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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Floral Waste Management and Production of Incense Sticks from Waste Marigold Flowers in Jaleswar Area of Balasore District, Odisha, India

Shatabdi Das and Srimay Pradhan*

Department of Botany, Centurion University of Technology and Management, Odisha, India.

Received: 28 Feb 2020 Revised:02 Apr 2020 Accepted: 04 May 2020

***Address for Correspondence**
Srimay Pradhan
Department of Botany,
Centurion University of Technology and Management,
Odisha, India.
Email: srimaypradhan@gmail.com

ABSTRACT

The importance of plants has been known to us since a very long time. It has been experienced that the utilisation of plant parts during various celebration and tradition in different areas over the world. Despite having various beneficial properties of plants, people are quite unaware about its proper utilisation. They discard the plants or plant parts thinking it as wastes. Those wastes is known to have various medicinal properties and can be used in various ways that could benefit to mankind. From the data collected from our survey, we have analysed that marigold flowers are utilised and discarded more as waste compared to others. So the wastes of marigold flowers along with cow dung, rosin, cotton, water, knife, dust of marigold flowers, flour, bamboo sticks, and perfume ingredients have been employed to produce pure homemade incense sticks.

Keywords: Floral waste, Marigold flowers, Utilisation, Incense sticks.

INTRODUCTION

Plants are the silent workers of our planet, as they maintain an ecological balance between different trophic level. They are important for the existence of planet and for all living things. Without them the living world would literally perish. The plant parts are use in different purposes like medicines, fuel products, organic matters etc. It is also used in various festivals. The essential relation of plants to the air we breathe, the food we eat and the energy we dissipate with such reckless abandon is based on two of their characteristics. These are their capacity to store the energy of the sunrays in starch, sugar, oils, fats, cellulose and other constituents of the plant body [1]. Not only in industrial and economic sectors, plants also play vital role in art, mythology, religion, literature etc. A number of valuable products have being extracted from plants as well as animals from ancient times [2]. India is known to be a land of festivals. Odisha, one of the state of India has preserved its position due to its culture and celebration. In Odisha festivals are

the significant cause to continue the culture and ethnic value among the people from generation to generation. There is never goes a day without celebration in Odisha. There is a popular saying in odia "Baro mase tero parba''- It literally means-thirteen festivals in twelve months and most of the festivals includes a lots of use if plant as well as plant parts. Hence, plants are important to human being not only environmentally, economically and industrially but also spiritually, historically and aesthetically [3]. The plants broadly used in different festivals includes *Cocous nucifera* (L.), *Artocarpus heterophyllus* Lam., *Calotropis gigantea* (L.), *Dendrocalamus strictus* (Roxb.), *Ficus benghalensis* L., *Mangifera indica* L., *Musa paradisica* L., *Phoenix sylvestris* (L.) Roxb., *Tamarindus indica* L., etc. [4]. Besides these now a days, demand for natural dyes has been increased rapidly due to developing awareness on hazardous, allergic and toxic reactions associated with artificial dyes. These natural dyes are obtained from natural resources such as plants, minerals and insects. All the plant created dye sources i.e. flowers, bark, seeds etc. [5]. Temple wastes majorly consist of marigold flowers, which are a rich source of carotenoid-leutin and flavonid- patulinin, two colorants that have been isolated and prepared for dyeing. Recycling temple wastes after dye extraction broadly consisted of organic matter [6].

The sustainable management of floral wastes by solid state fermentation for the conversion into varieties value added products i.e.; compost; biofuels; biogas; bioethanol; pigments; organic acids; dyes; biosurfactants production; food products; sugar syrup; incense sticks etc. [7]. The temple wastes consist of vegetable materials, milk products, water and grains most of which are biodegradable and contain elements required for improvement of microorganisms [8]. Nature looks more beautiful with varieties flowers, each flower has a unique fragrance which attracts every one and these flowers were used for occasions and other celebration [9].

MATERIAL AND METHODOLOGY

Study area

Balasore is present in state of Odisha. It is the costal district of Odisha and located at $21^{0}30^{'}$N and $86^{0}56^{'}$ E. its culture is a blend of traditional festivals, music and food. Jaleswar is a small town that belongs to Balasore district, which is connected to Calcutta is about 187 km from East and 268 km far from Bhubaneswar on the south-waste. The Jaleswar areas celebrate both Indian and Western festivals like Diwali, Holi, Durga puja, Ganesh puja, Saraswati puja, Maha shivaratri, which are some popular festivals in the city. But the major festivals are Durga puja, Basanti puja and Ratha yatra. There are so many plant parts are used in this festivals.

Data collection

The data were being collected regularly form December 2019 to February 2020 in different villages of Jaleswar area. From interaction with different categories of people the data has recorded about the different parts of the plants used in different festivals in their locality. From data plant identification process was done by taking the identification key from "Flora of Odisha by Saxena and Brahmam".

RESULTS AND DISCUSSION

It was observed that people were unconscious regarding the specific use of marigold flowers in different way. After collecting information from different people, it was acknowledged that the marigold was being used in different festivals, which was given in the table below-

After watching the marigold flowers to be wasted unnecessarily a thought was striked to prepare incense stick with the help of these wasted marigolds.

Collection of flower

It was noticed that marigold flowers were often being thrown out as a waste material to the dustbin after used in different festivals in different places of Jaleswar area Balasore district. Waste flowers were also collected from the dustbin outside of different temples like Kali temple, Durga temple etc.

Ingredients for production of incense stick

Bamboo stick

To carry out this process a bamboo was taken and cut into so many sizeable pieces and smooth small sticks were produced. It was dried up in the sun for 2-3 days.

Other ingredients for this purpose

To prepare these incense sticks other ingredients were used which are the parts of different plants as mentioned below-

1-Cow dung-30-40%, 2-Rosin-30-45%, 3-Cotton-35-40%, 4-Water-20%, 5-Knife 6-Dust of marigold flower-50-60%, 7-Flour-15% , 8-Bamboo stick-6 pieces, 9-perfume

Process of incense sticks production

After collecting the wasted marigold flowers, the petals made in to tiny pieces and dried in the sun for 2-3 days. Then it was crushed by rubbing in two hands. A pest was prepared taking the ingredients like cow dung, water, dust of marigold flowers. Cotton was mixed with these prepared pests to make it tight with the tiny bamboo sticks. Then the pest with sticks was rolled down in two hands to make it smooth and in proper shape and size. It was left for a little while to make it dry. A little amount of flour pasted on it to hold the rest amount of marigold dust to look it beautiful for well burning. Marigold flowers dusts are most important in this process. Then it was again dried up for 2 days in the sun. In the end, the dust of Rosin and perfume was sprinkle on it for good smell.

CONCLUSION

During the study, it has noticed that the variety types of plants have significant medicinal values in different areas. Hence it can be concluded that the waste marigold flower can be used in preparing herbal products like incense sticks without having any chemicals, as it is the commonest flower in different places of Jaleswar area of Balasore district. If wastage marigold could be used properly preparing the herbal products like incense sticks, than the poor people can earn a lot for their living hood with low cost materials. As incense sticks are profitable products, every poor people should be fascinated towards it to manage their maintenance, which should be encouraged. So public awareness and much more attention should be given to prepare these products, so that poverty can be eradicated. The government, social agencies, volunteer groups should come forward to encourage the poor people to have interest in it for their development, So that a healthy and sound economy of the people could be achieved through it.

ACKNOWLEDGEMENTS

The authors are thankful to the authorities of Centurion University of Technology and Management, Odisha, India for providing lab facilities and other essential arrangement during the research investigation.

