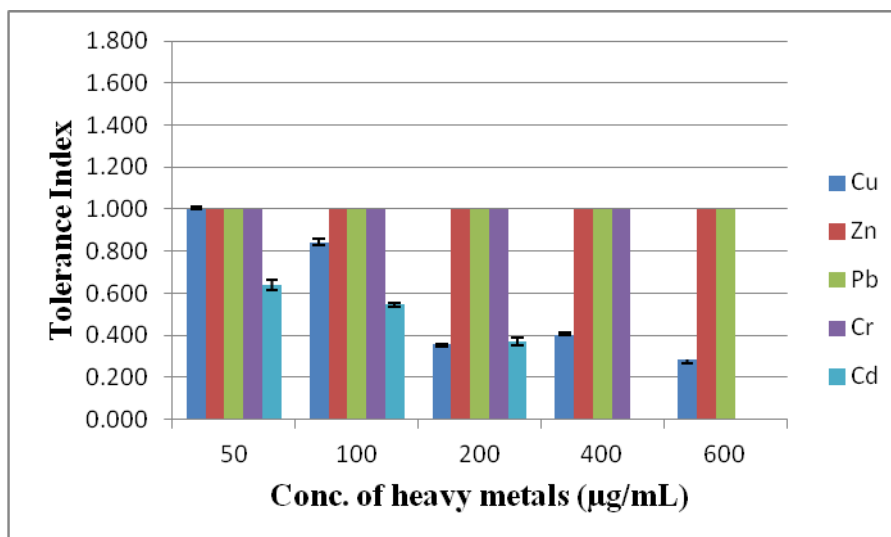


Figure 4: Heavy metal Tolerance index of fungus Pestalotiopsis sp

Figure 5: Heavy metal Tolerance index of fungus *Trichoderma* sp

CONCLUSION

The results of this investigation could provide a new direction for applying the endophytic fungi as prospective bioremediation agents for decontamination of pollutants favouring more environmental and economical concern. Also in the treatment of waste water, by taking advantage to grow in the presence of heavy metal, fungal endophytes would be helpful in the decomposition of organic matter present in waste water contaminated with heavy metals.

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ACHENE MORPHOLOGY AND ITS TAXONOMIC SIGNIFICANCE IN THE GENUS PYCREUS (CYPERACEAE) OF GOA, INDIA

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ABSTRACT

Taxonomic relationship among the species of Pycnus in Goa is elucidated by examining the scanning electron microscope (SEM) images of their achenes. Morphology of the achenes and their epidermal cells has been studied for this purpose with a taxonomic viewpoint. Achene shape and epidermal patterns were found distinctive and consistent within the species or infraspecific taxon. Variation in the epidermal cells is most evident with respect to size of the cell, nature of periclinal wall, the number, thickness and sinuosity of anticlinal walls and presence or absence of silica bodies. In the present study characteristics of epidermal cells are correlated with other morphological characters as well. The micromorphological characters of achene surface were found to be different in dissimilar taxa. However, there is close similarity of these characters in closely related taxa. Interpretation of the SEM images was found to be useful in determining the taxonomic relationship, identification and delimitation of different taxa of Pycnus at species level and infraspecific level. Keywords: SEM images, Achene morphology, Pycnus, Silica bodies, Anticlinal wall.

INTRODUCTION

The family Cyperaceae is one of the ten largest families of flowering plants and is the third largest of monocotyledons after Orchidaceae and Poaceae. Bruhl (1995) estimated approximately 5,000 species in about 80 genera and Goetghebeur (1998) included same number of species under 104 genera. But according to Mabberley (2009) there are 92 genera and 4450 species, and Govaerts et al. (2015) reported 97 accepted genera and 5486 species of Cyperaceae. Singh and Prasad (2001) estimated about 570 species of 39 genera in India and the present number is estimated to be about 580 species belonging to 32 genera (Patil and Prasad, (2016). In Goa it is represented by 94 species, 2 subspecies and 9 varieties belonging to 16 genera.

The genus Pycnus P. Beauv. of this family is very similar to Cyperus L. and hence, often treated together under the later sensu lato. However, Pycnus can be easily separated from Cyperus by an unique and constant character, i.e. its laterally compressed achenes, with one of the two edges towards the rachilla. But in Cyperus one face of the trigonous or laterally compressed achenes is towards the rachilla. At global level the genus has about 100 species (Mabberley, 2009) and is confined to tropical countries. A total number of 38 species of Pycnus are reported from India of which 7 have been reduced to synonyms by Prasad (2009, 2015). A total number of 8 species and one variety have been reported from Goa (Patil, 2013) and all were studied for their achene morphology. All the species have a wide range of distribution except P. malabaricus C.B. Clarke which is endemic to western and southern India, in the states of Maharashtra, Goa, Karnataka, Kerala and Tamilnadu.

The first basic study on epidermal silica bodies of the achenes was accomplished by Schuyler (1971) on two species of Scirpus L. and Eriophorum L. that lead to the development of a new set of characters that could re-evaluate the systematics of Cyperaceae. Varma et al. (1989) studied the epidermal surface patterns of the achenes in Eleocharis, Govindrajalu (1990) studied SEM images of Pycnus sect. Muricati. and Wujek et al. (1992) did the achene micromorphology of some Indian species of Cyperus, Fimbristylis, Pycnus, Scirpus and Scleria. Also Menapace et al. (2003) did the achene micromorphology of some Indian species as a possible systematic aid to the taxonomic recognition of different sections in Fimbristylis. Recently Patil and Prasad (2016, 2016a) revealed the micromorphology of the achenes of the genera Fimbristylis and Eleocharis found in Goa.

In the present study achenes of 9 taxa belonging to genus Pycnus in Goa have been studied and interpreted for their similarities and dissimilarities. The study includes gross morphology such as achene size, shape etc. using conventional methodology and the micro-epidermal cell structures like nature of periclinal wall and anticlinal wall, presence or absence of silica bodies, if present the shape and number of silica bodies per cell, etc. using SEM images.

MATERIALS AND METHODS

Achene samples were collected from the plant specimens collected from different localities in Goa. The specimens collected were identified utilising available facilities in Botanical Survey of India, Pune and the herbarium in Goa University. The herbarium specimens from which achene samples were taken are deposited in

BSI. For better result, mature specimens were selected to study the morphology of achenes by conventional method using stereo microscope and by the advanced method of interpreting the Scanning Electron Microscope (SEM) images. The shape and size of the achenes of each species were recorded and the micro structure of the achene surface was studied using SEM images. For this, achenes were extracted from the spikelets and mounted on glass slides with sticky tape, mounted on SEM stubs and then sputter coated with platinum and examined under JOEL JSM6360 Scanning Electron Microscope. The images were then photographed at different magnifications. The SEM images of the achenes of different species thus obtained were then interpreted with the help of relevant literature. Achene shape, size, its ornamentations and micro-epidermal structures such as nature of periclinal walls, anticlinal walls and silica bodies were studied to find out the similarities or dissimilarities.

RESULTS AND DISCUSSION

The genus *Pycreus* is characterized by bilaterally flattened achenes with one angle facing the rachilla of the spikelet. In all the 8 species, achene is biconvex and the shape in general is obovate or oblong with variations like obovate to obovate-elliptic in *P. diaphanus*, obovate to oblong-elliptic in *P. flavidus*, globose-obovate in *P. malabaricus*, broadly obovate to orbicular in *P. sanguinolentus*, broadly elliptic to obovate-orbicular in *P. stramineus*, oblong in *P. polystachyos*, oblong to obovate in *P. macrostachyos* and oblong-obovate in *P. pumilus*. The largest achene is found *P. macrostachyos* (1.5-2 x 0.6-1.37 mm) while the smallest in *P. pumilus* (0.5-0.8 x 0.3-0.5 mm). Achene in the variety *gracilescens* of *P. diaphanus* is smaller than the typical variety. Important findings are provided in table 1 and the SEM images of the achenes are shown in plate 1 & 2.

Table 1. Macro- and micro-morphology of achenes in the genus *Pycreus*

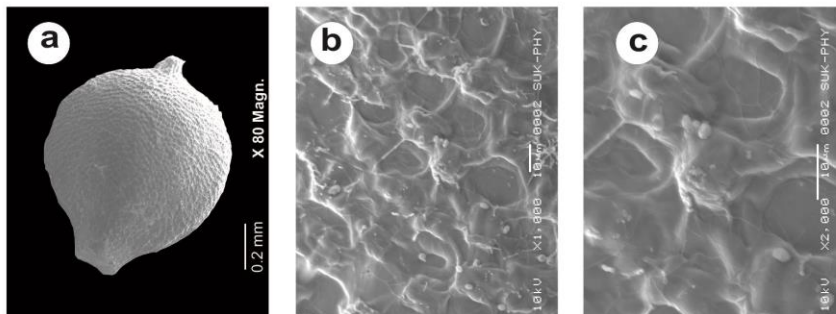
Sr.No.	Plant name and voucher specimen	Macromorphology	Micromorphology (interpretation of SEM images)
1.	<i>Pycreus diaphanus</i> (Schrad. ex Roem. & Schult.) S. Hooper & T. Koyama Bastora, Ucassaim, near St. Elizabeth's church, Bardez Taluk, North Goa, 20.9.2007, R.T. Patil 192641 (BSI) PLATE 1	Biconvex, laterally sub-compressed, obovate to obovate-elliptic, shortly apiculate at apex, narrowed at base, 0.94 x 0.85 mm.	Epidermal cells transversely oblong, irregularly hexagonal; anticlinal wall thick, straight, raised; periclinal wall smooth, flat, with inconspicuous smaller silica bodies, without elevation at the centre of each cell. Prominent nodular projections were found at the junction of anticlinal walls of nearby cells.
2.	<i>Pycreus flavidus</i> (Retz.) T. Koyama Parra, Bardez Taluk, North Goa, 17.10.2006, R.T. Patil 192510 (BSI). PLATE 1	Biconvex, laterally compressed, obovate to oblong-elliptic, shortly apiculate at apex, narrowed at base, 1.06 x 0.87 mm.	Epidermal cells isodiametric, hexagonal; anticlinal wall thick, straight, raised; periclinal wall smooth, flat, with minute silica bodies without much elevation at the centre of each cell. Inconspicuous nodular projections were found at the junction of 4 anticlinal walls of nearby cells.
3.	<i>Pycreus macrostachyos</i> (Lam.) J. Raynal Dona Paula-Miramar road, Tiswadi Taluk, North Goa, 24.11.2006, R.T. Patil 192518 (BSI). PLATE 1	Biconvex, laterally compressed, oblong-obovate, concave on one surface, apiculate at the obtuse apex, slightly stipitate, 1.84 x 1.37 mm.	Epidermal cells sub-isodiametric, hexagonal; anticlinal wall straight but indistinct; periclinal wall convex with mesa-shaped silica bodies at the centre of each cell. Buttresses not prominent.
4.	<i>Pycreus malabaricus</i> C.B. Clarke Tivim, Bardez Taluk, North Goa, 9.9.2007, R.T. Patil 192608 (BSI). PLATE 1	Biconvex, slightly laterally compressed, ovate to obovate-elliptic, asymmetric, minutely apiculate at the obtuse apex, 0.91 x 0.65 mm.	Epidermal cells linear or longitudinally oblong; anticlinal wall transversally ridged and sinuate while longitudinally straight stritullate; periclinal wall smooth, flat, without silica bodies.
5.	<i>Pycreus polystachyos</i> (Rottb.) P. Beauv.	Biconvex, laterally compressed, narrowly oblong	Epidermal cells sub-isodiametric, hexagonal; anticlinal wall straight

	Quepem, near court, Quepem Taluk, South Goa, 22.4.2007, R.T. Patil 192564 (BSI). PLATE 2	or oblong-obovate, sub-truncate and minutely apiculate at apex, stipitate. 1.12 x 0.5 mm.	but inconspicuous; periclinal wall convex with mesa-shaped single silica body in each cell; buttresses not prominent.
6.	<i>Pycrus pumilus</i> (L.) Nees var. <i>pumilus</i> Valpoi, Sattari Taluk, North Goa, 22.9.2007, R.T. Patil 192673(BSI). PLATE 2	Biconvex, laterally compressed, oblong-obovoid, minutely apiculate at the obtuse apex, minutely stipitate, 0.65 x 0.37mm.	Epidermal cells isodiametric, hexagonal; anticlinal wall straight, weakly depressed; periclinal wall smooth, convex, with mesa-shaped silica bodies arranged in longitudinal rows; buttresses not prominent.
7.	<i>Pycrus pumilus</i> var. <i>membranaceus</i> (Vahl) Karthik. Mulgaon, Shirowadi, Bicholim Taluk, North Goa, 9.9.2007, R.T. Patil 192614 (BSI). PLATE 2	Biconvex, laterally compressed, obovoid-oblong, minutely apiculate at the obtuse apex, minutely stipitate, 0.55 x 0.41 mm.	Epidermal cells isodiametric, hexagonal; anticlinal wall straight, weakly depressed; periclinal wall smooth, convex, with mesa-shaped silica bodies arranged in longitudinal rows; buttresses not prominent.
8.	<i>Pycrus sanguinolentus</i> (Vahl) Nees Valpoi, Koparde Fata, Sattari Taluk, North Goa, 22.9.2007, R.T. Patil 192670 (BSI). PLATE 2	Biconvex, laterally compressed, obovate-orbicular, minutely apiculate at the obtuse apex, notched at the posterior region, 1.18 x 1.21 mm.	Epidermal cells irregular hexagonal-polygonal; anticlinal wall thick, straight, raised; periclinal wall smooth, flattened; silica bodies absent. Achene surface wavy at low resolution, wrinkled.
9.	<i>Pycrus stramineus</i> C.B. Clarke Mulgaon, Shirowadi, Bicholim Taluk, North Goa, 9.9.2007, R.T. Patil 192612 (BSI). PLATE 2	Biconvex, laterally compressed, ovate to obovate-elliptic, asymmetric, minutely apiculate at the obtuse apex, 0.92 x 0.75 mm.	Epidermal cells linear or longitudinally oblong; anticlinal wall transversally ridged and sinnulate while longitudinally straight stritullate; periclinal wall smooth, flat, without silica bodies.

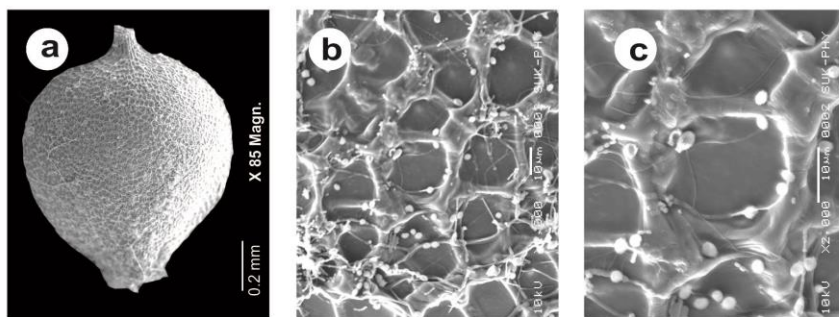
All the eight species were studied for their achene morphology. Besides the shape, size and colour of the achene, its surface is very important in the classification of the species of *Pycrus*. Achene surface is transversely wrinkled with longitudinally oblong epidermal cells in *P. diaphanus*, *P. malabaricus* and *P. stramineus*. But in all other species in Goa achene surface is smooth to finely reticulate with isodiametric epidermal cells. Both *Pycrus diaphanus* and *P. flavidus* possess inconspicuous, smaller silica bodies without elevation at the centre of each epidermal cell. But these two can be differentiated by the presence of prominent nodular projections at the junction of anticlinal walls of nearby cells in *P. diaphanus* and by the inconspicuous projections in *P. flavidus*. Achenes of *P. macrostachyos* and *P. polystachyos* are with very similar microstructure on achene surface, but both have mesa-shaped silica bodies at the centre of epidermal cells. These two can be separated based on achene size. *P. macrostachyos* have larger achene (1.5-2 x 0.6-1.37 mm) than *P. polystachyos* (1-1.5 x 0.4-0.5 mm). The two varieties of *P. pumilus* i.e. *P. pumilus* var. *membranaceus* and *P. pumilus* var. *pumilus* are very similar in their achene microstructure and both have silica bodies in the epidermal cells. So, these varieties cannot be separated using micromorphological characters of the achenes, but mainly by the arrangement of the glumes on the rachilla. Another very closely related species of *Pycrus* are *P. malabaricus* and *P. stramineus* which are separated mainly by colour of the spikelets, but shows similarity in achene size, shape and epidermal microstructure. In both the species silica bodies are absent and have distinct epidermal pattern than other species of *Pycrus*. Both possess linear or longitudinally oblong epidermal cells with transversally ridged, sinnulate and longitudinally straight, stritullate anticlinal walls in the epidermal cells.

In *P. sanguinolentus* silica bodies are absent on achene surface. Achene in this species is distinct from other taxa, being obovate-orbicular and by the presence of a notch at posterior region of the achene. Thus in *Pycrus* both macromorphology and micromorphology of the achene is very useful for identifying, and delimiting different taxa.

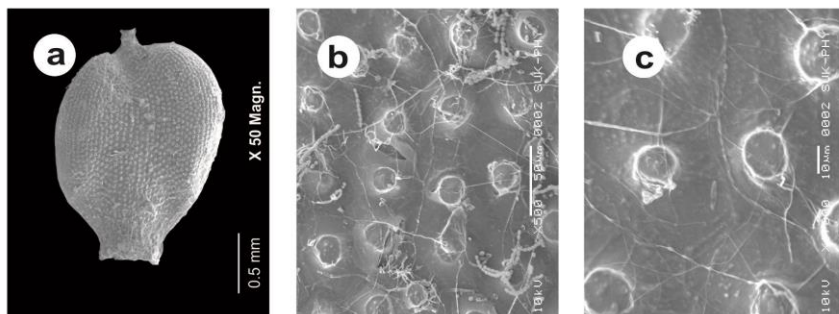
SEM MICROGRAPHS OF PYCREUS P. Beauv. ACHENES PLATE 1



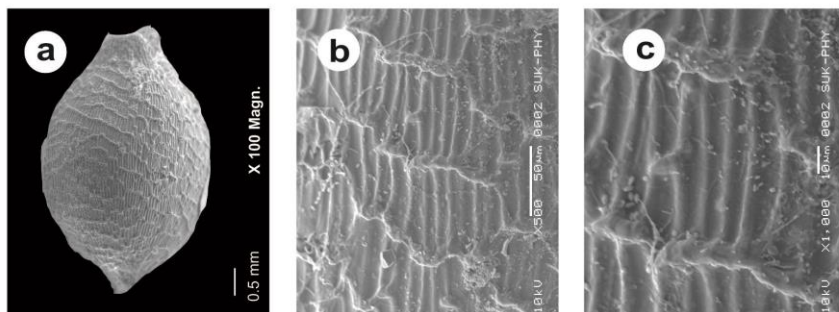
Pycreus diaphanus (Schrader ex Roemer & Schultes) S.S. Hooper & T. Koyama - a. Achene, b & c. Epidermal cells



Pycreus flavidus (Retz.) T. Koyama - a. Achene, b & c. Epidermal cells

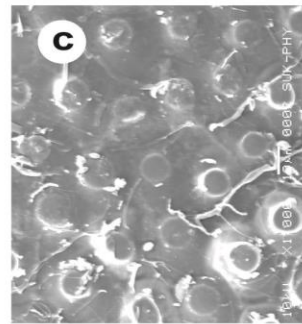
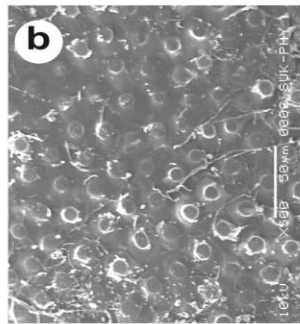
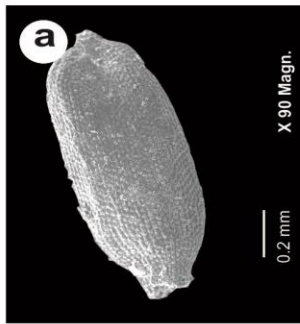


Pycreus macrostachyos (Lam.) J. Raynal - a. Achene, b & c. Epidermal cells

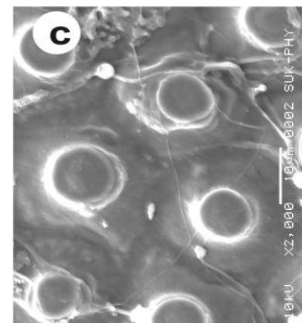
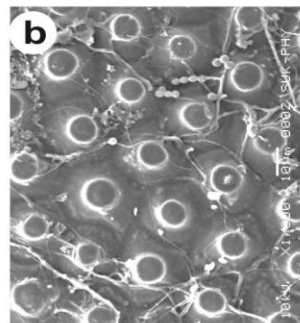
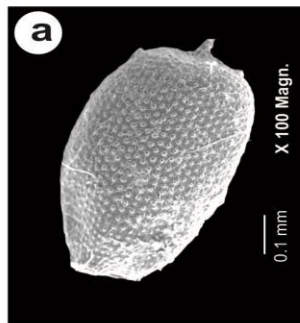


Pycreus malabaricus C.B. Clarke - a. Achene, b & c. Epidermal cells

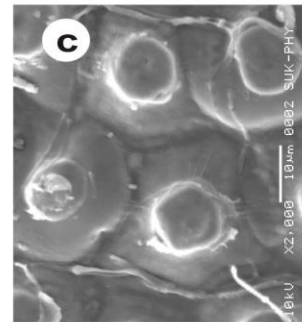
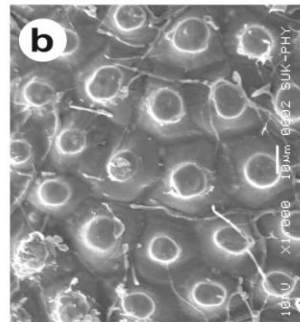
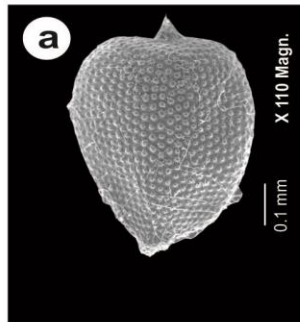
PLATE 2



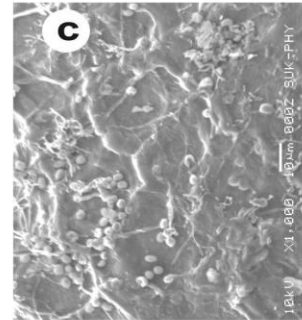
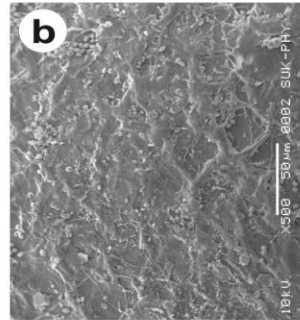
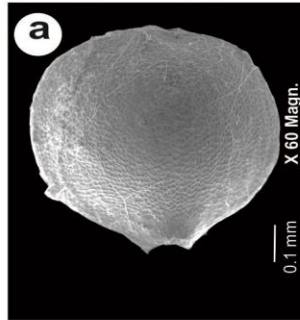
Pycnus polystachyos (Rottb.) P. Beauv. - a. Achene, b & c. Epidermal cells



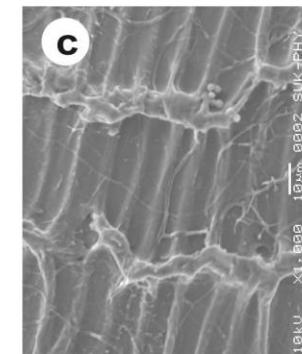
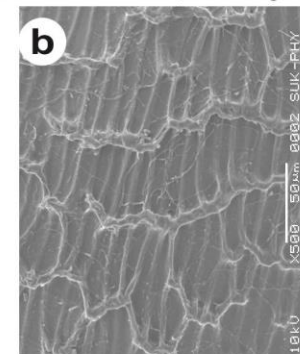
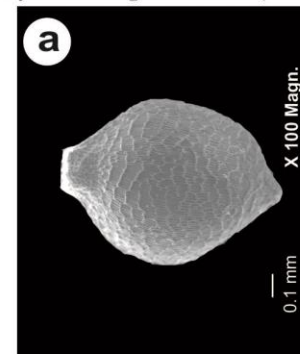
Pycnus pumilus (L.) Nees var. *pumilus* - a. Achene, b & c. Epidermal cells



Pycnus pumilus (L.) Nees var. *membranaceus* (Vahl) Karthik. - a. Achene, b & c. Epidermal cells



Pycnus sanguinolentus (Vahl) Nees - a. Achene, b & c. Epidermal cells



Pycnus stramineus C. B. Clarke - a. Achene, b & c. Epidermal cells

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COMPARATIVE STUDY OF ECONOMIC PARAMETERS OF DIFFERENT SILKWORM RACES OF BOMBYX MORI L. AFTER DRUG TREATMENT

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ABSTRACT

During large scale rearing of three commercial races, PM x CSR2, CSR2 x CSR4 and CSR4 x CSR2 of Bombyx mori the incidence of bacterial disease was observed mostly during rainy season. Various drugs such as Ampicillin, Chloramphenicol, Streptomycin and Penicillin and standard disinfectant Reshamkeet Aushadh were used against bacteria infected larvae and survival percent, various economic parameters compared and studied. The results obtained from present study showed that, out of the three hybrids, PM x CSR2 hybrid race is most suitable for Vidarbha region even at varied climatic conditions. During the adverse condition, the diseased larvae if treated with Chloramphenicol at early stages of infection, the menace due to disease could be controlled and cocoon crop yield may increase, which might attract more farmers to practice sericulture. Keywords- Antibiotics, Chloramphenicol, Ampicillin, Streptomycin, Penicillin, Reshamkeet Aushadh.

INTRODUCTION

The newly evolved races CSR hybrids have been introduced in Vidarbha apart of Central India where temperature usually ranged higher as compared to other states. In the beginning of 2000 these hybrids PM x CSR2, CSR2 x CSR4 and CSR4 x CSR2 were introduced on a large scale to improve the cocoon production with less efforts, but these hybrids suffered crop loss at many occasions due to abiotic factors like temperature and biotic factors such as diseases caused by virus, bacteria and protozoa. The silkworm eggs received from National Silkworm Seed organization (NSSO), are screened only for the infection of protozoan pathogen, Nosema bombycis whereas no screening is done for BmNPV and bacterial infection. The transmission of BmNPV and Bacillus sp. was not known till recently, Khurad et al., (2004) reported the transmission of BmNPV virus and Rai et al., (2010) Bacillus sp. transmission from infected parent through embryo to the next generation.

Since the technique is still not known to detect the viral and bacterial infection at an early stage, these pathogens are constantly perpetuating in the silkworm seeds and the culture of onward generation. Hence the present study was undertaken on incidence of bacterial disease mostly during rainy season, control by treatment of drugs and comparative economic characters of hybrids of silkworm, B. mori has been observed. Thereby the most suitable hybrid for Vidarbha region is suggested.

MATERIAL AND METHODS

During mass rearing of silkworm, the larvae with symptoms of bacterial infection were collected and haemolymph of the infected larvae was plated on agar and incubated at room temperature. The colonies of Bacillus sp. grown on the agar were observed, counted and used for further inoculation. A suspension of Bacillus sp. having concentration of about 5×10^7 particles/ml was prepared. The rearing of silkworm PM x CSR2, CSR2 x CSR4, CSR4 x CSR2 was undertaken and about 350 newly moulted healthy third instar larvae were selected from each hybrid. . All selected larvae were starved for about 10 - 12 hrs before the inoculation with B. sp. Out of selected larvae, 50 larvae from each hybrid kept as control group and fed with piece of mulberry leaf smeared with 2.5 µl of distilled water after air drying. Remaining 300 larvae of each hybrid were provided with mulberry leaf coated with 2.5 µl suspension of 5×10^7 Bacillus spore/ml. The larvae, that consumed whole piece of mulberry leaf were separated and further reared by maintaining on fresh mulberry leaves up to cocoon formation. These inoculated larvae from each hybrid separated into six groups of 50 larvae and used for four antibiotic treatment, one group for Reshamkeet Aushadh treatment and one group reared separately as infected group.

Prior to the antibiotic treatment the larvae were screened with four different dosages such as 100, 50, 10 and 4 mg/ml of which 4 mg/ml dose of antibiotic was effective hence preferred. Commercial drugs such as Ampicillin, Chloramphenicol, Streptomycin and Penicillin and standard disinfectant Reshamkeet Aushadh were used against Bacillus inoculated larvae. During rearing, survival percent and various economic parameters of antibiotics treated, infected and control group were studied and analyzed.

RESULTS

Survival percent of hybrids after antibiotics treatment

In PM x CSR2 at IV instar stage survival of control group was 96%, while infected group survived only 88%, whereas Chloramphenicol and Reshamkeet Aushadh treated groups showed 94%. At V instar stage the Chloramphenicol and Penicillin groups showed better survival than the other antibiotics treated groups. About 74% larvae went on spinning in control group while in infected only 10%. Streptomycin improved the survival to 40%, chloramphenicol 46%, more than the infected group. At the pupal stage better results obtained using the Chloramphenicol, then the Penicillin, Streptomycin, Reshamkeet Aushadh and Ampicillin (Table 1).

In CSR2 x CSR4 hybrid at IV instar Penicillin and Chloramphenicol showed good results and survival of larvae was close to control group, whereas at V instar stage survival reduced to 50% in Chloramphenicol and 48% in Penicillin treated groups. In Ampicillin and Streptomycin treated group 56% and 52% survival observed. At the spinning and pupal stages, Chloramphenicol and penicillin worked better and gave higher survival rate than the other treatments. Reshamkeet Aushadh did not perform well and lower survival was noticed however it was better than the infected groups (Table 1).

The IV instar stage of CSR4 x CSR2 larvae when treated with streptomycin the survival percent was similar as control group, which reduced to 66% during the V instar and only 32% larvae survived during spinning stage. By the time of spinning of the silkworm, the survival in penicillin and Chloramphenicol was 58% and 54%, similar to control, however it was reduced to 38 and 40% respectively when larvae reached pupal stage.

Economic Characters

The results indicated that in PM x CSR2 hybrid race all the parameters such as; shell ratio, length and weight of filament and denier are higher than the treated groups. The result indicated that chloramphenicol treated group, improved the quality of cocoon produced. Thickness of the filament was 2.316 in control and the lowest was in infected 1.937. The other drug treated groups also improved the denier of the silk filament, however significantly lower than control (Table 2).

In CSR2 x CSR4 hybrid control group gave higher 1.26 g/cocoon having 0.254 shell weight and 20.15% shell ratio. Length of filament was also higher 680 m/cocoon with 2.276 denier, whereas cocoon from inoculated group showed weight of 0.837 g/cocoon, 0.148 g/shell, ratio 17.682%, length approximately 480 m/cocoon and 1.687 denier. As observed earlier Chloramphenicol also improved all the characters as compared to infected larvae, however the improvement was comparatively lower than the control results. The use of Ampicillin, Streptomycin, Penicillin and Reshamkeet Aushadh lead to improvement in economic parameters of the cocoons but not up to the level of the control group (Table 3).

In CSR4 x CSR2 hybrid the cocoon weight was 1.252 and 0.568 g/cocoon in control and infected groups respectively. The application of Chloramphenicol although improved the cocoon and other economic characters, however it was still inferior to that of control group. The group received penicillin also showed improvement in overall characters of cocoon and filament. Reshamkeet Aushadh did not show any improvement as other antibiotic treated group; however the improvement was significantly better than the infected group (Table 4).

Fecundity of females after antibiotics treatment (F1 fecundity)

Fecundity showed that female of control group laid eggs 723, 683 and 688 eggs whereas infected group laid 15%, 23% and 18% in PM x CSR2, CSR2 x CSR4 and CSR4 x CSR2 respectively. In PM x CSR2, after drug treatment, 69% eggs laid by the female over control, where as other groups showed the range of 24% – 49% over controls. In CSR2 x CSR4 hybrid the highest number of eggs, 59% laid against control, and the other groups showed 26% in Reshamkeet Aushadh up to 46% in Penicillin treated groups. Quite similar results have been observed in CSR4 x CSR2 groups where Chloramphenicol produced 415 eggs as compared to 688 eggs/female in control, which was about 60% of the number of eggs laid in controls. (Table 5)

DISCUSSION

The fluctuation between day and night temperature and relative humidity prevailing in the rearing room are the important causes of infection in the silkworm larvae (Samson et al., 1990; Savanurmah et al., 1992). Rupasan and Gabriel (1976) reported that environmental factors especially temperature and humidity play a very important role during silkworm rearing in determining the cocoon characters and its existence in a particular zone. Watanabe (1919, 1928) and Kogure (1933) reported that, the quantitative characters of silkworm such as cocoon weight, shell weight, pupal weight, silk weight, filament length, filament thickness and survival rate of larvae in a known environment are of utmost importance in sericulture.

The results of the present study showed that application of Chloramphenicol improved the larval characters, which was almost equivalent to the control larvae in all the hybrids. Percent survival of larval stages was also improved in the three races with the use of Chloramphenicol and Penicillin. The recovery from infection was highest in PM x CSR2 with Chloramphenicol and also overall characters of the silkworm such as cocoon weight, shell weight, denier and fecundity. Chloramphenicol improved the above parameters in other two hybrid races, CSR2 x CSR4 and CSR4 x CSR2. The oral administration of chemicals along with the feed (mulberry leaves) to silkworm, *Bombyx mori* is to increase the economical characters of the larvae/cocoons or to prevent the occurrence of the diseases. The studies conducted on these aspects have shown that use of chemicals can prevent loss of crop due to various diseases. Manchev et al. (1984), Rai and Devaiah (1988) and Sridhar et al. (2000) observed reduction in disease incidence due to use of antibiotics, drugs and vaccines.

Table 1: - Survival % in infected and drug treated developmental stages in different races of silkworm, *B. mori*

Stage	Survival % (PM x CSR2)						
	Control	Infected	Ampicillin	Chloramphenicol	Streptomycin	Penicillin	Reshamket Aushadhi
IV instar	96	88	90	94	92	90	94
V instar	80	48	66	76	54	70	64
Spinning	74	10	30	46	40	42	22
Pupa	66	4	24	50	30	35	20
Survival % (CSR2 x CSR4)							
IV instar	92	80	85	86	82	90	84
V instar	74	30	56	50	52	48	42
Spinning	70	14	38	40	28	42	20
Pupa	56	5	36	42	24	39	15
Survival % (CSR4 x CSR2)							
IV instar	90	78	86	88	90	84	84
V instar	70	38	56	62	66	54	40
Spinning	58	12	32	54	32	58	19
Pupa	50	4	22	40	20	38	10

Table 2:- Economic parameters recorded of infected and drug treated PM x CSR2 race of silkworm, *B. mori*

Group	Weight of Cocoon (gm)	Shell weight (gm)	Shell Ratio %	Length of filament (m)	Weight of filament(gm)	Denier	Fecundity	
							Egg laying %	No. of eggs laid
Con.	1.24 ± 0.0	0.27 ± 0.0	21.61 ± 0.2	715 ± 0.1	0.18 ± 0.1	2.32 ± 0.0	-	723 ± 23
Ino.	0.80 ± 0.0	0.12 ± 0.0	15.18 ± 0.3	432 ± 0.1	0.09 ± 0.1	1.94 ± 0.1	15	109 ± 26
Amp.	1.02 ± 0.0	0.20 ± 0.0	19.63 ± 0.3	474 ± 0.1	0.11 ± 0.0	2.18 ± 0.1	47	341 ± 20
Chlor.	1.10 ±	0.24 ±	21.41 ±	672 ± 0.1	0.17 ± 0.0	2.28 ±	69	499 ±

	0.0	0.0	0.2			0.1		20
Strep.	1.09 ± 0.0	0.18 ± 0.0	17.03 ± 0.4	603 ± 0.1	0.15 ± 0.0	2.19 ± 0.2	43	310 ± 19
Peni.	1.11 ± 0.0	0.22 ± 0.0	19.78 ± 0.4	649 ± 0.1	0.16 ± 0.0	2.25 ± 0.1	29	209 ± 20
R.K.O	0.99 ± 0.0	0.17 ± 0.0	17.00 ± 0.2	488 ± 0.1	0.11 ± 0.1	1.97 ± 0.9	24	170 ± 23

Table 3:- Economic parameters recorded in infected and drug treated CSR2xCSR4 race of silkworm, B. mori

Group	Weight of Cocoon (gm)	Shell weight (gm)	Shell Ratio %	Length of filament (m)	Weight of filament (gm)	Denier	Fecundity	
							Egg laying %	No. of eggs laid
Con.	1.26 ± 0.0	0.25 ± 0.0	20.16 ± 0.2	680 ± 0.	0.172 ± 0.0	2.276 ± 0.1	-	683 ± 21
Ino.	0.84 ± 0.0	0.15 ± 0.0	17.68 ± 0.3	480 ± 0.1	0.090 ± 0.0	1.687 ± 0.1	23	159 ± 24
Amp.	1.18 ± 0.0	0.22 ± 0.0	18.71 ± 0.4	651 ± 0.0	0.152 ± 0.0	2.095 ± 0.1	35	244 ± 21
Chlor.	1.21 ± 0.0	0.24 ± 0.0	19.83 ± 0.2	640 ± 0.0	0.158 ± 0.0	2.221 ± 0.1	59	405 ± 25
Strep.	1.12 ± 0.0	0.21 ± 0.0	18.72 ± 0.2	539 ± 0.1	0.116 ± 0.0	2.061 ± 0.1	34	238 ± 21
Peni.	1.16 ± 0.0	0.23 ± 0.0	19.53 ± 0.3	620 ± 0.0	0.140 ± 0.0	2.032 ± 0.1	45	311 ± 22
R.K.O.	1.11 ± 0.0	0.19 ± 0.0	17.05 ± 0.2	554 ± 0.1	0.122 ± 0.0	1.981 ± 0.1	26	180 ± 26

Table 4: Economic parameters recorded in infected and drug treated CSR4 x CSR2 race of silkworm, B. mori

Group	Weight of Cocoon (gm)	Shell weight (gm)	Shell Ratio %	Length of filament (m)	Weight of filament (gm)	Denier	Fecundity	
							Egg laying %	No. of eggs laid
Con.	1.25 ± 0.0	0.26 ± 0.0	20.45 ± 0.2	655 ± 0.1	0.17 ± 0.0	2.28 ± 0.0	-	688 ± 23
Ino.	0.57 ± 0.0	0.10 ± 0.0	16.90 ± 0.4	400 ± 0.1	0.08 ± 0.1	1.84 ± 0.1	17	118 ± 23
Amp.	0.88 ± 0.0	0.17 ± 0.0	18.91 ± 0.3	649 ± 0.1	0.15 ± 0.0	2.10 ± 0.1	41	283 ± 22
Chlor.	1.11 ± 0.0	0.22 ± 0.0	19.80 ± 0.2	614 ± 0.1	0.15 ± 0.0	2.20 ± 0.1	60	415 ± 23
Strep.	0.95 ± 0.0	0.18 ± 0.0	19.16 ± 0.4	474 ± 0.1	0.10 ± 0.0	1.97 ± 0.0	38	260 ± 21
Penicillin	1.16 ± 0.0	0.23 ± 0.0	19.57 ± 0.4	618 ± 0.1	0.14 ± 0.0	2.04 ± 0.0	57	396 ± 20
R.K.O	0.84 ± 0.0	0.15 ± 0.0	17.72 ± 0.3	583 ± 0.0	0.13 ± 0.1	1.97 ± 0.1	24	166 ± 24

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IN VITRO ANTIBACTERIAL ACTIVITY OF ROOT EXTRACT OF *CYNODON DACTYLON* IN URINARY TRACT INFECTION

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ABSTRACT

Cynodon dactylon is one of the most important medicinal plant shows antibacterial activity against the uropathogens. It is commonly known as Doorva in Hindi while doorva or Haryali in Marathi. Total 100 urine samples were collected randomly from various hospitals and pathology laboratories in Chandrapur area and the root of *Cynodon dactylon* were collected from agriculture land of Gondpipari Taluka of Chandrapur district of Maharashtra state. Effect of methanol extract of *Cynodon dactylon* was tested in-vitro by agar well diffusion method at concentration of 1 µg/ul and 0.1 µg/ul in Dimethyl Sulphoxide. Methanol extract at concentration 1 µg/ul shows more activity against most of the bacterial strains isolated from urine samples. The effects produced by methanol extract were compared with Nitrofurantoin.

The study revealed that the *Cynodon dactylon* can be effective against the pathogens causing urinary tract infection and it is helpful to doctors to cure urinary tract infection.

Keywords : *Cynodon dactylon* , Antibacterial activity , Urinary tract infection

INTRODUCTION

Medicinal plants are a biological rich compounds have medicinal properties and it plays a role as an alternative to synthetic drugs. *Cynodon dactylon* is a type of grass that has antibacterial property and is used as an antibacterial agent traditionally. It has many medicinal properties such as antiemetic, anti-diabetic, diuretic, anti-inflammatory, hepato-protective activity, urinary tract infection, prostatic dysentery, syphilis etc. (Singh SK, 2007). The recent study shows that *Cynodon dactylon* was effective against various bacterial pathogens and fungal agents. (Kanimozhi D, 2013)

The aim of this study is to evaluate the antibacterial activity of root extract of *Cynodon dactylon* against the urinary pathogens in vitro.

MATERIALS AND METHODS

Collection and extraction of plant material :- The root of *Cynodon dactylon* were collected from agriculture land of Gondpipari Taluka of Chandrapur district of Maharashtra state, India. The roots of plant material were dried and subjected to grinding to prepare fine powder and methanol extract was prepared.

Collection of Urine specimens and isolation and identification of organisms: - Clean catch total 100 urine specimens were collected from indoor and outdoor patients from various hospitals and pathology laboratories in Chandrapur area in sterile disposable containers in aseptic condition. The loopful of the sample is cultured on Nutrient agar plates. Isolated colonies are separately cultured on UTI isolation agar plates (Himedia).

Antibacterial Assay: - Antibacterial activity of methanol extract of *Cynodon dactylon* (1 µg/ul and 0.1 µg/ul conc. in D.M.S.O.) was done by agar well diffusion method on Muller Hinton agar plates against isolated urinary pathogens such as *E. coli*, *Klebsiella species*, *Proteus species* and *Staphylococcus species*. (Parez. 1990). The standard antibiotic, Nitrofurantoin was used as positive control and the antibiotic assay was done by agar disc diffusion method by using Muller Hinton agar plates. (AW, Kirby AM, Sherris JC, & M., 1966) (Parez., 1990)

RESULT AND DISCUSSION

In various isolates, methanol extract of 1 µg/ul conc., *E. coli* shows maximum zone of inhibition was 17 mm, *Klebsiella species* shows 13 mm, *Proteus species* shows 24 mm and *Staphylococcus species* shows 14 mm. At extract of 0.1 µg/ul conc., *E. coli* shows maximum zone of inhibition was 13 mm, *Klebsiella species* shows 11 mm, *Proteus species* shows 16 mm and *Staphylococcus species* shows 11 mm. In our study, the methanolic extract of *Cynodon dactylon* has significant antibacterial activity against urinary pathogens such as *E. coli*, *Klebsiella species*, *Proteus species* and *Staphylococcus species*.

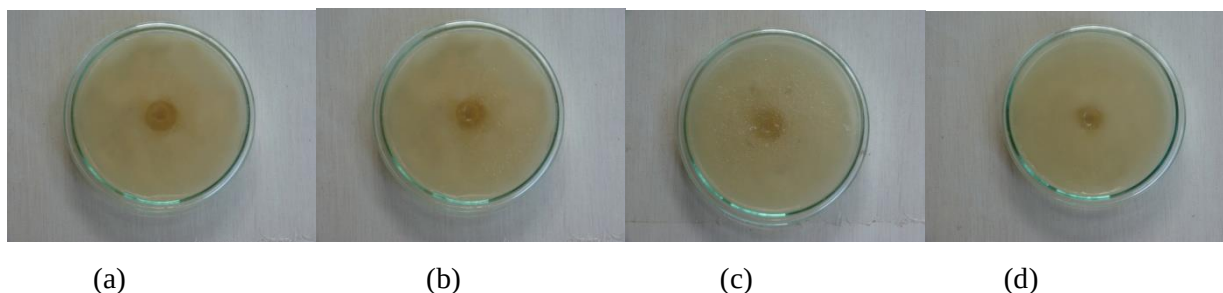


Figure :- In vitro antibacterial activity of root extract of *Cynodon dactylon* in uropathogens showing zone of clearance (a) *E. Coli* , (b) *Klebsiella Species* , (c) *Proteus species* and (d) *Staphylococcus species*.

CONCLUSION

The present study shows that the *Cynodon dactylon* shows antibacterial activity against the urinary pathogens such as *E. Coli* ,*Klebsiella species*, *Proteus species* and *Staphylococcus species*. Further the study helps to use this plant as antibacterial in urinary tract infection to prevent the patient from side effect due to use of synthetic chemotherapeutic agents.

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GENERATION MEAN ANALYSIS IN MAIZE (ZEA MAYS L.)

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ABSTRACT

The present investigation on generation mean analysis in maize was carried out during the year 2016-17 in RBD replicated thrice and data were recorded for grain yield and its contributing traits for six generations of three crosses viz., NMI-3 $\times$ NAUM-8, NAUM-8 $\times$ NMI-7 and NMI-3 $\times$ NAUM-26. ANOVA showed significant variation among generations. The data were subjected to test epistasis and different gene action by using scaling test and six parameter model of generation mean analysis. It was observed that all type of gene action i.e. additive, dominance and epistatic components were playing important role in the inheritance of different characters but their degree differed with their crosses. Estimation of significant simple scaling tests and joint scaling test indicated the presence of epistatic gene effects for grain yield and its component characters in all the crosses. Both additive and non-additive components of genetic variations were found important for the grain yield and its components with predominance of non-additive gene action. Among the epistasis effects, all three types of non-allelic interactions contribute more with higher magnitude of dominance $\times$ dominance (I) in most of the traits. Duplicate epistasis was preponderance in most of the characters. Non applicability of simple additive-dominance model revealed importance of epistasis components in yield and its contributing traits can be exploited through reciprocal recurrent selection.

Keywords: Maize, additive, dominance, epistasis, generation mean analysis, gene action, quantitative traits.

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop in the world belongs to family Poaceae. Maize is one of the versatile crop with wider genetic variability and able to grow successfully throughout the world covering tropical, subtropical and temperate agroclimatic conditions. It can grown throughout the year for different purposes including grain, fodder, green cobs, sweet corn, baby corn and pop corn. In any breeding program, it is essential to have an idea of the nature and magnitude of variability in respect of breeding material at hand. The simple scaling test (Mather, 1949) followed by generation mean analysis (Hayman, 1958) provide a more precise assessment of additive, dominance and epistatic gene effects in respect of individual cross.

Since nature and magnitude of gene effects tend to change with cross, more studied based on generation mean analysis in diverse crosses are warranted for getting deeper understanding of gene actions involved in inheritance of various traits in maize. Generation mean analysis is a simple but useful technique for estimating gene effects for polygenic traits and its greatest lying in the ability to estimate gene effects such as additive $\times$ additive, additive $\times$ dominance and dominance $\times$ dominance effects (Novoselovic *et al.*, 2004). The knowledge of genetic architecture and inheritance pattern of yield and yield contributing components is very essential for breeder to plan breeding program for getting efficient results in succeeding generations. Hence, present investigation was undertaken with the objective of studying genetic nature of yield attributing traits by applying simple scaling test for detection of non-allelic interaction and estimate gene effects by generation mean analysis.

MATERIALS AND METHODS

The present investigation was carried out at Agricultural research farm of College of Agriculture, Nagpur during 2017-18. Four homozygous and genetically diverse strains of maize viz., NMI-3, NMI-7, NAUM-26 and NAUM-8 were selected for building up the experimental materials. During *kharif* 2016-17, all four parental lines were crossed to produce three F_1 hybrids. The F_1 hybrids were selfed to obtain F_2 and backcrossed for setting BC_1 and BC_2 in *rabi* 2016-17. The experimental materials for the present investigation comprised of the six generations (P_1 , P_2 , F_1 , F_2 , BC_1 and BC_2) of each of the three crosses i.e. NMI-3 $\times$ NAUM-8, NAUM-8 $\times$ NMI-7 and NMI-3 $\times$ NAUM-26. All six generations of above crosses were grown in randomised block design with three replications. In each of replication non segregating parents P_1 , P_2 and F_1 's generations were represented by two rows, BC_1 and BC_2 by three rows and F_2 's by five rows. The rows 5 m long with row spacing 60 cm and 20 cm between plants within row. The data were recorded on 20 plants in parents and F_1 's, 30 plants in backcrosses and 50 plants in F_2 replication wise for days to 50% tasseling, days to 50% silking, days to maturity, number of grains cob⁻¹, 100 grain weight and grain yield plant⁻¹. The data were analyzed by using Indostat advanced breeding package for testing epistasis and six generations mean analysis.

RESULTS AND DISCUSSION

Mean performance of three crosses in six generations for various characters are presented in table 1. The estimates of scaling tests are presented in table 2, 3 and 4.

DAYS TO 50% TASSELLING

Significant differences among different generations under study for days to 50% tasseling indicated the presence of sufficient variability. Presence of non-allelic interaction was indicated by the significant of A, B, C and D scales in NAUM-8 x NMI-7 and NMI-3 X NAUM-26. The mean (m) effect for this trait was positive and significant in the NAUM-8 x NMI-7 and NMI-3 X NAUM-26 crosses. The genetic parameters viz., additive (d) and dominance (h) were highly significant but negative. The magnitude of dominance effect was more than that of additive, which confirmed that dominance (h) gene effect were found to contribute substantially in the inheritance of this trait, but negative sign of (h) indicated dominance of decreasing alleles (Table 3 and 4). The magnitude of dominance x dominance (l) gene effects was higher than other two types of interaction, which indicated that dominance x dominance (l) interaction was found to play important role in the genetic control of this trait in the NAUM-8 x NMI-7 and NMI-3 X NAUM-26 crosses. Moreover, the opposite sign of dominance (h) and dominance x dominance (l) showed the presence of duplicate epistasis for days to 50% tasseling in the NMI-3 x NAUM-26 and NAUM-8 x NMI-7 crosses. This kind of epistasis generally hinders the improvement through selection and hence, a higher magnitude of dominance and (l) type of interaction effects would not be expected. It also indicated that selection should be delayed after several generations of selection (single seed decent) until a high level of gene fixation was attained. This result was supported by the findings of Azizi *et al.* (2006); Sofi *et al.* (2006); Ishfaq (2011) and Wannows *et al.* (2015).

DAYS TO 50% SILKING

In the NAUM-8 x NMI-7 and NMI-3 x NAUM-26 crosses significant estimation of scaling test A, B, C and D indicated the presence of non-allelic interaction for this character. In NAUM-8 x NMI-7 and NMI-3 x NAUM-26 crosses, the mean (m) effect for the trait was positive and significant and genetic parameters viz., additive and non-additive were highly significant and dominance effect higher than additive but negative sign of both suggested dominance of decreasing alleles. All the epistasis effects were highly significant for this trait whereas, dominance x dominance (l) was higher than both non-allelic interactions i.e. (i) and (j). which confirmed that dominance (h) and dominance x dominance (l) gene effects were found to be contributed substantially in the inheritance of days to 50% silking in this cross. In case where dominance (h) was of major importance, the trait could be successfully utilized in the formation of hybrids and promoting earliness in the material. The presence of epistasis is mostly indicative of greater genetic diversity in the parents. The epistatic effects in controlling the inheritance of days to silking in maize are in agreement with the results obtained by (Singh and Roy, 2007). Moreover, the opposite sign of dominance (h) and dominance x dominance (l) showed the presence of duplicate epistasis for days to 50% silking in all the crosses. It is suggested that selection should be delayed until the fixation of alleles for this trait. The findings of other researchers like Kumar *et al.*, (2005) and Singh and Roy (2007) were in accordance with the results of the present study.

DAYS TO MATURITY

The mean (m) effect for the trait was positive and significant in cross NMI-3 x NAUM-8. The dominance (h) effect was positive and highly significant than additive (d) gene effect. Significant epistatic effects were also noticed in the material. The magnitude of additive x additive (i) gene effect was positive and highly significant than other two types. In case if dominance and additive x additive effects are present, it can be inferred that these type of gene effects would help in promoting earliness in this materials. In the cross NMI-3 x NAUM-26, all the genetic parameters were found to be significantly important in the genetic control of the trait except additive x additive (i). The magnitude of dominance (h) and dominance x dominance (l) gene effects prevailed over additive, additive x additive (i) and additive x dominance (j) gene effects which indicated the preponderance of (h) and (l) in the inheritance of this trait. The relative magnitude of dominance (h) estimates were greater compared to additive effects which suggest that additive gene effects made only a minor contribution to the inheritance of days to maturity in all the crosses. Although the relative proportion of dominance x dominance (l) gene effect was predominant in the NMI-3 x NAUM-26 cross whereas, in cross NMI-3 x NAUM-8, additive x additive (i) epistasis was higher than (l) gene effect. The prevalence of dominance genetic effects is more helpful in the formation of superior maize hybrids. These findings were similar to those encountered by Kumar *et al.* (2005). Moreover, the opposite sign of dominance (h) and dominance x dominance (l) showed the presence of duplicate epistasis for days to 50% maturity in the NMI-3 x NAUM-8 cross, therefore for efficient utilization of non-fixable components of genetic variation, reciprocal recurrent selection would be suggested. In cross NMI-3 x NAUM-26, (h) and (l) showed similar sign which indicated presence of complimentary type of gene action for this trait. Thus this trait can be exploited through

heterosis breeding. The results are in agreement with the findings of Iqbal (2010) and Ishfaq (2011), who found that this character was under the control of duplicate type of gene action.

PLANT HEIGHT

In the best fit model of joint scaling test, dominance (h) gene effect was significant. The magnitude of dominance (h) gene effect more than additive (d) effect in all three crosses namely NMI-3 × NAUM-8, NAUM-8 × NMI-7 and NMI-3 × NAUM-26, which confirm that dominance effects was found to be important in the inheritance of plant height but negative sign of (h) indicated dominance of decreasing alleles. Among the epistasis effect, all three types of epistasis were significant in all three crosses except additive × dominance (j) gene effect was non-significant in cross NMI-3 × NAUM-26. The magnitude of dominance × dominance (l) gene effect was higher than other gene effects in all the crosses. The prevalence of dominance genetic effects is more helpful in the formation of superior maize hybrids. These findings were similar to those encountered by Kumar *et al.* (2005). Existence of non-additive epistatic effects in some cases revealed the presence of greater genetic diversity in the parents. It was also observed that dominance (h) and dominance × dominance (l) gene effects were opposite in sign, which indicates the presence of duplicate type of epistasis for this trait among all the crosses. So the selection for plant height should be delayed to later generation when dominant effect is diminished. These results are in accordance with the findings of Iqbal *et al.* (2010); El-Bdawy (2012) and Shahrokhi *et al.* (2013), who reported that plant height was under the control of duplicate type of gene action in maize.

NUMBER OF GRAINS COB⁻¹

The mean (m) effect for the trait was positive and significant in all three crosses and dominance (h) effect was significant and higher than additive but in negative direction which exhibited dominance of decrease alleles. However magnitude of dominance × dominance (l) was higher than other gene effects, it can be concluded that, the number of grain cob⁻¹ was controlled by dominant gene effect and epistasis. Moreover, the sign of (h) and (l) were opposite in all the crosses which suggested the presence of duplicate type of epistasis. Azizi *et al.* (2006); Sofi *et al.* (2006); Ishfaq (2011) and Sher *et al.* (2012) have also reported that, the duplicate type of epistasis was found for this trait.

100 GRAIN WEIGHT (G)

The data pertaining to fit in crosses viz., NMI-3 × NAUM-8, NAUM-8 × NMI-7 and NMI-3 × NAUM-26 revealed significant estimates of all A, B, C and D scaling test showed the existence of epistasis. In best fit model of joint scaling test, dominance (h) gene effect was significant and higher magnitude than additive (i) gene effect in all crosses, which confirmed that dominance gene effect involved in the inheritance of 100 grain weight.

Among the epistatic effects, all three types of interactions were found to be significant for all three crosses. The magnitude of dominance × dominance (l) gene effect was higher than other two types of gene interactions in all the crosses. It was also observed that opposite sign of dominance (h) and dominance × dominance (l) gene effects confirmed existence of duplicate type of epistasis for 100 grain weight in all the crosses. This result is supported by the findings of Azizi (2006); Sofi *et al.* (2006); Ishfaq (2011) and Sher *et al.* (2012) who reported that, this character was exhibited duplicate type of epistasis for its genetic control.

GRAIN YIELD PLANT⁻¹ (G)

Significant differences among different generations under study for grain yield plant⁻¹ indicated the presence of sufficient genetic variability. Significant values of scaling tests in both the crosses showed presence of non-allelic genetic interactions. In cross NMI-3 × NAUM-8, dominance (h) gene effect was higher magnitude with negative sign, which showed dominance of decrease alleles. Among the non-allelic interactions, only additive × dominance (j) gene effect was significant and positive, it played a major role in the inheritance of this trait. In cross NAUM-8 × NMI-7, all the genetic parameters were found significant and important in genetic control of the trait. However, dominance (h) and dominance × dominance (l) gene effect with highest magnitude was played important role in the inheritance of grain yield plant⁻¹. The estimation of genetic parameters revealed that, both additive and dominance gene effects were non-significant for grain yield plant⁻¹ in the cross NMI-3 × NAUM-26. Among the non-allelic interactions, both additive × additive (i) and dominance × dominance (l) gene effects were significant. The magnitude of (l) was higher than (i), which played a major role in the inheritance of the trait. Moreover, the opposite sign of dominance (h) and dominance × dominance (l) showed the presence of duplicate epistasis for grain yield plant⁻¹ in all three crosses. Thus this indicates the importance of dominance and epistasis in the control of this trait. Previous researchers like Singh and Roy (2007) and Haq *et al.* (2010) reported duplicate type of epistasis for this trait in maize.

The genetic parameters estimated provide a test for different types of gene action and are useful in giving information for the improvement of these characters. In the present study in most of traits, magnitude of additive (d) was relatively small to that of dominance (h) and epistasis. This revealed that additive genes have lesser role in the inheritance of majority of characters, non-additive and epistasis gene effects played a major role as compared to additive gene action. Reciprocal recurrent selection will be effective in improvement of all traits that were governed by both additive and non-additive gene effects.

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Table 1: Mean for yield and it's contributing traits in six generations of three crosses

	Generations	Days to 50% tasselling	Days to 50% silking	Days to maturity	Plant height (cm)	No. of grains cob ⁻¹	100 grain weight (g)	Grain yield plant ⁻¹ (g)
NMI-3 × NAUM-8	P ₁	52.00 ±0.28	56.33 ±0.32	99.33 ±0.34	146.63±1.07	288.98±3.00	17.56 ±0.11	49.87 ±0.53
	P ₂	49.67 ±0.42	53.67 ±0.32	91.67 ±0.26	158.96±1.09	291.53±2.11	20.19 ±0.17	56.20 ±0.24
	F ₁	54.33 ±0.12	57.67 ±0.26	96.67 ±0.16	177.73±0.73	329.57±3.32	24.37 ±0.12	75.96 ±0.34
	F ₂	50.67 ±0.15	54.33 ±0.13	90.67 ±0.16	161.27±0.31	273.62±2.55	23.77 ±0.01	59.86 ±0.31
	BC ₁	51.67	55.33	95.33	153.31±0.42	250.24±2.	20.66	51.90

NAUM-8 × NMI-7		±0.13	±0.18	±0.08		37	±0.06	±0.79
	BC ₂	52.00 ±0.08	56.33 ±0.13	94.67 ±0.26	151.19±0.20	252.68±3. 19	23.31 ±0.10	59.96 ±0.76
	P ₁	49.67 ±0.42	53.67 ±0.32	91.67 ±0.26	158.96±1.09	291.53±2. 11	20.19 ±0.17	56.20 ±0.24
	P ₂	55.00 ±0.18	59.67 ±0.06	94.33 ±0.26	177.53±0.96	318.73±2. 93	22.81 ±0.11	61.96 ±0.49
	F ₁	58.00 ±0.10	62.00 ±0.10	100.00 ±0.31	177.12±0.43	338.28±2. 49	23.41 ±0.06	77.36 ±0.57
	F ₂	53.00 ±0.06	56.67 ±0.10	94.00 ±0.13	155.48±0.35	243.27±2. 13	19.67 ±0.05	47.33 ±0.15
	BC ₁	51.67 ±0.26	55.00 ±0.22	92.33 ±0.43	145.36±0.61	252.04±4. 10	20.54 ±0.08	49.34 ±0.57
NMI-3 × NAUM- 26	BC ₂	54.00 ±0.08	56.67 ±0.21	96.67 ±0.13	147.56±0.73	259.42±4. 81	19.16 ±0.04	49.25 ±0.17
	P ₁	52.00 ±0.28	56.33 ±0.32	99.33 ±0.34	146.63±1.07	288.98±3. 00	17.56 ±0.11	49.87 ±0.53
	P ₂	48.33 ±0.42	53.67 ±0.22	93.00 ±0.38	157.24±0.78	308.68±2. 39	20.61 ±0.16	57.44 ±0.53
	F ₁	57.33 ±0.12	60.67 ±0.16	103.33 ±0.67	166.71±1.15	333.43±1. 91	23.89 ±0.08	69.65 ±1.03
	F ₂	52.33 ±0.10	55.67 ±0.10	92.67 ±0.27	148.17±0.15	322.45±1. 53	21.24 ±0.01	67.02 ±0.26
	BC ₁	51.00 ±0.14	53.67 ±0.13	89.33 ±0.19	146.31±0.53	303.06±0. 77	19.41 ±0.07	56.93 ±0.63
	BC ₂	46.33 ±0.50	50.33 ±0.27	95.00 ±0.25	152.92±0.73	279.76±1. 63	22.25 ±0.08	62.49 ±0.90

Table 2: Scaling test, gene effects and gene action for different yield attributing characters in crosses NMI-3× NAUM-8.

Characters	Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height (cm)	No. of grains cob ⁻¹	100 grain weight (g)	Grain yield plant ⁻¹ (g)
Scaling test							
A	#	#	-5.33** ±0.52	-17.74** ±1.55	-118.07** ±6.53	-0.60** ±0.20	5.74** ±1.70
B	#	#	1.00 ±0.61	-34.31** ±1.38	-115.73* ±7.50	-1.93** ±0.29	-9.51** ±1.59
C	#	#	-21.66 ** ±0.86	-15.99** ±2.47	-145.18* ±12.73	8.61** ±0.32	-0.68 ±1.54
D	#	#	-8.66** ±0.46	18.03** ±0.78	44.31** ±6.47	5.57** ±0.12	1.54 ±1.26
Genetic effects							
m	#	#	78.16** ±0.95	188.86** ±1.74	378.88** ±13.08	30.01** ±0.27	52.97** ±2.55
d	#	#	3.83** ±0.21	-6.16** ±0.76	-1.27 ±1.83	-1.31** ±0.10	-0.003 ±0.29
h	#	#	31.5** ±2.43	-99.25** ±4.48	-371.74* ±32.07	-19.33** ±0.80	-1.66 ±7.13
i	#	#	17.33** ±0.92	36.06** ±1.56	-88.62** ±12.95	-11.14** ±0.24	-3.09 ±2.53
j	#	#	-6.33** ±0.77	16.56** ±1.79	-2.33 ±8.76	1.32** ±0.31	15.26** ±2.2
l	#	#	-13.00** ±1.54	88.12** ±3.10	322.4** ±20.3	13.68** ±0.57	6.86 ±4.76
Type of	#	#	Duplicate	Duplicate	-	Duplicate	-

epistasis							

*,** = Significant at 5% and 1% level respectively

= Gene effects were not estimated as their mean sum of square was non-significant.

Table 3: Scaling test, gene effects and gene action for different yield attributing characters in crosses NAUM-8 × NMI-7.

Characters	Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height (cm)	No. of grains cob ⁻¹	100 grain weight (g)	Grain yield plant ⁻¹ (g)
Scaling test							
A	-4.33** ±0.69	-5.66** ±0.57	#	-45.35** ±1.70	-125.73* *±8.83	-2.51** ±0.18	3.67** ±1.26
B	-5.00** ±0.27	-8.33** ±0.45	#	-59.54** ±1.81	-138.17* *±10.36	-7.89** ±0.15	-19.05** ±0.76
C	-8.66** ±0.57	- 10.66** ±0.56	#	-68.83** ±2.21	-313.74* *±10.54	-11.15** ±0.32	4.75** ±1.25
D	0.33 ±0.30	1.66** ±0.37	#	18.03** ±1.19	-24.92** ±7.63	-0.37** ±0.11	10.06** ±0.67
Genetic effects							
m	53.00** ±0.66	60.00** ±0.77	#	204.31** ±2.49	255.29** ±15.37	20.75** ±0.25	73.28** ±1.37
d	-2.66** ±0.23	-3.00** ±0.16	#	-9.28** ±0.73	-13.6** ±1.80	-1.31** ±0.10	-3.27** ±0.27
h	-5.00** ±1.89	- 15.33** ±2.12	#	-168.15** ±6.80	-131.08* *±42.04	-6.99** ±0.6	-47.67** ±3.92
i	-0.66 ±0.61	-3.33** ±0.75	#	-36.06** ±2.38	49.84** ±15.26	0.74** ±0.23	-20.13** ±1.35
j	0.66 ±0.72	2.66** ±0.71	#	14.18** ±2.41	12.44 ±13.15	5.38** ±0.22	22.72** ±1.3
l	10.00** ±1.25	17.33** ±1.38	#	140.96** ±4.43	214.0** ±27.3	9.66** ±0.36	35.51** ±2.70
Type of epistasis	Duplicate	Duplicate	#	Duplicate	Duplicate	Duplicate	Duplicate

*,** = Significant at 5% and 1% level respectively

= Gene effects were not estimated as their mean sum of square was non-significant.

Table 4: Scaling test, gene effects and gene action for different yield attributing characters in crosses NMI-3 × NAUM-26.

Characters	Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height (cm)	No. of grains cob ⁻¹	100 grain weight (g)	Grain yield plant ⁻¹ (g)
Scaling test							
A	-7.33** ±0.42	-9.66** ±0.44	-24.00** ±0.85	-20.72** ±1.90	-16.29** ±3.89	-2.63** ±0.21	-3.98* ±1.72
B	-13.00** ±1.10	- 13.66** ±0.62	-6.33** ±0.93	-18.11** ±2.03	-82.59** ±4.47	-3.99** ±0.25	0.44 ±2.15
C	-5.66** ±0.70	-8.66** ±0.65	-28.33** ±1.80	-44.63** ±2.74	25.28** ±8.18	-0.96** ±0.27	5.51* ±2.44
D	7.33** ±0.56	7.33** ±0.37	1.00 ±0.63	-2.89** ±0.96	62.08** ±3.55	2.83** ±0.12	4.52** ±1.23
Genetic effects							

m	64.83** ±1.16	69.66** ±0.76	98.16** ±1.29	146.14** ±2.03	422.99** ±7.36	24.74** ±0.26	58.26** ±2.48
d	1.83** ±0.25	1.33** ±0.19	3.16** ±0.25	-5.30** ±0.66	-9.85** ±1.92	-1.52** ±0.10	0.66 ±0.37
h	-42.5** ±3.36	- 47.00** ±2.11	-22.16** ±3.09	-12.49* ±6.06	-312.61* *±17.44	-13.14** ±0.77	-12.87 ±7.14
i	-14.66** ±1.13	- 14.66** ±0.73	-2.00 ±1.26	5.78** ±0.92	-124.16* *±7.11	-5.66** ±0.23	-9.05** ±2.45
j	5.66** ±1.17	4.00** ±0.73	-17.6** ±0.83	-2.61 ±2.25	66.3** ±5.27	1.36** ±0.30	-4.43 ±2.34
l	35.00** ±2.22	38.00** ±1.39	-32.33** ±2.23	33.05** ±4.56	223.0** ±10.9	12.28** ±0.53	12.59*±5.06
Type of epistasis	Duplicate	Duplicate	Complementary	Duplicate	Duplicate	Duplicate	-

*,** = Significant at 5% and 1% level respectively

= Gene effects were not estimated as their mean sum of square was non-significant.

KARYOTYPING OF TWO PLANTS- ALOE VERA AND CHLOROPHYTUM SP. IN MITOTIC METAPHASE

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ABSTRACT

The study of karyotyping of these two plants was done to prove the chromosome number of *Aloe vera* and *Chlorophytum sp.* is $2n=14$ and $2n=16$ respectively. Karyotype is the morphological aspect of chromosome complement seen in at mitotic metaphase. The karyotype is the chromosome complement of a cell individual or species classified according to the chromosome length, centromere position and bonding appearance produced by (Battaglia 1955). On the basis of arm ratio, centromere types has been differentiated.

Keywords: Chromosome number, chromosome length, arm ratio, sub median (sm), nearly sub terminal (nst).

INTRODUCTION

Morphological characters of chromosomes such as length of chromosome, relative arm length, presence or absence of satellite and their position describes the different characters of particular plants. The analysis done through karyomorphology and ideogram. Usually somatic metaphase chromosome and root tips of cell of different plant species are used for karyotype analysis because during mitotic metaphase the chromosome are shorter, thicker and easily stainable.

Karyotype analysis of number of cells refers to "Idiogram". The chromosome of a cell of an individual are arranged according to the species. Idiogram is the diagrammatic representation of karyotype of cell individual or species. It is based on the chromosome length and centromere position.

MATERIAL AND METHODS

In order to study these morphological features of chromosomes, somatic metaphase plate are chosen where the chromosome are closer and totally separated. For these the root tips of plants are first penetrated with 0.05% colchicine for 5-6 hours and process further for squash technique and slides are made permanently. The observation are carried out under high magnification. The cell showed selected chromosome is selected for karyotype study with the help of Lucida camera. The chromosome or sketch under magnification of $10\times \times 100\times$. The length of chromosome or the sketch diagram are also used whose length is measured with the help of thread or scale. The short arm length is denoted by 'S' for the long arm length is denoted by 'L' and the absolute length denoted by 'C' i.e. $C = S + L$.

Formula- Relative length in percentage = $\frac{\text{Length of particular Chromosome}}{\text{Length of largest Chromosome}} \times 100$

Arm ratio = $\frac{\text{Mean value of long arm (L)}}{\text{Mean value of short arm (S)}} = R_2$

Arm ratio = $\frac{\text{Mean value of short arm (S)}}{\text{Mean value of long arm (L)}} = R_1$

OBSERVATION

Adhikari in 1974 showed that the four types of chromosomes can be further subdivided on the basis of position of centromere as near sub median (Sm) and near the sub terminal (St). In *Aloe vera*, on the basis of centromere position, six chromosomes are near the sub terminal and eight chromosomes are near sub median while in *Chlorophytum sp.* Eight chromosomes are near sub terminal and another eight chromosomes are near sub median. These nomenclature is given on the basis of arm ratio of particular chromosomes.

The idiograms are sketched one group letter representing the total number of chromosome pairs. The idiograms are the sketch in graph paper using the scale to represent the length of each chromosome and relative size of chromosome. The long arm sketch towards the lower side and the short arm towards the upper side.

OBSERVATION TABLE

Aloe vera –

Table No.1

S.N.	Total length	Length of long arm	Mean value	Length of short arm	Mean value	Absolute Length
1	40mm	28mm	29	10mm	9.5	38.5

2	37mm	30mm		9mm		
3	36mm	30mm	28.5	7mm	6.5	34.5
4	33mm	27mm		6mm		
5	29mm	25mm	25.5	6mm	6.5	30.5
6	32mm	26mm		7mm		
7	35mm	26mm	26.5	9mm	8	35
8	35mm	27mm		7mm		
9	12mm	7mm	6.5	3mm	3.5	11
10	10mm	6mm		4mm		
11	13mm	8mm	8	4mm	4	12.5
12	12mm	8mm		4mm		
13	12mm	8mm	7.5	5mm	4	11
14	10mm	7mm		3mm		

Table No.2

S.N	Mean value of long arm (L)	Mean value of short arm (S)	Arm ratio (L/S) R_2	Arm ratio (S/L) R_1
1	13.18	4.318	3.052	0.327
2	12.95	2.954	4.383	0.228
3	11.59	2.954	3.923	0.254
4	12.04	3.636	3.311	0.301
5	2.954	1.590	1.857	0.538
6	3.636	1.818	2	0.5
7	3.409	1.818	1.875	0.533

Table No.3

S.N.	R_1	R_2	Notation	Nomenclature
1	0.327	3.052	St	Nearly sub terminal
2	0.228	4.383	St	Nearly sub terminal
3	0.254	3.923	St	Nearly sub terminal
4	0.301	3.311	St	Nearly sub terminal
5	0.538	1.857	Sm	Sub median
6	0.5	2	Sm	Sub median
7	0.533	1.875	Sm	Sub median

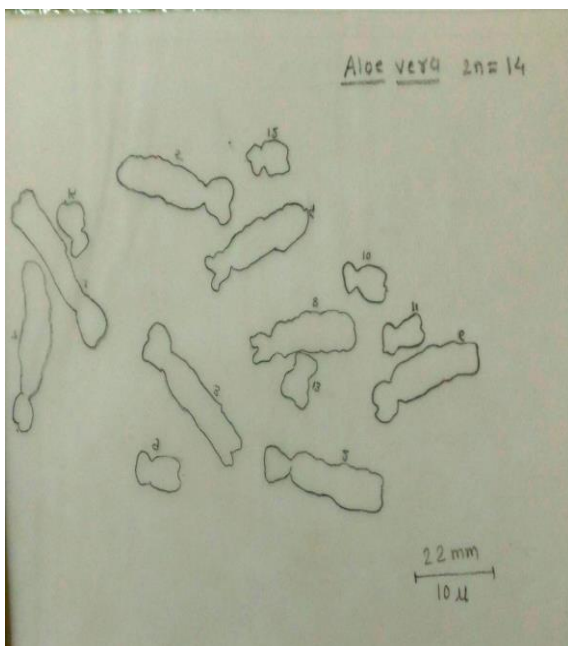


Fig: Traced Somatic metaphase plate of Aloe vera

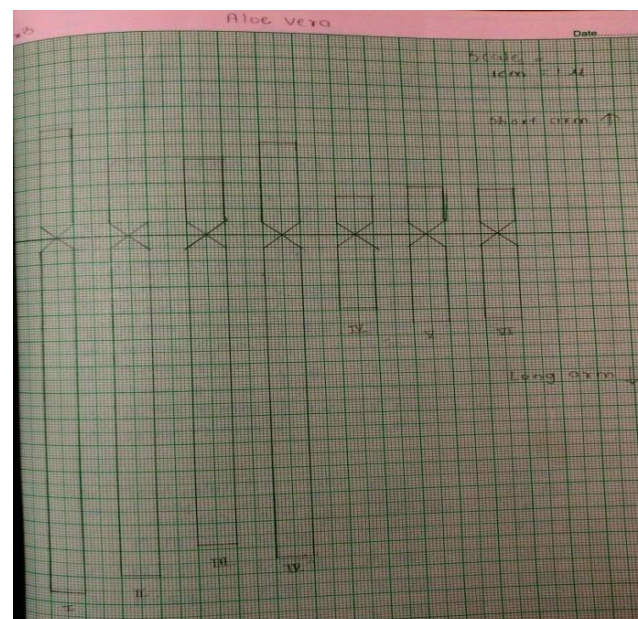


Fig: Idiogram of Aloe vera

Table No.1-

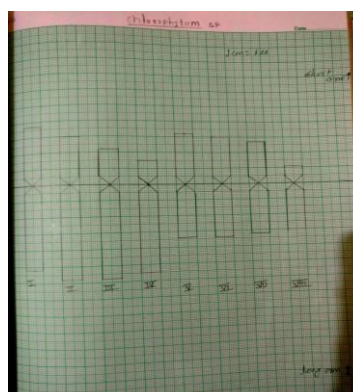
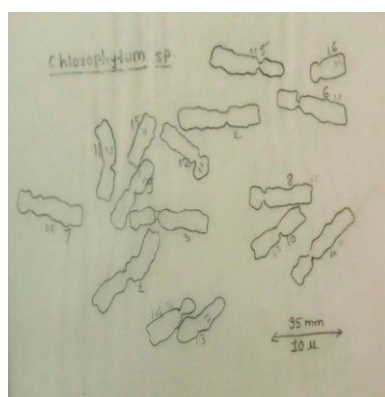
S.N.	Total length	Length of long arm	Mean value	Length of short arm	Mean value	Absolute Length
1	32mm	12mm	13	20mm	18.5	31.5
2	31 mm	14mm		17mm		
3	31mm	21mm	20.5	10mm	10.5	31
4	31mm	20mm		11mm		
5	29mm	20mm	20.5	9mm	8	28.5
6	28mm	2mm		7mm		
7	25mm	20mm	19.5	5mm	5.5	25
8	25mm	19mm		6mm		
9	24mm	11mm	12	13mm	11.5	23.5
10	23mm	13mm		10mm		
11	23mm	13mm	12	10mm	10.5	22.5
12	22mm	11mm		11mm		
13	21mm	13mm	11.5	8mm	9.5	21
14	21mm	10mm		11mm		
15	16mm	12mm	10.5	4mm	4	14.5
16	15mm	11mm		4mm		

Table No.2

S.N	Mean value of long arm (L)	Mean value of short arm (S)	Arm ratio (L/S) R ₂	Arm ratio (S/L) R ₁
1	5.285	5.714	0.702	1.422
2	5.857	3	1.952	0.512
3	5.857	2.285	2.563	0.410
4	5.571	1.571	3.546	0.281
5	3.428	3.285	1.043	0.958
6	3.428	3	1.142	0.875
7	3.285	2.714	1.210	0.826
8	3	1.142	2.626	0.380

Table No.3

S.N.	R ₁	R ₂	Notation	Nomenclature
1	0.493	2.025	Sm	Sub median
2	0.262	3.812	St	Nearly sub terminal
3	0.159	6.251	St	Nearly sub terminal
4	0.079	12.61	St	Nearly sub terminal
5	0.918	1.088	Sm	Sub median
6	0.766	1.305	Sm	Sub median
7	0.682	1.464	Sm	Sub median
8	0.144	6.91	St	Nearly sub terminal


Fig: Traced Somatic metaphase plate of *Chlorophytum* sp. Fig: Idiogram of *Chlorophytum* sp. (2n=16)

RESULT AND DISCUSSION

The present study was done to prove the chromosome number of *Aloe vera* and *Chlorophytum sp.* is $2n=14$ and $2n=16$ respectively on the basis of karyomorphology. From the idiogram it is reported that in *Aloe vera*, three chromosome pairs are near the sub terminal and four chromosome pairs are near sub median while in *Chlorophytum sp.* four chromosome pair are near sub terminal and another four chromosome pair are near sub median. *Aloe vera* consist four pairs of long chromosome size ranged from 1.8 to 2mm and short chromosome size ranged from 3 to 4.3mm. *Chlorophytum sp.* consist of four pairs of long chromosome size ranged from 3.8 to 12.6mm and short chromosome size ranged from 1 to 2 mm.