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Table 1- List of flowers are used in festivals

Serial number	Festivals	Plant Flowers used
1	Mahalaya	*Tagetes erecta* L., *Clitoria ternatea* L., *Hibiscus rosa sinensis* L., etc
2	Dola purnima	*Jasminum sambac* (L.) Aiton , *Tagetes erecta* L., etc
3	Durga puja	*Tagetes erecta* L., *Nelumbo nucifera* Gaertn., etc
4	Ratha yatra	*Jasminum auriculetum* Vahl, *Tagetes erecta* L., *Rosa indica* L., etc
5	Laxmi puja	*Tagetes erecta* L., *Nymphaea pubescens* Willd. ,etc
6	Janmastami	*Jasminum sambac*(L.) Aiton, *Tagetes erecta* L., etc
7	Maha shivaratri	*Hibiscus rosa sinensis* L., *Tagetes erecta* L., etc
8	Maker sankranti	*Tagetes erecta* L., *Clitoria ternatea* L., etc
9	Ganesh puja	*Tagetes erecta* L., *Jasminum grandiflorum* L., etc
10	Janmastami	*Hibiscus rosa sinensis* L., *Tagetes erecta* L., *Rosa indica* L., etc
11	Rakhi purnima	*Tagetes erecta* L., *Rosa indica* L., *Jasminum officinale* L., etc
12	Saraswati puja	*Tagetes erecta* L., *Tabernaemontana divaricata*(L.) R. Br. ex Roem. ,Schult. etc

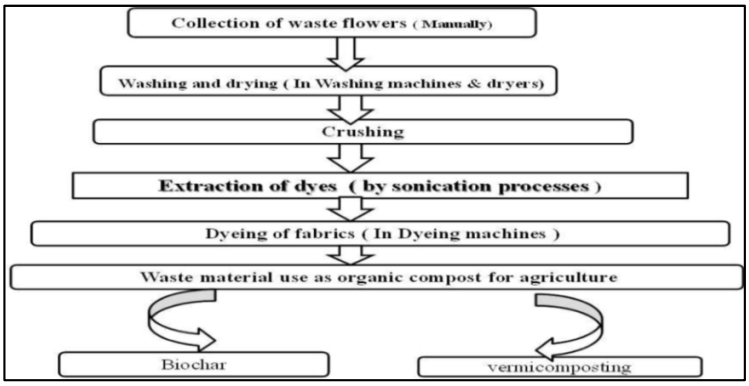

Figure 1- Illustrative representation of sustainable utilisation of floral and vegetable wastes [6].

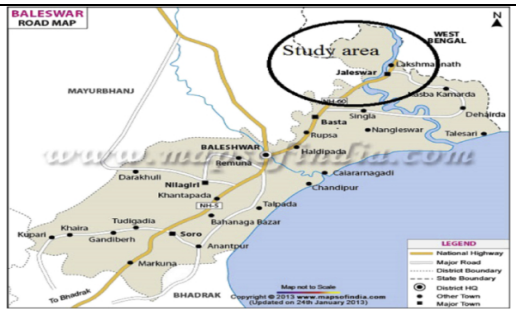

Figure 2- Study area showing Jaleswar area in Balasore district

Figure 3- Wasted Marigold flowers

Figure 4- Collection of flowers

Figure 5- Bamboo sticks

Photo plate 1

(a)

(b)

(c)

(d)

Photo plate 1: a- Waste marigold flower, b-Drying of flowers, c-Process of incense sticks, d- Final product

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Study of Avian Diversity in Chandikhol

Jibanjyoti Bidyasagar and Pradip Kumar Prusty*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 01 M 2020 Revised:03 Apr 2020 Accepted: 05 May 2020

***Address for Correspondence**
Pradip Kumar Prusty
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: pradipkumar.prusty@cutm.ac.in

ABSTRACT

Avian diversity study is a vital factor in maintainance of the ecological balance of any given region. This present study on the distribution and diversity of bird species in Chandikhole of Jajpur district was carried out from January 2020- February 2020. During the observation period, a total 25 species of birds belonging to 9 different families were identified. The number of bird species may vary however accordingly based on the habitat, food and water availability, human population with increase urbanization in this region has become a matter of concern and construction of blueprint for conserving the flora and faunal diversity.

Keywords: Birds, Diversity, Chandikhole, Urbanization, Deforestation, ICUN and Habitat

INTRODUCTION

Avian diversity (Bird diversity) is the variability amongst birds and applies to diversity within specie, between species and the ecosystem.Avian diversity studiesarean important indicator for evaluating different ecosystems(Gouda et al.,2017;Bilgrami, 1995). In forest ecosystem birds plays an important role as pollinators or seed dispenser, scavenger and pest controller (Gregory et al., 2003; Sodhi et al.,2011). Birds are always being the center of attraction for their magnificent colour, voice and social behavior. Above 10,425 species of birds are present worldwide in different habitats(World Conservation Union 2014).In India about 1300 species of birds are found belonging to 88 families(Manakadan and Pittie,2001; Rasmussen and Anderton, 2005). But in Odisha above 500 species of birds under 77 families (Mishra et al.,1996). Avian diversity is affected by various factors such as habitat loss and degradation, hunting, pollution, introduction of invasive species, natural calamities, disease and climate change(Sodhi et al.,2011). According to IUCN Red Data book, 1226 bird species have come under the threatened list among them 88 species are from India (Bird life International 2010).

MATERIALS AND METHODOLOGY

Study Area

The study was conducted in Chandikhole area of Jajpur District.The area lies between the coordinate 20°41'58" N to 86°8'2"E. The area comes under the the coastal belt of Odisha. This area includes the Great Barunabanta hill, which is a part of Eastern Ghat mountain range. The mountain is covered with dense forest and provide proper habitat and vegetation for birds. In this location comprises of lakes, ponds, small forests, canals and agricultural fields that provide diverse geographic area which is suitable for bird diversity.This study was done in an area of approaximately 5-6sq Km area which includes Barunabanta hill, Bethialake, Akarabata dam, Palasabani ground and also in some agricultural fields.

METHODOLOGY

The bird observation was conducted from morning 6 am to evening 6 pm. Birds were observed with help of Nikon action 10X50mm binocular and the snaps were taken by Canon powershot 5X 50Hs camera. The study was conducted through open ou search method and observational technique. The location was divided by 4 small divisions to make observation simple. The technique includes call of the bird and the prime fact is to choose the right place where the bird species were found.

RESULT AND DISSCUSSION

As a whole 26 species of birds were identified belonging to 9 families among 9 orders. Chandikhole locality of Jajpur district shows quite diverse population of birds. Number of species were belonging to Passeriformes followed by Pelecaniformes and Columbiformes. Some other orders are Accipitriformes, Acculiformes and Gruiformes shown in the Table 1.

CONCLUSION

This short span study which identified 26 species of bird in this studylocation, but it might not be contradicted that this study area is facing enormous anthropogenic disturbances like rapid urbanization, deforestation and habitat degradation. Though this represent overall sound bird diversity in this location. In the end it may be noted that a few locations were studied within a short period of time, a more comprehensive study would surely reveal more avian species. A detailed study regarding the increased anthropogenic activity and their impact on biodiversity needed in this region.

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Table1. Birds of Chandikhole, Jajpur,Odisha, India.

Common name	Scientific name	Family	Order
Little Egret	*Egretta garzetta*	Ardeidae	Pelecaniformes
Cattle Egret	*Bubulcus ibis*	Ardeidae	Pelecaniformes
Great Egret	*Ardia alba*	Ardeidae	Pelecaniformes
Rock Dove	*Columba livia*	Columbidae	Columbiformes
Spotted Dove	*Streptopelia chinensis*	Columbidae	Columbiformes
White throated Kingfisher	*Halcyon smyrnensis*	Cuculidae	Cuculiformes
Rusty breasted Cuckoo	*Cacomantis sepulcralis*	Cuculidae	Cuculiformes
Asian Koel	*Eudynamys scolopacea*	Cuculidae	Cuculiformes
Pheasant tailed Jacana	*Hydrophasianus chirurgus*	Jacanidae	Charadriiformes
Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	Charadriiformes
Pied Myna	*Gracupica contra*	Pyenontidae	Passeriformes
Greater Coucal	*Centropus sinensis*	Cuculidae	Cuculiformes
Green Bee eater	*Merops orientalis*	Meropidae	Coracicformes
Red vented Bulbul	*Pycnonotus cafer*	Pycnonotidae	Passeriformes
Little black Cormorant	*Phalacrocorax sulcirostis*	Phalacrocoracidae	Suliformes
Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	Suliformes
Jungle Babbler	*Turdoides striatus*	Timaliindae	Passeriformes
Black Drongo	*Dicrurus macrocercus*	Dicruridae	Passeriformes
Common Myna	*Acridotheres tritis*	Sturnidae	Passeriformes
Oriental Magpie Robin	*Copsychus saularis*	Turdindae	Passeriformes
Jungle Crow	*Corvus culminates*	Pycnontidae	Passeriformes
Black headed oriole	*Oriolus xanthornus*	Pycnontidae	Passeriformes
Rufiustree-pie	*Dendrocitta vagabunda*	Cuculiformes	Cuculiformes
Common wood Shrike	*Tephrodornis pondicerianus*	Pycnontidae	Passeriformes
Shikra	*Accipiter badius*	Accipitridae	Accipitriformes
White breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	Gruiformes

Figure 1. Rock Dove

Figure 2. Bronze-winged Jacana

Figure 3. Green bee-eater

Figure 4. Black Drongo

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Parameter Analysis and Different Geometrical Approach for Ultra Wideband Planner Antenna

Deepak Kumar Barik[1]*, Shibashis Pradhan[1], Prabhat K Patnaik[2], Subhraraj panda[1] and Chandra Sekhar Dash[1]

[1]Department of Electronics and Communication Engineering, Centurion University of Technology and Management, Bhubaneswar, Osisha, India.
[2]Department of Electronics and Communication Engineering, Centurion University of Technology and Management, Parlakhemundi, Odisha, India.