CONCLUSION

The present investigation on karyotyping of two plants *Aloe vera* and *Chlorophytum sp.* was done by tracing the somatic metaphase plate and idiogram was reported variations in chromosome and its size such as long arm and short arm on the basis of position of centromere. This karyotyping was done to prove it can be analyze in mitotic metaphase due to condensed and clear chromosome. By concluding that ratio of arms and absolute length Chromosomes can be differentiated on the basis of position of centromere ant present study proved that the *Aloe vera* is having chromosome number $2n=14$ and *Chlorophytum sp.* is having chromosome number $2n=16$.

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Author is highly grateful to Department of Botany, Shri Shivaji Arts, Commerce and Science College, Akot and Dr. Atul Bobadey sir for their valuable advice and assistance to complete this work.

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STUDY OF GERMINATION PERCENTAGE OF POLLEN GRAINS OF THEVETIA PERUVIANA, VINCA ROSEA AND HAMELIA PATENS FROM THE UNIVERSITY CAMPUS OF AMRAVATI.**Ashwini. B. Phokmare**

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ABSTRACT

The objective of this study was to describe germination percentage of pollen grains of *Thevetia peruviana*, *Vinca rosea* and *Hamelia patens*. In nature after successful pollination, pollen grains are germinated on the surface of stigma and to study its percentage these beneficial plants were collected from the campus. Artificial method such as Hanging drop method is used to calculate the percentage of pollen grains of these three plants. Many pollen germination medium ranging from simple sugars to complex one having vitamins, growth regulators, etc. in addition to various minerals have been standardized to germinate pollen artificially. Successful pollen germination method, procedure from pollen germination studies with *Thevetia peruviana*, *Vinca rosea* and *Hamelia patens* are discussed.

Keywords: Germination percentage, pollen germination method, sucrose solution.

INTRODUCTION

In 1824, Amici was first observed pollen germination in stigmatic tissue of *Portulaca* and later he observed the germinating pollen tube entering ovule. To the embryo of female plant, pollen acts as a vehicle. Assessing pollen viability is very crucial in artificial pollination involving different species or genera. *In vitro* pollen germination is the most reliable method among diverse techniques used to assess pollen viability.

MATERIALS AND METHODS

The flowers of *Thevetia peruviana*, *Vinca rosea* and *Hamelia patens* were collected from the University campus of Amravati. To collect pollen grains, anthers are excised from flowers and are collected in a petridish. The artificial media i.e. sucrose solution mixed with distilled water was prepared with its different concentrations 10%, 20%, 30%, 40% and 50%. Hanging drop method is used to determine *in vitro* germination. On a cavity slide a drop of a sucrose solution was taken with its different concentrations separately. Pollen grains from anther were dusted on a drop of sucrose solution. Cavity slide was covered with the help of cover slip. The cover slip was sealed with sucrose solution and slide was observed under microscope in inverted manner to observe pollens in germinating condition.

PROJECT SAMPLE

The flower of plant Species belonging to Malvaceae family which were more dominant in Academic year 2013-2014 were collected.

REQUIREMENT

Compound microscope, dissecting microscope, Cavity slide, cover slip, forceps, needle, etc.

MICROSCOPIC EXAMINATION

The microscopic examination was made under dissecting microscope as well as compound microscope. The examination was made on pollen germination percentage. The temporary slides prepared for observation of germinated as well as non-germinated pollen and slides were examined using compound microscope under 10X magnification.

OBSERVATION

In sucrose solution, pollen started germinating by producing pollen tube. Germination of pollen grains of *Thevetia peruviana*, *Vinca rosea* and *Hamelia patens* were started due to presence of sucrose solution. All these observation which is helpful in determination of germination percentage are mentioned in following observation table.

OBSERVATION TABLE

1) For *Thevetia peruviana*-

Plant Material	Concentration of sucrose solution	No. of germinated pollen grain	No. of non-germinated pollen grain	Total No. of pollen grains	% of pollen germination
Thevetia peruviana	10%	11	63	74	85.13%
	20%	20	39	59	66.10%

	30%	05	10	15	66.66%
	40%	04	08	12	66.66%
	50%	06	39	45	86.66%

2) For *Vinca rosea*-

Plant Material	Concentration of sucrose solution	No. of germinated pollen grain	No. of non-germinated pollen grain	Total No. of pollen grains	% of pollen germination
<i>Vinca rosea</i>	10%	13	117	130	90%
	20%	92	22	114	19.29%
	30%	21	142	163	87.11%
	40%	29	159	188	84.57%
	50%	27	142	169	84.02%

3) For *Hamelia patens*-

Plant Material	Concentration of sucrose solution	No. of germinated pollen grain	No. of non-germinated pollen grain	Total No. of pollen grains	% of pollen germination
<i>Hamelia patens</i>	10%	113	3	116	2.58%
	20%	91	3	94	3.19%
	30%	120	4	124	3.22%
	40%	61	6	67	8.95%
	50%	25	73	98	74.48%

CALCULATIONS

To find out germination percentage of pollen grains. Firstly the total number of pollen grain in one microscopic focus are counted. The total number of germinated pollen as well as non germinated pollen in different concentration of sucrose solution was counted. The calculation was done in terms of percentage of pollen germination.

FORMULA

$$\text{Percentage of pollen germination} = \frac{\text{Number of germinated pollen Grains}}{\text{Total Number of Pollen Grains}}$$



Thevetia peruviana



Vinca rosea



Hamelia patens

RESULT AND DISCUSSION

The present study was undertaken with a view to elucidate the pollen germination percentage in *Thevetia peruviana*, *Vinca rosea* and *Hamelia patens*. Germination of pollen grains by hanging drop method takes place in 20% and 30% of sucrose solution. Pollen viability and its germination in sucrose solution that could be exploited in improving the characterization as well as to increase the number of these plants by observing pollen germination.

CONCLUSION

The present investigation on pollen germination percentage in *Thevetia peruviana*, *Vinca rosea* and *Hamelia patens* was undertaken from Sant Gadge Baba Amravati University Campus during academic year 2014. In determining the germination percentage of pollen grains, hanging drop method by using different concentration of sucrose solution is the easiest method. Results of the present study strongly supported this approach.

ACKNOWLEDGEMENT

Author is highly grateful to Dr. Atul Bobadey sir and Dr. Prashant Gawande Sir for their valuable advice and assistance to complete this work during 2014

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ACTION OF ACACIA NILOTICA MEDICINAL PLAUUUUNT EXTRACT ON MDR BACTERIAL PATHOGENS ISOLATED FROM HUMAN URINARY TRACT.

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ABSTRACT

As Gram positive and Gram-negative bacteria both are emerging as a multidrug resistant it is tough to control these bacterial species. Some strict methodologies and definitions are given describing resistant to antimicrobial agent. In which epidemiological surveillance data has been reliably collected and compared across health care settings and countries. In a definition, multidrug resistant organisms (MDROs) are termed when such bacteria are resistant to more than one antimicrobial agent. Plants represent number of secondary metabolites as alkaloids are organic heterocyclic nitrogen rich compounds capable of forming water soluble fats. Its nitrogen, usually received from an amino acid. Further alkaloids are grouped into true alkaloids, Pseudo alkaloids and Proto alkaloids.

Key words: MDR, Bacteria, Plant secondary metabolites, alkaloids.

INTRODUCTION

Medical science has developed number of antimicrobial compounds and made it available to treat infection. This has revolutionized the therapy concept for sure. In today's scenario antibiotics have become integral part of medical therapies especially in solid organ transplantation, cutting edge surgical practices, cancer treatment and many others. Unfortunately, we are now experiencing tremendous increase in antibiotic resistance among common bacterial pathogens which has become the certain threat to the whole world. It is especially becoming the increasing concern for ill patients receiving such a therapy who are critical. In a view, now world health organization declared antibiotic resistance as one of the three most public health threat of the 21st century (WHO, 2014).

Multidrug resistance (MDR) organism infection generally increases mortality as well as economic burden which were estimated to be 20 billion dollar per year in the US only (Cosgrove, 2006; Diaz Granados et al., 2005; Sydnor and Perl, 2011). As per the report of centre for disease control and prevention about 23,000 people die annually when suffered with antibiotic resistant organisms (CDC, 2013).

As Gram positive and Gram-negative bacteria both are emerging as a multidrug resistant it is tough to control these bacterial species. In a requirement, some strict methodologies and definitions are given describing resistant to antimicrobial agent. In which epidemiological surveillance data has been reliably collected and compared across health care settings and countries. In a definition, multidrug resistant organisms (MDROs) are termed when such bacteria are resistant to more than one antimicrobial agent. Here patient suffering from these bacteria can lead to inadequate or delayed antimicrobial therapy, and in most cases leads to poor patient outcomes (Anderson et al., 2006; Cosgrove et al., 2003; Roberts et al., 2009; Ibrahim et al., 2000).

MEDICINAL PLANTS WITH ANTIBACTERIAL ACTIVITY

Alkaloids: Alkaloids are organic heterocyclic nitrogen rich compounds capable of forming water soluble fats. Its nitrogen, usually received from an amino acid. Further alkaloids are grouped into true alkaloids, Pseudo alkaloids and Proto alkaloids. In a pure form or concentrate they showcase analgesic effect; morphine alkaloids and pain relievers and generally find its application in narcotics (Savoia, 2012).

Acacia nilotica: Medicinal plant *A. nilotica* belongs to family *Mimosaceae*. It is majorly distributed in tropical and subtropical regions. It is having major medicinal value especially of its leaves, bark and pods. *A. nilotica* is useful in treatment of cough, cancer, diarrhoea, small pox, fever, piles, and menstrual problem as reported by Ambasta (1992). When prepared with different solvents like ethanol and petroleum ether extracts, plant *A. nilotica* appeared to give better antibacterial features to control pathogenic microbes such as *Pseudomonas aeruginosa*, *Mycobacterium tuberculosis*, *E. coli* and *Staphylococcus aureus* (Oladosu et al., 2013). *A. nilotica* also registered better antimicrobial activity against *Staphylococcus aureus*, *Salmonella typhi*, *E. coli* when compared to antimicrobial activity of other *Acacia* species (Saini et al., 2008).

According to Sadiq et al., (2017) exact mechanism of action of *A. nilotica* remains possible to understand. They investigated the antibacterial activity of leaf pod and bark extract and observed that minimal bactericidal

concentration of *Acacia* leaf. Hence the plant reported as promising candidate for drug discovery for future treatment.

3. MATERIALS AND METHODS

SAMPLE COLLECTION

In diagnostic laboratory labelled sterile urine bottles were kept and patients were allowed to urinate in the labelled bottles. After urine collection only, gender and date of collection of the samples was recorded. Here we did not record patients name, referring doctor, to avoid any ethical issues and to prevent leak of patient's details in any circumstances.

PLATING METHOD

Once the urine samples were collected, these samples were inoculated on the nutrient agar medium as well as on selective media such as Eosin methylene blue (EMB) agar, Mannitol salt agar (MSA), Pseudomonas isolation agar (PIA), McConkey agar (MA). Among them nutrient agar allows growth of all bacterial species and in case of EMB agar *E. coli* and *Salmonella* grows profoundly; on MSA growth of *S. aureus* was recorded; on PIA agar growth of *P. aeruginosa* was recorded and on MA growth of *Klebsiella species* has been confirmed.

Once all the plates were inoculated with the urine samples, those were allowed to grow at 37°C for 24-48 hours and in between growth of isolates as a colony was recorded as a positive growth.

MACCONKEY AGAR (MAC)

Ingredients	Grams/Litre
Gelatine peptone #	17
HMC peptone ##	3
Lactose monohydrate	10
Sodium chloride	5
Bile salts	1.5
Neutral red	0.03
Crystal violet	0.001
Agar	13.5

pH after sterilization (at 25°C) 7.1±0.2

**Formula adjusted, standardized to suit performance parameters

Pancreatic digest of gelatine

Peptones (meat and casein)

Usually, gram negative bacteria grow well and are differentiated on the ability to ferment lactose. Lactose fermenting strains grow red/pink due to the production of acid from lactose whereas, lactose non-fermenting strains such as *Shigella* and *Salmonella* are colourless. *Yersinia enterocolitica* appear small, non-lactose fermenting at room temperature.

MANNITOL SALT AGAR (MSA)

Ingredients	Grams/Litre
Peptic digest of animal tissue	5
Pancreatic digest of casein	5
Beef extract	1
Sodium chloride	75
D-Mannitol	10
Phenol red	0.025
Agar	15

pH after sterilization (at 25°C) 7.4±0.2

**Formula adjusted, standardized to suit performance parameters

S. aureus ferment mannitol and produce yellow coloured colonies with yellow zones while coagulase negative strains of *S. aureus* are generally non-fermenters hence produce pink to red colonies with purple zones.

Gram staining: All these isolates were successfully Gram stained as per the standard protocol given

Identification of Bacterial species: Based on the selective media colony characteristics and Gram staining, identified bacterial species were grouped as *Escherichia coli*, *Staphylococcus aureus*, *Salmonella aboney*, *Klebsiella species*, and *P. aeruginosa* and tested further.

Plant extract preparation: In this study, plant extract was attempted to be produced by cold treatment method in which organic solvents such as petroleum ether, ethanol and methanol was used in a pure form and water was also used as other solvent. With these four solvents, set at 30ml volume prepared and plant powder / leaf cuts were weighed about 10 grams and both kept in together in a plastic bottle/tubes for reaction up to 96 hours in a dark condition at room temperature. This incubation stage allowed the plants to release many bioactive compounds directly into the solvents which may be positive for tested antibacterial compounds. During the course of evaporation, plant extract got concentrated and settled at the bottom as a layer which was scrapped off as it gets completely dried off and stored in an air tight bottle.

Antibacterial properties of plant extract: The potential of *A. nilotica* as an antibacterial agent when their plant extracts prepared in solvents such as petroleum ether, methanol, ethanol and distilled water. In a preparation, different plant part-based extracts were tested against *E. coli*, *K. pneumoniae*, *S. aureus*, *P. aeruginosa* and *S. enterica* strains by using well diffusion method. Here each organism was one day before by inoculation allowed to grow in a nutrient agar broth and kept on incubating at 37°C for 24 hrs. On a next day, obtained growth recorded as turbidity was set at 1 O.D. as per spectrophotometric analysis when light band set at 620nm.

4. RESULT AND ANALYSIS

1) ISOLATION AND IDENTIFICATION OF BACTERIAL ISOLATES

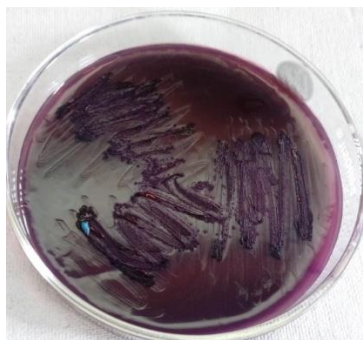
Based on the routine urine samples collection followed by screening of them on various nutrient and selective media prominently five bacterial species were obtained and those were identified as *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Salmonella enterica*. The success of this isolation can be attributed to the selective media such as Eosin methylene blue, mannitol salt agar, *Pseudomonas* isolation agar and Mc Conkey agar on which when urine sample inoculated, bacteria positive urine samples developed some typical colonies which have been easily identified.

Table 1: Gram staining results for the promising isolates

Sr. No.	Bacteria	Colour	Gram staining	Shape
1	<i>Escherichia coli</i>	Pink	gm-ve	Cocco bacilli shaped
2	<i>Staphylococcus aureus</i>	Purple	gm+ve	cocci shaped
3	<i>Pseudomonas aeruginosa</i>	Pink	gm-ve	rod shaped
4	<i>Klebsiella pneumoniae</i>	Pink	gm-ve	rod shaped
5	<i>Salmonella enterica</i>	Pink	gm-ve	rod shaped

Table 2: Colony characteristics recorded for the isolates grown on different media isolated from urine samples

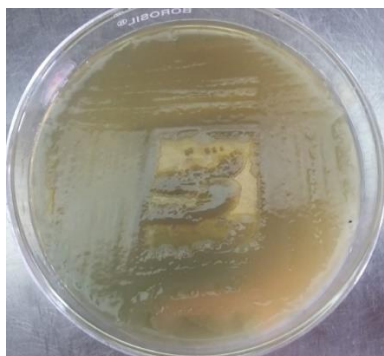
Sr. No.	Bacteria	Media	Cultural characteristics
1	<i>E. coli</i>	Eosin Methylene Blue (EMB)	dark purple colonies with green metallic sheen
2	<i>S. aureus</i>	Mannitol Salt Agar (MSA)	circular, yellow colonies
3	<i>P. aeruginosa</i>	<i>Pseudomonas</i> Isolation Agar (PIA)	colourless/cream colonies,
4	<i>K. pneumoniae</i>	Macconkey Agar (Mac)	circular, Pink-red colonies
5	<i>S. enterica</i>	Eosin Methylene Blue (EMB)	purple colonies



E. coli



S. aureus



P. aeruginosa



K. pneumoniae



Fig. 1 : Typical colonies of representative isolates recorded on the selective/ differential media

COLLECTION OF PLANTS

In the present study it has been evident that urine sample remained positive for the number of MDR bacterial pathogens and those were attempted to be controlled by using medicinal plant with their selected parts such bark and leaves Babool- *Acacia nilotica* Fig. 2

This plants were collected from the region of Gondia district, Maharashtra, India as shown in Fig. 4 a-d.



Fig. 2: Collection of plant parts of *Acacia nilotica* (Babool)

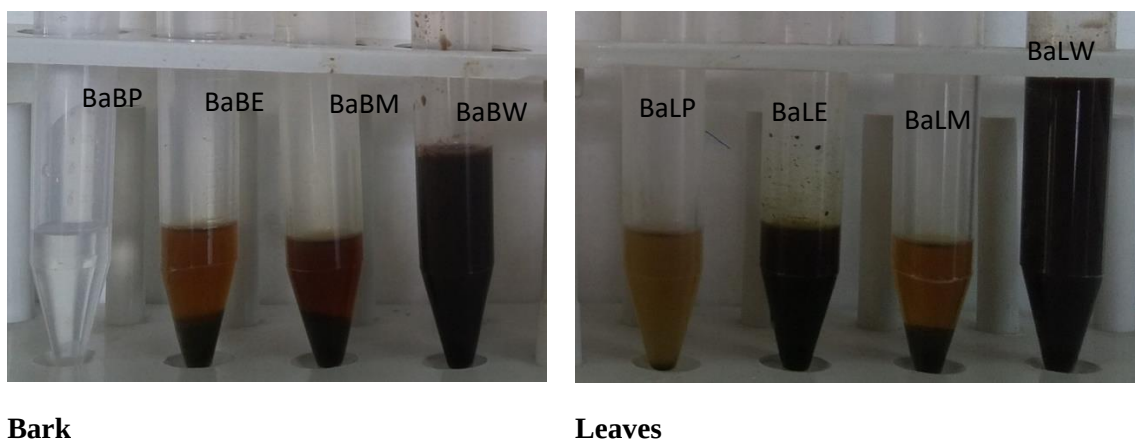
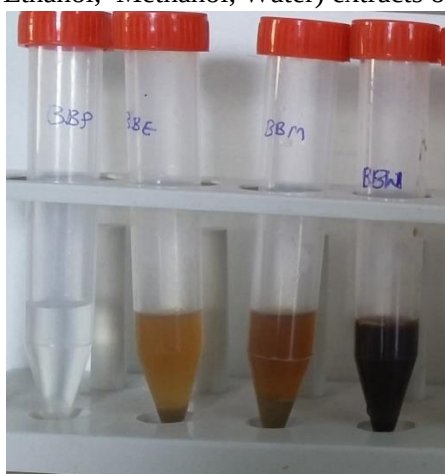


Fig. 3: (Petroleum ether, Ethanol, Methanol, Water) extracts of *Acacia nilotica* (Babool)

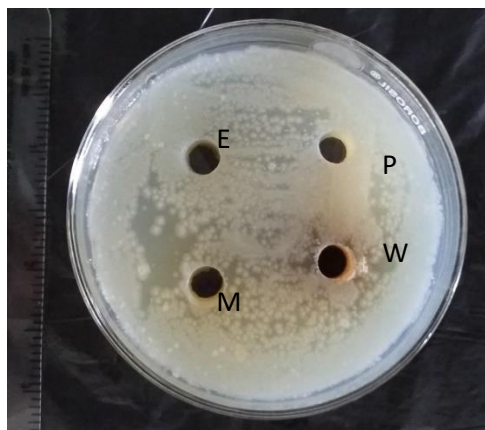


2) ANTIBACTERIAL ACTIVITY OF PLANT EXTRACTS:

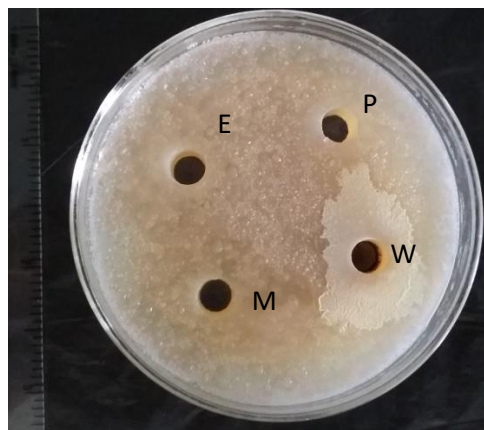
In first set of study plants featured with antibacterial activity was carried out. Here ability of all prepared extracts of medicinal plant *Acacia nilotica* as MDR controlling agent has been tested by well diffusion method.

MDR bacterial isolates such as *E. coli*, *S. aureus*, *Pseudomonas aeruginosa*, *Klebsiella sp.*, and *S. enterica* one each strain was selected out of 50 isolates when mass screened.

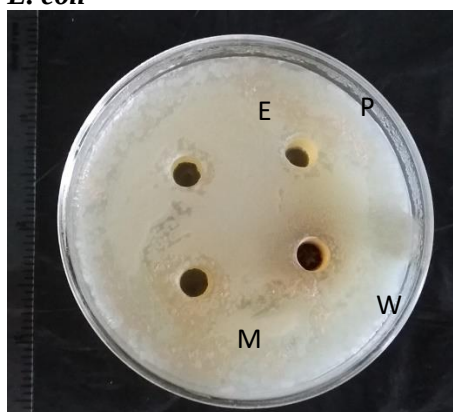
In a test result, with the plant extract concentration (0.03 mg/100 μ l) loaded in a well with respective pathogens on agar. Overall result showcased the better antibacterial activity of *Acacia nilotica* (Babool) inhibitions results after performing antibacterial activity where in case of bark and leaf no zone of inhibition was observed.



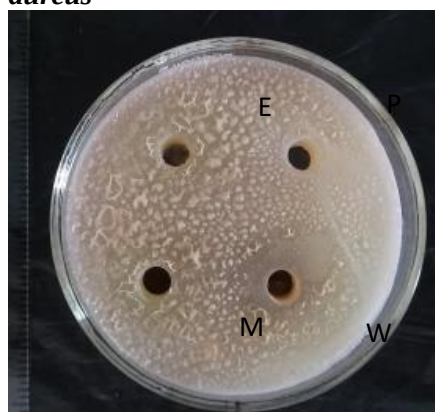
Antimicrobial activity of bark extracts against *E. coli*



Antimicrobial activity of bark extracts against *S. aureus*



Antimicrobial activity of bark extracts against *P. aeruginosa*



Antimicrobial activity of bark extracts against *K. pneumoniae*

In *A. nilotica* set, bark and leaves extract when treated with MDR bacteria such as *E. coli*, *S. aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *S. enterica* remained sensitive to inhibition.

In *A. nilotica* set, bark and leaves extract when treated with MDR bacteria such as *E. coli*, *S. aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *S. enterica* remained sensitive to inhibition.

5. DISCUSSION

Present study successfully reported that urine samples of infected patients found to be positive for the presence of *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Salmonella enterica* irrespective of gender as male and female.

Presence of *Escherichia coli* in the urine sample has been confirmed by inoculating it on Eosin methylene blue agar medium. This media is able to give typical colony characters as dark purple colony with green metallic sheen which is a featured marker of *E. coli*.

In a similar report success of Eosin methylene blue (EMB) agar for the isolation of *E. coli* has been reported when inoculated with food sample. They also reported that *E. coli* strains remained present for virulence genes when detected by polymerase chain reaction especially for *elt* gene (Barbosa et al., 2018).

In the present study isolation of *S. aureus* from the urine sample has been made possible by inoculating it on Mannitol salt agar which has been detected by circular yellow colonies as representative of *S. aureus*.

Similar to the present study, Adame-Gómez et al., (2018) reported the presence of Methicillin-resistant *Staphylococcus aureus* remain present in unpasteurized cow milk cheese samples when inoculated on Mannitol salt agar medium. In many reports use of Mannitol salt agar for the isolation of *S. aureus* has been reported when inoculated with different sample types such as isolation of *Methicillin resistant S. aureus* (MRSA).

Overall study using selective media for the isolation of these five pathogens recorded a success that UTI infection does carry these pathogens and needs to be analysed for antibiotic resistance in the next step.

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IMPACT OF FOLIAR SPRAYS OF CHITOSAN AND IBA ON CHEMICAL , BIOCHEMICAL AND YIELD CONTRIBUTING PARAMETERS OF PIGEONPEA

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ABSTRACT

The Physiological response of foliar sprays of chitosan (25, 50, 75 ,100 and 125 ppm) and IBA (25, 50, 75 ,100 and 125 ppm) on the chemical, biochemical and yield contributing parameters of pigeonpea cv.PKV-Tara was studied during kharif 2017-2018 at farm of Botany section, College of Agriculture, Nagpur. Experiment was laid out in RBD design with three replications and eleven treatments. Spraying of chitosan and IBA was done two times i.e. on 45 and 65 DAS. Observations about chemical and biochemical parameters like leaf chlorophyll, N, P, K content in leaves, protein content in seed were also estimated. Observations on yield contributing parameters like 100 seed weight, number of pods plant⁻¹, number of seeds pod⁻¹, seed yield plant⁻¹, plot⁻¹ were recorded. Foliar sprays of 25 ppm IBA followed by 50 ppm chitosan significantly enhanced chemical and biochemical parameters and yield contributing parameters when compared with control and rest of the treatments under study.

Keywords: Pigeonpea, chitosan, IBA, foliar application, morpho-physiological parameters, yield

INTRODUCTION

Pulses are important constituent of Indian diet. It is an important grain legume of the semiarid region and tropics area and forms a significant component of the diet of vegetarians. According to binomial classification pigeonpea name as (*Cajanus cajan* L. Millsp.) is a important legume and belongs to family *Leguminosae* and genus *cajanus*. *Cajanus* is derived from Malay word 'katschang' or 'katjang' meaning pod or bean. According to FAO pigeonpea is also known as Red gram, tur, arhar, dal (India). Pigeonpea having high drought tolerance and the ability to use residual moisture during the dry season make it an importance crop. It is often cross pollinated crop (20 to 70 %) with diploid chromosome number 2n=22. Pigeonpea is divided into two botanical varieties "var flavr" and "var bicolor". The cultivar of variety flavus are earlier maturing, shorter plants with yellow standard and green globrous pods which are light coloured in the peninsula. The cultivar of variety bicolor are perennial, late maturing large bushy plants with dorsal side of standard red or purple or streaked with these colours and hairy pods blotched with maroon or dark coloured or speckled when ripe.

The importance of legume ranged from food to fodder and also ornamentals. Legumes also play a vital role in biological nitrogen fixation Green legume (pulses) are an important source of dietary protein, fiber and calories. Interest in this crop is growing in many countries because of its multiple uses as source of food, livestock fodder and also improves soil fertility. Pigeonpea is nutritionally important as it contains protein 22.3 %, fat 1.7 %, calcium 7.3 mg, thiamine 0.45 mg, riboflavin 0.19 mg, niacin 2.9 mg. Besides this they are also the sources of minerals and some vitamins

Plant growth regulators are substances when added in small amounts modify the growth of plant usually by stimulating or inhibiting part of the natural growth regulation. They are considered as new generation of agrochemicals after fertilizers, pesticides and herbicides. Plant growth regulators are capable of increasing yield by 100-200 per cent under laboratory conditions, 10 -15 per cent in the field conditions. Plant growth regulators like promoters, inhibitors or retardants play a key role in internal control mechanism of plant growth by interacting with key metabolic processes such as nucleic acid and protein synthesis. The most commonly used growth regulators in pigeonpea are IBA, chitosan, Ethrel, cycocel, salicyclic acid, IAA, GA3 etc. are enhancing growth and productivity of crop plants.

MATERIALS AND METHODS

Considering the above fact present work was undertaken to study the response of chitosan and IBA on chemical, biochemical and yield contributing parameters. Experiment was laid out in randomized block design with eleven treatments and three replications. Plot size of individual treatment was gross 4.20 m x 4.40 m and net 3.0 m x 4.0 m. Seeds were sown at the rate of 20 kg ha⁻¹ by dibbling method at spacing of 60 cm x 20 cm on 1st July 2017. Treatments comprised of control (T₁), 25 ppm chitosan (T₂), 50 ppm chitosan (T₃), 75 ppm chitosan (T₄), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 25 ppm IBA (T₇), 50 ppm IBA (T₈), 75 ppm IBA (T₉), 100 ppm IBA (T₁₀), 125 ppm IBA (T₁₁). The foliar application of chitosan and IBA was given at two stages i.e. at 45 and 65

DAS on pigeonpea. Observations on chemical and biochemical parameters were recorded at 45, 65, 85 and 105 DAS and yield contributing parameters were recorded after harvesting. The crop was kept free from disease and pest during the growth period. Harvesting was undertaken after the crop attained maturity. Data were analysed by statistical method suggested by Panse and Sukhatme (1954).

RESULTS AND DISCUSSION

Chlorophyll content in leaves

Data clearly indicated that, the chlorophyll content was varied at 45 DAS. Significantly highest chlorophyll content was recorded in treatments 25 ppm IBA (T₇) and 50 ppm chitosan (T₃) followed by treatments 50 ppm IBA (T₈), 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) in a descending manner when compared with control (T₁).

At this stage (65 DAS) the leaf chlorophyll content was varied from 0.956-1.311 in which treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃), 50 ppm IBA (T₈) and 75 ppm chitosan (T₄) increased chlorophyll content significantly than other treatments. Whereas, treatments 75 ppm IBA (T₉) and 100 ppm chitosan (T₅) also increased chlorophyll content. But treatments 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂), 125 ppm IBA (T₁₁) were found at par with control (T₁) in chlorophyll content.

At 85 DAS chlorophyll content in leaves ranged from 1.111-1.357. The chlorophyll content was highest in treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃) and 50 ppm IBA (T₈) over control (T₁) and rest of the treatments. Similarly treatments 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀) and 25 ppm chitosan (T₂) were also increased chlorophyll content significantly. Treatment 125 ppm IBA (T₁₁) was found at par with control (T₁) in chlorophyll content.

At 105 DAS chlorophyll content was reduced than that of chlorophyll content at 65 DAS and 85 DAS. At 105 DAS maximum chlorophyll content was noted in treatment 25 ppm IBA (T₇) and 50 ppm chitosan (T₃). The next best in order of merit were treatments 50 ppm IBA (T₈), 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆) and 100 ppm IBA (T₁₀). But treatments 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) were found at par with control (T₁) in chlorophyll content at this stage of observation.

Shraiy and Hegazi (2009) conducted an experiment to study the effect of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-butyric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly increased total chlorophyll in leaves.

Farouk and Amany (2012) reported that foliar application of chitosan @ 250 ppm under water stress conditions significantly enhanced chlorophyll content of cowpea plant.

Leaf nitrogen content

The best results related to leaf nitrogen content obtained at 45 DAS in treatments 25 ppm IBA (T₇) and 50 ppm chitosan (T₃) followed by treatments 50 ppm IBA (T₈), 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂). But treatment 125 ppm IBA (T₁₁) was found at par with control (T₁) in leaf nitrogen content (T₁).

The result obtained during investigation leaf nitrogen at 65 DAS was significantly enhanced by the treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃), 50 ppm IBA (T₈). Next to these treatments the treatments 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) also increased leaf nitrogen content significantly. Whereas treatment 125 ppm IBA (T₁₁) was found at par with control (T₁) in leaf nitrogen content.

At 85 DAS significantly highest leaf nitrogen content was observed in treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃) followed by treatments 50 ppm IBA (T₈), 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) when compared with control (T₁).

Nitrogen content at 105 DAS was decreased than that of 85 DAS observation but in which treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃) and 50 ppm IBA (T₈) were significantly increased nitrogen content over control (T₁). Rest to the treatments viz., 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) also increased nitrogen content significantly over control except treatment 125 ppm IBA (T₁₁).

Amin *et al.* (2013) tested two plant growth regulators putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l⁻¹ applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l⁻¹ significantly enhanced nitrogen of chickpea (*Cicer arietinum* L.).

Sharifa (2013) carried out a field experiment on common bean to study the effect of different concentrations of chitosan (100, 200 and 400 ppm) and found that foliar application of 200 ppm chitosan increased inorganic nitrogen content in leaves.

Leaf phosphorus content

Phosphorus is an important constituent of protoplasm and nucleic acid and protein also, it is essential for the formation of grain.

Data pertaining to phosphorus content in leaves were estimated at four stages of observations i.e. 45, 65, 85 and 105 DAS. Phosphorus has been recognized as an important environmental factor limiting crop growth and production. Significant results were recorded at all the stages of observations.

Data indicates that at 45 DAS treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃) and 50 ppm IBA (T₈) were found superior over rest of the treatments in leaf phosphorus content. Similarly treatments 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂), 125 ppm IBA (T₁₁) also increased phosphorus content significantly over control (T₁).

At 65 and 85 DAS the highest value was recorded in treatment 25 ppm IBA (T₇). Similarly remaining treatments under study viz., 50 ppm chitosan (T₃), 50 ppm IBA (T₈), treatments 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) were also showed their significance over control (T₁) in phosphorus content.

At 105 DAS the best and significant results were obtained in treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃), 50 ppm IBA (T₈), 75 ppm chitosan (T₄) and 75 ppm IBA (T₉). Two treatments viz., 100 ppm chitosan (T₅) and 125 ppm chitosan (T₆) also increased leaf phosphorus content significantly over rest of the treatments and control. Treatments 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) could not achieve their target and were found at par with control (T₁).

Amin *et al.* (2013) studied two plant growth regulators viz., putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l⁻¹, applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l⁻¹ significantly increased phosphorus content of chickpea (*Cicer arietinum* L.).

Deotale *et al.* (2016) applied putrescine and IBA (50, 75, 100, 125 and 150 ppm each) with one control on soybean and observed that two foliar sprays of 100 ppm putrescine and 100 ppm IBA at two stages i.e. before flowering and 10 days after flowering were found to be most effective in enhancing phosphorus content in leaves.

Leaf potassium content

At 45 DAS was significantly maximum in treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃) and 50 ppm IBA (T₈), followed by treatments 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) when compared with control (T₁).

It is evident from experiment at findings that at 65 and 85 DAS significantly maximum potassium content was noticed in treatment 25 ppm IBA (T₇). Other treatments viz., 50 ppm chitosan (T₃), 50 ppm IBA (T₈), 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆), 100 ppm IBA (T₁₀), 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) also enhanced potassium content significantly over control (T₁).

The trend indicates that significantly maximum potassium content at 105 DAS was noted in treatments 25 ppm IBA (T₇), 50 ppm chitosan (T₃) and 50 ppm IBA (T₈), followed by treatments 75 ppm chitosan (T₄), 75 ppm IBA (T₉), 100 ppm chitosan (T₅), 125 ppm chitosan (T₆) and 100 ppm IBA (T₁₀). But treatments 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) were found at par with control (T₁) in potassium content.

Farouk and Amany (2012) observed that foliar application of chitosan @ 250 ppm under water stress conditions significantly increased inorganic potassium content of cowpea plant.

Amin *et al.* (2013) test two plant growth regulators i.e. putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l⁻¹, applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l⁻¹ significantly enhanced potassium content of chickpea (*Cicer arietinum* L.).

Protein content in seeds

Data revealed that significantly higher protein content was observed in treatment 25 ppm IBA (T₇) , remaining treatments also showed significant and positive response [50 ppm chitosan (T₃) , 50 ppm IBA (T₈) , 75 ppm chitosan (T₄) , 75 ppm IBA (T₉) , 100 ppm chitosan (T₅) , 125 ppm chitosan (T₆) , 100 ppm IBA (T₁₀) , 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁)] when compared with control (T₁) .

Shraiy and Hegazi (2009) carried out an experiment to study the effect of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-butyric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly increased protein content.

Sharifa (2013) formulated a field experiment on common bean to study the effect of different concentrations of chitosan (100, 200 and 400 ppm) and observed that foliar application of 200 ppm chitosan increased protein content.

Yield and yield contributing parameters

Grain yield and its related parameters in pigeonpea were influenced by the application of growth regulators which have different influence on the allocation of assimilates between vegetative and reproductive organs. In general crop yield depends on the accumulation of photo-assimilates during the growing period and the way they are partitioned between desired storage organs of plant. In present study, it is revealed that the application of plant growth regulators significantly increased the number of grains, 100 grain weight and finally grain yield determining components in pigeonpea.

Number of pods plant⁻¹

The highest number of pods plant⁻¹ were recorded in treatment receiving 25 ppm IBA (T₇) . The range of pods plant⁻¹ was 145.8 pods in control (T₁) to 256.60 pods in treatment 25 ppm IBA (T₇). Number of pods plant⁻¹ also increased significantly in treatments 50 ppm chitosan (T₃) , 75 ppm chitosan (T₄) , 75 ppm IBA (T₉) , 100 ppm chitosan (T₅) , 125 ppm chitosan (T₆) , 100 ppm IBA (T₁₀) , 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) when compared with control (T₁) .

Shraiy and Hegazi (2009) studied the effect of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-butyric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly increased number of pods plant⁻¹.

Mondal *et al.* (2013) tested different concentrations of chitosan viz., 0 (control), 25, 50, 75 and 100 ppm at 25 and 35 DAS. They observed that foliar application of chitosan @ 50 ppm on mungbean significantly increased number of pods plant⁻¹ over control.

Number of seeds pod⁻¹

In general it can be said that foliar application of chitosan and IBA significantly enhanced number of seeds pod⁻¹ when compared with control. Treatments 25 ppm IBA (T₇) , 50 ppm chitosan (T₃) and 50 ppm IBA (T₈) significantly increased number of seeds pod⁻¹. Treatments 75 ppm chitosan (T₄) , 75 ppm IBA (T₉) , 100 ppm chitosan (T₅) , 125 ppm chitosan (T₆) , 100 ppm IBA (T₁₀) , 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) also showed their significance over control (T₁) in respect of number of seed pod⁻¹ .

Shraiy and Hegazi (2009) tried different concentrations of acetyl salicylic acid (ASA) @ 10 and 20 ppm, indole-3-butyric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly increased seeds number pod⁻¹ over control.

Mondal *et al.* (2013) applied different concentrations of chitosan viz., 0 (control), 25, 50, 75 and 100 ppm at 25 and 35 DAS. They observed that foliar application of chitosan @ 50 ppm on mungbean significantly increased seeds pod⁻¹ over control.

Test weight

It is evident from table that significantly maximum 100 seed weight was recorded in treatments 25 ppm IBA (T₇) followed by treatments 50 ppm chitosan (T₃) , 50 ppm IBA (T₈) , 75 ppm chitosan (T₄) and 75 ppm IBA (T₉). But treatments 100 ppm chitosan (T₅) and 125 ppm chitosan (T₆) , 100 ppm IBA (T₁₀) , 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) were found at par with control (T₁) in test weight .

Shraiy and Hegazi (2009) tested the impact of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-butyric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly enhanced 1000 seeds weight over control.

Wagh (2015) tested different concentrations of putrescine and IBA (0, 50, 75, 100, 125 and 150 ppm) on soybean sprayed at 30 and 45 DAS. He observed that two foliar sprays of putrescine and IBA @ 100 ppm significantly increased 100 seed weight.

Seed yield

Seed yield is the economic yield which is final result of physiological activities of plant. Economic yield is the part of biomass that is converted into economic product. (Nichiporovic, 1960).

Seed yield and its related parameters were influenced by the application of different growth regulators in pigeonpea which indicated that these chemicals have differential influence on the allocation of assimilates between vegetative and reproductive organs. In general, crop yield depends on the accumulation of photo-assimilates during the growing period and the way they are partitioned between desired storage organs of plant. In the present study, it can be inferred that the application of PGRs significantly increased the number of pods, 100-seed weight and finally seed yield plant⁻¹, plot⁻¹ which are the most important yield determining components in pigeonpea .

The significantly maximum seed yield plant⁻¹, plot⁻¹ were recorded in treatment 25 ppm IBA (T₇) followed by treatments 50 ppm chitosan (T₃) , 50 ppm IBA (T₈) , 75 ppm chitosan (T₄), 75 ppm IBA (T₉) and 100 ppm chitosan (T₅) . Remaining treatments 125 ppm chitosan (T₆) , 100 ppm IBA (T₁₀) , 25 ppm chitosan (T₂) and 125 ppm IBA (T₁₁) were found at par with control (T₁) .

Amin *et al.* (2013) studied the effect of two plant growth regulators putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l⁻¹ applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l⁻¹ significantly increased seed yield of chickpea (*Cicer arietinum* L.).

Rabbi *et al.* (2016) formulated an experiment to study the effect of chitosan (0, 25, 50, 75 and 100 ppm) on mungbean sprayed at 30 and 40 DAS. Results showed that application of chitosan @ 50 ppm significantly enhanced seed yield.

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Table 1: Effect of chitosan and IBA on chemical and biochemical parameters of pigeonpea

Treatments	Leaf chlorophyll content				Leaf nitrogen content				Leaf phosphorus content				Leaf phosphorus content				Seed protein content
	45 DAS	65 DAS	85 DAS	105 DAS	45 DAS	65 DAS	85 DAS	105 DAS	45 DAS	65 DAS	85 DAS	105 DAS	45 DAS	65 DAS	85 DAS	105 DAS	
T ₁ (Control)	0.754	0.956	1.111	0.413	2.049	2.203	2.373	2.376	0.300	0.796	0.616	0.632	0.615	0.456	0.617	0.641	15.22
T ₂ (25 ppm Chitosan)	0.946	1.033	1.192	0.541	2.226	3.046	3.113	3.190	0.319	0.831	0.693	0.654	0.755	0.511	0.726	0.655	18.18
T ₃ (50 ppm Chitosan)	1.059	1.217	1.328	1.066	2.596	3.804	3.916	3.761	0.364	0.912	0.811	0.776	0.916	0.583	0.871	0.791	24.17
T ₄ (75 ppm Chitosan)	1.006	1.171	1.294	0.741	2.376	3.471	3.556	3.593	0.346	0.870	0.746	0.759	0.888	0.559	0.759	0.772	21.04
T ₅ (100 ppm Chitosan)	0.987	1.114	1.253	0.717	2.325	3.316	3.406	3.550	0.330	0.862	0.725	0.713	0.860	0.537	0.737	0.731	19.93
T ₆ (125 ppm Chitosan)	0.980	1.079	1.229	0.673	2.293	3.193	3.356	3.453	0.322	0.852	0.717	0.697	0.845	0.534	0.734	0.709	18.88
T ₇ (25 ppm IBA)	1.078	1.311	1.357	1.192	2.686	3.873	4.146	3.976	0.367	0.947	0.908	0.786	0.924	0.605	0.892	0.799	25.35
T ₈ (50 ppm IBA)	1.027	1.212	1.333	0.891	2.383	3.661	3.643	3.703	0.356	0.874	0.750	0.766	0.911	0.574	0.783	0.785	21.27
T ₉ (75 ppm IBA)	0.998	1.148	1.275	0.718	2.376	3.363	3.413	3.573	0.344	0.863	0.733	0.747	0.868	0.547	0.747	0.758	19.98
T ₁₀ (100 ppm IBA)	0.963	1.043	1.197	0.647	2.262	3.176	3.291	3.256	0.320	0.839	0.714	0.667	0.834	0.521	0.731	0.663	18.67
T ₁₁ (125 ppm IBA)	0.866	0.981	1.147	0.476	2.063	2.836	2.816	2.706	0.314	0.814	0.684	0.642	0.716	0.488	0.709	0.646	18.07
SE (m) ±	0.0147	0.0518	0.019	0.057	0.033	0.082	0.106	0.111	0.0041	0.0054	0.0057	0.0141	0.0097	0.0041	0.0097	0.0060	0.324
CD at 5%	0.0436	0.1530	0.056	0.168	0.098	0.243	0.314	0.327	0.0120	0.0160	0.0168	0.0416	0.0288	0.0123	0.0286	0.0179	0.958

Table 2: Effect of chitosan and IBA on yield and yield contributing parameters of pigeonpea

Treatments	Number of pods plant ⁻¹	Number of seeds pod ⁻¹	Test weight (g)	Seed yield plant ⁻¹ (g)	Seed yield plot ⁻¹ (kg)
T ₁ (Control)	145.58	3.31	9.16	12.25	1.225
T ₂ (25 ppm Chitosan)	181.54	3.54	9.72	13.04	1.304
T ₃ (50 ppm Chitosan)	246.47	3.93	11.81	16.51	1.651
T ₄ (75 ppm Chitosan)	230.53	3.84	10.72	14.33	1.433
T ₅ (100 ppm Chitosan)	208.43	3.73	10.05	14.07	1.407
T ₆ (125 ppm Chitosan)	194.58	3.65	9.80	13.83	1.383
T ₇ (25 ppm IBA)	256.60	4.00	12.89	17.88	1.788
T ₈ (50 ppm IBA)	237.69	3.94	10.79	15.28	1.528
T ₉ (75 ppm IBA)	222.47	3.75	10.67	14.17	1.417
T ₁₀ (100 ppm IBA)	188.44	3.63	9.75	13.54	1.354
T ₁₁ (125 ppm IBA)	161.48	3.53	9.73	13.02	1.302
SE (m) ±	0.558	0.041	0.308	0.613	0.062
CD at 5%	1.648	0.121	0.910	1.578	0.153

APPLICATION OF REMOTE SENSING AND GIS FOR SITE SUITABILITY OF RAIN WATER HARVESTING STRUCTURES

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ABSTRACT

Site suitability studies for rainwater harvesting structures are an integral part of watershed management. It needs a large volume of multidisciplinary data from various sources. Remote sensing is of immense use for natural resources mapping and generating necessary spatial database required as input for GIS analysis. GIS is an ideal tool for collecting, storing and analyzing spatial and non - spatial data, and developing a model based on existing factors to arrive at a suitable natural resources development and management action plans. Both these techniques in conjunction with each other are the most efficient tools for selecting suitable sites for rain water harvesting structures. In the present study, an integrated remote sensing and GIS based methodology is adopted for identifying the suitable sites for rain water harvesting structures in the chosen study area located in the Solani watershed of Dehradun District, Uttarakhand, India. IRS-1D P6 - LISS III & IV precision geocoded FCC data on 1:50,000 scale and field observation data were used for extracting thematic information such as geomorphology, geological structures, soil, landuse landcover, well locations, drainage pattern etc. of the area. Slope map and flow accumulation maps were prepared using Survey of India toposheets on 1:50,000 scale. The various thematic layers and field observation data were integrated into GIS and various spatial and non spatial queries were performed. The suitable sites for installation of artificial recharge structures and water harvesting structures were identified.

Keywords: watershed, rain water harvesting, remote sensing, GIS, farm pond, check dam, DEM, stream order, barren land.

INTRODUCTION

Watershed management is an integrated effort for increasing production through better utilization of primary resources without causing any adverse effect on the ecological balance. The watershed approach has conventionally aimed at treating degraded lands with the help of low cost and locally accessed technologies such as in situ soil and moisture conservation measures, afforestation etc. and through a participatory approach that seeks to secure close involvement of the user communities. Watershed management has been defined as an integration of technologies within natural boundaries of a drainage area for optimum development of land and water resources to meet the basic minimum needs of the people in a sustainable manner. The concept of integrated treatment of all lands on watershed basis was adopted and implemented by the Damoder Valley Corporation in the areas of Bihar and West Bengal (Guy Honore 1999). Integration of remote sensing and geographical information system (GIS) provides a reliable, accurate and update database on land and water resources which is prerequisite to identify suitable site for water harvesting such as farm pond, check dams, percolation tanks and gully plugs (I.P. Abrol, Dhurv Narayan et. al. 1997).

A large number of techniques have been recently evolved for the watershed management. After a considerable amount of experimentation and model building, it has been felt that these techniques have to be integrated in a comprehensive manner. Remote sensing and GIS technology provide a ground for integrating the various parameters over a geographical platform with high and analytical capabilities, like the location of feature over space and time, the patterns and trends of development and different analytical permutation and combination.

Remote sensing and GIS are valuable tools for generating and analyzing this thematic information (Ouattara et.al 2004). Harvested water can be used for variety of purposes when the common sources such as: springs or well fails to meet the demand. In addition to supplying drinking water for people, livestock and wildlife; water harvesting system can provide supplemental water for growing food and fibre crops (Verma et.al.1995). Water harvesting can be done at domestic level it is a common practice to harvest rainwater from roofs, hillrock surfaces and store it in tanks or to recharge the groundwater. Jeykumar (2001), Hannah (2001), and Adhitayan (2001) discuss the methodology of roof water harvesting and its use. At society level, water harvesting can be done at large level to meet the local irrigation and drinking demand for some extent by constructing check dams and farm ponds and percolation tanks etc. Durgaroa et.al.(2001) demonstrated the role of remote sensing and geographical information system (GIS) in selecting suitable sites for water harvesting structures. Raju has proposed an innovative design for some water harvesting structures such as check dams and percolation tanks.

Verma et.al.(1995) and IMSD(1995)suggested some guide lines for identifying suitable sites for water harvesting structures.

The use of remote sensing and Geographical Information System (GIS) methodology is well suited for the quantification of heterogeneity in the topographic and drainage features of a catchment (Shamsi, 1996; Rodda *et al*, 1999). The objectives of this project were to use Remote sensing and GIS for the site suitability for rainwater harvesting in Solani watershed depending on the physical characteristics of watershed as slope, land use and H.S.G. type, all of which affect to collect rainwater in various structures in the different sub-watersheds of a catchment.

STUDY AREA

The study area for the analysis is Solani watershed (Figure 3), which is a subwatershed of Ganga River – the largest river in India. Solani watershed is located between 29° 47' 57"-30° 16' 16" N and 77° 44' 05"-78° 04' 26" E latitude. The area is about 577 km². Elevation varies from 252 m (lower plat agriculture lands) to 908 m (upper hilly area). Administratively Solani watershed belongs to Uttarakhand and partly Uttar Pradesh.

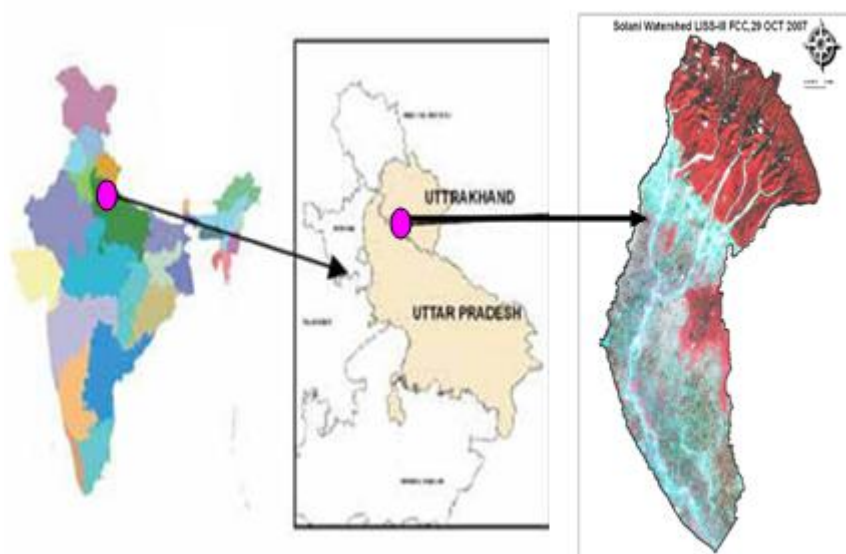


Figure 1: Location of Solani watershed

In terms of topography, Solani watershed has three major types of terrains: hill, piedmont and plain. The hills are Siwalik range, located at northern margin of watershed; elevation ranges approximately from 252 to 908 m . The Siwalik range is composed of a gentle northern slope and steeper southern slope. The plains are bordered by the mountain which is major character of the watershed. Solani River emerges from the Siwalik range, length of the main river is 45 km. Kaluwala, Chillawal, Shahjahanpur and Mohan rivers are some of the major tributaries of Solani main river.

The study area experiences sub-tropical monsoonal type of climate. Most of the rainfall occurs during the period June-September (Indian monsoon season) and annual precipitation varies from 1200 to 1500 mm. About 84% of the season is associated with the western disturbances across the northern latitudes. The surface winds in winter are westerly to northern-westerly. Average maximum temperature varies between 20-40°C and relative humidity varies from 35 to 80%. On the basis of the existing weather conditions the area has been divided into four seasons: 1) winter (December-February); 2) summer (March-May); 3) south-west monsoon (June-September); 4) post-monsoon (October-November).

OBJECTIVES

The broad objective of the study is to test application of GIS for the location of suitable sites for construction of different water harvesting structures. The main objectives of the study can be delineated as under:

- Generation of various thematic parameters.
- Identification of suitable sites for farm pond.
- Identification of suitable sites for check dam.
- To develop a set of Geodata-base for any watershed for testing the application in real world.

METHODOLOGY

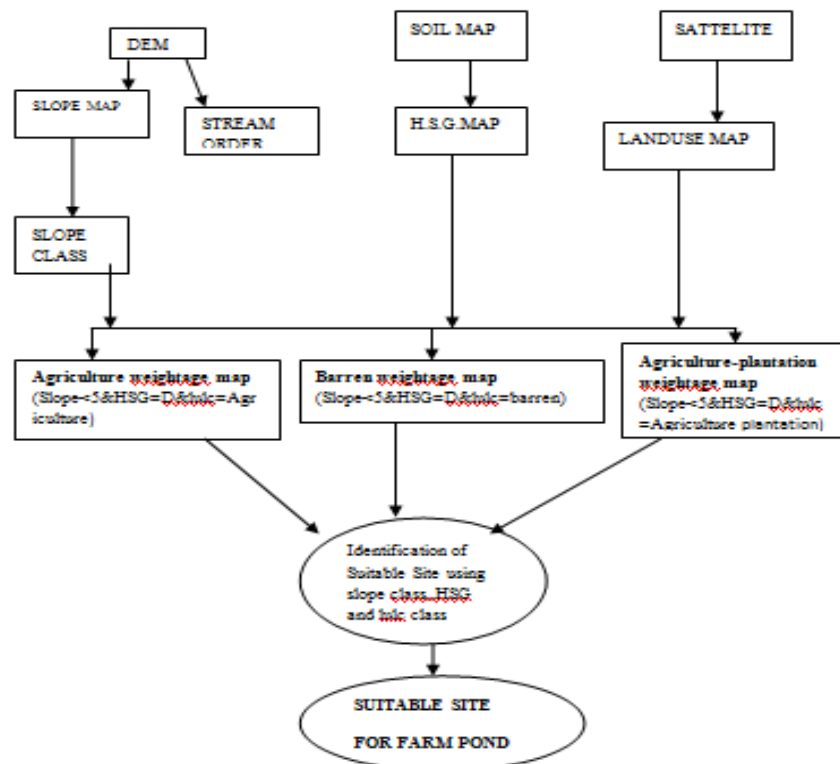


Figure 2 : Methodology

In the present study, an integrated remote sensing and GIS based methodology is adopted for identifying the suitable sites for rain water harvesting structures in the chosen study area located in the Solani watershed of Dehradun District, Uttarakhand, India. IRS-1D P6 - LISS III & IV precision geocoded FCC data on 1:50,000 scale and field observation data were used for extracting thematic information such as geomorphology, geological structures, soil, land use land cover, well locations, drainage pattern etc. of the area. The comprehensive methodology of this study is described above in figure- 2.

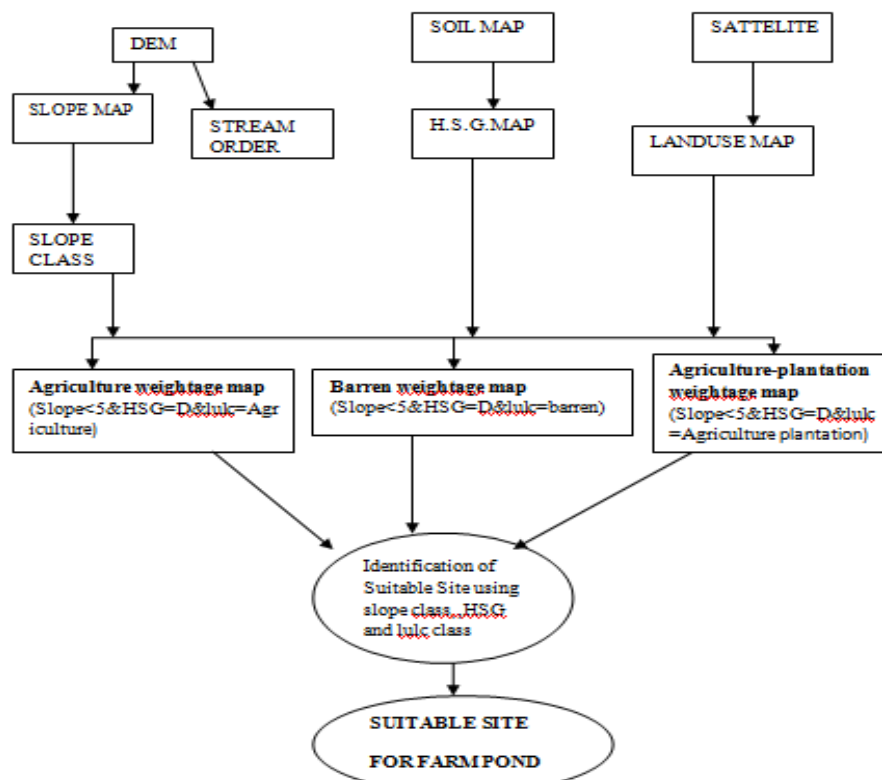


Figure-3. Flow diagram of site selection for farm ponds.

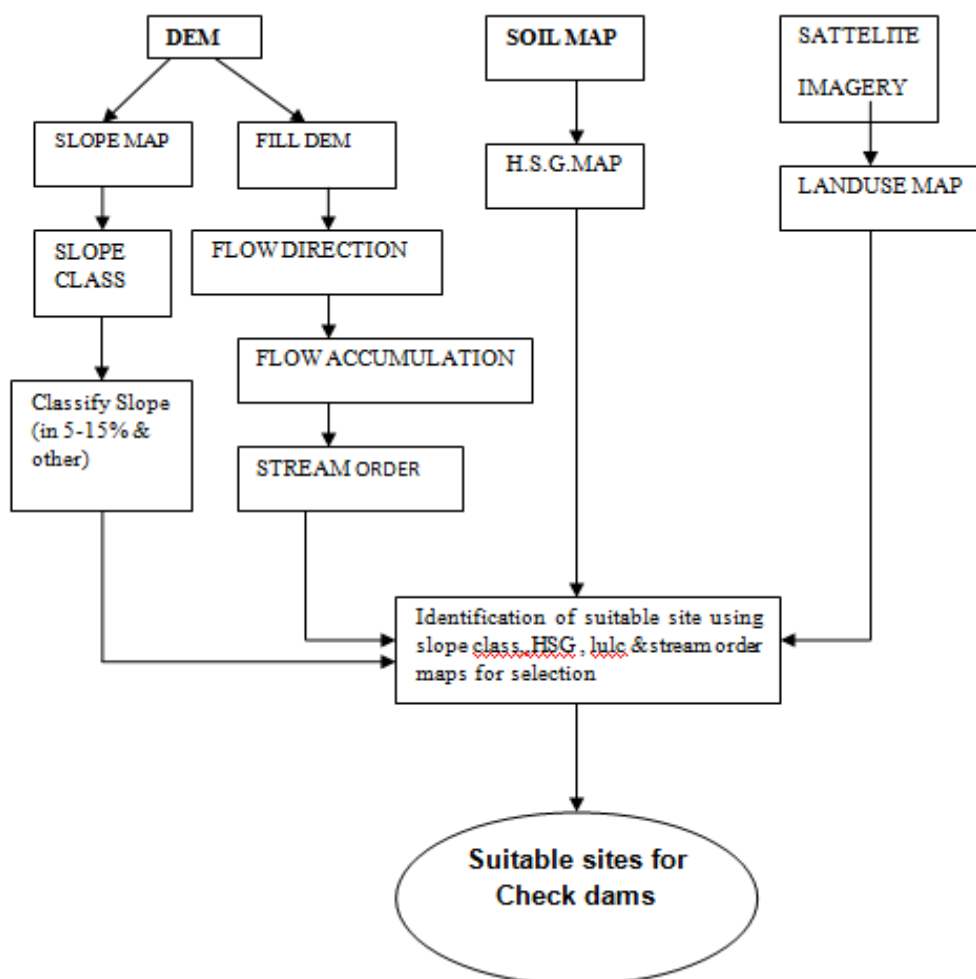


Figure-4: Flow diagram of site selection for check dams

The present study has been conducted by following a well defined methodology as given in Flow charts (Figure 1 and 2). One for the selection of suitable sites for farm ponds and the other for selection of suitable sites for check dams in the Solani watershed.

SELECTION OF SUITABLE SITES FOR WATER HARVESTING STRUCTURES

Technical guidelines for selecting suitable sites for conserving water is given by The Integrated Mission for Sustainable Development (IMSD), Technical guideline prepared by National Remote Sensing Centre (NRSC) India and guideline given by "Indian Committee on Hydrology (INCOH).

Farm Ponds : Farm Ponds are made either by constructing an embankment across a water course or by excavating a pit or the combination of both. Normally such structures are provided within individual farms. According to IMSD guidelines the main objectives of construction of farm pond are:

- To provide water storage for life saving irrigation in a limited area,
- To provide drinking water for livestock and human beings in arid areas,
- To serve as water storage for providing critical irrigation to limited number of fruit plants for establishment purpose and
- To moderate the hydrology of small watersheds.

SITE CONDITIONS

Dugout ponds are generally created by excavating pits in areas having flat topography and location having a low soil permeability. Design criteria can be decided by the concern user. Approximate locations can be selected based on remote sensing data interpretation and consultation of topo-sheet.

CHECK DAMS

In general they are constructed on lower order stream (up to third order) with medium slopes. They are proposed where water table fluctuation is very high and the stream is influent or intermittently effluent. The catchment

area vary widely, but an average area of about 25 hectare should be there. The parameters to be considered are slope, soil cover, and thickness and hydrological conditions such as rock type, thickness of weathered strata, and fractures depth to the bedrock etc. There should be some irrigation well in the down stream of the proposed structure. The structure will serve for dual purpose. Firstly it reduces runoff velocity thereby minimizing erosion and secondly allows the retained water to percolate and thus results is increased recharge in the wells located down stream of the structure.

STAGES

The methodology can be divided into three different parts:

Formulation of different parameters for construction of water harvesting structures.

1. Generation of geo-data layers.
2. Generation of different thematic and derived maps.

Stage 1: Formulation of different parameters for construction of water harvesting structures.

A set of criteria have been selected for the site suitability analysis for construction of water harvesting structures. Main parameters adopted in in all analysis are as follows:

Slope map: The main attribute characteristics with the slope of a region should be the slope type and percentage of slope.

The slope classes can be divide into following categories:

Sr. No.	Slope classes (in percentage)	Type
1	< 1	Nearly level
2	1-3	Very gently sloping
3	3-5	Gently sloping
4	5-10	Moderately sloping
5	10-15	Steep
6	15-35	Very steep
7	> 35	Extremely steep

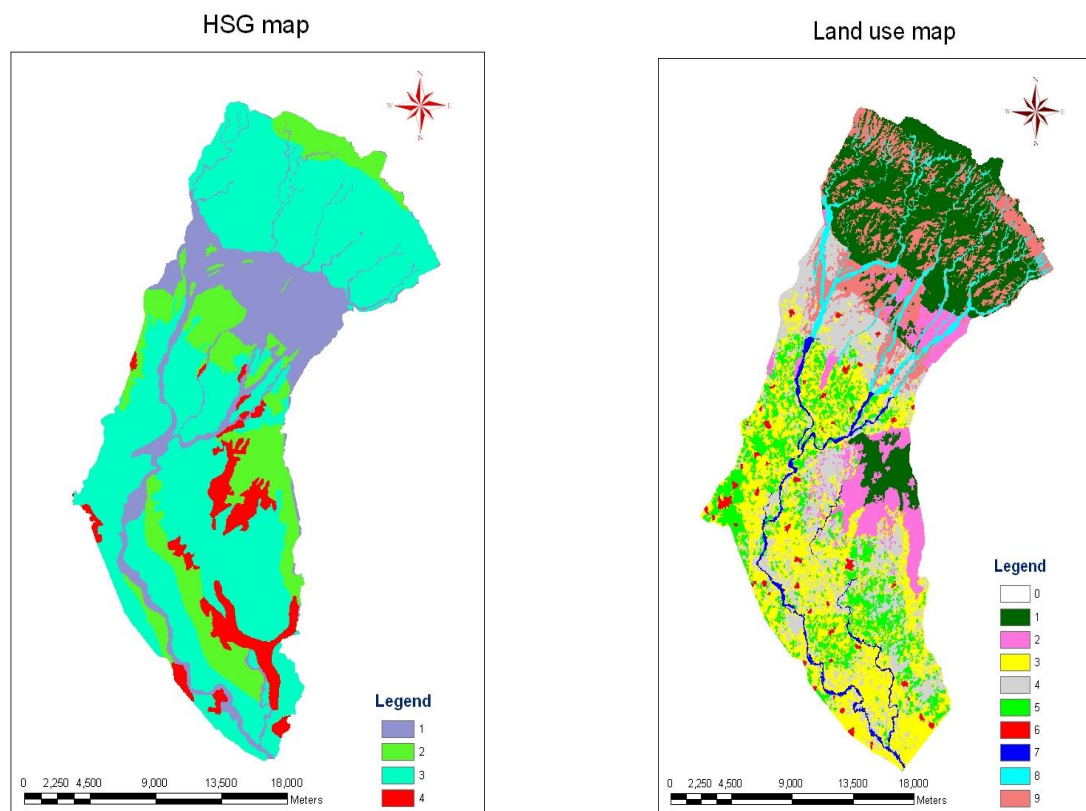


Figure 5: HSG and Land use maps of Solani Watershed

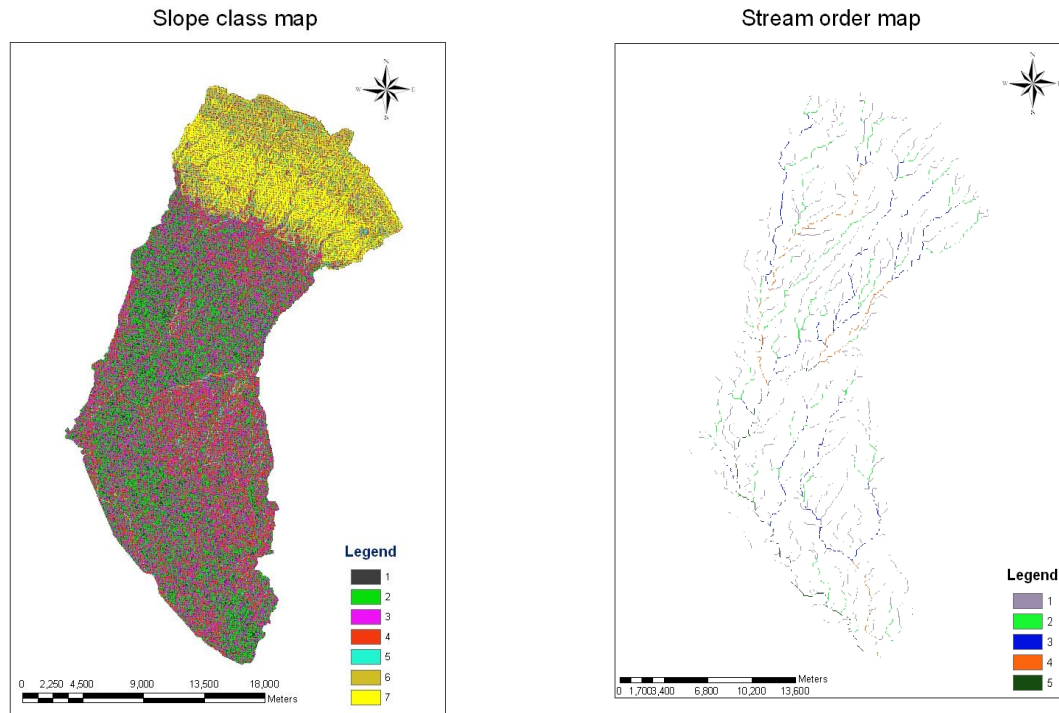


Figure 6: Slope class and stream order maps of Solani Watershed

H.S.G. map: HSG map is created from soil map. The main attribute characteristics with the HSG group of a region should be in four categories.

Sr. No.	H.S.G. Group
1	A
2	B
3	C
4	D

LAND USE/LAND COVER MAP

The main attribute characteristics with the land use/land cover of a region should be the type:

- Dense forest
- Sparse forest
- Agriculture
- Fallow and barren land
- Agriculture-plantation
- Built up area
- River perennial
- River seasonal
- Scrub

STREAM ORDER MAP

Stream order map is created from flow accumulation map(Dem-Fill Dem-Flow direction-flow accumulation).The main attribute characteristics with stream order of a region should be the order:

- First order
- Second order
- Third order
- Fourth order
- Fifth order

Stage 2. Generation of geo-data layers: The input for the geo- data base development:

1. **Dem:** The layers which are extracted from DEM for the study include the slope, and stream order.

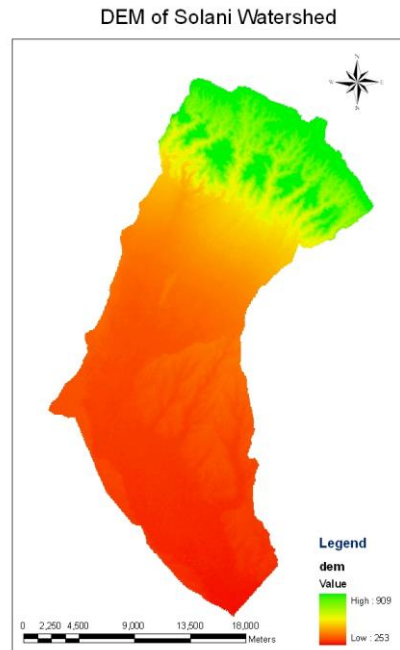


Figure 7: Dem of Solani Wateshed(source:WRD,IIRS,Dehradun)

2. LISS IV of IRS 1D (P6) data of March season (16.3.2009) used for creation of land use and land cover map.
3. Secondary data related to geological structure.

Stage 3. Generation of different thematic and derived maps:

Slope and stream order maps were generated from the DEM and land use/landcover map was generated from the satellite imagery (1D-P6) for the period of 16 march ,2009(LISS IV)using ERDAS Imagine software. HSG map was generated from soil map.