Received: 01 M 2020 Revised:03 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
Deepak Kumar Barik
Department of Electronics and Communication Engineering,
Centurion University of Technology and Management,
Bhubaneswar, Odisha, India.

ABSTRACT

Abstract-In this context, two major part is clearly explained .One is parameter analysis in time domain for wireless application and for different UWB architecture .Other one is different geometrical approach to design Ultra wideband (UWB) for different band width, resonant frequency, patterns multiple notch. In Parameter analysis, all types of antennas (double ridged TEM, resonant monopole, horn, log-periodic pyramid, cavity backed Archimedean spiral, tapered slot areal and bicon antennas) are taken and analyzed and compared along with time domain analysis and modelling of channel in multi path propagation. In geometrical approach, different possible geometry is taken and deigned for different application in ultra wide band range for different range of frequency of operation, different band width, patterns with multiple notch.

Keywords: UWB system; parameter; time domain; bandwidth; Design; application

INTRODUCTION

The name wideband suggest that a system which is uses very wider or larger bandwidth .Due to this large bandwidth there are various advantages which includes high penetration on obstacle , interference free, maximize data rate, maximize time resolution, low consumption of power , low cost and etc. Especially this benefits are used in imaging, positioning and radar tracking. In 1983, Hertz has experimented on UWB in wireless communication by using discharge of the arc and gap of the spark between carbon rods which creates radio wave. After that so much

experiment and research are going on different application. UWB system need minimum power for transmission and reception as it uses wideband (high bandwidth for same channel capacity as per formula.

$$C = W \log\left(1 + \frac{P}{WN_0}\right)$$

Where C = channel capacity, W = band width, P = message power and N_0 = Noise power spectral density. In 2006, USA FCC accept and approved that from 3.1GHz to 10.6 GHz and Spectrum having a bandwidth of 7.5GHz for power level -41.3dBm/MHz for UWB system. As per FCC spectral regulation ,UMB system able to use power as minimum as order of 0.5 milliwatts as all energy of the UMB signals spreads over wide band. A radio system that has -10dB bandwidth greeter than 25% from center frequency is used for UWB wireless communication systems (UWBWCS). UWB technology spreads its interest among the young researcher in many recent and future applications. [17]. Any UWB signal radiator is a major component of UWB system. .An UWB transmitter and receiver operate over an excessive wide band frequency range covering band width of UWB signal without any distortion ideally. [19]

Parameter analysis in time domain for wireless application and for different UWB architecture

Characteristic study of different UWB architecture and its parameter analysis

Here, Author described variation in different parameters in different UWB architecture. The author has conducted a study on different parameters to find which antenna would be more suitable in the given context of an UWB communication system. The antennas analyzed in this article are double ridged TEM, resonant monopole, horn, log-periodic pyramid, cavity backed Archimedean spiral, tapered slot areal and bicon antenna. A brief time domain analysis is done for various broadband antenna architectures [3]. A fixed benchmark level is taken for each user to enable all to compare different architecture depending upon the specific application. In test set up two similar antennas are given same input over wider frequency band and were measured and analyzed using the HP8510 VNA (vector network analyzer) for time domain. By using this HP8510, frequency domain data converted to corresponding time-domain values using FFT which give an effective Gaussian excitation.

Modelling of channel in time domain for multipath propagation for UWB wireless application

Here, author has proposed a generalized time domain multipath channel model for design and analysis of Ultra-wideband (UWB) optimum wireless receiver [4]. The author has found a different type of theoretical frame work structure using the closed formed interpretations which allows to analyze the Ultra-wideband radiator performance. Here author analyzed how the BER and SNR changes when geometry is modified and experimented it by taking diffraction concept.

Different geometrical approach to design Ultra wideband (UWB) for different band width, resonant frequency, patterns multiple notch.

A printed simplified monopole ultra-wideband antenna using Notched geometry

Here, Auther have proposed a printed simplified monopole ultra-wideband antenna using Notched geometry [5]. The notched-band characteristic of UWB antenna is implemented by a compact coplanar waveguide (CPW) resonant cell (CCRC).Basically this proposed structure is applied to band of wireless local area network. The following are summarized in table no1.

Design of Goblet like patch (GP)) antenna on half ellipse ground (HEG) and application to UWB.

Here, Author have designed a goblet like patch (GP)) antenna on half ellipse ground (HEG) [6]. This GP over an HEG geometry can be used for the range of ultra-wide band. This planar UWB antenna is simulated and analyzed in time domain whose performance comes good enough than previous observation. The proposed antenna is printed on two side of dielectric substrate (FR-4) having permittivity of 4.4 reference to vacuum ($\varepsilon_r = 4.4$).The antenna is feed through a 50 ohm microstrip feed line The upper half of full radiator is designed like elliptical disc structure of vertical axis length 14mm..The lower half of the full radiator is half of a circular disk having 6mm radius, upper half of radiator is a half ellipse disk.. The mean effective coefficient (MEC) is one of the performance parameter is 0.926 which indicate very good pulse fidelity of the radiator. The substrate geometry and result are summarized in Table no 2. Designed Structure is given in figure 3

Dual Notched Ultra-wideband antenna at 3.4 GHz and 5.5 GHz.

Here, Author have proposed a dual notch ultra wide band antenna at 3.4GHz and 5.5 GHz [08]. A compact UWB antenna with size of 26mm X 30mm is proposed by the author. The antenna comprises of a beveled rectangular metallic patch & a 50 ohm CPW) transmission feeding line. By engraving a C-shaped hole in the radiating section, solitary band-notched behavior from 5 GHz to 6 GHz is easily obtained and by engraving two nearby C-shaped hole in the radiating section, double band-notched behavior from 3.3-3.6 GHz and 5-6 GHz is designed by author to minimize the interferences among narrow band and ultra-wide band systems.. The simulation and measurement results show a VSWR < 2 for the operating range and VSWR≥3 for the band notched frequency. It shows stable radiation patterns and gain of 2 to 4 dBi except a sharp decrease at band notched frequencies. Complete design and simulated gain is shown in fig-4 and fig-5 respectively.

A method to enhance the bandwidth of the UWB microstrip antenna with a modified ground plane

Here, The author proposed a method to enhance the bandwidth of the UWB microstrip antenna with a modified ground plane by using diagonal edges, rectangular slot and a T-shaped cut on the on the ground plane[09]. The dimension of every four-sided slot is 5cm×3 cm and the Tee shaped size is 8×4mm.A circular patch of radius R is printed on a 3cm×5.1 cm×0.16 cm FR4 substrate. The radius R of the circular patch is optimized to get lowest S_{11} parameter (return loss) and widest bandwidth whereas other parameters (limits) are kept fixed. The optimized value of the R is 11mm.The width of the W_g of the microstrip feed line is 3mm for the impedance of 50Ω. The magnitude of the ground plane is 30×15 mm.

A hanger shaped ground plane planner monopole radiator having triband notched behavior

Here, Writer have designed and proposed a hanger shaped ground plane planner monopole radiator having triband notched behavior [10]. An antenna of overall dimension of 36mm in x axis and 34mm in Y axis is designed where Ω (ohm) like structural slot and a half cut octagon structure resonant ring on the lower side of the antenna is embedded to achieve three notched frequency. The following results are come out. At notch point, that is at 3.5, 5.2 and 5.85, the gain of antenna decreases slightly. The time domain characteristics of the antenna shows fixed group delay and slow variation in transfer function, which suggest that the antenna shows phase linearity at required UWB frequencies. That means it can handle the pulse accurately. The antenna is insensitive to fabrication acceptances as well as finite ground size tolerances. Due to which practical antenna design more flexible compare to other cases. Complete design and simulated VSWR is shown in fig-6 and fig-7 respectively.

Small size UWB antenna for gain enhancement for wireless body area network (WBAN) applications

Here, In this context, Author Presented a paper on gain Enhancement of small size UWB antenna for wireless body area network (WBAN) applications [16]. The proposed UWB antenna is modified by means of a perfect electric conducting (PEC) plane which is used as a reflector closely from body surface. PEC plane dimension and position are taken then it is simulated. Simulation result indicates good performance for this modified antenna in time domain. Using additional layers of antenna substrate, the effect of body is reduced and gain of the antenna is increased. The partially rectangular element positioned at the lower edge of the radiation portion reduces lower cut off frequency (fl).To get high range of impedance bandwidth, all turns of the radiation parts have been tapered. The following antenna is printed RF35 substrate and simulated using CST design software .The design parameters and result is summarized below

Folded step-by-step impedance resonator along with two notched bands monopole antenna for UWB application

Here, Author has proposed a folded step-by-step impedance resonator along with two notched bands monopole antenna for UWB application with two notched bands based on the [18]. The proposed antenna consists of a circular-shaped radiating element, double short-circuited crumpled step-by-step impedance resonators (SIRs) over a ground plane which is partially truncated. The overall size of the antenna is 33 mm x 25 mm. To get band rejection characteristics The SIRs are located nearby the feed line at 3.41-3.68 GHz and 5.37-6.01 GHz. It shows a good UWB characteristics from around 3.07-10.61 GHz for VSWR<2. The measured radiation patterns of E-plane at 3, 6 and 9 GHz are almost Omni-directional and the H-plane patterns are monopole-like. A sharp decline of aerial gain in notched frequency band at 3.51GHz and at 5.83 GHz respectively is observed. The compact magnitude and simplest configuration of the antenna also makes it suitable for UWB systems which is shown in figure.

CONCLUSION

In this context, a clear picture of ultra wide band antenna is explained in simplified manner. A revision of different structures and models for different application is properly arranged and presented. In addition with some parametrical analysis is done and compared. Advantage and demerits of different shape and size is discussed. The design and implementation of new structure proposed to improve efficiency, gain, bandwidth, and notch point and radiation pattern.

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Table l. A printed simplified monopole ultra-wideband antenna using Notched geometry

Length	Width	Band range	Notched band range	VSWR	Pattern
46mm	30mm	2.47 GHz to 12GHz	5.10 GHz to 5.94 GHz	≥ 3	Omnidirectional

Table 2. Design of Goblet like patch (GP)) antenna on half ellipse ground (HEG) and application to UWB

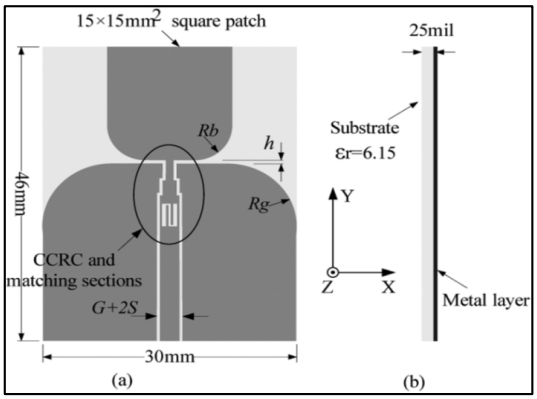
Length of substrate	Width of substrate	Thickness of substrate	Length of 50Ω MS feed line	Width of 50Ω MS feed line	Bandwidth of return loss	mean effective coefficient(MEC)
26 mm	27mm	1.6 mm	3 mm	11mm	3.8GHz to beyond 12 GHz	0.926

Table 3. A hanger shaped ground plane planner monopole radiator having triband notched behavior

VSWR	Bandwidth	1st Notch	2nd Notch	3rd Notch	Radiation Pattern in E plane	Radiation Pattern in E plane
< 2	10.1 GHz (2.9–13 GHz	3.3–3.9 GHz	5.2–5.35 GHz	5.8–6.0 GHz	monopole like patterns	nearly Omni-directional patterns

Table 4. Small size UWB antenna for gain enhancement for wireless body area network (WBAN) applications

Length in X axis of patch	Width in y axis of patch	Substrate thickness	Substrate dielectric constant	loss tangent tanδ of substrate	Result band width
17mm	26mm	1.524mm	3.5	0.0018	3.1 to 10.6 GHz



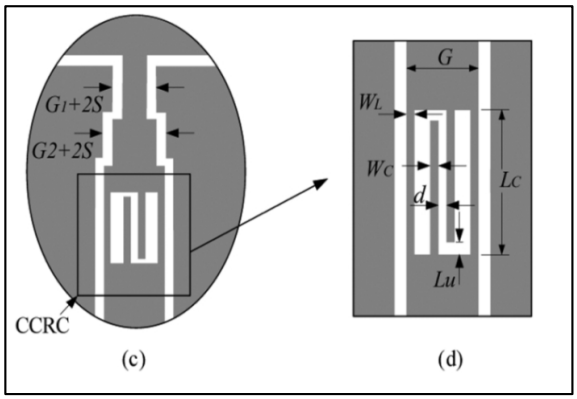


Figure 1 : Geometry of antenna :a) top view b) side view c)matching section d) CCRC

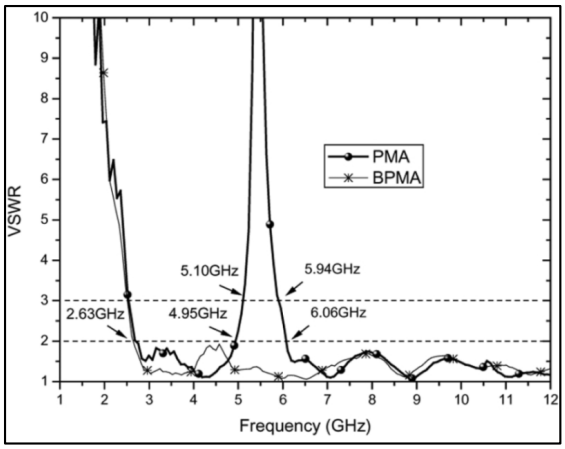


Figure 2: comparison of band notched printed monopole antenna (BPMA) and monopole printed antenna

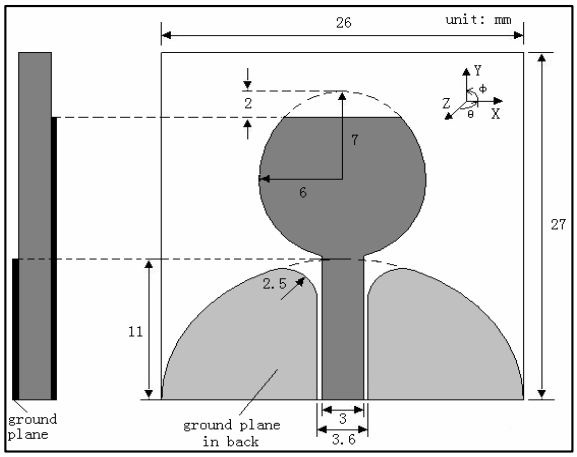


Figure 3: Geometry of Goblet like patch (GP)) antenna on half ellipse ground (HEG)