Selection of sites for **farm pond**: three maps were generated:

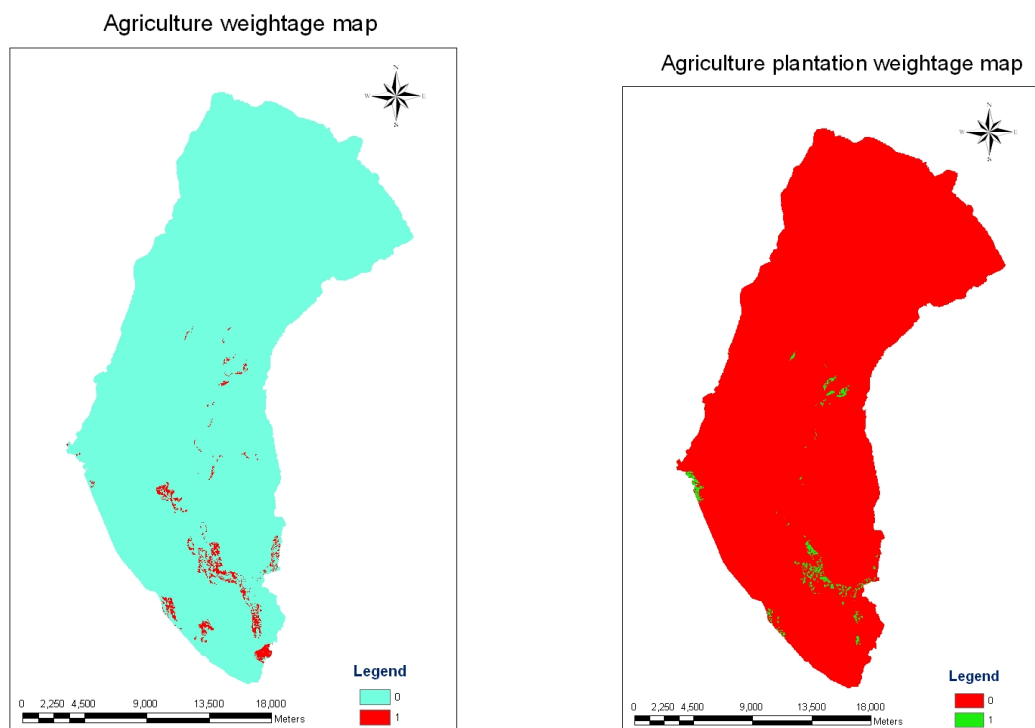


Figure 8 a & 8 b: Agriculture and Agriculture-plantation weightage maps

1. Agriculture weightage map(agri_wtg.image)- condition in raster calculator is: con(slope=< 5 and HSG=D and lulc=Agriculture(no.from attribute table)).Fig.8 a
2. Barren weightage map(barren_wtg.image)- condition in raster calculator is: (slope=< 5 and HSG=D and lulc=barren land(no.from attribute table)). Fig. 9
3. Agriculture-plantation weightage map(agri_plant_wtg.image)- condition in raster calculator is: con(slope=< 5 and HSG=D and lulc=Agriculture plantation(no.from attribute table)). Fig.8 b

After generation of these three maps in raster calculator following condition has been applied:

Con((agri_wtg.image)=1 or(barren_wtg.image)=1or (agri_plant_wtg.image)=1,1,0)

Finally map of suitable sites for construction of farm ponds was generated.(Fig.10.1)

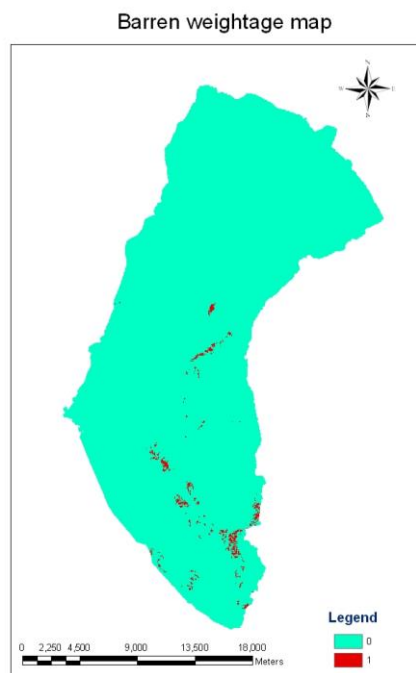


Fig.9: Barren weightage map

For Selection of site for **check dams** four maps were used in raster calculator:

Con((slope_per)=8&(lulc)=1&(HSG)=4&(stream order)=>3 ,1,0)

Slope map has been reclassified into two classes; first is 5-15% and given value -8(for selection of ideal site for check dam), second is other class (rest of all class).

Finally map of suitable sites for construction of check dams was generated (Figure 10.2).

4.2. REMOTE SENSING AND OTHER DATA USED

Slope map, Land use map, HSG map, and stream order and geological and meteorological data are the main inputs for hydrological models. Followings are the main material used in this study:

- Slope map created from Aster-DEM .
- Stream order map created from Aster-DEM.
- HSG map: this map was prepared from Soil map.
- Land use map: This map was prepared using LISS-III images in the WRD IIRS and this was updated and validated through field observations during present study period.

4.3. SOFTWARE USED

- ERDAS 9.2,
- Arc GIS 9.3,
- ILWIS 3.3
- Microsoft Office software.

RESULTS AND CONCLUSIONS

Selection of suitable sites for construction of farm pond and check dam was based on IMSD guidelines for water resources development and analysed using remote sensing and GIS technology. For construction of farm pond the suitable site were selected in agriculture, agriculture-plantation and barren land.

FARM POND:

The decision rules applied for farm pond in GIS environment are :

- Agriculture weightage map(agri_wtg.image)- condition in raster calculator is: $\text{con}(\text{slope} \leq 5 \text{ and HSG} = \text{D and } \text{lulc} = \text{Agriculture}(\text{no. from attribute table}))$. Fig.8 a
- Barren weightage map(barren_wtg.image)- condition in raster calculator is: $(\text{slope} \leq 5 \text{ and HSG} = \text{D and } \text{lulc} = \text{barren land}(\text{no. from attribute table}))$. Fig.9
- Agriculture-plantation weightage map(agri_plant_wtg.image)- condition in raster calculator is: $\text{con}(\text{slope} \leq 5 \text{ and HSG} = \text{D and } \text{lulc} = \text{Agriculture plantation (no from attribute table)})$. Fig.8 b

In Solani watershed those areas were selected for construction of farm pond where flat topography with less than 5 percentage of slope and location having low soil permeability. In this watershed 1587.59 hectare area was selected for construction of farm pond. Results are displayed on the map, as the sites where the farm ponds are to be constructed for water harvesting. (Fig. 10.1)

Check Dam: The decision rule applied for farm pond in GIS environment is :

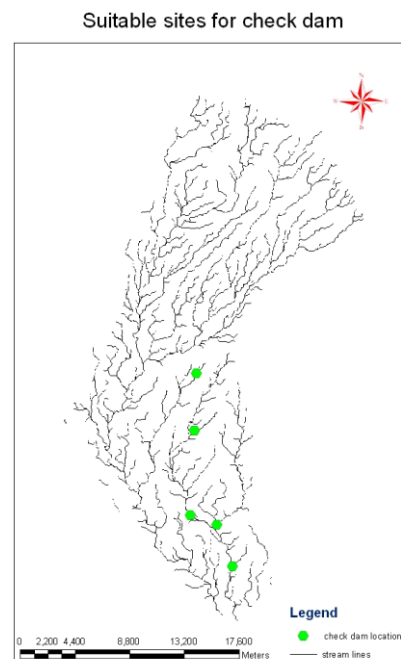
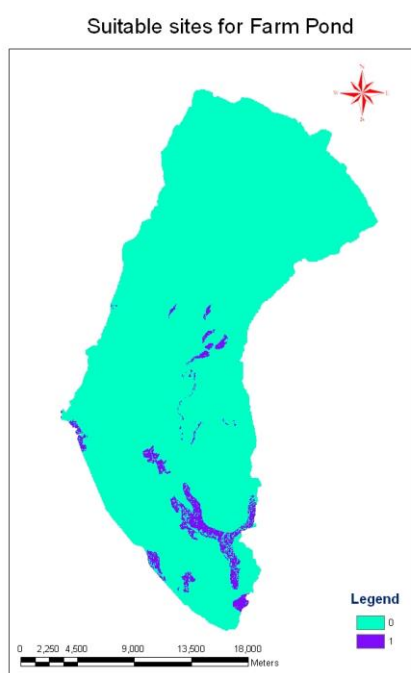
Con((slope_per)=8&(lulc)=1&(HSG)=4&(stream order)=>3 ,1,0)

Selection of suitable site for construction of check dams was also based on IMSD guidelines. The parameters to be considered are slope(in percentage),HSG,lulc and stream order. Those areas were selected for construction of check dams where slope was 5 percent to 15 percent(moderately sloping to steep)and location having low soil permeability(HSG-D) on first to third order streams. (Fig.10.2)

In Solani watershed there were five sites selected for constructing check dams, from which two sites situated on second order stream and three sites situated on first order stream. Results are displayed on the map, as the sites where the check dams are to be constructed for water harvesting.

Fig.10.1: Suitable site map for farm pond

Fig.10.2: Suitable site map for check dam



5.2. CONCLUSIONS

In this study, the following conclusions were derived from this study:

- Out of total area of the watershed 1687.59 hectare area is found suitable for construction of farm ponds

- Five locations are identified for construction of check dams.
- Remote sensing and GIS techniques helped in minimising the time required for locating suitable sites for water harvesting structures as compare to tradition method of selecting sites.
- Also is more scientific and precise method. Further these sites should be finalised based on conducting field visit, discussion with the beneficiaries and benefit - cost analysis.
- This approach could be applied easily for other watersheds for efficient and effective planning and implementation for locating suitable water harvesting structures.
- Analysis can be increased for more accurate location analysis for the structures.

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TRADE POTENTIALITIES OF NORTH-EAST INDIA

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INTRODUCTION

The North-East Region (NER) of India which comprises of eight states, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura shares most of its boundary with China, Bangladesh, Bhutan and Myanmar. The NER accounts for about 8% of the country's geographical area and about 4% of population. Tribals account for more than 30% of the total population of NER. Inadequate and poor infrastructure, inhospitable terrain and a comparatively late start in the development process are some of the reasons for economic backwardness of the region. However, the NER has certain strengths in different angles to achieve economic development in easy way. From the geo-political angle, the NER is located in a strategic location as it is bounded by these several foreign countries. Naturally it has got both advantages and disadvantages due to its location. So far advantages are concerned it is connected with the South-East Asian countries mainly China, Myanmar, Bhutan, Bangladesh, Malaysia, Thailand, Philippines, Cambodia and Indonesia etc where almost half of the world's population live. There is no doubt that this vast population could have great advantage for establishing any kind of trade and commerce. But the vary geographical condition basically the rivers and mountains of the country stand as a barrier and create geo-political tensions which ultimately act as most disadvantages factors in creating a conducive atmosphere in the path of developing trade relation among those countries. But in the recent developments in the field of communication and technology, some visible changes are taking place. Now the NER have felt the need of the hour regarding the modern facilities of lives. They have realized that in order to develop the economy of the nation, the border trade could be an effective solution. Border trade would help to great extent in the field of economic development and also the route between production points of India to the Northern district of Myanmar via North-East region is economic viable as it is much shorter than sea route.

Border trade has special significance for the economies of the North-Eastern States, which have a large segment of international border on their boundaries. Of the border trade conducted through the international border of these states, it has been mentioned in the report of the Inter-Ministerial Task force that the trade with Bangladesh and Myanmar is especially important for a variety of reasons. Apart from the fact that these two nations account for the major portion of the border trade with the North-Eastern States, India has to forge special trade relationship with both Myanmar and Bangladesh in view of the Inter-Country trade issues. It is also important in view of the need to promote trade in locally produced goods in which the region has strength. The report suggests that a focus or promotion of export through the border trade will promote greater value addition in the North -East and help in shifting the export initiatives from the trading centres located outside the region to those located within the region. So a special importance needs to be given to the measures connected with simplification and facilitation of border trade.

The objectives of this paper are: (a) to examines the trends in export from North East India, (b) to search the potentialities of border trade pertaining to India's North-East region, (c) to investigate the underlying challenges for the development of North East border trade and its opportunities in the event of emergence of a strong regional cooperation among Bangladesh, China, India, Myanmar and Bhutan and finally conclusion follows.

a. TRENDS IN EXPORT FROM NORTH EAST INDIA

The export from North East Region (NER) takes place both directly and indirectly. Direct trade flows through Land Custom Stations (LCSs)/custom check post along the international border. The items of trade, quantity and value are recorded at LCSs. However, in case of indirect trade, it is hard to estimate the contributions of NER as the items produced in the region are exported from outside its geographic boundaries after a value addition in the process of production.

Table-1 depicts the NER's export over the last 10 years. NER's export to neighbouring countries viz., Bangladesh, Bhutan and Myanmar consists of diversified products and varies from primary commodities to manufacturing items. NER also exports to countries like UAE, UK, Sri Lanka, Germany, USA, Ireland, Pakistan, Egypt, Indonesia, Japan and Netherlands. It mainly exports tea to these countries. The export from NER has exhibited a fluctuating trend in past ten years. Meghalaya dominates the total export from NER to Bangladesh followed by Assam. NER Export to Myanmar through Moreh (Manipur) LCS initially gained momentum and reached its peak but started declining from 1997-98. It could not sustain initial thrust due to various factors. Apart from exporting tea to various countries, NER exports perfumery compound and aquilaria

agallocha. NER export to Bhutan through Hatisar (Assam) LCS is also negligible. Having discussed about the trend in the export from NER, an attempt has been made to study the composition of export from this region.

Table-1: Total Exports from NER (Value in Rupees Crores)

NER Export to Bangladesh					NER Export to Myanmar	NER Export to other countries		NER Export to Bhutan	Total Export from NER
Year	Meghalaya	Assam	Tripura	Total Export	Manipur	I.C.D. Amingaon	L.G.B.I Airport	Assam	
1996-97	86.08	17.42	0.16	103.67	30.86	182.90	-	-	317.43
1997-98	80.77	43.71	0.97	125.45	23.84	251.75	-	-	401.04
1998-99	85.24	51.26	2.24	138.75	5.03	244.95	-	-	388.72
1999-00	129.99	37.51	2.31	169.81	3.31	222.77	-	-	395.89
2000-01	129.83	20.64	0.75	151.23	5.53	247.01	0.30	-	404.07
2001-02	166.93	17.69	1.28	185.89	1.23	190.60	1.43	-	379.15
2002-03	171.99	28.97	1.59	202.55	5.00	201.16	1.26	0.15	410.12
2003-04	188.51	48.29	1.38	238.18	9.41	184.90	0.71	1.82	435.02
2004-05	163.79	25.14	1.49	190.42	6.49	188.73	0.90	5.49	392.03
2005-06	179.51	35.68	0.74	215.93	3.87	199.82	0.65	17.55	437.82

Source: Office of the Commissioner of Customs, Shillong Meghalaya

COMPOSITION OF EXPORTS FROM NORTH EAST INDIA

The composition of exports from NER in terms of value and its percentage in total value of export from NER during the period 1996-97 to 2005-06 are presented in Table-2. The bulk of items exported from NER are grouped under mineral, agricultural and allied products, and other products. Minerals are mainly consisting of coal and limestone. Other minerals are boulder stone, crushed stone, sand stone, crude marble etc. and are exported without any value addition. Agricultural and allied products mainly consists of tea, fruits and some horticultural products like ginger, oranges, citrus, fruits, garlic, pears etc. Other products include synthetic and woolen fabrics, construction items like brick, cement, tiles, plywood, door, frames and low-value manufacturing products. The main exports from NER consist of mineral, agricultural and allied products as portrayed in the table-2. The table-2 also reveals a very high fluctuating trend of export from NER in case of mineral and agricultural and allied products. It ranges from 25.74 to 48.35 per cent in case of mineral and 45.31 to 74.01 per cent in case of agricultural and allied products. It cannot be denied that the major driving force behind the NER growth in export is tea, particularly that of Assam which produces around 53 per cent of the total production. Other products including textiles, building materials and other constitute a very negligible part of total export from NER ranging from 0.12 to 4.12 per cent.

The exports from NER to Bangladesh mainly comprise of mineral and agricultural and allied products. There are two types of minerals – coal and limestone. Both are mined in southern belt of Meghalaya and directly exported to Bangladesh. They are also found in Sutarkandi and Karimganj (Assam) and are exported without any value addition. The bulk of other items exported from NER include boulders, fruits, agricultural products and low-value manufacturing produces. Horticultural products like ginger, oranges, citrus fruits, garlic, pears etc. have a contribution in the total NER's export volume. These are cultivated mainly in Meghalaya and N.C. Hills of Assam. The complementarities between the resource base of hills of NER and the plains of Bangladesh provide a firm basis of trade between them. The people residing on both sides would certainly find their lives much easier with border trade and commerce since marketability is least costly as compared to respective main land alternatives in their own countries. The distance to nearest port of NER is Kolkata which is about 1100 km. to 1700 km. from different capitals of North Eastern States.

Meghalaya has become important amongst eight sister States with regard to volume of trade with Bangladesh. The cement plant at Chattak in Bangladesh, the only major public sector cement manufacturer, depends solely on the limestone brought from Shella and Nongtra areas of Meghalaya. Lafarge, the international cement giant, has reiterated its commitment to implement its \$25 million dollar investment for mining limestone in the State. The French company has established a joint venture to feed its mammoth cement plant at Chattak in Bangladesh. Chairman of Japan Development Institute (JDI), Mr. Shoichi Kobayashi during his recent visit to North-East observed that Bangladesh is deficient in cement production and requires not less than “8 million metric tones of cement” annually for its domestic consumption. Bangladesh is currently importing limestone from South East Asian nations. “Meghalaya which has abundant limestone can set up a cement plant and export it to Bangladesh,” Kobayashi said. (Sikidar, Bora and Adhikari, 2010).

Table-2: Composition of Exports from NER

Items	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Mineral	102.34 (32.24)	106.62 (26.59)	100.04 (25.74)	165.29 (41.75)	148.00 (36.63)	182.50 (48.14)	197.39 (48.13)	235.58 (54.15)	185.05 (47.20)	211.69 (48.35)
Agricultural and allied Products	215.08 (67.76)	294.42 (73.41)	287.70 (74.01)	230.11 (58.12)	254.81 (63.06)	195.04 (51.45)	210.38 (51.30)	197.10 (45.31)	200.03 (51.02)	208.07 (47.53)
Others	0.00	0.00	0.98 (0.25)	0.49 (0.12)	1.26 (0.31)	1.57 (0.41)	2.35 (0.57)	2.33 (0.54)	6.96 (1.77)	18.05 (4.12)
Total	317.42	401.04	388.72	395.89	404.07	379.11	410.12	435.02	392.03	437.81

Source: Self Compilation from Official Data.

B. POTENTIALITIES OF BORDER TRADE PERTAINING TO INDIA'S NORTH-EAST REGION

The potentialities of growth in India's trade with the neighbouring countries are immense. The North-Eastern region can also be a partner of this emerging trade scenario. The major impediment towards the growth of Border trade with India's Eastern neighbours is found to be the absence due to lack of strong and efficient transport and communication networks between India and the countries of BCIM because of their geographical proximity to each other. To achieve such benefits from Border trade, the physical linkages among the trading partners in the form of Trans-National Highways, Railways, waterways and Airways, wherever possible, are essential. A huge amount of capital expenditure would be necessary to build such infrastructural facilities. It is possible only through financial assistance from international financial institutions and the participation of multinational corporation (MNCs).

The prosperous East and South East Asian countries are attractive destinations for Indian exports. ASEAN markets provide big opportunities for India. Most of ASEAN populations have similar cultural background as in India. Affinity in cultural background will make Indian products acceptable and saleable in ASEAN markets. By the end of the year 2000 Indian exports to Indonesia, Malaysia and Singapore increased impressively (87% increase to Indonesia; 47% to Malaysia and 39% to Singapore.). Export figures to other countries of the region have also shown market increase. Seeing such export figures India realized that East and South-East Asian region offered attractive destination for exports. Accordingly, India decided to diversify its export direction towards the East. This is another aspect of India's Look East Policy. It is hoped that spectacular success would be achieved in this endeavor. The NER has following resources:

1. FOREST AND HORTICULTURE PRODUCTS

North East India is famous for its exotic flora and fauna. The North East is one of the few bio-diversity zones in the world. It has immense flora and fauna. The world's annual trade on medicinal and aromatic oil/plants is of amount, over \$60 billion. North East only supplies the raw materials for many of the industries inside and outside the country. Out of the 925 varieties of orchids available in India, as many as over 650 can be grown in the region due to the favourable climatic conditions. In fact approximately 200 varieties are unique to this region and 60 per cent of these are ornamental in nature with high demand at the international markets. It is also ideally situated to produce spices, fruit & vegetables, flowers and herbs. Therefore, the North East India can emerge as an exporter of orchids, flowers, apple, orange, pineapples, spices, herbs etc. Some of the best and rare quality fruits and vegetables are produced in North East region for example, pine-apples produced in North East are considered to be of the highest quality. Moreover, the forests of North East offer a vast array of aromatic plants which can be used in the aromatic industry for the manufacture of perfumes, incenses etc. In fact, there is an increasing international trend towards natural perfumes and room fresheners, shifting the focus from chemical ones. With proper planning there exists scope for establishing aromatic industry in the region. The climate of North East is also suitable for wide range of agro-horticultural as well as exotic floricultural products.

With support services like training, tissue culture labs, production, finance, marketing tie-ups and farm to market roads, the region can produce both for domestic market and international market.

2. TOURISM

The North East India is well known for its bio-diversities and heritage sites. Tawang in Arunachal Pradesh, Majuli, Kaziranga, Manas, Pabitora etc. in Assam can be developed further as tourist spots attracting more tourists from Europe and America. The multi-ethnic culture coupled with snow capped mountains and mighty Brahmaputra provides ideal setting for development of tourism. The name Tawang was given by Mera Lama in the 17th century. Tawang Monastery popularly known as the 'Tawang Gompa' is the second oldest Monastery in Asia more than 460 years old and the largest Monastery in the Himalayan region constructed by Lama Lodre Gyatso in 1681 AD. Tawang is the birth place of the sixth Dalai Lama, the only Indian so far who rose to the highest position in Gelupa Sect of Buddhism. If modern transport and communication system between the ASEAN countries and India along with the requisite infrastructural facilities are developed, then tourists visiting the ASEAN countries are likely to extend their tour programmes to the North East India, a few hundred miles away, for visiting its exotic bio-diversity and heritage sites. In 1996, an internationally reputed consultancy firm, Coopers and Lybrand submitted a report to the Government of Assam, which state that if the vast tourism potentials of the North East India are fully tapped and developed, within 20 years the region will receive more tourists than Singapore or Bangkok. Because almost all the Western and Japanese tourists visiting South East Asian region would fly or drive a few hundred kilometers more to enjoy the scenic and cultural beauties of the North Eastern Region. This alone can boost the economy of the entire North East. But for this, road and airways between the South- East Asian region and India have to be developed. All this is possible only when the region can attract foreign direct investment complemented with domestic investment.

Recently, the Madrid-based World Tourism Organization has evinced interest in promoting tourism in North East India and already identified Nagaland and Sikkim as its priorities. These United Nations-affiliated organizations will assist initially Nagaland in preparing a suitable tourism development programme with emphasis on employment, especially for women and other disadvantaged groups. The World Tourism Organization has advised the Union Tourism Ministry to constitute a panel of consultants for framing suitable tourism development programmes in Nagaland and Sikkim in the areas of rural tourism, eco-tourism, social-tourism, architecture-tourism and historical tourism.

3. MEDICAL TOURISM

Now-a-days, India is a position to give world class medical treatment at a low cost in comparison to the developed countries. India has advantage due to low cost of treatment, large number and high quality of Indian health care professionals, world class corporate hospitals (Apollo, Escorts), presence in niche areas. It attracts the patients throughout the world especially the African and Middle East countries. Presently, patients from developing and developed countries are coming to receive treatment in Indian hospitals. Health tourists from Middle East, CIS countries, neighbouring countries, Non Resident Indians in developed countries, foreigners from some developed countries are coming every day. It is observed that 130, 000 international patients came to India (2003) from South Asia, Africa, Gulf mainly for treatment in India. Again, many foreign patients seek treatment in traditional and alternative medicine (unani, ayurvedic, herbal treatment). The north-eastern region is the home of ayurvedic and herbal medicine. 90% herbal medicine of India is seen in this Himalayas belt. The State like Arunachal Pradesh where almost all of herbals are available has a bright scope to attract health tourists to give treatment at a low cost.

The Central Council for Research in Ayurveda and Siddha, Department of Ayush, Ministry of Health and Family Welfare, Govt. of India has initiated research programmes in this state from the early seventies. Accordingly it has taken up a special survey tour programme to study the traditions, culture, customs, folk medical practices and the extent of availability and the quality of the medicinal plants in the State. Consequently, the council has also initiated other important research programmes, such as clinical research programme in the State and established Regional Research Centre at Itanagar in May, 1979. The status of the centre has been upgraded to Regional Research Institute with effect from 09.09.1999.

4. HYDROELECTRICITY

Due to its geographical location and its hilly terrain, the North-East Region has an immense hydel potential to use the power of water to produce electricity. The region is of turbulent perennial several rivers, big and small having high gradients which possess enormous hydro-electric generation potential. Arunachal Pradesh, which possessing a huge hydro power potential, may alone fulfill 60 per cent of the existing demand of the country if the potential is fully harnessed. The National Hydroelectric Power Corporation (NHPC) has already undertaken to construct several mega multipurpose hydropower projects in upper reaches of the Brahmaputra River in

Arunachal Pradesh, estimated to generate 25,000 MW of power. The projects included Subansiri upper, lower and middle; Dihang, Dibang and Siang hydro projects. In near future Arunachal Pradesh is expected to be made a Power Surplus State so much that after fulfilling the home demand it would earn much revenue by exporting power to rest of the country. The hydro-power potentialities of the major five rivers in Arunachal Pradesh are shown in Table 3.

Table 3: Major river basins and their potentials

Name of the River/Basin	Probable Hydro Potentials (MW)			Name of Districts
	ROR	Storage	Total	
Kameng	3799	847	4646	W&E/Kameng
Subansiri	10141	5050	15191	U&L/Subansiri/Kurung Kumey
Siang	3557	11700	15257	W&E/Siang U/Siang
Dibang	5946	1282	7228	U & L/Dibang Valley
Lohit	3594	3075	6669	Lohit
Total Potentials	27037	21954	48991	

Source: Deptt. of Power, Govt. of Arunachal Pradesh, Itanagar.

Therefore, Arunachal Pradesh, having untapped estimated hydro power potential of 49,000 MW, may alone emerge as Power House of India when this potential is fully harnessed. The power sector will herald a golden era for the region once its hydel potential is harnessed to make it the power house of the country. A major part of this power can be exported to neighbouring countries. But the development of these power projects requires huge investment and technological support, which is possible only through foreign direct investment. The WTO regime has given an opportunity to develop these power potentialities of the region.

5. OIL AND GAS

Assam alone has an estimated 1,300 million tonnes of oil and 156 billion cubic metres of natural gas. Not even 40% area has been explored. Assam, Mizoram, Tripura, Nagaland, Arunachal and even Brahmaputra have a number of oil bearing strata, still to be explored. Other mineral resources like Thorium, Limestone etc. are available in huge quantities.

6. PLANTATION

- (i) **Tea:** Assam alone produces about 50 per cent of country's tea and tea industry in India needs new international markets. However, to capture such market, tea industry needs attention on the fronts that the tea industry has to overcome the two major problems of low productivity and high cost of production faced by the tea industry of the country. However, Indian tea will have to compete with other tea producing countries of the world in terms of quality also and tea industry of Assam, vis-à-vis North East should also take up the challenge in the coming years.
- (ii) **Coffee:** Although coffee regions in India are in the three southern states of Karnataka (53 per cent), Kerala (28 per cent) and Tamil Nadu (11 per cent), a small quantity (approx. 8 per cent) is grown in the non-traditional belts of Andhra Pradesh and the North Eastern States such as Assam, Nagaland and Arunachal Pradesh. However, the non-traditional coffee areas of North East is certainly preserving not only the natural forests in these areas by preventing shifting cultivation and providing employment to the tribal force (90 per cent of whom are women and uplifting their socio-economic status) but also enabling the preparation of some fine distinct coffees from the areas. Therefore, such qualitative coffee plantation in North East India has great prospects for exports.
- (iii) **Rubber:** The world natural rubber production was 6.8 million tons in 2002. There is a high demand for natural rubber in the world market. At present India is producing about 613000 tons and India's production is projected at 720,000 tons by 2010. The Government of India selected North East as a major production centre of natural rubber during the Tenth Five Year Period (2002-2007). The rubber planters have been guaranteed a grant of Rs. 20,000/- per hectare for holdings up to 5 hectares and Rs.16,000/- per hectare for holdings about 5 hectares to 20 hectares. The target of plantation and re-plantation of rubber for the entire North East has been fixed at 7050 hectares by the end of the Tenth Plan against 1410 hectares at the end of the Ninth Plan. The highest target of 3500 hectares has been fixed for Tripura followed by Assam at 2000 hectares. Considering the potentialities of the region and the growing global demand for natural rubber the target in the Tenth Plan appears to be too conservative. Therefore, during Eleventh Plan Period (2007-2012), rubber plantation in this region should get top priority so that plantation coverage can be expanded by at least ten-fold increase.

c. Challenges for the Development of North East Border Trade and its Opportunities

To develop border trade there are so many barriers that should be overcome first. Some of these are given below.

1. INSURGENCY-RELATED ISSUES

Insurgencies in the region have already caused serious damage to the regional economy and taken away a number of valuable human lives. A consensus is emerging among scholars that contrary to popular belief, civil wars and ethnic conflicts in several parts of the world are not due, primarily to ethnic and religious diversity, but rather to high levels of poverty, failed political institutions and economic natural resources. Deep political and economic development failures, not tribalism, ethnic hatred and linguistic fragmentation, are the root causes of the problem. The implication of these findings is significant. Something can be done to reduce the prevalence of violent conflicts in the affected countries and prevent their recurrence. Democratic reforms, improved political governance and institutions for economic management are needed in the societies to manage effectively the challenges to maintain political stability and also to diversify their economies. Based on the observations, central government and state governments in the regions need to restructure the styles and systems of governance to address the root cause of conflicts in the regions.

2. TRANSPORT AND COMMUNICATION AND OTHER FACILITIES

Trade between BCIM countries can flourish only when people, goods and vehicles can move with minimal technical and procedural obstacles across the borders. Development of an efficient transport and communication system greatly contributes to rapid progress of the merchandise trade. Transport cost being a significant determinant of competitiveness, cheaper mode of transportation is essential for the development of trade and services between the BCIM countries. In hills, the construction as well as the reconstruction of roads in- the north-east region involves rock cutting, soiling in soft patches, construction of retaining walls, etc. which requires a lot of human labour throughout the year. The whole of topography was dissected into isolation by numerous rivers and streams, many of which being big and at the same time full of rocks as well as subjected to very strong cross current rendering navigation impossible to a considerable extent. Such type of characteristics of this area signifies how many difficulties to construct roads in this area the agencies face. As the region has very heavy rainfall, the roads suffer from surface and gully erosion. The situation is further deteriorated by the loose soil-base derived largely from alluvium in the plains and such sedimentary rocks as sandstone, mudstone, shale etc. in the hills. The roads have, therefore, to be constantly repaired and maintained in serviceable condition, needing a huge expenditure. It is completely disrupted during every monsoon season. Railway services are yet to reach the nooks and corners of the region while the road network is not free and smooth. The Telex-communication facilities are available only in and around the urban centres and the postal services cannot be said to be satisfactory.

The region has numerous turbulent rivers and hill-streams which flow with fury during the rainy season. Besides, many of them change their course very often. Some of them, again, are very wide. They are not only wide but also subject to very cross current. The roads need to be frequently bridged and many culverts, retention walls, spurs etc. have to be constructed requiring huge labour and expenditures. But it must be noted that unless exportable surpluses are produced within it, regarding roads, airports, power, railways, telecommunication, banking and finance the North Eastern Region could not be able to derive the full benefits of all developments simply by acting as a corridor of exports of other countries.

3. INSTITUTIONAL AND STRUCTURAL CORRUPTION

There is no dearth of funds to hasten the development of the NER since 1996 when the former prime Minister H. D. Deva Gowda first declared a package of Rs.6100 crores for the infrastructural development in the region. But one does not know how much of these huge funds actually flowed down the development pipeline. The leakages of development funds in the region have been at a higher level than it is in the rest of the country. All financial allocations for development and the wealth generated thereof have flowed out of the region or into the hands of the corrupt politicians, bureaucrats and contractors. The region has remained still cut off both physically and emotionally from the national mainstream primarily due to the absence of a coherent perspective on development.

4. LACK OF TRANSIT FACILITY

The North-East States are very far from the main land of India. So far trade is concerned; distance is also a vital factor in view of transport cost. This distance will be reduced if Bangladesh gives transit facility to India. If it is occurred, both the countries will be benefited. It will help to stimulate not only the bilateral trade between North-East States and Bangladesh, but also the international trade between India and ASEAN through

Bangladesh and Bangladesh and ASEAN through North-East States. The transit facilities through Bangladesh would help bypass the difficult chicken neck corridor that connects the landlocked North-East States with the rest of India. If Dhaka provides transit facilities to India and allows the use of Chittagong international port and other ports in Bangladesh, commodities and machinery can be transported to the North-East Region from various parts of India and abroad, saving huge time and money. Agartala, the capital of Tripura is 1,650 km. from Kolkata and 2,637 km. from New Delhi via Guwahati, whereas the distance between Agartala and Kolkata via Bangladesh is 350 km. only (Arunachal Front, March 07, 2009)

OPPORTUNITIES

There are a vast economic opportunities and benefits to link North-East Region with dynamic Asia including the deepening social and cultural ties between the people of northeast and its neighbouring countries.

1. There are a variety of benefits that India can extract through North-East India from FTA with ASEAN:
 - (a) FTA has the potential to speed up the reforms process in North-East India. There will be a greater urgency to align India's economic policies with those of ASEAN. Clearly, economic liberalization under the provisions of FTA would happen even in areas that are considered sensitive. It creates incentives for countries to liberalize in the context of these agreements, which, in turn, favours deeper liberalization in the context of multilateral negotiations. Proponents of this view argue that 'competitive regionalism' can catalyze global trade liberalization (Hilaire et al, 2004)
 - (b) There would be significant gains for North-East India's economy and industry in terms of free flow of trade, services and investment. Besides, being a part of an important regional block will also enhance India's bargaining capacity at the WTO.
 - (c) If a zero duty imports are allowed in certain sectors then cost-benefit analysis of a number of Indian companies may alter. It will be an opportunity to establish new units and create new capacities to cater the local market in the northeast region and ASEAN markets. Indian companies can also set up plants in ASEAN and export to the entire ASEAN region through this region. By setting up plants abroad Indian companies can leverage some of the cost efficiencies that may come from better infrastructure and lower tariff and non-tariff barriers in this region.
 - (d) It will put immense pressure on Indian policy makers to align their own tax policies with those of other ASEAN so as to make investments equally attractive in North-East India.
2. Regional cooperation through trade and investment among the BCIM countries is the only way for rapid economic development in the zone. The following areas and measures that need immediate attention of the BCIM governments in this regard are discussed below.

The border disputes among some of the BCIM countries are to settle for good immediately;

- (a) To sign joint trade agreements;
- (b) To actively promote plural and diversified trade;
- (c) To develop and expand overland transit through cross-border infrastructural development;
- (d) To establish BCIM trade centres, research and training institutions for promotion of trade and human resource development;
- (e) To establish BCIM free trade zone in due course of time.

3. BORDER HAAT

- a) The Border Haat may be established to cover a well-defined geographical area of about 1 km radius on both sides of the border at specified locations so as to enhance the living standard and to facilitate the good fruits of modern age in the border areas. The border crossing should be at specified entry points and proper record of entry/exit should be kept.
- b) The Traders may be allowed to carry goods by head load, rickshaw and other non-merchandised means of transport only. Merchandised Transport should not be permitted.
- c) Identity cards may be issued to the traders by the respective Governments for which a common procedure/system may be worked out.

- d) In the specified zone of the Border Haat, the traders should be allowed to do transaction in the local currency of the respective countries. The transaction should be duty-free and there should be there should be no requirement for customs documentation, licensing etc.
- e) Border Haat may be held 2-3 days per week.
4. The economic liberalization will have a bearing upon the present volume of trade and commerce between India and its neighboring countries. If the Government of India takes positives steps for the development of routes between India and it neighboring countries and improve the relations, whole economic scenario of the North-East India would be changed which would ultimately solve many of our existing problems specially unemployment and over dependence on agricultural sector.
5. There is a very strong case both on economic and political grounds for India regarding its northeast region to extend unilateral duty-free and quota-free access to its market for products from the least developed countries of the region.

CONCLUSION

It is true that along with bringing in lot of benefits, the outward looking development strategy of the region may also import a few vices such as erosion in social bond in tribal society, emergence of economic inequality at the initial stage, spread of HIV, drug addiction, women trafficking etc. These are the costs of development. What is necessary is to find out a trade-off. The economic benefits of the market- oriented, trade-led, outward looking economic strategy would definitely outweigh the costs in the form of importation of vices, imaginary or real. Thus the globalization and India's 'Look East Policy' can accelerate trade /border trade between India and the South East Asian countries, which can bring in progress and prosperity for the entire country including North East India.

With the developments discussed above, the North East India with its geo-strategic location advantage could emerge as a business transit centre for the BCIM, SAARC and ASEAN groups of nations.

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SYE-705 : HIGH MILLING RECOVERY OF RICE GENOTYPE**Shende P. V.**

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ABSTRACT

Milling recovery is one of the most important criteria of rice quality especially from the standard point of marketing. A variety should possess a high turnout of whole grain (head) rice and total milled rice. As a part of continuous effort to evolve high milling recovery with good cooking quality rice variety, the cross made between PKV HMT x Tarori Basmati resulted in the development of new culture SYE-705-17-12. It has been tested extensively in Maharashtra level research trials. SYE-705-17-12 recorded 80.39, 76.33 and 67.68 % of milling which is higher than most popular variety PKV HMT (76.11, 72.66 and 64.75 %) and RTN-24 (78.82, 76.53 and 62.24%) during the year 2012, 2013 and 2014 respectively. This genotype has more head rice recovery with 68.62 % (on two years average basis). It has also recorded good amylose percentage (22.18%) with good cooking quality. The genotype is found short slender grain type with 14.43 g test weight which having acceptability in Vidarbha market. Beside this it found significantly superior yield over the best check Vidarbha PKV HMT and State check RTN 24.

INTRODUCTION

Rice is staple food of 2/3rd of the population of the world. Globally Rice is planted in about 150 m ha and 497 million tons of produce is harvested annually (FAO, 2014), Asia account for 90 % production and consumption of rice. In India, it ranks first, contributing for 43 % of the total food grain production and 55% of cereal production followed by wheat (41%). The total area under rice cultivation in the country is 44.6 (20 % of cropped area) million hectares producing 104.32 million tons with the productivity of 2.40 tons /ha (FAO, 2015).

The total area under rice in the Maharashtra state is 15.57 lakh ha with an annual rice production of 29.46 lakh tons (43.12 lakh tones rough rice) and the average productivity is 1.90 ton/ha (2.71 ton/ha rough rice). (Maharashtra State Statistics Department, Pune Report 2014-2015).

Vidarbha region is the major rice producing area of Maharashtra. Nearly 7.69 lakh ha area of Vidarbha (contributes 49.57 % of the state area) is under rice crop with production of 15.93 lakh tones rough rice (11.14 lakh tones milled rice). The average productivity of rough rice in Vidarbha region is 2.07 tones/ha (1.44 tones/ha milled rice) (Maharashtra State Statistics Department, Pune Report 2014-2015).

Over the years, efforts were made to increase the rice production transformed the state from food deficit to net surplus. For achieving and maintaining self-sufficiency in rice, in view of ever increasing population, continuous enhancement of rice production is the need of hours as suited the irrigated ecological condition. The mid-late duration varieties are very popular in Vidarbha region. In Vidarbha region the proportion of area under early, midlate and late varieties is about 30, 40 & 30 percent respectively.

In Vidarbha region short slender grain type have more demand in market and also from farmers for cultivation. So this research station was trying to develop short slender genotype with good quality parameter varieties in crop improvement programme. As a part of continuous efforts to evolve high yielding good quality variety in midlate duration, the cross effected between PKV HMT x Tarori Basmati at Agriculture Research station, Sindewahi resulted in the development of new culture SYE-705-17-12 to fulfill the requirement of fine grain type (Short Slender) midlate duration high yielding rice variety for the farmers of Maharashtra state.

The culture SYE-705-17-12 was accepted for pre-release for Eastern Vidarbha region of Maharashtra state during research findings and recommendation committee meeting at DR.PDKV, Akola on date 9th May 2017.

MATERIALS AND METHODS

The field and laboratory experiments were conducted during the year 2012, 2013 and 2014 at 11 locations over Maharashtra. The standard package of practices were followed by all centers. In Vidarbha as per soil fertility status recommended dose of fertilizer was applied as 100: 50:50 NPK kg /ha. The new genotype SYE-705-17-12 was tested with different checks i.e. PKV HMT (Vidarbha Check) and RTN 24 (State Check). The yield and yield contributing parameters tested on field condition at different locations at Vidarbha region. The grain quality characters viz., Milling %, Head Rice Recovery %, Kernel Length, amylose content, gel consistency (Webb 1985). Head Rice recoverability is an inherited trait, although environmental factors are known to influence grain breakage during milling (Bhattacharya 1980) of SYE-705-17-12 was tested at RARS, Karjat,

Dist- Raigad after harvesting in the year 2012, 2013 and 2014. The various rice genotypes including local and state check were arranged in RBD design with three replications in advanced varietal trial with 21 days old seedlings @2-3 seedlings per hill in tractor puddled soil by adopting 20 x 15 cm spacing in plot size of 5 x 3 m(15 sq.m.)

RESULT AND DISCUSSION

The different genotype were tested in Advanced Varietal Trial 14-18 g with different duration and yield parameters was recorded (Table 1). The ANOVA showed that, genotype SYE-705-17-12 having significantly superior over PKV HMT (Local Check) i.e. 28.16 % increase in average of six years. Whereas, over state check RTN 24, it recorded 38.11 % higher yield in university level trials.

The same genotype were also tested at Maharashtra level trials with state check RTN 24 during 2012 to 2014. it recorded significantly 17.28 % higher yield over RTN 24 (Table 3).

SYE-705-17-12 is midlate duration with 101 days to 50 % flowering, dwarf stature having plant height 90 cm, 236 average panicles/m² and 231 spikelets / panicle in university level trials (Table 2). Whereas in Maharashtra trials SYE-705-17-12 recorded 102 days for 50 % flowering, 87 cm plant height, 245 panicles/m² and 214 spikelets / panicle with test weight 14.43 g and short slender grain type (Table 4).

The genotype recorded higher milling % i.e. 67.68 to 80.39 % with HRR 64.99 to 72.04 % as compared to Local check PKV HMT state check RTN-24. The amylose content 22.18% which is most acceptable in market (Table 5).

SALIENT FEATURES OF SYE-705-17-12

1. Duration : 130-135 Days to seed Maturity (Midlate Duration)
2. Fine grain type (Short Slender) having– Test weight – 14.43 g
3. In university level trials it recorded 28.16 % and 38.11 % higher yield over PKV HMT and RTN 24
4. In state level trials it recorded 20.84 %, 14.55 % and 16.46 % higher yield over state check RTN 24.
5. Good cooking quality and intermediate Amylase content (22.18 %) and high milling recovery (74.80%)

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Table 1 : Grain Yield – (Kg/ha) - Summary performance of SYE-705-17-12 in University AVT Trials (2010-2016)

Name of the trial	Year	SYE-705-17-12 (PDKV Akshad)	PKV HMT (Ch)	RTN-24(S.Ch)
Station trial	2010	3853	2465	2446
% increase over check			58.31	57.52
AVT	2011	3801	3143	2030
% increase over check			20.93	87.24
AVT	2012	3034	2705	1900
% increase over check			12.16	59.68
AVT	2013	3393	2983	2229
% increase over check			13.74	52.22
AVT	2014	2661	2251	2388
% increase over check			18.21	11.43
AVT	2015	3617	3012	3365

% increase over check			20.08	7.48
AVT	2016	4400	3868	3569
% increase over check			13.75	23.28
Mean % Increase	2010-16		28.16	38.11

Table 2 : Mean ancillary characters of SYE-705-17-12 in University trial conducted during Kharif 2010-2016

Trial / Year	Designation	Days to 50% flowering	Plant height (cm)	No. of Panicles per sq.m.	Spikelet / Panicle	Test weight	Grain type
Station trial 2010	SYE 705-17-12	104	89	187	224	15.0	SS
	PKV-HMT	112	89	232	209	14.6	SS
	RTN 24 (S.Ch)	91	93	205	131	15.2	SS
AVT-SS 2011	SYE 705-17-12	98	104	315	307	15.8	SS
	PKV-HMT	102	93	315	228	13.0	SS
	RTN 24 (S.Ch)	85	103	264	223	17.40	SS
AVT-SS 2012	SYE 705-17-12	103	83	202	179	16.6	SS
	PKV-HMT	110	78	243	149	13.4	SS
	RTN 24 (S.Ch)	102	106	224	135	14.8	MS
AVT-SS 2013	SYE 705-17-12	99	88	252	224	13.9	SS
	PKV-HMT	109	88	249	167	14.50	SS
	RTN 24 (S.Ch)	92	87	254	167	14.9	SS
AVT-SS 2014	SYE 705-17-12	92	89	185	244	13.6	SS
	PKV-HMT	95	83	144	123	12.4	SS
	RTN 24 (S.Ch)	84	111	189	199	14.0	SS
AVT-SS 2015	SYE 705-17-12	103	88	263	167	15.5	SS
	PKV-HMT	103	84	240	166	13.6	SS
	RTN 24 (S.Ch)	101	107	256	152	15.1	SS
AVT-SS 2016	SYE 705-17-12	105	91	245	272	15.4	SS
	PKV-HMT	111	86	274	192	14.5	SS
	RTN 24 (S.Ch)	105	121	315	159	17.3	SS
Average	SYE 705-17-12	101	90	236	231	15.11	SS
	PKV-HMT (C)	106	86	242	176	13.71	SS
	RTN 24 (S.Ch)	94	104	244	167	15.53	SS

Table 3 : Grain Yield (Kg/ha) performance of SYE-705-17-12 in (AVT-Quality) State Co-ordinated Trial at different zones of Maharashtra state during 2012 to 2015

Year of Testing	Designation	Yield performance (Kg/ha & % increase)				
		KN	WM	V	Mean over locations	% increase
2012	SYE -705-17-12	3723	4233	4020	3965	
	RTN 24 (S.Ch)	3384	4058	2367	3281	20.84
2013	SYE -705-17-12	4185	5127		4588	
	RTN 24 (S.Ch)	3780	4306		4005	14.55
2014	SYE -705-17-12	3757	4249	3437	3757	
	RTN 24 (S.Ch)	3318	4034	2293	3226	16.46
Average	SYE -705-17-12	4312	4572	3379	4231	
	RTN 24 (S.Ch)	3494	4133	2330	3504	17.28

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Table 4: Mean ancillary characters of SYE-705-17-12i n MSCRIP trials conducted during Kharif 2012-2014

Trial / Year	Designation	Days to 50% flowering	Plant height (cm)	No. of Panicles per sq.m.	Spikelet / Panicle	Test weight	Grain type	White Belly
AVT-SS 2012	SYE 705-17-12	101	85	221	200	14.96	SS	A
	RTN 24 (S.Ch)	91	96.2	236	172	15.22	SS	A
AVT-SS 2013	SYE 705-17-12	102	89.3	246	195	15.10	SS	A
	RTN 24 (S.Ch)	94	96.4	237	171	13.18	SS	A
AVT-SS 2014	SYE 705-17-12	102	86.4	268	246	13.22	SS	A
	RTN 24 (S.Ch)	94	97.7	255	182	15.34	SS	A
Average	SYE 705-17-12	102	87	245	214	14.43	SS	A
	RTN 24 (S.Ch)	93	96.7	242.6	175	14.58	SS	A

Reference: Progress Report of MSCRIP Kharif 2012 P.74, Kharif 2013 P.91 and Kharif 2014 P.83

Table 5: Grain quality characteristics of SYE-705-17-12 in MSCRIP Advance Variety Trial (M) Short Slender Kharif 2012-14

Entry	Year	Mill (%)	HRR (%)	KL (mm)	Grain type	Grain Chalk	WU (ml)	KLAC (mm)	VER	ER	ASV	AC (%)	GC (mm)	GT (°C)
SYE 705-17-12	2012	80.39	-	5.27	SS	A	300	9	3.6	1.7	3	20.2	35	High, Intermediate
	2013	76.33	72.04	5.16	SS	A	360	9	4.25	1.74	3	23.42	37	High, Intermediate
	2014	67.68	64.99	5.33	SS	A	180	9	4.38	1.69	3	22.93	35	Intermediate
Mean		74.80	68.52	5.25			280	9.00	4.08	1.71	3.00	22.18	35.67	
RTN 24 (S.Ch)	2012	78.82	-	5.28	SS	A	260	11	5.66	2.08	5.3	26.96	35	Intermediate
	2013	76.53	73.4	5.65	SS	A	340	12	3.78	2.12	5	21.67	34	Intermediate
	2014	62.24	55.69	5.66	SS	A	330	9.5	5.83	1.68	5	25.1	89	Intermediate
Mean		72.53	64.55	5.53			310	10.83	5.09	1.96	5.10	24.58	52.67	
PKV-HMT	2012	76.11	-	5.22	SS	A	340	9	5.41	1.72	3.5	20.09	36	High, Intermediate
	2013	72.66	68.67	5.39	SS	A	320	10	4.86	1.86	3	24.99	83	High, Intermediate
	2014	64.75	59.29	5.63	SS	A	230	9.5	5	1.69	3.5	25.86	93	High, Intermediate
Mean		71.17	63.98	5.41			297	9.50	5.09	1.76	3.33	23.65	70.67	

Mill–Milling (%); **HRR**–Head rice recovery (%); **KL**–Kernel length (mm); **WU**–Water uptake (ml); **KLAC**–Kernel length after cooking (mm); **VER**–Volume expansion ratio; **ER**–Elongation ratio; **ASV**–Alkali spreading value; **AC**–Amylose content (%); **GC**–Gel consistency (mm) & **GT**–Gelatinized temperature

REFERENCE

Progress Report of MSCRIP 2012 p.p.-151, 2013 p.p.-203, 2014 p.p.-177

CAGL-93 : A PROMISING HIGH YIELDING LATHYRUS GENOTYPE

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ABSTRACT

Particularly in Eastern Vidarbha Zone of Maharashtra State, after paddy crop during kharif season second important crop is *Lathyrus sativus* (L.) which is cultivated during rabi season, which is bonas crop for paddy growers. The farmers cultivated this crop under Utera condition in paddy field. As a part of continuous effort a new genotype CAGL-93 was developed with high yielding and medium bold seeded. It has been tested in University research trials under sown condition during the year 2015-16 to 2018-19 in rabi season. The new genotype CAGL-93, was found significantly superior with higher yield over the most popular lathyrus variety viz. , Ratan, Prateek and Mahateora during the year 2015-16 to 2018-19 at Sindewahi location. The genotype found good test weight i.e. 7.34 g (medium bold) which is having demand by growers and consumers. CAGL-93 having higher number of branches plant⁻¹ (4.75) and number of pods plant⁻¹ (9.25) than checks.

INTRODUCTION

The *Lathyrus sativus* (L.) (2n = 14) locally called as grass pea, khesari dal, peavine or chanamatra. It belongs to legume family Fabaceae, sub family Papilionoideae and genus *Lathyrus* with 130 species occurring all over temperate region of Northern hemisphere and the higher altitude of tropical Africa. In India, besides the ornamental *Lathyrus odoratus*, the only other specie cultivated is *Lathyrus sativus* which yield the khesari dal. The edible *Lathyrus sativus* originated in the West Central Asia

Mediterranean region and North India was its centre of domestication, were 3600 years old remains have been discovered. In India, it is grown over an area of about 1.5 million hectares with a total production of about 0.8 million tones and average productivity of 5.33 q ha⁻¹. It is the most economically important and widely cultivated crop for human consumption (Gurung *et al.*, 2011).

The states which cultivate grass pea are Maharashtra, Madhya Pradesh, Bihar, West Bengal and Eastern Uttar Pradesh contributing about 4.5 % total pulse production of the country. In Maharashtra it is cultivated in Bhandara, Chandrapur, Gadchiroli, Gondia and Nagpur districts of eastern Vidarbha, accounting to 50,152 hectares area (Anonymous, 2018)..

Though the consumption, sale and cultivation of grass pea is banned, it is cultivated, consumed and sold without any hesitation in countries like India, Bangladesh, Burma, Nepal, Pakistan and Ethiopia. *L. sativus* gave the highest carbohydrate, protein, ash, saturated fatty acid and polyunsaturated fatty acid content, and lowest fat and energy value. Furthermore, it also showed the highest concentration of flavonoids and antioxidant activity. (Sarmiento *et al* 2015).

It is also rich in carbohydrates (58.2%). Its foliage and seeds make valuable forage. They can be used fresh, dried as hay or made into silage (Emile *et al.*, 2008; Yadav *et al.*, 2006). Grass pea straw and chaff are particularly valuable, Immature pods and young plants are cooked and eaten as vegetables (Yadav *et al.*, 2006).

Lathyrus is an N-fixing legume that is often used to provide N to the main economic crop (Campbell, 1997). Grass pea has positive effects on soil structure as its deep taproot prevents soil compaction. When ploughed in, grass pea is a good green manure that returns nutrients to the soil and provides organic matter (Lazanyi, 2000).

The plant is considered as a great boon against drought, floods, hails and various pests. The plant is strongly drought resistant. Being a legume, it fixes atmospheric nitrogen through root nodules, part of which could be available to succeeding crop. It is mostly sown in standing crop of paddy as a 'Utera' or 'Paira' crop in rabi season (Singh, 1979).

Secondly, the main pulse crop Tur (Pigeonpea) is grown only on bunds, hence the production of Tur is not sufficient for the requirements of these paddy region. This gives the chance to *Lathyrus* to serve as alternative pulse. Thirdly, the lathyrus plant type is considered to be strongly drought resistant (Angelova *et al.*, 1995) and grows luxuriantly without any cultivation input and lastly, this pulse is consumed in various forms like chapatias, wadas, pests balls and curries and fed to cattle as green fodder and stover (dried chaff) since ancient times. Besides this *Lathyrus* contain toxic alkaloid which causes paralysis of lower limbs known as Lathyrism. The continuous consumptions of this pulse that too in undercooked condition of low temperature causes paralysis. The neurotoxin which is responsible for the crippling disorder is β -N Oxalyl - α - β - Diaminopropionic acid (ODAP) and is one of the breeding aspects in *Lathyrus* breeding. The development of low ODAP content

line such as BIOR-212 and Pusa-90-2 will be useful in development of lathyrus varieties. Some good varieties also developed i.e. Ratan, Pratik and recently Mahateora (Ratan x JRL-2), where as Mahateora is having 46 cm height, 94 days duration and less ODAP content (0.074%), it is pink flower variety which is having good yield potential i.e. in sole crop (15 q ha⁻¹) and in Utera (7.0 q ha⁻¹), which was released and notified (No. SO 2458 [E]/16-10-2008) by IGKV, Raipur.

Lathyrus grown for seeds in India yielded an average of 300-500 kg seeds/ha, but yields up to 1.5 t seeds/ha have been reported (Ecocrop, 2014).

Beside this also farmers required the high yielding lathyrus variety for cultivation, the genotype CAGL-93 is identified the good genotype of lathyrus, which is superior in grain yield over all released lathyrus variety for paddy growers in Eastern Vidarbha Zone.

MATERIALS AND METHODS

The field experiments were conducted during the year 2015, 2016, 2017 and 2018 at Agriculture Research Station, Sindewahi Dist. Chandrapur. The standard package of practices were followed as per recommendation. In Vidrabha as per soil fertility status recommended dose of fertilizer was applied as 20: 40:00 NPK kg ha⁻¹. The new genotype CAGL-93 was tested with different checks i.e. Ratan, Pratik and Mahateora. The yield and yield contributing parameters tested on field condition at Sindewahi Dist. Chandrapur locations at Vidrabha region of Maharashtra State. The various lathyrus genotypes including local and state check were arranged in RBD design with three replications in Multilocal varietal trial with Direct sowing condition. 2-3 seeds hill⁻¹ in well cultivated field condition by adopting 30 cm x 10 cm spacing in plot size of 4 x 2.40 m (9.60 sq.m.). The sowing was done in the month of last week of October during each year.

RESULTS AND DISCUSSION

The different genotype were tested in Multilocal varietal Trial at University level and yield parameters was recorded (Table 1). The ANOVA showed that, genotype CAGL-93 found significantly superior in respect seed yield to i.e. 27.02 % over Ratan, and 19.85 % increase over Pratik and Mahateora checks in average of four years.

CAGL-93 is midlate in duration, which 50% flowered occurs in 44-46 days to 50 % flowering, dwarf stature with plant height 29-37 cm, 4 – 5 average number of branches and 9-11 pods plant⁻¹ in university level trials (Table 2). Whereas test weight 7.34 g (medium bold). The genotype CAGL-93 can be used for cultivation and breeding programme also.

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Table 1 : Grain Yield – (Kg ha⁻¹) - Summary performance of CAGL-93 in University Level Multilocal varietal Trials (MVT) (2015-2018)

Name of the trial	Year	CAGL-93	Ratan	Pratik	Mahateora	SE±(m)	CD at 5%	CV %
MVT	2015-16	1041	960	897	1079	27.78	83.16	5.34
% increase over check			8.33	15.94	-3.52			
MVT	2016-17	1078	1088	1005	922	96.14	288.17	16.69
% increase over check			-0.91	7.26	16.92			
MVT	2017-18	1394	922	1072	1072	70.8	212.1	12.-09
% increase over check			51.19	30.04	30.04			
MVT	2018-19	1244	775	995	896	55.85	167.45	11.11
% increase over check			60.52	25.03	38.84			
Pool mean (2015-16 to 2018-19) Four years one location		1189.25	936.25	992.25	992.25			
Over all Mean % Increase			27.02	19.85	19.85			

Table 2 : Mean ancillary characters of CAGL in University Level Multilocal varietal Trials (MVT) (2015-2018)

Trial / Year	Designation	Days to 50% flowering	Plant height (cm)	No. of branches /plant	No of Pods/plant	Test weight
MVT- <i>Lathyrus</i> Rabi 2015-16	CAGL-93	46	33.4	5	14	7.43
	Ratan (Ch)	44	31.6	4	9	7.70
	Pratik (Ch)	44	34.6	5	16	6.00
	Mahateora (Ch)	43	31.4	4	10	7.00
MVT- <i>Lathyrus</i> Rabi 2016-17	CAGL-93	46	37.8	6	13	7.16
	Ratan (Ch)	46	36	5	10	7.77
	Pratik (Ch)	47	35.6	5	10	6.07
	Mahateora (Ch)	49	32.6	4	9	5.21
MVT- <i>Lathyrus</i> Rabi 2017-18	CAGL-93	43	23.4	4	5	7.5
	Ratan (Ch)	42	25.4	3	5	9.0
	Pratik (Ch)	45	25.6	3	4	9.1
	Mahateora (Ch)	47	28.4	4	8	7.4
MVT- <i>Lathyrus</i> Rabi 2018-19	CAGL-93	42	24.2	4	5	7.3
	Ratan (Ch)	41	24.0	3	5	8.8
	Pratik (Ch)	41	25.0	3	4	9
	Mahateora (Ch)	50	27.8	4	6	7.2
Average (Four years)	CAGL-93	44.25	29.7	4.75	9.25	7.34
	Ratan (Ch)	43.25	29.25	3.75	7.25	8.31
	Pratik (Ch)	44.25	30.2	4	8.5	7.54
	Mahateora (Ch)	47.25	30.05	4	8.25	6.70

ANTIHELMINTHIC ACTIVITY OF CALOTROPIS PROCERA ON DIFFERENT STAGES OF LIFECYCLE OF MELOIDOGYNE INCOGNITA

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ABSTRACT

Calotropis procera (Ait) plant parts (leaves, stem, flower, root and latex) extract was evaluated for invitro antihelminthic activity on different stages (egg hatching, larval mortality and juvenile infection) of lifecycle of *Meloidogyne incognita*. 100% concentrated latex extract revealed maximum inhibition, followed by 50 and 25% concentration. Rest of the plant part extracts show moderate inhibition in egg hatching. The larval mortality was found to differ between plant part extracts. The latex extract show maximum toxicity at each concentration. For evaluation of nematicidal activity of *Calotropis procera* on L₃ infectious stage of juveniles, the pot experiment was conducted and minimum galls were observed with latex amendments in soil.

Keywords: antihelminthic, nematicidal, amendments, juveniles, galls.

INTRODUCTION

Root knot disease causing nematode *Meloidogyne incognita*, have a wide range of host and cause problems for many crops. It is ranked number one among the ten phytoparasite nematode with wide geographical distribution and phytophagous food habit. *Calotropis procera* (Asclepiaceae), a giant weed is known for its pharmacological importance is used in treating various diseases. This plant is a promising source of antimicrobial, insecticidal and larvicidal properties. Several medicinal plants have been assessed for their nematicidal potential (Vijayalakshmi et al, 1979, Tyagi et al, 1983, Hussain et al, 2011). Hence, to assess the nematicidal activity of *Calotropis*, plant part extracts were used to evaluate its effect on egg hatching and larval mortality. *Calotropis* plant parts were used as soil amendments to evaluate the antihelminthic activity on juvenile (L₃ stage) infection in soybean plants.

MATERIALS AND METHODS

The present investigation was undertaken from the month of July to October in 2015. The experiments were carried out by following procedures

Preparation of Plant part extract. 10 gm of each *Calotropis* plant part powder was soaked overnight in 50ml of distilled water at 60°C, filtered with muslin cloth and the volume was raised to 100 ml and this concentration was considered as 100% and then dilutions were prepared to make 50%, 25%, 10% and the control was without any plant material. 10ml latex was dissolved in 100 ml of distilled water. 1

Collection of Egg. Eggs of *M. incognita* were collected from infected roots of soybean plants. The roots were vigorously shaken with 200 ml 5.2% of sodium hypochlorite in stopper flasks for 2 minutes. Eggs were washed by rinsing with tap water through 75µ sieve and collected in 26µ sieve into distilled water to get the egg suspension. 500µl egg suspension was placed in a petridishes and eggs were counted under a stereomicroscope. 5ml of aqueous extracts of each plant part dilution was added separately in petridish. Petridishes containing distilled water served as control. Each treatment was replicated four times. These petridishes were incubated at room temperature. Hatching was observed after four days and percentage inhibition was calculated by the formula:

$$\% \text{ inhibition} = \frac{\text{Mean value of hatch inhibition}}{\text{Mean value of total no. of Eggs}} \times 100$$

Effect of plant parts extract on M2 Juveniles. 5 ml dilution of each *Calotropis* plant part extract was separately poured into petridishes and 20 freshly hatched II stage juveniles were added to each petridish. All treatments were replicated four times at room temperature. Percent mortality was calculated after 24 and 48 hours.

Effect of extracts on L3 stage larva infection on soybean: By pot experiments. Sterilized pot (4X6 inches) were filled with 500gm of sterilized soil to which *Calotropis* plant parts powder was added in concentrations w/w (1%, 2.5% and 5%). 5 seeds of soybean were sown and the growth of crop was observed through different parameters like root, shoot length, fresh and dried weight. After a month the plants were uprooted, washed, and number of galls was counted to find the activity of weed plant parts against nematode infection.

All the data collected was analyzed using Analysis of Variance with Duncan's Multiple Range Test (Gomez et al, 1984).

RESULT AND DISCUSSION

Table no.1 reveals the maximum inhibitory activity in latex extract. 100% concentrate of latex extract shows maximum inhibition followed by 50 and 25% concentration. Rest of the concentrates of extracts shows moderate inhibition in egg hatching. Leaves extract shows minimum inhibition. All the plant part extract exhibited some level of toxicity towards juvenile of *M. incognita*. Mortality of larva was found to differ significantly between different plant parts extracts. *Calotropis* latex extract showed maximum toxicity at each concentration. Chemical analysis of *Calotropis procera* latex has been performed by various researcher and various compounds have been detected such as cardenoloids, proteolytic enzymes, alkaloids and carbohydrates. Dhar and Singh, (1973). Giridhar et. al (1984) found compounds with larvicidal activity in the latex of *Calotropis procera* for the first time. The crude fresh latex was evaluated for its toxic effects upon egg hatching and larval development Ramos et al, (2006). They found the whole latex caused 100% mortality of II instars within 5min. Presence of pesticide compounds such as Calotropin and Calotoxin in the Milk weed extracts seems to be the most important factors in causing mortality of larva. From the above tables nematocidal activity of *Calotropis* latex amendments in soil under pot conditions was observed. There was a significant reduction in the number of galls in soybean root system with fewer and less developed galls. With the increase in concentration of botanicals in the soil, toxicity was found increased by all parts of the weed plant. However, the leaf amendments stimulated the growth of soybean plant by increasing root; shoot length, dry and fresh weight of treated plants.

Allelopathy is defined as chemical warfare between plants. It represents plant against plants aspect in broader arena of chemical ecology, within which all the organisms tends to respond or regulate by producing a variety of toxins. For management of phytonematodes some organic amendments of soil, like phytothemaplic substances and toxic plants may be utilized. Taking this into consideration the nematocidal potential of *Calotropis procera* was studied. Bhatti and Nandal (1994) have reviewed the information on nematode management through phytotheuraptic substances. Rhode (1972) reported a compound from mary gold root extracts. Mishra and Mojumder (1994) have studied antihelminthic properties through organic amendments of soil.

Johnson (1963) used dried crop residues in pots containing soil, infested with rootknot and observed reduction in galls/plant in *Meloidogyne incognita*. Hussain et al (2011) evaluated the nematocidal activity of four medicinal plants on *M. incognita*. Of these four *Azadirachta indica* and *Calotropis procera* caused maximum reduction in number of galls, egg masses and reproduction factor. Same results were observed by Muller and Gooch (1982), Ali (1990), Akhtar and Alam (1990) and Rather et al. (2007). Papavizas and Dubey, (1992) suggested that the addition of soil amendments results in considerable increase of CO₂ through microbial activity which can suppress the activities of disease causing agent. Akhtar et al (1982) reported that nematode populations may be reduced due to the accumulation of toxic substances that are decomposed in soil. Sayre (1980) postulated that, soil amendments are directly toxic to plant nematodes on addition of amendments initiate a cascade of events favoring the microbial growth those are antagonistic to parasite nematodes. Anon (2005). Nematocidal activity in *Datura stromonium* is due to the alkaloids. The presence of several compounds like phenolics, alkaloids, triterpenes in higher quantity that are the cause of nematostatic activities (Dwivedi et al. 2014). The results reveals that all the extracts exhibited higher mortality in concentration, same results were observed by Jain and Saxena (1993) on *M. incognita* by using *Mangifera indica* as a test plant. The latex loaded with several toxic compounds also justifies the nematocidal effect is due to phytoconstituents present in *Calotropis procera*.

CONCLUSION

The ovicidal and larvicidal properties in latex can be exploited for biological control of *Meloidogyne incognita* and can be implemented in agriculture for sustainable development of agroecosystem.

Table no. 1: Effect of *Calotropis* plant parts on egg hatching and larval mortality

S.No	Plant part	Conc.	No. of Eggs			Hatch Inhibition %			Larval Mortality							
									24 hr			%	48 hr			%
1	Leaves	100	41.8	±	1.1	17.4	±	0.8	13.0	±	0.7	75.0	7.3	±	0.8	36.3
		50	42.8	±	2.2	9.9	±	0.8	7.3	±	0.7	65.0	17.3	±	0.8	86.3
		25	45.3	±	3.6	5.5	±	0.5	6.3	±	0.8	36.3	15.8	±	0.4	78.8

		10	45.0 ± 1.6	2.2 ± 0.7	0.5 ± 1.1	31.3	8.5 ± 1.1	42.5
		0	44.8 ± 1.3	0.6 ± 0.4	15.3 ± 0.5	2.5	0.8 ± 0.4	3.8
2	Stem	100	44.8 ± 2.4	22.4 ± 0.7	13.0 ± 0.4	76.3	17.0 ± 0.7	85.0
		50	44.5 ± 3.2	18.5 ± 0.4	7.3 ± 0.7	65.0	14.3 ± 1.1	71.3
		25	44.5 ± 3.2	11.2 ± 0.7	6.3 ± 0.8	36.3	9.5 ± 0.9	47.5
		10	44.8 ± 0.8	5.6 ± 0.5	0.3 ± 0.8	31.3	8.5 ± 1.1	42.5
		0	44.8 ± 3.1	1.1 ± 0.5	17.0 ± 0.4	1.3	0.8 ± 0.4	3.8
3	Flower	100	44.0 ± 3.7	26.1 ± 0.5	15.5 ± 0.7	85.0	18.0 ± 0.7	90.0
		50	44.3 ± 3.3	20.3 ± 0.7	11.5 ± 1.1	77.5	17.5 ± 1.1	87.5
		25	45.0 ± 1.2	15.6 ± 0.7	9.0 ± 1.1	57.5	13.5 ± 1.1	67.5
		10	45.8 ± 3.0	7.1 ± 0.4	0.5 ± 0.7	45.0	9.5 ± 1.1	47.5
		0	45.0 ± 1.2	0.6 ± 0.4	15.5 ± 0.5	2.5	0.8 ± 0.4	3.8
4	Root	100	44.0 ± 1.6	27.8 ± 0.8	13.8 ± 1.1	77.5	17.3 ± 0.8	86.3
		50	43.5 ± 3.2	20.1 ± 0.8	13.3 ± 0.8	68.8	15.3 ± 0.4	76.3
		25	44.5 ± 1.1	18.5 ± 0.8	7.3 ± 0.8	66.3	15.0 ± 0.7	75.0
		10	42.3 ± 1.9	20.1 ± 0.5	0.8 ± 1.1	36.3	8.0 ± 0.7	40.0
		0	43.8 ± 2.4	1.7 ± 0.4	20.0 ± 0.4	3.8	1.0 ± 0.0	5.0
5	Latex	100	42.5 ± 1.8	100.0 ± 2.3	19.8 ± 0.0	100.0	20.0 ± 0.0	100.0
		50	42.8 ± 2.4	90.1 ± 1.1	18.0 ± 0.4	98.8	20.0 ± 0.0	100.0
		25	42.0 ± 1.6	94.6 ± 1.5	15.8 ± 0.7	90.0	19.8 ± 0.4	98.8
		10	43.0 ± 1.2	52.9 ± 3.3	0.3 ± 0.8	78.8	18.3 ± 0.8	91.3
		0	43.0 ± 2.2	0.9 ± 0.3	0.2 ± 0.4	1.3	0.8 ± 0.4	3.8

Effect of extracts on L3 stage larva infection on soybean: By pot experiments

Table no. 2: 1gm Botanicals/500cc soil

S No .	Plant parts	Root Length cm ± sd	Shoot Length cm ± sd	Foliage no .± sd	Root Wt gm ± sd	Shoot Wt gm ± sd	Galls no. ± sd
1	CONT ROL	18.6 ± 2	20.2 ± 07	23.3 ± 5	0.2 ± 2	1.3 ± 6	28.00 ± 4
2	LATEX	19.0 ± 3	21.2 ± 0.3	17.3 ± 2	0.2 ± 6	1.1 ± 4	11.32 ± 7
3	ROOT	19.4 ± 6	23.3 ± 0.7	22.6 ± 5	0.2 ± 5	1.2 ± 7	18.33 ± 2
4	FLOW ER	19.0 ± 6	23.2 ± 0.3	23.6 ± 7	0.2 ± 4	1.2 ± 5	20.67 ± 9
5	STEM	20.3 ± 0	23.6 ± 0.4	20.3 ± 9	0.2 ± 3	1.2 ± 6	21.67 ± 7
6	FOLIA GE	23.3 ± 6	24.4 ± 0.5	25.3 ± 5	0.2 ± 1	1.5 ± 8	23.30 ± 3
Note : Tabular F (i) at 0.05 = 3.11 and (ii) at 0.01 = 5.06 and t-value at 5% = 1.78 , a* = significant at 5%							

Table no. 3: 2.5gms Botanicals/500cc soil

S No.	Plant parts	Root Lth cm $\pm$ sd	Shoot Lth cm $\pm$ sd	Foliage no. $\pm$ sd	Root Wt gm $\pm$ sd	Shoot Wt gm $\pm$ sd	Galls no. $\pm$ sd
1	CONTR OL	15.5 0. 0 $\pm$ 5	21.2 $\pm$ 2 0.	18.6 0. 7 $\pm$ 9	0.2 0. 2 $\pm$ 3	1.26 $\pm$ 9 0.	27.3 0. 3 $\pm$ 5
2	LATEX	17.1 0. 0 $\pm$ 6	25.9 $\pm$ 9 0.	20.6 0. 6 $\pm$ 7	0.2 0. 7 $\pm$ 1	1.22 $\pm$ 2 0.	12.0 0. 8 $\pm$ 3
3	ROOT	21.0 0. 3 $\pm$ 9	30.7 $\pm$ 7 0.	18.3 0. 3 $\pm$ 9	0.2 0. 8 $\pm$ 1	1.21 $\pm$ 6 0.	18.3 0. 3 $\pm$ 5
4	FLOWE R	20.6 0. 0 $\pm$ 3	30.4 $\pm$ 7 0.	13.6 0. 7 $\pm$ 4	0.2 0. 9 $\pm$ 4	1.22 $\pm$ 3 0.	17.3 0. 3 $\pm$ 4
5	STEM	21.3 0. 3 $\pm$ 4	27.6 $\pm$ 7 0.	19.0 0. 0 $\pm$ 8	0.3 0. 1 $\pm$ 1	1.30 $\pm$ 5 0.	12.0 0. 0 $\pm$ 4
6	FOLIAG E	17.6 0. 3 $\pm$ 6	28.6 $\pm$ 2 1.	16.5 0. 7 $\pm$ 4	0.4 $\pm$ 3 0.	1.32 $\pm$ 3 0.	16.3 0. 3 $\pm$ 5
Note : Tabular F (i) at 0.05=3.11 and (ii) at 0.01=5.06 and t-value at 5% = 1.78, α^* = significant at 5%							

Table no. 3, 5gms Botanicals/500cc soil

S No.	Plant parts	Root Lth cm $\pm$ sd	Shoot Lth cm $\pm$ sd	Foliage no. $\pm$ sd	Root Wt gm $\pm$ sd	Shoot Wt gm $\pm$ sd	Galls no. $\pm$ sd
1	CONTROL	18.4 $\pm$ 0.2	24.2 $\pm$ 0.2	18.67 $\pm$ 0.9	0.22 $\pm$ 0.3	1.26 $\pm$ 0.9	27.33 $\pm$ 0.5
2	LATEX	19.9 $\pm$ 0.6	23.9 $\pm$ 0.9	20.66 $\pm$ 0.7	0.27 $\pm$ 0.1	1.02 $\pm$ 0.2	5.08 $\pm$ 0.3
3	ROOT	19.8 $\pm$ 0.8	25.7 $\pm$ 0.7	18.33 $\pm$ 0.9	0.28 $\pm$ 0.1	1.21 $\pm$ 0.6	8.03 $\pm$ 0.5
4	FLOWER	21.7 $\pm$ 0.3	25.4 $\pm$ 0.7	19.67 $\pm$ 0.4	0.29 $\pm$ 0.4	1.22 $\pm$ 0.3	7.53 $\pm$ 0.4
5	STEM	19.3 $\pm$ 0.4	27.6 $\pm$ 0.7	19.00 $\pm$ 0.8	0.31 $\pm$ 0.1	1.30 $\pm$ 0.5	10.00 $\pm$ 0.4
6	FOLIAGE	21.6 $\pm$ 0.6	29.6 $\pm$ 1.2	20.57 $\pm$ 0.4	03.4 $\pm$ 0.3	1.32 $\pm$ 0.3	12.33 $\pm$ 0.5
Note: Tabular F (i) at 0.05=3.11 and (ii) at 0.01=5.06 and t-value at 5%=1.78, α^* = significant at 5%							

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**SOCIO DEMOGRAPHIC DETERMINANTS OF ORGAN DONATION AMONG ADULTS
ASSOCIATION OF AWARENESS AND APPROACH CONCERNING ORGAN DONATION AMONG
THE ADULTS WITH THE SELECTED DEMOGRAPHIC VARIABLES**

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ETHICAL STATEMENT

The entire procedures accomplished in human participants were in accord with moral values of the institutional testing committee and with the 1964 Helsinki declaration and its later amendments or similar ethical standards. This research is not prepared by the studies containing animal testing performed by any authors.