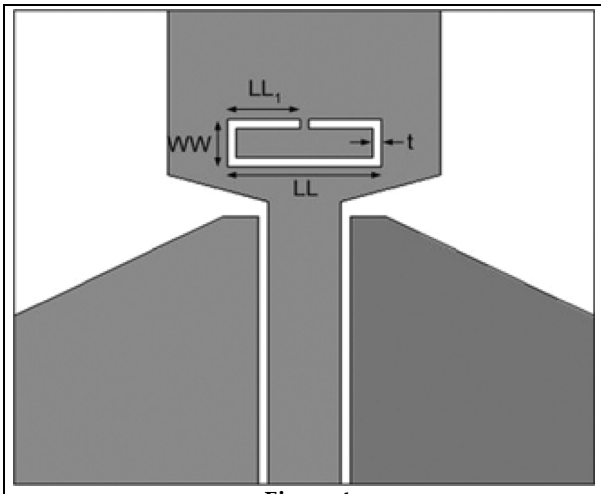


Figure.4

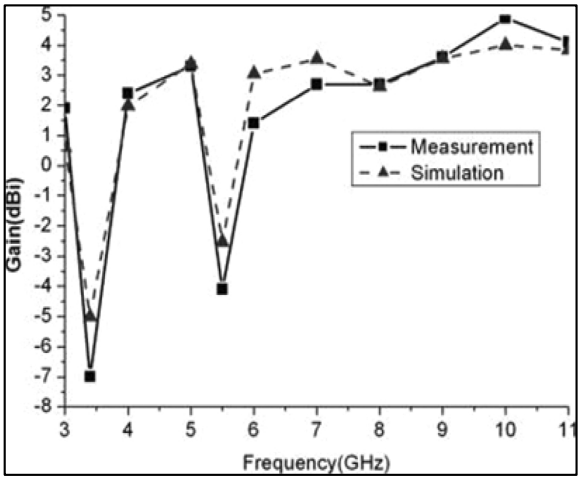
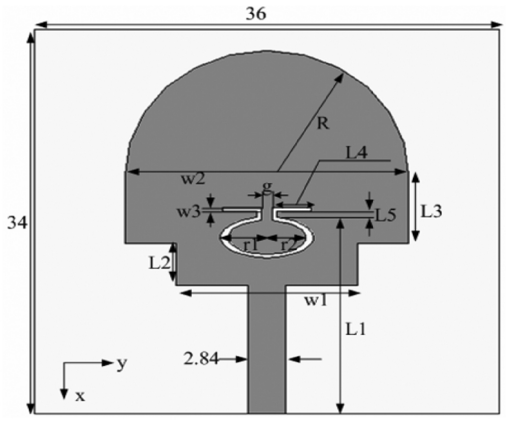


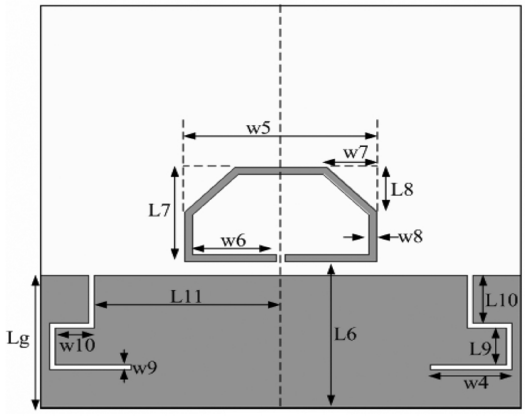
Figure.5

Figure 4& 5. Complete design and simulated gain



(a)

Figure.6 (a)



(b)

Figure.6 (b)

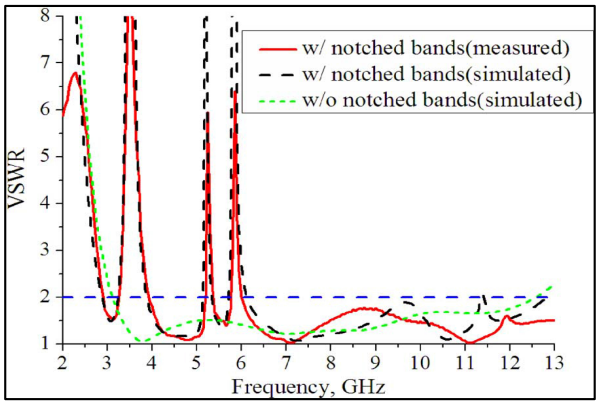


Figure.7

Figure 6 & 7. Complete design and simulated VSWR

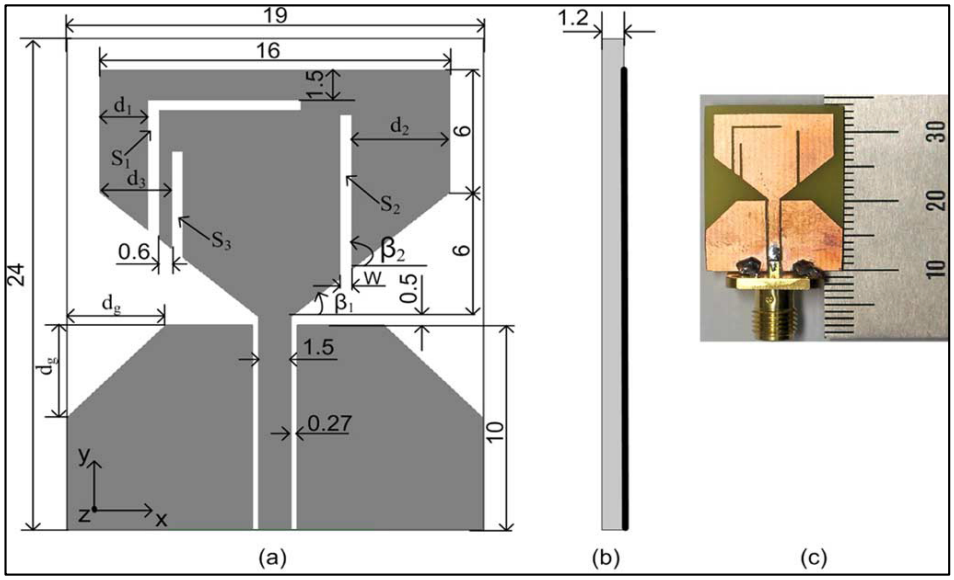


Figure 8. Complete design and simulated UWB systems

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Anomaly based Intrusion Detection System using Machine Learning Techniques

Anshuman Khuntia[1], Chinmayee Chaini[1] and S. Chakravarty[2*]

[1]Utkal University, Odisha, India.
[2]Centurion University of Technology & Management, Bhubaneswar, Odisha, India

Received: 02 Mar 2020 Revised: 04 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
S.Chakravarty
Senior Member IEEE
Centurion University of Technology & Management,
Bhubaneswar, Odisha, India
Email: sujata.chakravarty@cutm.ac.in

ABSTRACT

Intrusions constitute one of the main issues in computer network security. Through malicious actions, hackers can have unauthorized access that compromises the integrity, confidentiality, and the availability of resources or services. Intrusion detection systems (IDSs) have been developed to monitor and filter network activities by identifying attacks and alerting network administrators. Different IDS approaches have been emerged using data mining, machine learning, statistical analysis, and artificial intelligence techniques such as Genetic Algorithms, Artificial Neural Networks, Fuzzy Logic, Swarm Intelligence, etc. However, higher-quality training data is an essential determinant that could improve detection performance. The experiment will be conducted on the NSL KDD dataset consists of a 20% training dataset, which is an advanced version of the KDDCUP99 dataset. In this thesis, the work is based on developing a binary classification of Anomaly Based Intrusion Detection System with the help of Machine Learning techniques. The uses of PSO with NB return an RMSE of 0.0128 as compared to only Naïve Bayes which is 0.3271. The NB classifier combined with the Hybrid PSO Feature Selection method proves to be the best feature selection capability without degrading the classification accuracy. It is further proved to be an effective method for mining large structural data in much less computation time.