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CONFLICT OF INTEREST

Authors declare that there's no potential conflict of interest.

ABSTRACT**INTRODUCTION****OBJECTIVE**

With the chosen demographic variables the aim of the research is to establish the association of awareness and approach concerning donation of organs among adults.

METHODS

In the process of selecting samples the sampling undertaken was Non-probability Convenience sampling. Structured awareness questionnaire and Likert scale in particular fields were taken for collection of data. Pearson Chi-square test is involved in associations testing.

RESULTS

Awareness and approach about organ donation were appreciably connected with educational prominence 7.82 ($p < 0.05$). People who were highly educated showed a great motivation and support towards organ donation. Several logistical multivariate analyses unrestrained that the next stage of education status was significant ($p < 0.05$) ad hoc predictors of information and angle standing of organ donation.

CONCLUSION

Enhanced awareness and approach may stimulate into the vigorous organ donation. Efficient methods should be taken to instruct people with appropriate information with the association of medical and nursing officers.

Keywords: Adults, Awareness, Approach, Organ donation, Association

INTRODUCTION

The process and the cycle of life is dynamic and vibrant. The process starts with the birth of a person and it ends abruptly because of death. The in between life is struck with full of problems in different stages of life with so many varieties of diseases. The medical advancement and technology has begun to save lots of lives and also the most miraculous accomplishment of contemporary medication is organ transplantation that has the ability to save lots of the lives of the client [1].

Organ donation is nothing but it is the process which involves transplanting an organ or any particular part of an organ to another person who is in need. To become organ donor if the person is under age 18, his/her parent or guardian must give permission. If he/she is 18 or more than 18 than he/ she can shown to be a donor of organ by signing a donor card as an evident. Every human has to be a part of this noble and charitable act [2].³

BACKGROUND

The necessitate for Organ contribution and donation in spite of its quantity of transplants, there are still not adequate donor organs to fill up the requirements of those who need them. Transplantation or organ donation are both same in some sense because both involve in the act of donation of biological tissue from one person to another who requires or it is the donation of connect organ of the human who is living or mortal for the person in need. Transplantable organs and tissues square measure separate in a remarkably surgery subsequent a purpose, in support of the donor's therapeutic and collective the past, of that square measure suitable for the

transplantation. According to the solstice, 2013, there square measure 118,617 individuals pending in need of their life-saving organ transplants inside the U.S. Within these, 96,645 expect for transplantation of kidney [3-5].¹⁴

Thousands of lives have been saved worldwide due to organ transplantation. On the basis of United Nations agency report, urinary organ transplants ar meted out in ninety one countries. "Around 66,000 kidney donations, 21,000 liver donations and 6000 heart donations were transplanted globally in 2005" [1] [6].

"There is conjointly a scarcity of accord on the influence of the socioeconomic variables of education and financial gain on the disposition to give dead body organs".^{13,14}

On the other hand, a different study did not discover any arithmetic relation in between education and the readiness to bestow.¹⁵ One of the study taken in United Kingdom showed an contrary relationship between income to donate organs and willingness to donate, but the study taken in Canada was opposite to that.

On the aspects of the public, social, multi-cultural and multi-religious residents gives a good example to handle the further research on the hypothesis that customs, traditions, race, sex and belief on one side and on the opposite side it takes financial profit and education, could serve as a strong control over the temperament of folks to present the organs of dead body. Therefore, These findings and research could engender healthy strategy connotation to restructure the stuff of a rising shortage among stipulate and deliverance of human organs.

As a result, the goal of the given research and report was to fill up the space regarding civic consciousness about donation of organs. The research aimed at determining the factors which prompt and encourage each and every individual in organ donating. For the purpose of future campaigns and for specific targeted programs the given information and data would be helpful.

OBJECTIVE

To find out the pursuit of awareness and approach of adults concerning Organ donation with their chosen variables of demography.

HYPOTHESES

There is a noteworthy organization of awareness and approach ranges of adults concerning Organ donation with their chosen variables of demography.

METHODS AND MATERIALS

To promote organ donation across the world and with intention to expand the noble cause the research had applied a grant with request of the people who are willing to donate their organs.

The given study uses an Evaluative research approach. The present study has a pre-investigational research method which consists of one group pre-test and one group post test. For choosing the sample the sampling technique used was Non probability convenience. As a sample the research chooses 80 adults. A planned knowledge survey and Likert level was developed to measure the pre test association of awareness and approach on donating organs in both Hindi and English. The research was permitted by the institution beliefs commission and permission was taken from chief medical and Health officer of selected area. The information consent was also obtained. By performing so, the researchers adopted the method that other most important researches have taken to make sure a high retort charge when the research intakes in quest of susceptible information. Information of every adults age group between 20 years to 60 years and who willingly decided to take part in the research were chosen and recorded.

The researchers in the study had worn each graphic figure and data then manifold strategic reversions for the logical method with the concluding leading for substitution special effects. The huge model assisted in generating various healthy results and conclusions for elucidation.

RESULTS

The number of persons who decided to contribute their organs after their death by age, gender, faith, education status, profession, family income, previous knowledge and source of information are shown in (Table 1).

These results are not surprising because educated adults are more willing to donate than the age, gender, religion, education status, occupation, family income, previous knowledge and source of information among the adults.

Educational status is significant with the knowledge scores of adults regarding organ donation. The remaining characters i.e. age, gender, religion, occupation, family income, previous knowledge and source of information

are not significant with the pre-test knowledge and attitude scores of adults regarding organ donation. The adults having educational status of post-graduation having the higher knowledge regarding the organ donation and others are having the less knowledge (Table 2).

Educational status is significant with the attitude scores of adults regarding organ donation. The remaining characters i.e. age, gender, religion, occupation, family income, previous knowledge and source of information are not significant with the attitude scores of adults regarding organ donation. The adults having educational status of post-graduation having the higher attitude regarding the organ donation and others are having the fewer attitudes (Table 3).

ARGUMENT

The multi-cultural and multi-spiritual setting of the populace formed attractive conclusions, that will be helpful to illustrate suggestions for various locations. The result shows there is an organization of pre-test attitude of adults with the selected demographic variables with respect to Educational status. The remaining characters i.e. age, gender, religion, occupation, family income, earlier awareness and basis of knowledge are not significant with the pre-test awareness and approach levels of adults concerning donation of organ. So, there was an important alliance among awareness scores of the adults with their chosen variables of demography.

The Chi-square (χ^2) value of educational status with the awareness levels of adults concerning donation of organ is 11.3535 S^* was significantly higher than the p-value ($P>0.05$) at 5 % level. The result shows that there is an Association of pre-test knowledge of adults with the selected demographic variables with respect to Educational status. The Chi-square(χ^2) value of educational status with the attitude scores of adults regarding organ donation is 11.52 S^* was significantly higher than the p-value ($P>0.05$) at 5 % level Result shows that there is an Association of pre-test attitude of adults with the selected variables of demography with respect to Educational status.

CONCLUSION

In the present scenario, organ donation is considered to be a best and natural treatment after organ failure. Organ failure is a serious complication in present era due to life style changes. The below said conclusions was drawn. The researchers discovered that alertness of donating organ is associated with respect to educational status. The remaining characters i.e. age, gender, religion, occupation, family income, prior awareness and foundation of knowledge are not significant with the knowledge and attitude scores of adults concerning donating organ. So, there was major alliance amid awareness levels of the adults with their chosen variables of demography. Methods should be occupied to teach people with applicable knowledge, plus the settlement of donating organ and probable problems as well so that persons can build well-versed options in the outlook. In the lack of sufficient baseline knowledge, it is certainly tricky to remark on whether the universal people are previously conscious of this easy facade. With complete revelation of such information, they can then make the option of contributing an organ to a different human being in the noblest courage of generosity and kindness.

NURSING OR PRACTICE IMPLICATION

The result of the research should be used on the root of in-service culture programs for nurses so as to make them awake of the development and latest trends to educate the patients and attenders about the organ donation and their benefits. Training programmes for the organ donation will promote the knowledge among the nurses by doing organ donation a man can save a life.

There is a call for widespread study in this area so that strategy for taming persons towards the donation of organ among adults can be developed. Findings of this study will provide the baseline data about organization of awareness and attitude towards donation of organ.

SUGGESTIONS

On the foundation of the result of the research, the following suggestions were provided.

- A parallel research can be undertaken on a larger scale for better generalization.
- An Evaluative study can be done on the assessment of an adult's awareness and approach toward donating organ.
- A relative research can be done on the effect of a different method of teaching knowledge towards organ donation.
- An evaluative study can be done to measure the awareness and attitude toward donation of organ among health care worker.

- A Similar kind of study can be undertaken in different settings and different target population, such as adults and elder people.

KEY POINTS

- The organ donation improves the quality of life.
- Organ failure is the major health problem in entire world.
- More efforts are required for motive towards organ donation.

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Table 1: Percentage distribution of adults according to their demographic Characteristics N = 80

S.no.	Demographical Variable	Characters	frequency	%
1.	Age in years	21-30	61	76.25%
		31-40	13	16.25%
		41-50	02	2.50%
		51-60 years	04	05%
2.	Gender	Male	52	65
		Female	28	35
3.	Religions	Hindu	80	100%
		Muslim	00	00
		Christian	00	00
		Others	00	00
4.	Educational status	High school	14	17.50%
		Higher secondary	11	13.75%
		Under graduate	33	41.25%
		Post graduate and above	22	27.50%
5.	Occupation	Govt. Employee	10	12.50%

		Private employee	17	21.25%
		Business	07	8.75%
		Unemployed	46	57.50%
		4000-5000 Rupees	28	35%
6.	Family income	5001-10000 Rupees	05	6.25%
		10001-15000 Rupees	07	8.75%
		15001 and above	40	50%
		Yes	65	81.25%
7.	Previous-knowledge	No	15	18.75%
		Seminar	03	3.75%
8.	Source of information	Friends and family	08	10%
		Health personal	14	17.5%
		Mass media	40	50%

Association of knowledge and attitude of adults with the selected demographic variables

Table: 2: Abstract of Chi-square results of socio demographic characteristics and association of knowledge of adults regarding organ donation. N=80

S. no.	Characteristics	Chi-Square Value	Df	Result	'p' value
1	Age	1.45	5	N.S.	11.07 (p>0.05)
2	Gender	.27	3	N.S.	7.82 (p>0.05)
3	Religion	0.57	5	N.S.	11.07 (p>0.05)
4	Educational status	11.35	3	S*	7.82 (p<0.05)
5	Occupation	2.166	6	N.S.	12.59 (p>0.05)
6	Family income	1.67	6	N.S.	12.59 (p>0.05)
7	Previous knowledge	0.740	1	N.S.	3.84 (p>0.05)
8	source of information	0.351	6	N.S.	12.59 (p>0.05)

NOTE - N.S.*- Not Significant * (p>0.05)–denotes the significance at 5% level

S*- Significant * (p<0.05)–denotes the significance at 5% level

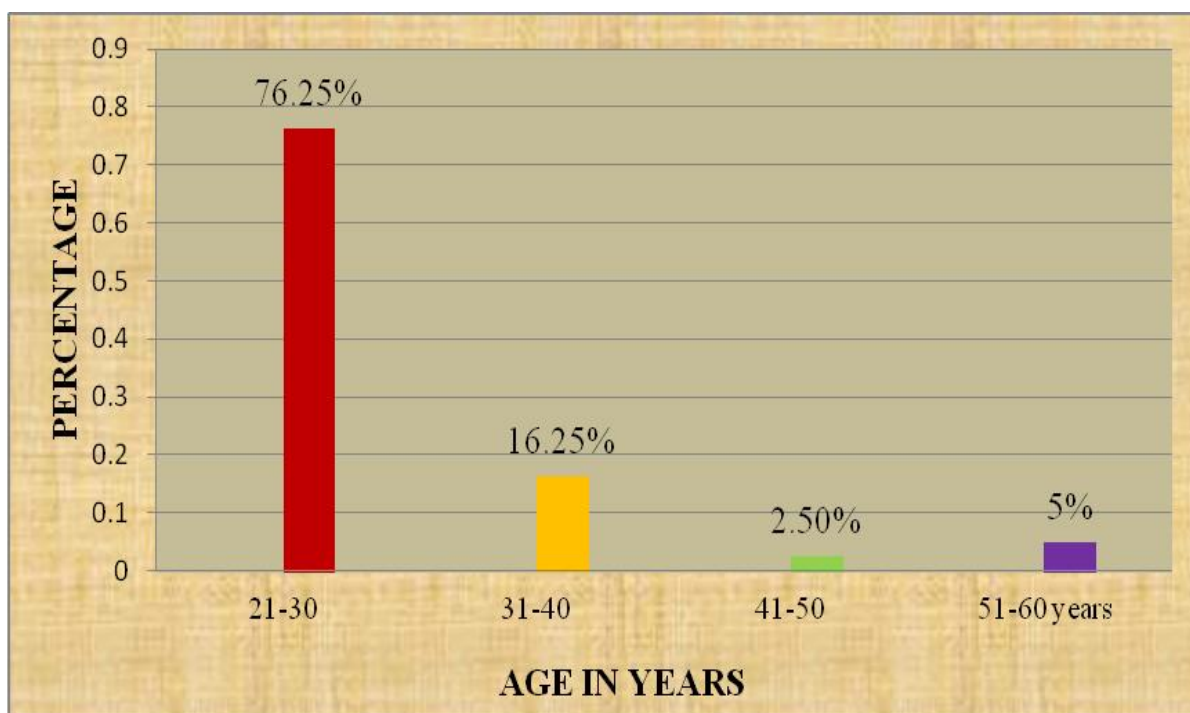
Table: 3: Abstract of Chi-square results of socio demographic characteristics and association of attitude of adults regarding organ donation. N=80

S. no.	Characteristics	Chi-Square Value	Df	Result	'p' value
1	Age	3.25	5	NS	11.07 (p>0.05)
2	Gender	.15	3	NS	7.82 (p>0.05)
3	Religion	0.51	5	NS	11.07 (p>0.05)
4	Educational status	11.52	3	S*	7.82 (p<0.05)

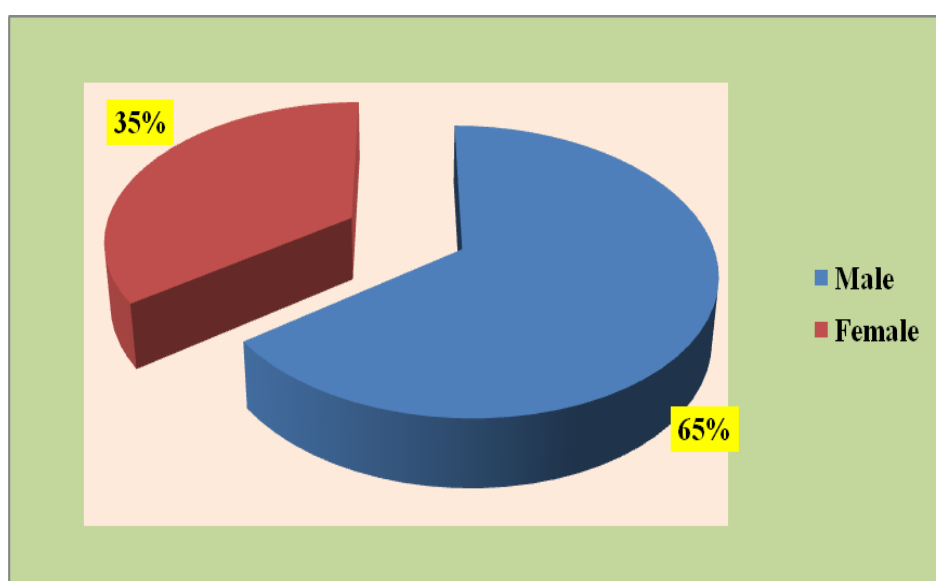
5	Occupation	2.81	6	NS	12.59 ($p>0.05$)
6	Family income	7.86	6	NS	12.59 ($p>0.05$)
7	Previous knowledge	0.244	1	NS	3.84 ($p>0.05$)
8	source of information	6.5	6	NS	12.59 ($p>0.05$)

NOTE - N.S.*- Not Significant * ($p>0.05$)—denotes the significance at 5% level

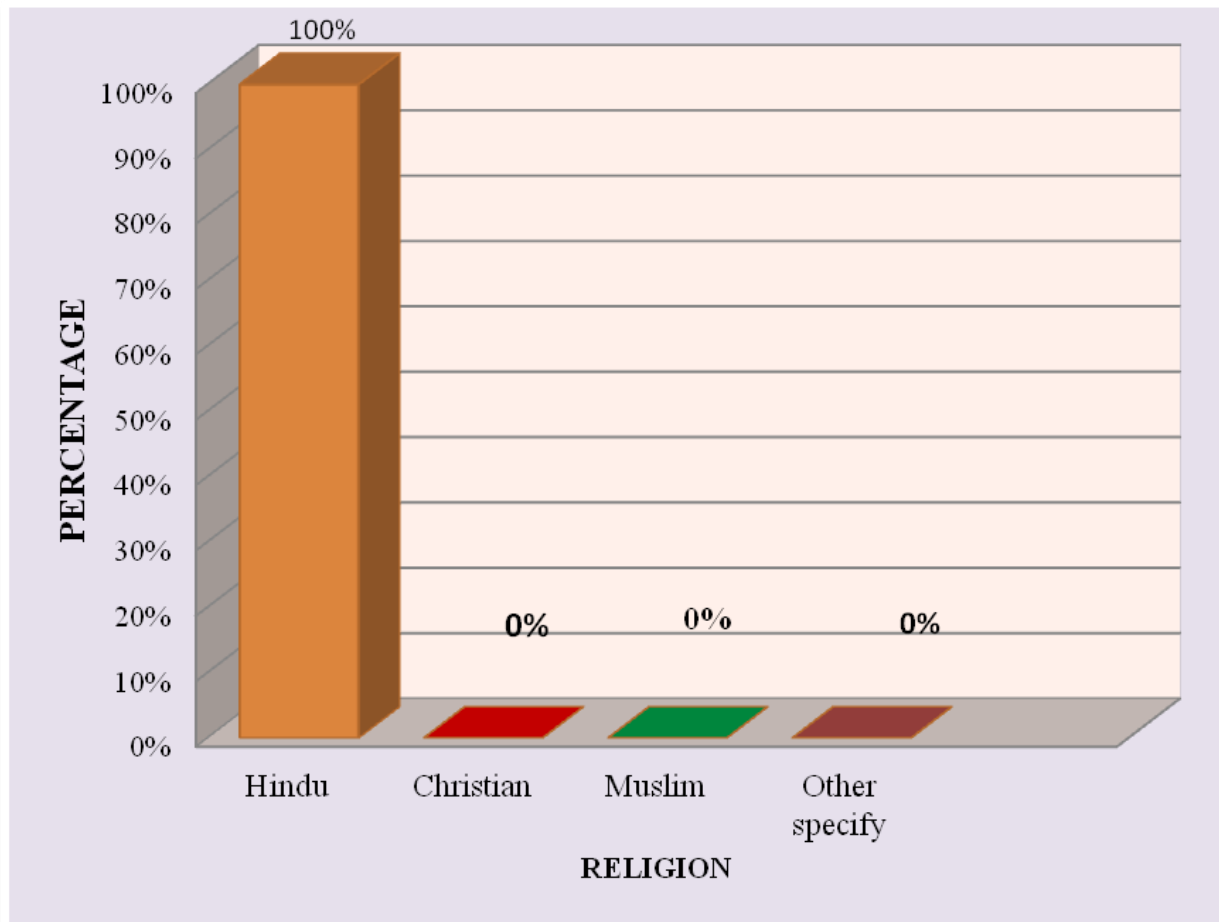
S*- Significant * ($p<0.05$)—denotes the significance at 5% level



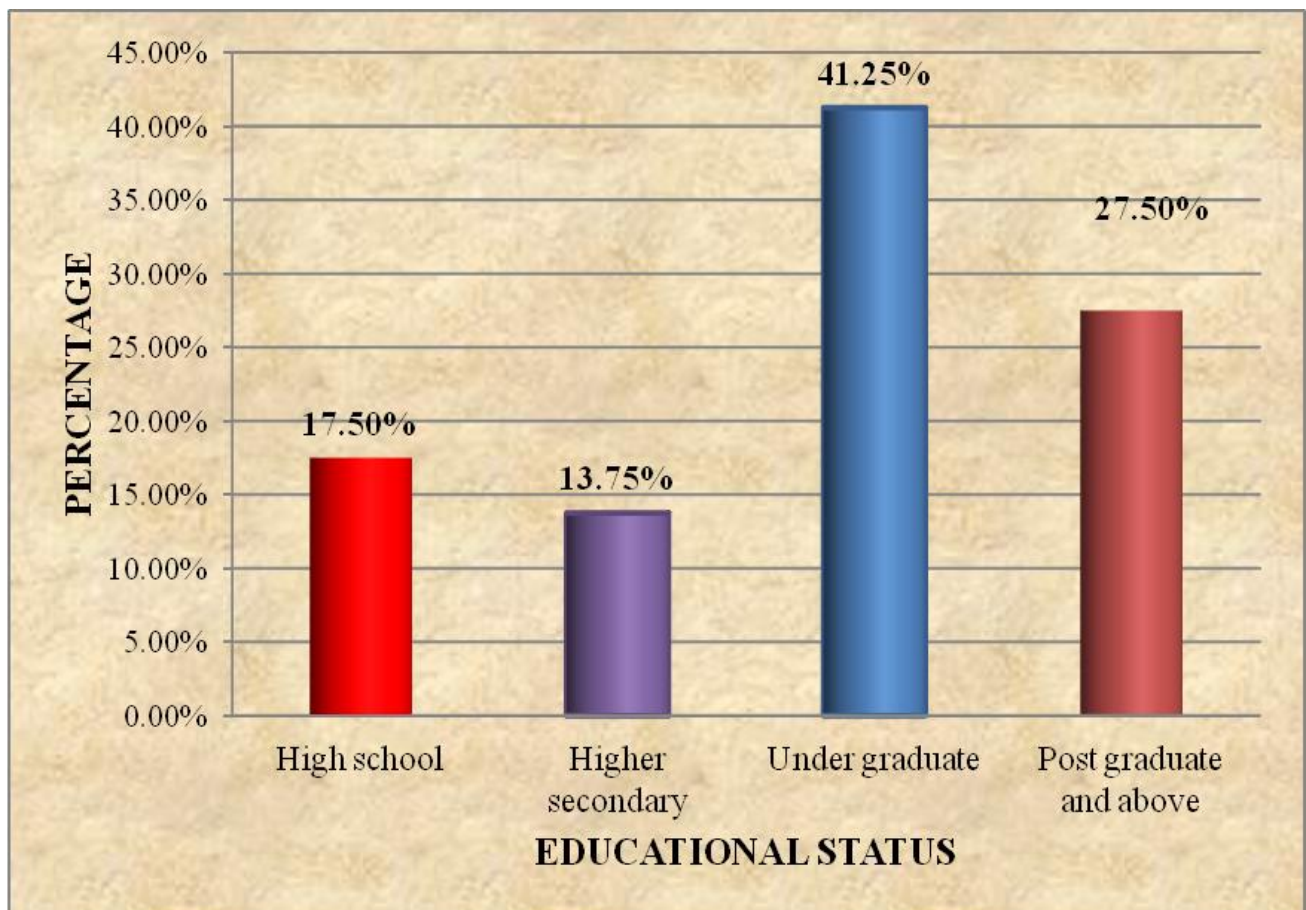
Graph: 1 Percentage distribution of adults by age



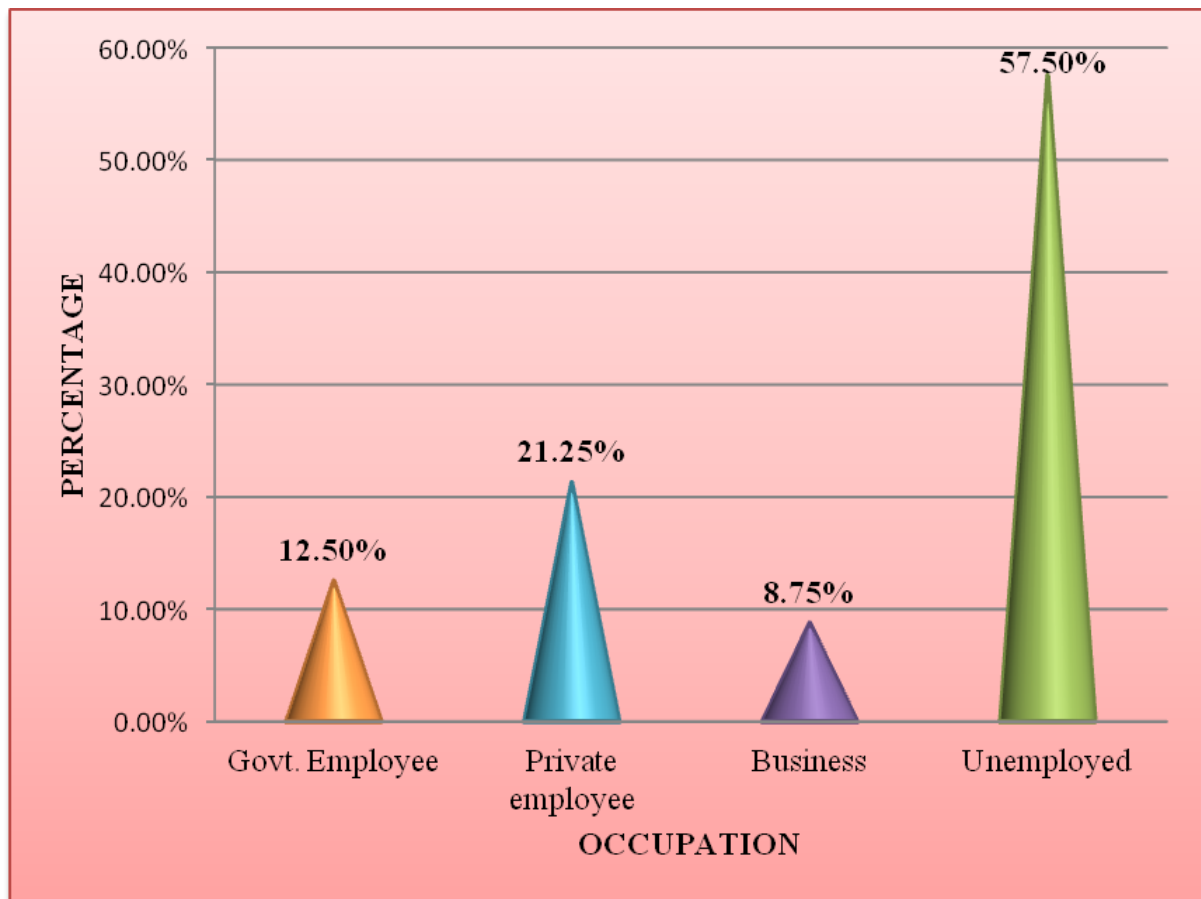
Graph: 2 Percentage distributions of adults by gender



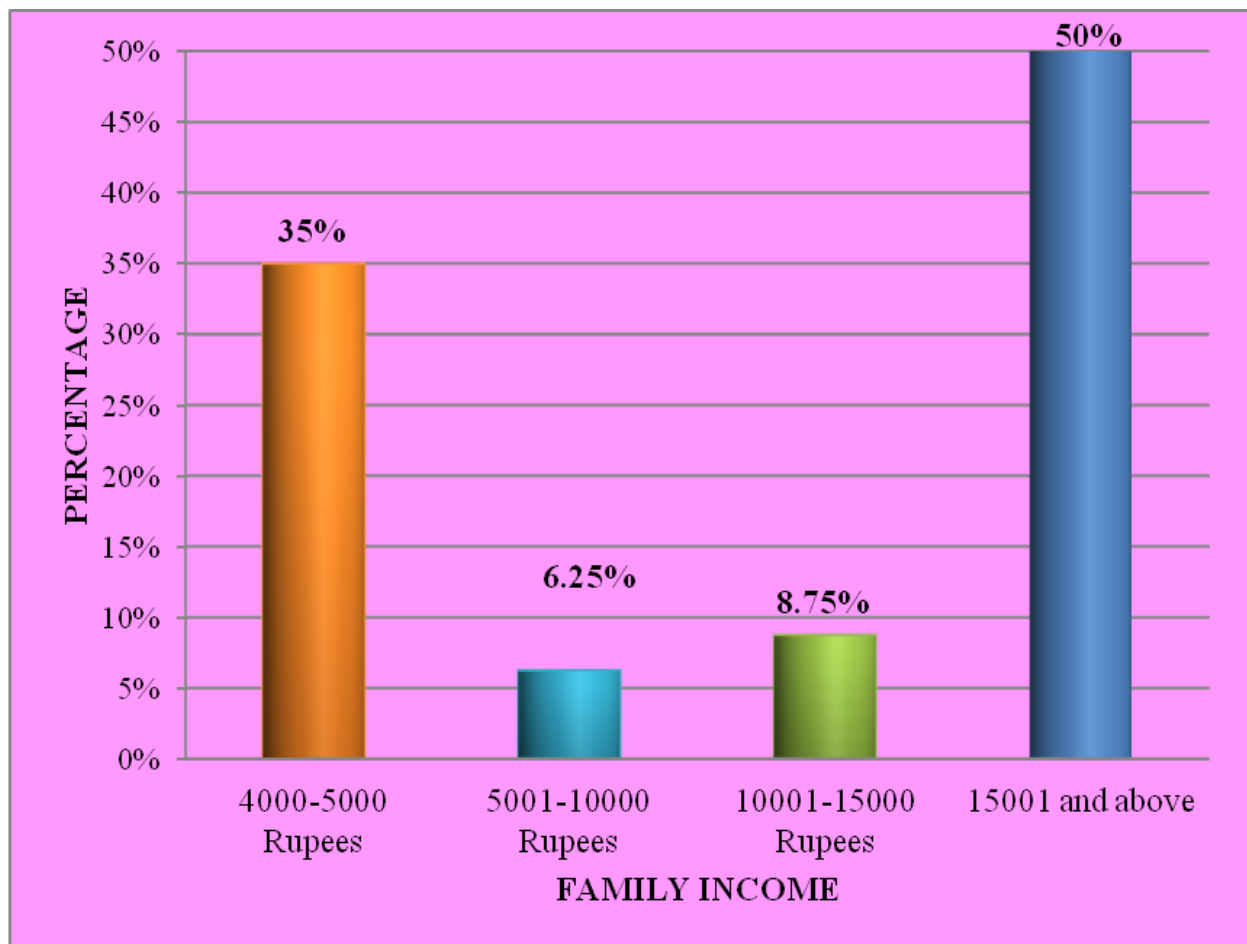
Graph: 3 Percentage distributions of adults by religion



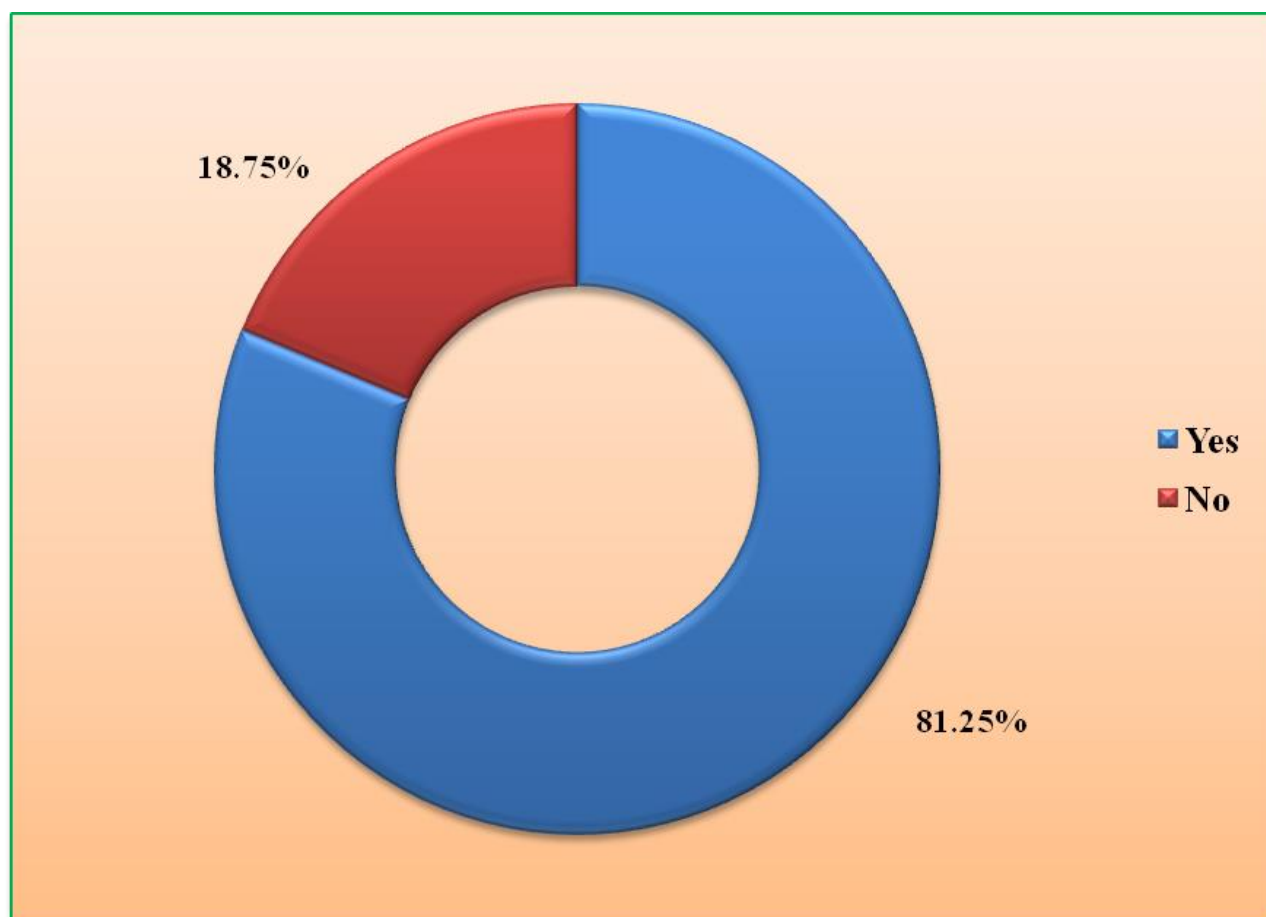
Graph: 4 Percentage distributions of adults by educational status



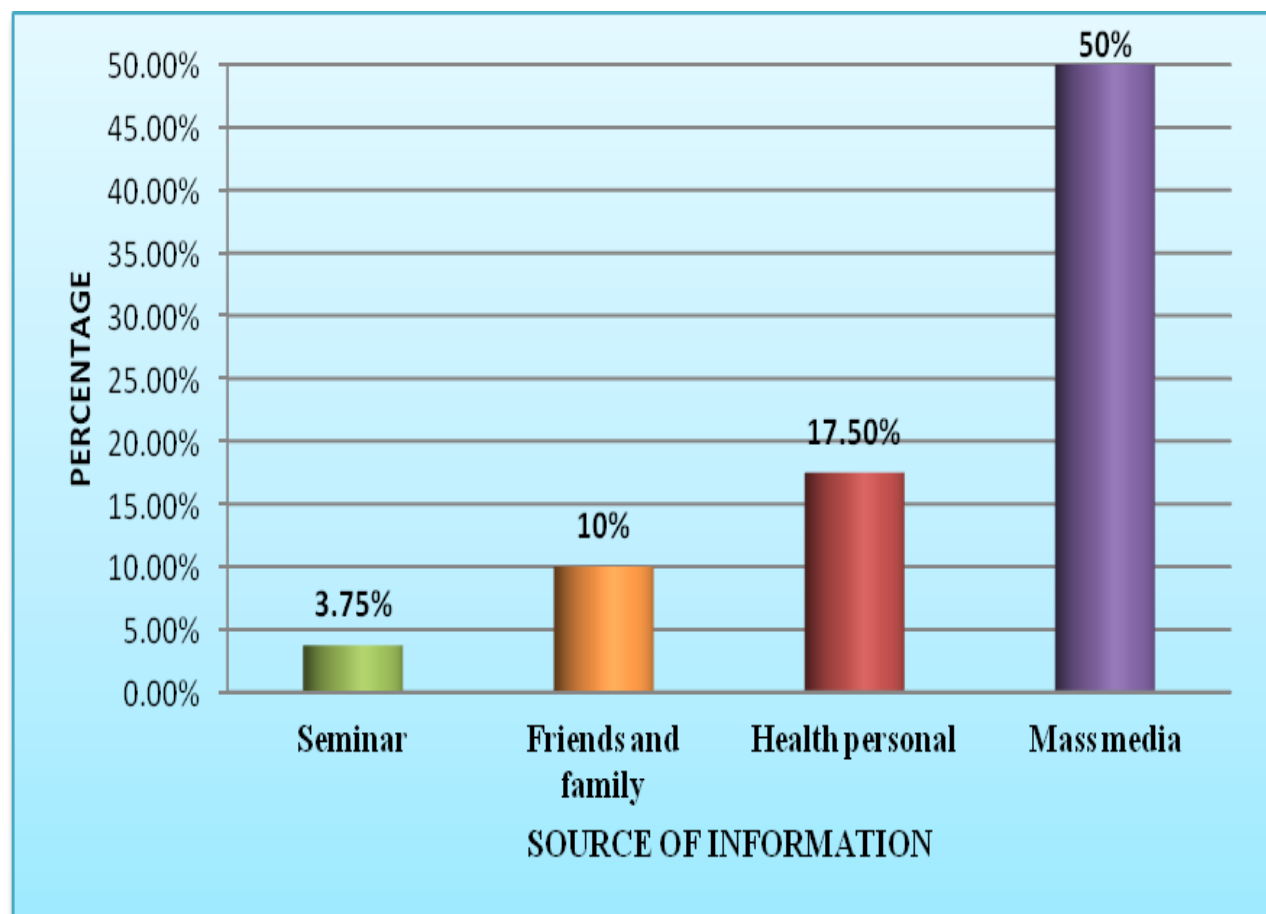
Graph: 5 percentage distribution of adults by occupation



Graph: 6 Percentage distributions of adults by family income



Graph: 7 Percentage distributions of adults by previous knowledge



Graph: 8 Percentage distributions of adults by source of information

HYBRID ANN-GA BASED MODELING AND OPTIMIZATION OF QUALITY PARAMETER IN EDM USING SUPERALLOY

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ABSTRACT

Titanium superalloy is most widely used in aircraft, spacecraft, naval ships, missiles and many other important industries due to its superior mechanical properties. The unconventional machining processes (UMPs) are the best manufacturing methods to shape these types of materials. Electrical discharge machining (EDM) is one of such thermal energy based UMP which has been widely accepted for machining of Titanium alloy. In the present research the EDM has been carried out in Ti-6Al-4V alloy by varying peak current, pulse-on time and pulse-off time to evaluate material removal rate (MRR). The artificial neural network (ANN) model has been developed for MRR and finally a hybrid approach of ANN and genetic algorithm has been applied for single objective optimization of MRR.

Keywords: Artificial neural network, EDM, genetic algorithm, material removal rate, optimization

1. INTRODUCTION

Superalloys belong to a relatively newer class of materials which have become very popular due to their enhanced mechanical and physical properties. Hastelloy, Inconel, Rene alloys, Waspaloy Incoloy etc. are few of examples of superalloys. Ti-6Al-4V is such a superalloy which is very popular in aviation and automobile industries. However, machining of this material is very difficult by conventional method. Unconventional machining processes (UMPs) are very popular to machine such materials. Many UMPs have been developed in past to process these materials. The most popular UMPs today are electrical discharge machining (EDM), ECM, LBM, PAM, AJM, USM etc. EDM is a thermal energy based UMP which utilizes the thermal energy of the spark generated between the tool and the workpiece. The removal of the material takes place due to melting and or vaporization of workpiece due to localized intense heat [1-2].

Researchers have done considerable amount of work using EDM during machining of Titanium alloys. Pramanik et al. [3] tried to improve the efficiency of wire EDM (WEDM) process by reducing the wire rupture during cutting of Ti-6Al-4V superalloy. Flushing pressure, wire tension and pulse-on time were considered as input control factors. They discussed various mode of wire fracture and also suggested that to reduce wire fracture, less tension, lower pulse-on time and higher flushing pressure should be used. Mustafa et al. [4] performed micro-EDM on Ni-Ti memory shape alloy by using different electrode materials and by varying capacitance and discharge voltage. The output parameters were MRR, TWR, SR, taper, circularity and overcut. They concluded that capacitance and electrode material are dominant factors affecting performance of the process. They also identified the optimum control factors to minimize the TWR and SR by using MOGA-II. De et al. [5] machined pure sintered titanium by using WEDM. Pulse-on time, pulse-off time, wire tension and feed were varied to evaluate two of the most important output process parameters; kerf width and overcut. By using 4 factors- 3 level factorial design, they developed response surface models for kerf width and overcut and found models to be appropriate to predict the behavior of the process. Zhang et al. [6] performed magnetic field assisted EDM on Ti-6Al-4V superalloy by considering current, pulse-on time, pulse-off time and magnetic field intensity as input control factors. Apart from improving the MRR and TWR, they also aimed to improve the performance of the process by reducing the energy consumption and machining noise. They concluded that the present technology significantly improves the performance of EDM by reducing the electrode wear, energy consumption, carbon emissions, and machining noise. Jing et al. [7] attempted to address the issue of arcing during EDM of titanium alloy. They used multiple-input, multiple-output adaptive control system to reduce the arcing during the process. Arikatla et al. [8] carried out WEDM on Ti-6Al-4V alloy by considering pulse-on time, pulse-off time, servo voltage, wire tension and power as input control factors. They developed empirical model for kerf width, MRR and SR by using response surface methodology. Wu et al. [9] investigated the effect of EDM on crater size, phase transformation in heat affected zone and residual stress by using finite element method. They predicted crater size, phase transformation and residual stress for different discharge energy levels during the process. Kolli et al. [10] mixed surfactant and graphite powder in dielectric to improve the process performance of EDM during machining of Ti-6Al-4V superalloy. MRR, TWR, SR and recast layer thickness were considered as performance parameters. They concluded that discharge current and surfactant concentration are most significant control factors for MRR and TWR while discharge current and powder concentration are most significant for SR and recast layer thickness. Baroi et al. [11] carried out EDM on

Titanium Grade 2 alloy to evaluate MRR, TWR and SR by using L_{16} orthogonal array design of experiments. They obtained optimum values of all the three quality parameters by using Taguchi robust design method.

The available literature shows that people have studied the effects of different process parameters during EDM/WEDM of Titanium alloys to explore the various process performances. Also, few researchers have used conventional optimization techniques for modeling and optimization of the process. But modeling and optimization using artificial intelligence based approach requires further attention during EDM of Ti-6Al-4V. Keeping above in the mind in the present research the machining has been performed on Ti-6Al-4V by varying peak current, pulse-on time and pulse-off time. One of the most important performance parameters; MRR has been evaluated. The artificial neural network (ANN) model in mathematical form has been developed for MRR. Further, a combined approach of ANN and genetic algorithm (GA) has been applied for optimization of MRR.

2. METHODOLOGY

2.1. Artificial neural network (ANN)

ANN is one of the tools of artificial intelligence, whose working is analogous to the brain. In ANN very large numbers of neurons are interconnected and they propagate the information among themselves. ANN architecture consists of input layer, hidden layer and output layer. Apart from these layers, the weights and biases are also very important elements in ANN. The first signal (in terms of control factors) is given to input layer which processes these signals by considering weights and bias. Then it is processed by some activation function such as log-sigmoid, tangent-sigmoid, pure-linear etc. to give the output. The output from each neuron is forwarded to the neurons in the next layer and the process is repeated. A typical ANN architecture is shown in the Fig. 1.

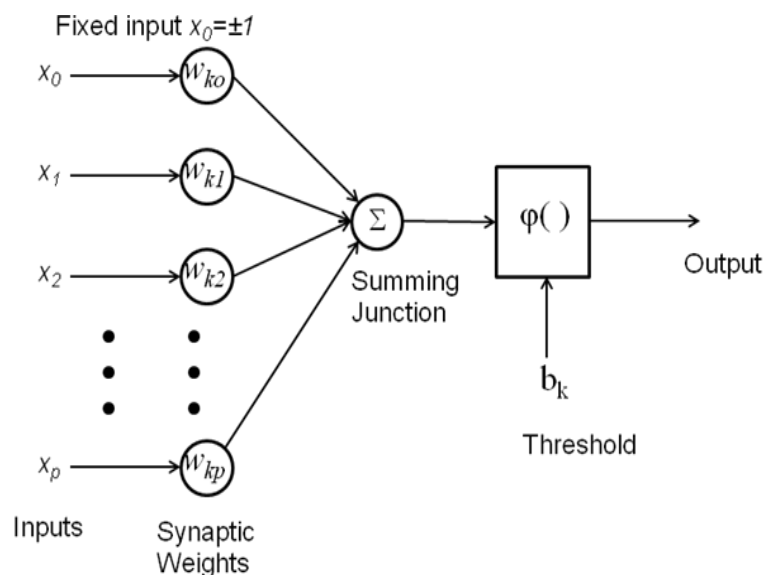


Fig. 1 Architecture of artificial neural network

In feed forward back propagation fully connected ANN, each neuron in a layer is connected with all other neurons of previous layers and receive input from them. All the inputs to the neuron are summed up in the summation junction as mentioned below [12]:

$$net_p = \sum_{i=1}^N w_{kp} X_k + b_p \quad (1)$$

Where w_{kp} is the weight of connection to p th neuron in a particular layer from preceding layer and b_p is the bias to that particular neuron. N is the total number of inputs to p th neuron. X_k is the input from the neuron in the preceding layer to the forward layer. The output of summation junction is processed by some activation function (ϕ) to give final output Y_p from the neuron as given below:

$$Y_p = F(net_p) \quad (2)$$

Activation functions for a particular ANN are selected in such a way so as to minimize the mean square error (MSE) between experimental values and model predicted values.

2.2. Genetic Algorithm (GA)

GA is a metaheuristic which is based on the process of the natural selection. Normally it is used to solve non linear optimization problems where classical methods are slow or not able to give best results. GA starts with initialization of random population and then moves towards finding best or optimal solution through the process of selection, crossover and mutation. The population is checked with the objective function to identify the best individuals. The best fitness individuals are used to create new population through the process of cross-over and mutation. These new individuals are again checked for their fitness with respect to objective function and this cycle is repeated to satisfy some termination criteria [12].

3. EXPERIMENTAL DETAILS

The experiments were performed on CNC Electronica Smart die sinking electrical discharge machine as shown in the Fig. 2. The input control factors selected were peak current, pulse-on time and pulse-off time. The different input control factors and their levels are given in Table 1.



Fig. 2 EDM machine tool

Table 1 CONTROL FACTORS AND THEIR LEVELS

Factors →	Peak current (A)	Pulse-on time (μ s)	Pulse-off time (μ s)
Level ↓	X_1	X_2	X_3
Low (-1)	5	50	25
Central (0)	7	75	50
High (1)	9	100	75

The positive polarity has been used during the experimentation. The Ti-6Al-4V has been selected as workpiece material. The experiments have been performed using box-behnken design of experiments. Each experiment was performed for 45 minutes and the response MRR in each experimental run are obtained by calculating the difference of mass of the workpiece/tool measured before and after the experiment. The precision electronic digital weight balance with 0.1 mg resolution was used to measure the mass of the samples.

The MRR in mg/min were calculated by following formula:

$$MRR = \frac{m_i - m_f}{t_p} \quad (3)$$

Where m_i and m_f are the initial & final mass of the workpiece (after machining); respectively. The observed value of quality characteristic has been shown in Table 2.

Table 2: Experimental Observation

Experiment No	Control factors			MRR(mg/min)
	x_1	x_2	x_3	
1	0	0	0	0.62
2	-1	-1	0	0.59
3	0	0	0	0.63
4	-1	1	0	0.59
5	0	1	-1	0.70
6	0	1	1	0.73
7	1	1	0	0.89
8	1	-1	0	0.76
9	1	0	-1	0.75
10	0	0	0	0.63
11	-1	0	1	0.60
12	0	-1	-1	0.61
13	-1	0	-1	0.44
14	1	0	1	0.96
15	0	-1	1	0.68

4. MODELING AND OPTIMIZATION

4.1. Artificial Neural Network Model

In this research, after trying different activation functions and their combinations, it has been found that log sigmoid and pure linear activation function, for hidden layer and output layer, respectively, are best for all the quality characteristics. So, the log sigmoid and pure linear activation function has been utilized to develop ANN models.

The values of weights and biases, after network getting trained, have been used to develop the ANN model of MRR in mathematical form. The model with 5 neurons in the hidden layer has been found appropriate for MRR model. The ANN model in mathematical form can be expressed as:

$$MRR = 0.18111 * y_1 + 0.25081 * y_2 - 0.3219 * y_3 - 0.65823 * y_4 + 0.63698 * y_5 + 0.26168$$

(4)

Where,

$$y_1 = \frac{1}{1 + e^{-(-3.3924 * x_1 - 0.8639 * x_2 - 1.4398 * x_3 + 4.8762)}}$$

$$y_2 = \frac{1}{[1 + e^{-(-0.52686 * x_1 - 0.0275 * x_2 + 0.037796 * x_3 - 2.4171)}]}$$

$$y_3 = \frac{1}{[1 + e^{-(-1.428 * x_1 + 4.2696 * x_2 + 3.5469 * x_3 - 0.1161)}]}$$

$$y_4 = \frac{1}{[1 + e^{-(-1.428 * x_1 + 4.2696 * x_2 + 3.5469 * x_3 - 2.418)}]}$$

$$y_5 = \frac{1}{[1 + e^{-(-1.428 * x_1 + 4.2696 * x_2 + 3.5469 * x_3 - 4.7439)}]}$$

Fig. 3 compares the experimental values of MRR with the models predicted values. The MSE is a yardstick to measure the model accuracy. The MSE for MRR by ANN model has been found to be 1.12×10^{-5} , which are almost negligible. So, it can be concluded here that model is capable enough to predict MRR.

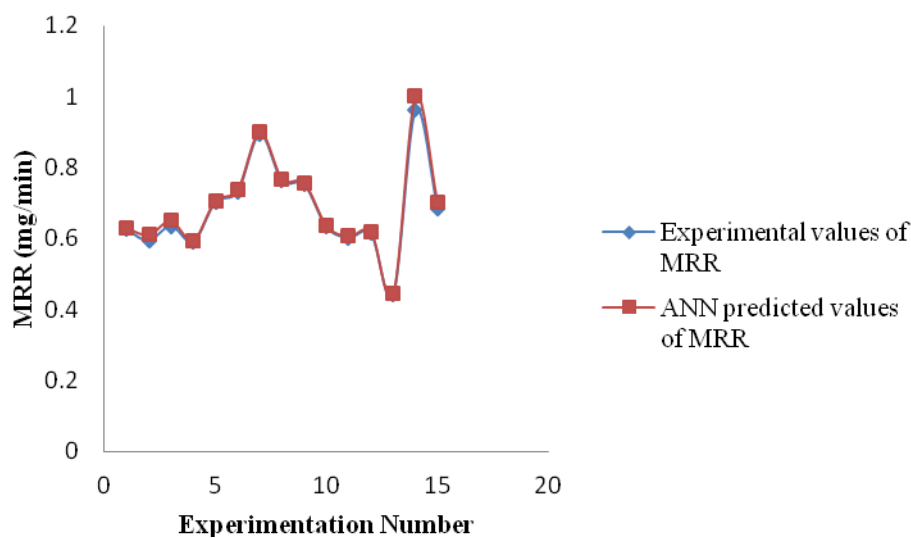


Fig. 3 Comparison of model predicted values with experimental values for MRR

4.2. Optimization using GA

Fig. 4 shows the flow chart for ANN-GA hybrid approach during modeling and optimization of the process

In the present case, the objective function of optimization problem can be stated as below:

Find: x_1 , x_2 and x_3

Maximize:

$$MRR = 0.18111 * y_1 + 0.25081 * y_2 - 0.3219 * y_3 - 0.65823 * y_4 + 0.63698 * y_5 + 0.26168 \quad (5)$$

With range of process input parameters:

$$5 \leq x_1 \leq 9$$

$$50 \leq x_2 \leq 100$$

$$25 \leq x_3 \leq 75$$

The critical parameters of GA are the size of the population, mutation rate, cross-over rate and number of generations. After trying different combinations of GA parameters, the population size 50, cross-over rate 0.8, mutation rate 0.05 and number of generation 110 have been taken for MRR. The objective function in Eq. (5) has been solved without any constraint. In Fig. 5, the best and mean fitness curves are illustrated in the search space. The fitness function is optimized when the mean curve converges to the best curve after 20 generation. The corresponding values of control factors peak current, pulse-on time and pulse-off time have been identified

as 9 A, 50 μ s and 75. Hence these are the optimum values of control factors. Using these values, the value of MRR has been obtained as 1.102 mg/min.

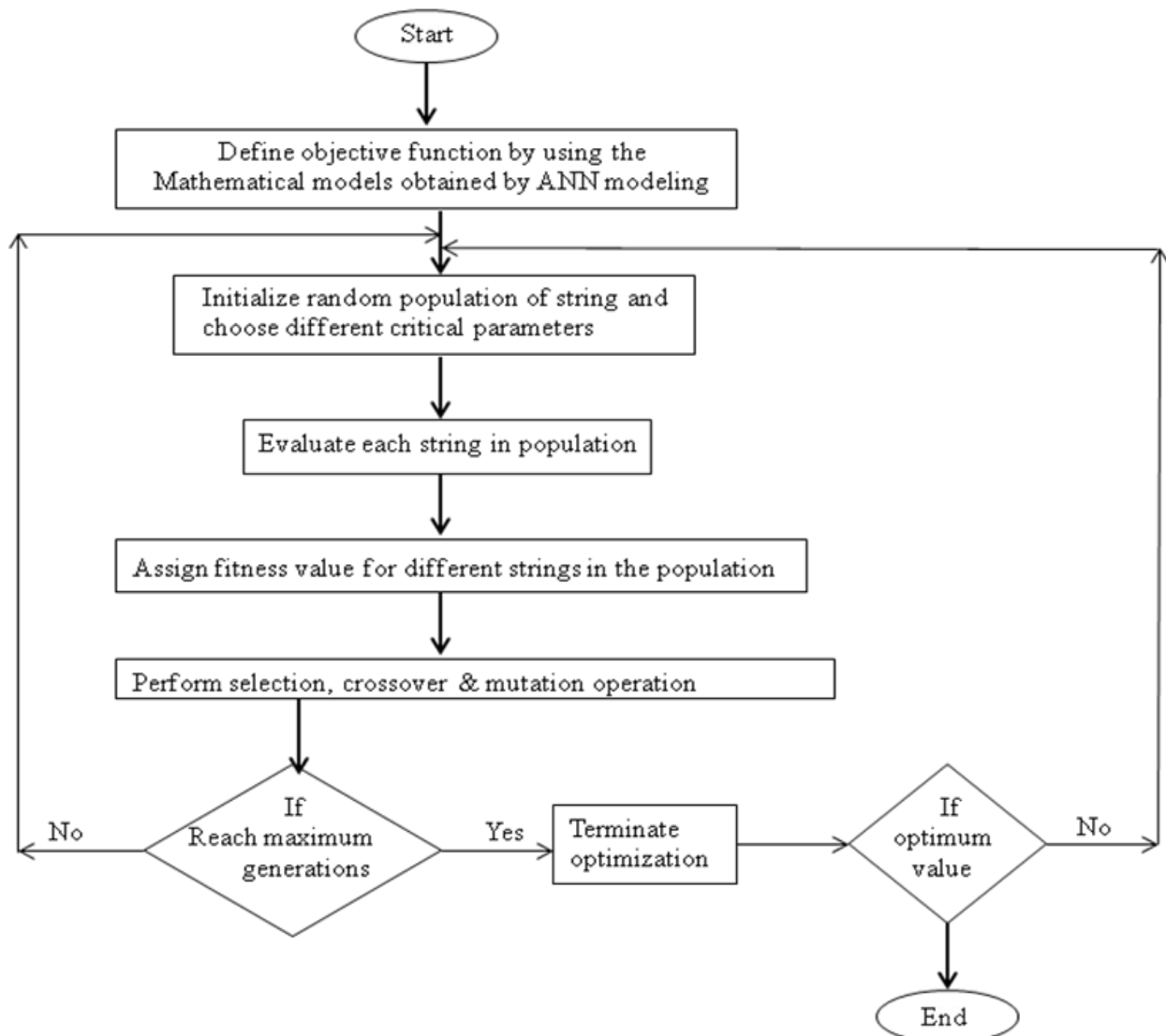


Fig. 4 ANN-GA hybrid approach

The confirmation experiment has also been performed at predicted optimum level of control factors and shown in Table 3. The comparison of optimum result with that of results obtained at initial level of control factors show considerable improvement of 74% in MRR.

Table 3 Optimization and confirmation results for MRR

Increment (%)	Initial process		Optimal process	
	parameters		parameters	
		Prediction	Experiment	
Peak current (A)	7.0	9	9	-
Pulse-on time (μ s)	75	50	50	-
Pulse-off time (μ s)	50	75	75	-
MRR (mg/min)	0.62	1.1	1.1	74

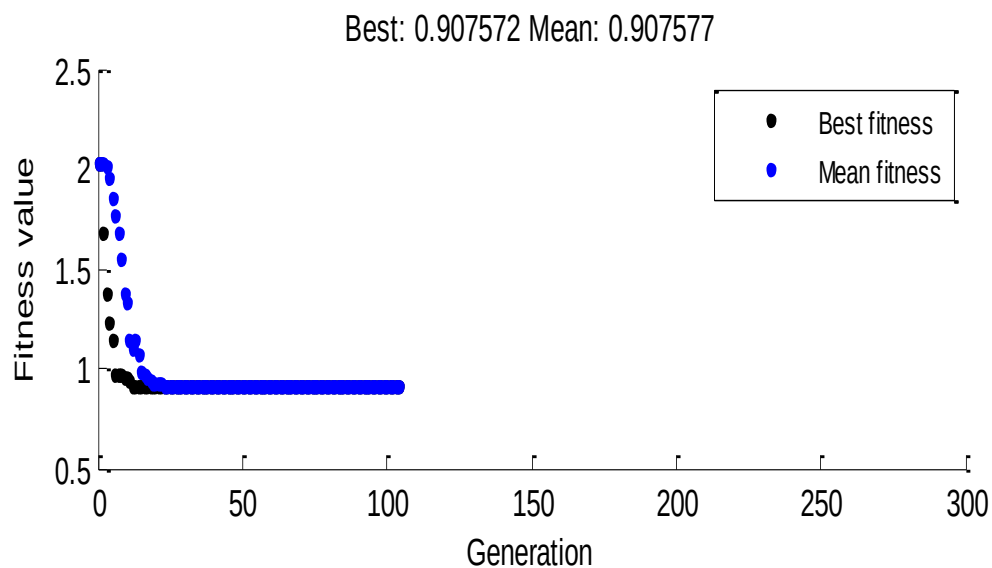


Fig. 5: Generation-fitness graphics for MRR

5. CONCLUSIONS

Following conclusions can be drawn from the present research:

1. Electrical discharge machining is a feasible process to machine advanced materials such as superalloys.
2. The artificial neural network (ANN) is best modeling tool when process behavior is non-linear. As the developed model with negligible prediction error are accurate and reliable.
3. Hybrid approach of ANN and genetic algorithm shows the considerable improvement of 74% in material removal rate.

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ON FOURIER TRANSFORM AND ITS FRIENDS

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ABSTRACT

The Fractional Fourier Transform (FRFT) is a generalization of the classical Fourier Transform. The original purpose of FRFT is to solve the differential equation in quantum mechanics. Optics problems can also be interpreted by FRFT. In fact, most of the applications of FRFT now are applications on optics. But there are still lots of unknowns of the signal processing community. Because of its simple and beautiful properties in time-frequency plane, we believe that many new applications are waiting to be proposed in signal processing. In this paper survey on Fourier Transform (FT) and its Friends are exploited. We have briefly introduced the FRFT and several simplified FRFT. Then Linear Canonical Transform (LCT) is a more generalized of FRFT is introduced. Lastly some Advantages and applications of FRFT and LCT are presented.

Keywords: Fractional Fourier transform, Simplified Fractional Fourier Transform, Linear canonical transform, Fresnel Transform

I. INTRODUCTION

Fourier analysis is one of the most frequently used tools in signal processing and many other scientific fields. It is well known that Fourier Transform are powerful integral transform and have innumerable application in variety of disciplines not only in engineering side like signal processing, optics communications but also in music economics and geography like subjects. The motivation for the Fourier transform comes from the study of Fourier series. Since any complicated functions can be written as the sum of simple waves mathematically represented by sine and cosine functions[1]. Besides the Fourier Transform(FT), time-frequency representation of signals, such as Wigner Distribution (WD), Short Time Fourier Transform(STFT), Wavelets transform(WT) are also widely used in speech processing, image processing or quantum physics. The FRFT is also a linear transformation generalized from the conventional FT. And it reduces to the conventional FT when the fractional order equals to 1.

In this paper we explore introduction to the definition, the properties and the approaches to the FT and its friends.

II. BACKGROUND

Because the FRFT comes from the conventional FT, we first review the definition of FT. The FT and its inverse FT of a function f are defined as

$$F[f](w) = \hat{f}(w) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(t) e^{iwt} dt \dots (2.1)$$

$$f(t) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} \hat{f}(w) e^{-iwt} dw$$

2.1 FRACTIONAL FOURIER TRANSFORM(FRFT)

FRFT is a generalization of FT. It is not only richer in theory and more flexible in application, but is also not expensive in implementation. It is a powerful tool for the analysis of time-varying signals. It has many applications in solution of differential equations, optical beam propagation and spherical mirror resonators, optical diffraction theory, quantum mechanics, statistical optics, optical system design and optical signal processing, signal detectors, correlation and pattern recognition, etc[2].

The one dimensional FRFT with parameter α of $f(x)$ denoted by $R^\alpha f(x)$ is defined as

$$[R^\alpha f(x)](t) = F_\alpha(t) = \int_{-\infty}^{\infty} K_\alpha(x, t) f(x) dx \dots (3.1)$$

where the kernel

$$K_\alpha(x, t) = \frac{e^{i\frac{\alpha}{2}}}{\sqrt{2\pi i \sin \alpha}} \exp \left[\frac{i}{2 \sin \alpha} ((x^2 + t^2) \cos \alpha - 2xt) \right] \dots (3.2)$$

It is possible to recover the function f by means of the inversion formula:

$$f(x) = R^{-\alpha} [F_{\alpha}(t)] \int_{R^n} F_{\alpha}(t) K_{-\alpha}(x, t) dt$$

R^{α} represents the signal to correspond to the original coordinates (t,w) counterclockwise rotates to the original coordinates (u,v) with angle α in time- frequency plane, as fig1.1

$R^0 = I$ (identity operator): zero rotation

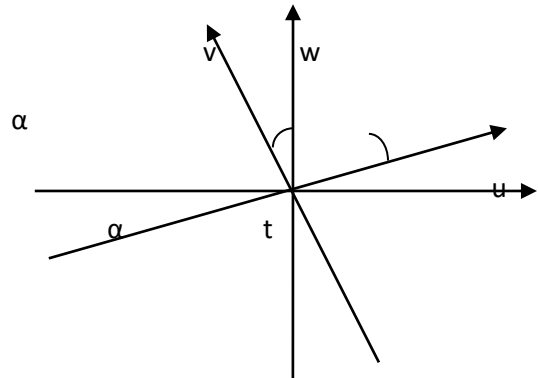
$R^{\pi/2}$: FT operator

R^{π} : time-reverse operator

$R^{3\pi/2}$: inverse FT operator

$R^{2\pi} = I$: 2π rotation

$R^{\beta} R^{\alpha} = R^{\alpha+\beta}$: additivity



These are the basic properties of the FRFT with the operator R^{α} . When $\alpha = \pi/2$ FRFT can become the FT, and the FRFT with $\alpha=0$ corresponds to the identity operator. At the same time, FRFT solve the problems that can't be solved by FT. For example, many noises that can't be removed by the FT will be filtered out successfully, but FRFT can do. So, all the applications of the FT are also the applications of the FRFT, and using the FRFT instead of the FT for these applications may improve the performance.

2.2 LINEAR CANONICAL TRANSFORM

We have seen that FRFT is the general form of conventional Fourier Transform whereas there is a more general form of these transform which is called the Linear Canonical Transform (LCT)[4]

It has four parameters and one constraint. The linear canonical transform generalizes the Fourier, Fractional Fourier transform, Laplace, fractional Laplace, Fresnel transform, Gauss-Weierstrass transform, dilation operation etc as its particular cases.

The linear canonical transform can be represented in many ways; most easily it can be viewed as 2×2 matrix

$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ with $ad-bc=1$, the corresponding integral transform is

$$O_F^{(a,b,c,d)} \{f(x)\} = G_{(a,b,c,d)}(u)$$

$$= \int_{-\infty}^{\infty} K_{\alpha}(x, u) f(x) dx,$$

$$\text{where } K_{\alpha}(u, x) = \frac{1}{\sqrt{2\pi ib}} e^{\frac{i}{2} \left(\frac{d}{b} u^2 + \frac{a}{b} x^2 \right) - i \frac{u}{b} x}, b \neq 0$$

Many classical transform are special cases of the linear canonical transform:

- **Fourier Transform (FT)**

The FT is represented by the matrix or $(a,b,c,d) = (0,1,-1,0)$ which is rotation of a time domain function by 90° .

- **Fractional Fourier Transform (FRFT)**

The fractional Fourier Transform corresponds to rotation by an arbitrary angle and given by the matrix $(a, b, c, d) = (\cos\theta, \sin\theta, -\sin\theta, \cos\theta)$

- **The Fresnel Transform**

This is obtained for $(a,b,c,d) = (1,b,0,1)$ in the sense that with $b = \frac{z}{2\pi}$

It is defined as

$$[Fresnel^z f](\xi) = \frac{e^{\frac{i\pi z}{l}}}{\sqrt{ilz}} \int_{-\infty}^{\infty} e^{i\left(\frac{\pi}{l}\right)(u-x)^2} f(x) dx$$

• **Gauss-Weierstrass Transform or Chirp Convolution**

This is the transform obtained for (a,b,c,d)=(1,b,0,1)

It is define as

$$O_F^{(a,b,c,d)} \left\{ f(x) = \frac{1}{\sqrt{2\pi ib}} \int_{-\infty}^{\infty} \exp \left\{ \frac{i(x-u)^2}{2b} \right\} f(u) du \right.$$

• **Laplace Transform**

• If the parameters (a,b,c,d) are allowed to be complex number then it gives LT if (a,b,c,d)=(0,i,0,0) define as

$$L(f(t)) = \int_0^{\infty} e^{-st} f(t) dt$$

• **Fractional Laplace Transform**

It corresponds with (a,b,c,d) = (cosθ,isinθ,isinθ,cosθ)

It is define as

$$L^\alpha(u) = \int_{-\infty}^{\infty} f(t) K_\alpha(t,u) dt$$

$$\text{where, } K_\alpha(t,u) = \sqrt{\frac{1-icota}{2\pi i}} e^{\frac{t^2}{2}cota + \frac{u^2}{2}cota - tucsc\alpha}, \alpha \text{ is not a multiple of } \pi$$

$$= \delta(t-u), \alpha \text{ is multiple of } \pi$$

• **LCT with 6 parameters {a, b, c, d, m, n}**

LCT with 6 parameters

$$O_F^{(a,b,c,d,m,n)} f(t) = \begin{cases} \sqrt{\frac{1}{j2\pi b}} e^{jnu} e^{\frac{j}{2}d(u-m)^2} \int_{-\infty}^{\infty} e^{-\frac{j}{b}(u-m)t} e^{\frac{j}{2}at^2} f(t) dt, b \neq 0 \\ \sqrt{d} e^{jnu} e^{\frac{j}{2}cd(u-m)^2} f(d(u-m)), b=0 \end{cases}$$

with the constraint ad-bc=1.

The 2 extra parameters m,n represent the time-shifting and modulation operations. The LCT with 6 parameters is useful for optical system analysis.

III. SIMPLIFIED FRACTIONAL FOURIER TRANSFORM (SFRFT)

The abilities of SFRFTs are equivalent to the FRFT for fractional filter design or fractional correlation . Besides, the SFRFTs can be used in many applications.

3.1. THE SIMPLIFIED FRFT OF TYPE 1

The parameter of the LCT change

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} cota & 1 \\ -1 & 0 \end{bmatrix} \quad (3.1)$$

We can define the SFRFT of type 1:

$$O_{IF(1)}^\alpha(f(t)) = (j2\pi)^{-\frac{1}{2}} \int_{-\infty}^{\infty} \exp \left(-jut + \frac{j}{2}t^2cota \right) f(t) dt. \quad (3.2)$$

Its inverse:

$$O_{IF(1)}^\alpha(F_\alpha(u)) = \left(\frac{j}{2\pi}\right)^{\frac{1}{2}} \exp \left(-\frac{j}{2}u^2cota \right) \int_{-\infty}^{\infty} \exp(jut) F_\alpha(u) du. \quad (3.3)$$

In digital implementation and conventional convolution, the simplified FRFT of type 1 is simpler than the FRFT, but it has same effects as the FRFT of order α for filter design. Furthermore, the simplified FRFT of type 1 has a main use in optical implementation.

3.2. THE SIMPLIFIED FRFT OF TYPE 2

The parameter of the LCT change

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 1 & \tan\alpha \\ -2\cot\alpha & -1 \end{bmatrix} \quad (5.4)$$

We can define the SFRFT of type 2:

$$O_{F(2)}^\alpha(f(t)) = \left(\frac{\cot\alpha}{j2\pi}\right)^{1/2} \exp\left(-\frac{j}{2}u^2\cot\alpha\right) \int_{-\infty}^{\infty} \exp\left(-jut + \frac{j}{2}t^2\cot\alpha\right) f(t) dt. \quad (3.4)$$

Its inverse:

$$O_{IF(2)}^\alpha(F_\alpha(u)) = \left(\frac{j\cot\alpha}{2\pi}\right)^{\frac{1}{2}} \exp\left(-\frac{j}{2}t^2\cot\alpha\right) \int_{-\infty}^{\infty} \exp\left(jut\cot\alpha + \frac{j}{2}u^2\cot\alpha\right) F_\alpha(u) dt. \quad (3.5)$$

The SFRFT of type 2 a main use in optical implementation for reduction of the optical components.

3.3. THE SIMPLIFIED FRFT OF TYPE 3

The SFRFT of type 3 a main use in implementation of gradient-index (GRIN) medium.

The parameter of the LCT change

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} \cos\phi & W_x \sin\phi \\ -\frac{\sin\phi}{W_x} & \cos\phi \end{bmatrix} \quad (3.6)$$

$$\text{where } W_x = \frac{1}{k} \left(\frac{1}{n_x n_0}\right)^{1/2}, \phi = L \left(\frac{n_x}{n_0}\right)^{1/2}.$$

We can define the SFRFT of type 3:

$$O_{F(3)}^{(\cos\phi, W_x \sin\phi, -\frac{\sin\phi}{W_x}, \cos\phi)}(f(t)) = \left(\frac{\csc\phi}{j2\pi W_x}\right)^{1/2} \exp\left(\frac{j}{2W_x}u^2\cot\phi\right) \int_{-\infty}^{\infty} \exp\left(-jut\frac{\csc\phi}{W_x} + \frac{j}{2W_x}t^2\cot\phi\right) f(t) dt.$$

The SFRFT of type 3 has additive and periodic properties that can use the GRIN medium to design fractional filter that the total length of the system is independent of the value of ϕ .

3.4 THE SIMPLIFIED FRFT OF TYPE 4

The SFRFT of type 4 a main use in implementation of radar system.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 1 - R_A^{-1}D & -D/k \\ k(R_A^{-1} - R_B^{-1} + R_A^{-1}R_B^{-1}D) & 1 + R_B^{-1}D \end{bmatrix}. \quad (3.7)$$

Here we let $R_A = D/2$ that the value of a to be -1. Furthermore, we suppose $R_B \rightarrow \infty$, then

Eq(4.9) becomes

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} -1 & -D/k \\ 2k/D & 1 \end{bmatrix}. \quad (3.8)$$

We can define the SFRFT of type 4:

$$O_{F(4)}^{(D)}(f(t)) = \sqrt{\frac{j}{\lambda D}} \exp\left(-\frac{jk}{2D}s^2\right) \int_{-\infty}^{\infty} \exp\left(\frac{jk}{D}st + \frac{jk}{2D}t^2\right) f(t) dt. \quad (3.9)$$

IV. ADVANTAGES OF FRFT/LCT CONTRAST WITH FT

The FT is one of special cases, which the FRFT/LCT. The FRFT/LCT can solve the problems that the FT can't solve. Here we will illustrate that advantages of FRFT/LCT contrast with FT as below.

- 1) The FRFT/LCT are more general and flexible than the FT. So, applications, properties and operations of the FT can be generalized by the FRFT/LCT. When FRFT's $\alpha = \frac{\pi}{2}$, FRFT can become the FT. Similarly, When LCT's $\{a, b, c, d\} = \{0, 1, -1, 0\}$, LCT also can become the FT.
- 2) The FRFT/LCT can be applied to partial differential equations (order $n > 2$). If we choice appropriate parameter α , then the equation can be reduced order to $n - 1$. Furthermore, then FRFT/LCT can be used in optical systems.
- 3) Since the FT only deals with the stationary signals, we can use the FRFT and LCT to deal with time – varying signals.
- 4) The one dimensional (1-D) FRFT can let filters to reduce the sampling rate and encryptions, but the FT can't do that.
- 5) Using the FRFT/LCT, many noises can be filtered out that the FT can't remove in optical system, microwave system, radar system, and acoustics.
- 6) In encryption, because the FRFT/LCT have more parameters than the FT, it's safer in using the FRFT/LCT than in using the FT.
- 7) In signal synthesis, using the transformed domain of the FRFT/LCT to analyze some signal is easier than using the time domain or frequency domain to analyze signals.
- 8) Using the FRFT/LCT to calculate the ambiguity function (AF) that the position of output sampling points is freely selected.
- 9) In multiplexing, we can use multiplexing in fractional domain for super-resolution and encryption.

4.1 APPLICATIONS OF FRFT AND LCT

- 1) Quantum Mechanics in application of the FRFT
- 2) Filter Design
- 3) Optics Analysis and Optical Implementation
- 4) GRIN System Analysis
- 5) SAR/ISAR
- 6) Space-Variant Pattern Recognition
- 7) Sampling
- 8) Modulation
- 9) Solving Multi-Paths Problems
- 10) Encryption and Phase Retrieval
- 11) Signal Synthesis
- 12) Matching Pursuit
- 13) Solving Differential equations
- 14) Calculating WDF and AF
- 15) Multiplexing
- 16) Uncertainty Principle

CONCLUSION

In the present review, Fourier Transform and its friends are presented. First we have introduced fractional Fourier transform which is extension of Fourier transform. Then we have introduced several simplified fractional Fourier transform (SFRFT). The abilities of the SFRFT's are equivalent to the FRFT for fractional filter design or fractional correlation but it simpler than the FRFT. Then the Linear Canonical transforms (LCT) has been introduced. The LCT is more general than the FRFT. The FRFT has one free parameter α but the LCT has four parameters to adjust the signal. Also the LCT with 6 parameters is useful for optical system analysis. Lastly Advantages of FRFT/LCT contrast with FT is presented. Also some applications are introduced.

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