Keywords: Intrusion Detection System, Anomaly Based Intrusion detection system, Naïve Bayes, Particle Swarm Optimization

INTRODUCTION

Intrusion Detection Systems (IDSs) are nowadays recognized as necessary tools for the security of computer systems. IDSs aims at identifying violations of security policies, also known as intrusions, or intrusion attempts. In response to such events, IDSs can also perform automatic counteractions to protect computer systems and information [1]. As we know, compromising the security of the computerized systems is becoming easier today, due to the abundance of free hacking tools widespread over the internet. Users do not need high skills to apply such malicious actions [2]. Ensuring the integrity and the privacy of these data is becoming a real challenge. There are many software tools such as firewalls, antivirus, encryption, and authentication that protect of data and networks from the incoming threats, yet they cannot be efficient for all existing threats [3]. To resolve this problem, many researchers have been conducted in this field. Intrusion detection systems (IDSs) have been developed to monitor and filter network activities by identifying attacks and alerting network administrators [4].There are two main approaches for IDS: misuse and anomaly detection techniques. Neither is efficient for all kinds of threats, yet each has strengthened and limitations [5]. The misuse detection approach is efficient for detecting known attacks but not for the unseen ones. In contrast, the anomaly detection approach is efficient for detecting new attacks. In literature, most of the research in intrusion detection focused on the anomaly detection technique because it seems more promising.The KDD'99 dataset was used by researchers for over a decade even though this dataset was suffering from some reported shortcomings and it was criticized by a few researchers.In 2009,Tavallaee M.et al. proposed a new dataset (NSL-KDD) extracted from the KDD'99 dataset to improve the dataset where it can be used for researching in anomaly detection [6].Therefore, the existing irrelevant and redundant features are omitted from the dataset resulting in not only faster training and testing processes but also less resource consumption while maintaining high detection rates [7].Commonly known NIDSs are Signature Based and Anomaly Based. Anomaly Based NIDS deals with detecting of unknown attacks in network traffics [8].

Literature Survey

Ananda Kumar, Arpitha, Latha, and Sahana proposed an algorithm namely Flexible Mutual Information Feature Selection (FMIFS) supervised by Filter Based feature selection algorithm. FMIFS modifies the Battitis algorithm which redundancy among the features and eliminated the redundancy used in MIFS and MMIFS. The proposed algorithm has been evaluated here with the help of the NSL KDDCUP 99 data set. The performance is evaluated in the term of accuracy, detection rate, false positive and F-measure [1].S. Revathiand, Dr. A. Malathi has analyzed the NSLKDD dataset that solves some of the issues of KDD cup99 data. Their experiment has been carried out with different classification algorithms for the dataset with and without feature reduction and it is clear that Random Forest shows a high test accuracy compared to all other algorithms in both the cases. So in the case of a reduced feature set that analysis shows that Random Forest is speeding up the training and the testing methods for intrusion detection that is very essential for the network application with high speed and even providing utmost testing accuracy [2].L.Gnanaprasanambikai et.al. generated decision rules for anomaly intrusion detection. According to them, to generate decision rules a prior work of Data pre-processing work is implemented with PCA as dataset dimensionality reduction. The features set used in decision rule serve for determining DDOS (distributed Daniel of service) attack in turn identifying traffic volumes in the network. These Decision rules are generated for Traffic Anomaly Intrusion Detection and they serve as initial rules for the Genetic Algorithm Process [3, 4].Particle Swarm Optimization introduced by Eberhart and Kennedy in 1995 has several advantages compared with the other algorithms in this group such as simple to implement, scalability, robustness, quick in finding approximately optimal solution, and flexibility [5].The main advantage of Anomaly Detection is that it can detect unknown attacks. However, this advantage is paid for in terms of a high false positive rate because, in practice, anomalies are not necessarily intrusive [6].Kumar et al. applied Binary Particle Swarm Optimization (BPSO) and Random Forests (RF) classifier algorithms to classify the PROBE attacks. They found out that the increase in the number of trees in the forest reduces the false positive rate when determining the attacks [7, 8]. Bajaj and Arora examined the contribution

of all the features (#41) in the NSL-KDD dataset and found that J48, Naïve Bayes, NB tree, SVM, and simple cart methods were applied for binary classification [9]. Three out of 41 features [urgent (#9), num_outbound_cmds (#20) and is_hot_login (#21)] using the NSL-KDD training dataset had no significant role in the detection of attacks [10]. Five out of 41 features [su_attempted (#15), num_file_creations (#17), num_access_files (#19), dst_host_count (#32) and dst_host_rerror_rate (#40)] had little significant role in detection of attacks [11]. The proposed method achieved 91% classification accuracy using only three input features and 99% classification accuracy using 36 input features, while 41 input features achieved 99% classification accuracy [12, 13].

MATERIALS AND METHODS

Data

NSLKDD dataset is an advanced version of the KDDCUP99 dataset with no redundancy, no duplication of records, and with less complexity level. NSLKDD dataset consists of a 20% training dataset, a full training dataset of 125,973 instances, and a testing dataset of 22,544 instances. In this paper, we are using from 20%training datasets [14].

Naïve Bayes

Naive Bayes classifier uses the probabilistic method to predict a class for every instance of data set. The specific working process of Naive Bayes is as follows:
Let T as the training sample set. Each sample has category labels. Sample set has a total of m classes: C1, C2...Cm. Each sample is represented by an n-dimensional vector X={x1, x2...xn}, and each vector describes n attributes A1, A2... An.

1. Given a simple X, the classifier will predict that X belongs to the highest posterior 0probability of class. If and only if P(Ci|X)>P(Cj|X), 1≤i, j≤m, X is predicted to belong to class Ci. According to the bayes' theorem, P(Ci|X)=P(X|Ci)P(Ci)/ P(X). Because P(X) is the same for all classes, it only needs to find the largest P(X|Ci)P(Ci). The prior probability of class Ci can be calculated. P(Ci)=si/s, si is the number of training samples of class Ci, and s is the total number of training samples. If the prior probability of class Ci is unknown, it is usually assumed that the probability of these classes is equal, then P(C1) = P(C2)= …= P(Cm), therefore the problem is transformed into how to get maximum P(X|Ci) [15-17].

2. If the data set has many attributes, the workload of calculating P (X|Ci) is very high. To reduce the computational overhead of P(X|Ci), simple assumptions that under certain condition attribute characteristic value is independent of each other. Mathematics is expressed as:

   P(X |Ci)! P (xk |Ci) k=1 n …….(1)

3. Probability P(x1|Ci), P(x2|Ci), …, P(xn|Ci) can be calculated from the training set. Here xk refer to the attribute AK of sample X. If and only if P(X|Ci)P(Ci) is maximum, the classifier prediction sample X belongs to class Ci.

Particle Swarm Optimization

Kennedy and Eberhart integrated group behavior, human decision, and simulation of birds' flight to forage behavior, and proposed Particle Swarm Optimization algorithm [18]. In this algorithm, each solution of the Optimization problem is searching a bird in the space, which is called as the "Particle". All particles have a fitness value that is measured by the fitness function and have a speed to decide the direction and distance of particle flight.Like other Evolutionary Algorithms, Particle Swarm Optimization algorithm also uses concepts such as the group and a Novel Naive Bayes Classification Algorithm. And the algorithm operates according to individual fitness

value. But the Particle Swarm Algorithm does not like other evolutionary algorithms using evolutionary operators for the individual. Instead, each individual is seen as in n-dimensional search space without weight and volume of the particles, and at a certain flight speed in the search space. According to the individual flight experience and group flight experience, the flight speed can be adjusted dynamically. The PSO algorithm is initialized to a group of the random particle (random solutions), and then through the iteration to find the optimal solution. In each generation, particles update themselves by tracking two extrema. The first extrema is the optimal solution for the particle it has ever experienced. This solution is known as individual extrema.

Another extreme is the optimal solution for the whole population they have ever experienced at present. This extrema is known as global extrema. Also, a part of the whole population can be selected as the particle's neighbors, the extrema that in all neighbors called local extrema. This algorithm makes use of information sharing mechanisms in birds, and it is the whole population movement from disorderly to orderly evolution process in problem-solving space and can obtain the optimal solution. Assume the number of particles in the group is s. The best position visited by all particles in the group is Pg (t), Pg (t)∈{P0 (t), P1 (t)… Ps (t)},

$f(Pg(t))=min\{f(P0(t)), f(P1(t)),\ldots, f(Ps(t))\}$ ……. (2)

The evolution equation of particle swarm optimization algorithm can be described as

$vij\ (t+1) = vij\ (t) + c1\ r\ 1\ j\ (t)\ (\ pij\ (t)-xij\ (t)) + c2\ r\ 2\ j\ (t)(\ pgj\ (t) - xij\ (t))$……..(3)

$Xij\ (t+1) = xij\ (t) + vij\ (t) +1$…….(4)

In equation (3) and (4), the subscript j represents the j dimensional of the particle, the subscript represents particle i, t represents the t generation. C1 is a Cognitive Learning factor, C2 is a Social Learning factor, and they are usually set from 0 to 2.0. When the learning factor C1 and C2 are set to the same value,it means that the particles in the search for itself and social aspects have the same proportion, r1∼U(0, 1) and r2∼ U(0, 1) are two independent random functions.When the maximum generation is reached or the designated value of the fitness is achieved, iterations of the PSO are terminated. The PSO is also called continuous PSO in our study [19].

Proposed Algorithm

```
%% PSO Parameters
 MaxIt=50;       % Maximum Number of Iterations
 nPop=100;        % Population Size (Swarm Size)
 w=1;            % Inertia Weight
wdamp=0.99;      % Inertia Weight Damping Ratio
c1=1.5;          % Personal Learning Coefficient
```

EXPERIMENTAL RESULTS

The next step after applying implementing machine learning models is to seek out how effective is that the model, i.e. how the models performed on the datasets. This is carried out by running the models on the test dataset which was set earlier.The NSL-KDD dataset includes 41 features with normal classes and 4 types of attacks: Probe, R2L, U2R, and Denial of Service Attack (DoS) [20].

Confusion matrix

The Confusion matrix is a matrix that represents the result of classification. It represents true and false classification results. Summarization the performance of a classification algorithm is based on a technique which is known as a confusion matrix. It is arguably the easiest way to regulate the performance of a classification model by comparing how many positive instances are correct/incorrect classified and how many negative instances are

correctly/incorrectly classified. In a confusion matrix, as shown here, the rows represent the actual labels while the columns represent the predicted labels.

Naïve Bayes Result
After calculating the Naïve Bayes result we got theses mentioned below

PSO Result
After implementing PSO on NSL KDD Datasets, we got these result.

Performance Matrix

Root Mean Square Error (**RMSE**) is the standard deviation of the residuals (prediction errors). Residuals are a measure of how far from the regression line data points are; RMSE is a measure of how spread out these residuals are. In other words, it tells you how concentrated the data is around the line of best fit.

Precision: is one of the primary performance indicators. It presents the total number of records that are correctly classified as attack divided by a total number of records classified as attack. The precision (P) is the proportion of attack cases that were correctly predicted relative to the predicted size of the attack class.
Recall: Recall refers to the true positive rate. It is the ratio of positive samples classified correctly as positive. The recall (r) or (true positive rate – tpr) is the proportion of correctly predicted attack cases to the actual size of the attack class,

F-Measure: F-measure is a measure of classification models accuracy depending on the precision and the recall metrics. It is a weighted average of both Precision and Recall metrics. F-score scores the balance between precision and recall. The F-score is a measure of the accuracy of a test. The F-score can be considered as the harmonic mean of recall and precision.

Convergence curve
Above convergence curve represents the error(RMSE) of about 0.01289 is obtained with just #50 iteration and the result can be more improvised with increased number of iteration but may consume more time. So increment of number of iterations should be considered carefully.

Comparative Result
Comparative Analysis

Looking at above figure reduction in false negative counts and increment in true positive count impacts the improved results as discussed in previous section.The result above compares four important statistical measures that ensure use of optimization techniques like PSO highly improves performance measures. Specifically in case of RMSE and recall the results are obtained as 0.01289 and 8.9783 respectively as compared to 0.3271 and 0.3171 in case of simple Naïve Bayes respectively

CONCLUSION

In this paper, the work is based on developing a binary classification of anomaly Based Intrusion Detection System with the help of Machine Learning Classification techniques. However, among all those literature survey we purposed comparison result Naïve Bayes classification and Particle Swarm Optimization to get best result on NSL datasets. NSL datasets is improved version of original KDD dataset of intrusion detection. The uses of PSO with NB return an RMSE of 0.0128 as compared to only Naïve Bayes which is of 0.3271.

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Table 1.Basic Feature of each Network Connection Vector

Attribute No.	Attribute Name	Description	Sample Data
1	Duration	Length of time duration of the connection	0
2	Protocol type	Protocol used in the connection	Tcp
3	Service	Destination network service used	ftp_data
4	Flag	Status of the connection – Normal or Error	SF
5	Src_bytes	Number of data bytes transferred from source to destination in single connection	491
6	Dst_bytes	Number of data bytes transferred from destination to source in single connection	0
7	Land	if source and destination IP addresses and port numbers are equal then, this variable takes value 1 else 0	0
8	Wrong fragment	Total number of wrong fragments in this connection	0
9	Urgent	Number of urgent packets in this connection. Urgent packets are packets with the urgent bit activated	0

Table 2.Content Related Features of each Network Connection Vector

Attribute No.	Attribute Name	Description	Sample Data
10	Hot	Number of „hot indicators in the content such as: entering a system directory, creating programs and executing programs	0
11	Num_failed _logins	Count of failed login attempts	0
12	Logged_in	Login Status : 1 if successfully logged in; 0 otherwise	0
13	Num_compromised	Number of ``compromised'' conditions	0
14	Root_shell	1 if root shell is obtained; 0 otherwise	0
15	Su_attempt ed	1 if ``su root'' command attempted or used; 0 otherwise	0
16	Num_root	Number of ``root'' accesses or number of operations performed as a root in the connection	0
17	Num_file_creations	Number of file creation operations in the connection	0
18	Num_shells	Number of shell prompts	0
19	Num_acces s_files	Number of operations on access control files	0
20	Num_outbo und_cmds	Number of outbound commands in an ftp session	0
21	Is_hot_logi n	1 if the login belongs to the ``hot'' list i.e., root or admin; else 0	0
22	Is_guest_lo gin	1 if the login is a ``guest'' login; 0 otherwise	0

Table 3.Time Related Traffic Features of each Network Connection Vector

Attribute No.	Attribute Name	Description	Sample Data
23	Count	Number of connections to the same destination host as the current connection in the past two seconds	2
24	Srv_count	Number of connections to the same service (port number) as the current connection in the past two seconds	2
25	Serror_rate	The percentage of connections that have activated the flag (4) s0, s1, s2 or s3, among the connections aggregated in count (23)	0
26	Srv_serror_rate	The percentage of connections that have activated the flag (4) s0, s1, s2 or s3, among the connections aggregated in srv_count (24)	0
27	Rerror_rate	The percentage of connections that have activated the flag (4) REJ, among the connections aggregated in count (23)	0
28	Srv_rerror_rate	The percentage of connections that have activated the flag (4) REJ, among the connections aggregated in srv_count (24)	0
29	Same_srv_rate	The percentage of connections that were to the same service, among the connections aggregated in count (23)	1
30	30 Diff_srv_rate	The percentage of connections that were to different services, among the connections aggregated in count (23)	0

Table 4: Host Based Traffic Features in a Network Connection Vector

Attribute No.	Attribute Name	Description	Sample Data
32	Dst_host_coun t	Number of connections having the same destination host IP address	150
33	Dst_host_srv_ count	Number of connections having the same port number	25
34	Dst_host_same _srv_rate	The percentage of connections that were to the same service, among the connections aggregated in dst_host_count (32)	0.17
35	Dst_host_diff_ srv_rate	The percentage of connections that were to different services, among the connections aggregated in dst_host_count (32)	0.03
36	Dst_host_same _src_port_rate	The percentage of connections that were to the same source port, among the connections aggregated in	0.17

		dst_host_srv_count (33)	
37	Dst_host_srv_ diff_host_rate	The percentage of connections that were to different destination machines, among the connections aggregated in dst_host_srv_count	0
38	Dst_host_serro r_rate	The percentage of connections that have activated the flag (4) s0, s1, s2 or s3, among the connections aggregated in dst_host_count (32)	0
39	Dst_host_srv_s error_rate	The percent of connections that have activated the flag (4) s0, s1, s2 or s3, among the connections aggregated in dst_host_srv_c ount (33)	0
40	Dst_host_rerro r_rate	The percentage of connections that have activated the flag (4) REJ, among the connections aggregated in dst_host_count (32)	0.05
41	Dst_host_srv_r error_rate	The percentage of connections that have activated the flag (4) REJ, among the connections aggregated in dst_host_srv_c ount (33)	0

Table 5.Confusion Matrix

	Predicted Negative	**Predicted Positive**
Actual Negative	TN	FP
Actual Positive	FN	TP

Table 6.Confusion Matrix of Naïve Bayes

True Positive (TP)	717
False Positive (FP)	20
True Negative (TN)	1036
False Negative (FN)	181

Table 7.Confusion Matrix of PSO

True Positive (TP)	826
False Positive (FP)	20
True Negative (TN)	1036
False Negative (FN)	72

Table 8. Performance Matrix of Naïve Bayes

RMSE		0.3271
PRECISION	TP/(TP+FP)	0.9814
RECALL	TP/(FP+FN)	0.3171
F SCORE	2/(1+Recall)+(1+precision)	0.8418

Table 9. Performance Matrix of PSO

RMSE		0.01289
PRECISION	TP/(TP+FP)	0.9764
RECALL	TP/(FP+FN)	8.9783
F SCORE	2/(1+RECALL)+(1+PRECISION)	2.1768

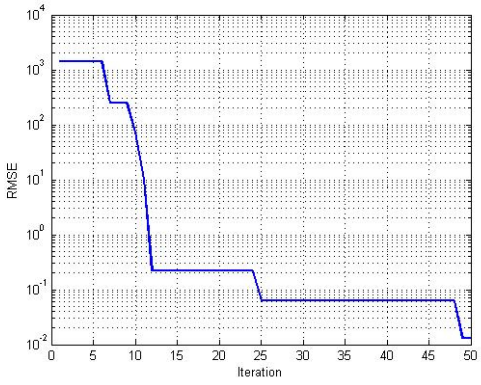

Figure 1. Convergence Curve for Optimized Naïve Bayes

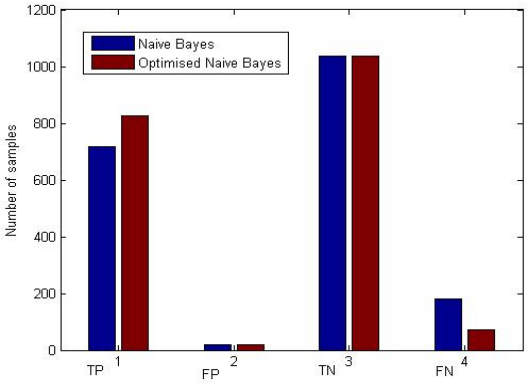

Figure 2: comparison result of Confusion Matrix

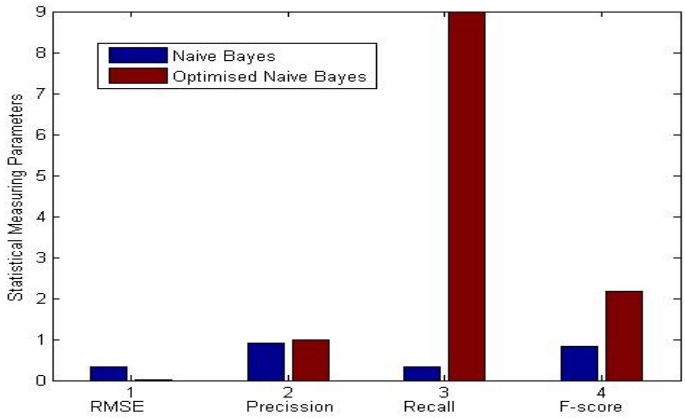

Figure 3.Comparison Result of Performance Matrix

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Study of Behavioural Ecology of *Ratufa indica* in Kapilash

Subham Nanda and Pradip Kumar Prusty*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 01 Mar 2020 Revised: 03 Apr 2020 Accepted: 05 May 2020

***Address for Correspondence**
Pradip Kumar Prusty
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: pradipkumar.prusty@cutm.ac.in

ABSTRACT

The Indian Giant Squirrel *Ratufa indica*, an endemic species to India, is widely distributed from the evergreen to moist and dry deciduous forests of Western and Estern Ghats and the central Indian hills.I studied its population distribution, activity, feeding and nesting behaviour. The present study was conducted in Kapilash of Dhenkanal district,Odisha. Nesting characteristics assessed through 31 nests surveyed along the area. Daylight activity and feeding patterns assessed through direct observations.

Keywords: Breeding, ecology, dreys, behaviour, feeding,population,*Ratufa indica.*

INTRODUCTION

The *Ratufa indica* belong to the class: Mammalia,Order:Rodentia and Family:Sciuridae of Phylum:Chordata.The average length of head and body is about 36cm and the length of the tail is 45cmand the weight is about 1.7 to 1.8 kg in both the sexes (Thorington,2012).The colour of these squirrel may be whitish creamy-beige,buff,tan,rust,reddish-maroon,brown,a dark seal brown or black (Prater,1971).It is an upper-canopy dwelling species (Datta & Goyal,1996).It freezes or flattens itself against the trunk of the trees when it feels danger (Tritsch,2001).The species oftenly live solitary but during breeding time they come together.However these are found alone or in pairs.They use leaves and twigs for constructing globular nests or dreys within their home range in multiple numbers.They prefer nest in most deciduous forest as compared to dry deciduous and throne dry forest for better canopy.They placed their dreys on thinner branches where large predators cannot get to them.The Indian Giant Squirrels are omnivorousin nature.They feed on fruits, flowers, nuts, barks, bird eggs and insects (Payne,1979; Ramachandran,1992).Again the species comes under the Red list of threatened species in IUCN in 2016 (Molur,2016).The species *Ratufa indica* was described by a German NaturalistJohann Christian Polycarp Erxleben in 1977.The species is commonly called as Indian Giant Squirrel.

MATERIALS AND METHODS

Study Area

The selected species were studied at Kapilash. This area lies between 20º35′ to 20º46′ N and 85º40′ to 85º56′ E longitude (Palei et al,2017). The altitude of the area varies between 100 and 600 meter above mean sea level with rolling plateau and Rockymountain. The temperature of Kapilash varies between 30 to 35º C. The annual rainfall varies from 1500 to 1700 mm during the monsoon seasons between the month of June and September. The forests of this region are categorized as tropical moist deciduous and dry deciduous forests (Champion and Seth, 1968).

The study on the Indian Giant Squirrel was conducted through different methods. Data on activity pattern, feeding and nesting were recorded by actual sighting of Indian Giant Squirrel with the help of a 10 × 40 binocular. Focal animals were followed and observations were recorded by Cannon 500 D, Digital SLR with Cannon 75-300 mm lens. Indian Giant Squirrel was continuously observed for a period of time and recorded its activity budget, feeding, resting, moving and other activities like nest construction at every minute interval for a period of 10 minutes.All data were recorded by a data sheet. Observation was made during daylight hours as the animal diurnal in nature. Observation was considered complete when animal stopped feeding. Once an observation was completed, I searched for next observation.

RESULTS AND DISCUSSION

In Kapilash Wildlife Sanctuary, Indian giant squirrel mostly relied on tree as fodder plants. It was found to be fed primarily on fruits besides bark, seeds, leaves, flowers, piths and buds. All tree squirrels distributed from the tropical forest to subarctic forest are generally fruit eaters as fruits compose the largest proportion of their diet (Glanz, 1984; Kato, 1985; Setoguchi, 1990; Palei et al., 2015a). Compared to other plant parts, fruits are the preferred food for tree squirrels because they are rich in nutrition and energy while being more digestible (Alvarenga and Talamoni, 2006).The trend is common globally for all species of tree squirrels; similar feeding habits of the Indian giant squirrel have been described asfrugivorous in the tropical deciduous forest of India (Borges, 1992).

Feeding

The squirrels were found to be active during early hours of morning and evening. Indian Giant Squirrel feeds on petiole, leaf, flower, seed, fruit, bark from different plants. Present study reveals that seeds formed the highest component of its diet. The reason of seeds forming the bulk of Indian Giant Squirrel diet could be due to it is availability around the year and it is high calorific value. Ramachandran states that Indian Giant Squirrel is basically a seed feeder, switches over to leaves and barks when seeds are not available (Ramachandran 1992).

Nesting

The giant squirrel constructs globular nests or dreys using leaves and twigs, multiple in numbers within their home range. The higher abundance of nest in moist deciduous forest compared to dry deciduous and thorn dry forest could be attributed to better canopy contiguity in the former habitat than the latter as reported elsewhere. Nest building process included gathering gathering of materials, carrying materials by mouth to the nest and placing materials in the nest. An Indian Giant Squirrel very often constructed and used more than one nest within a territory at a given time during a season. Nest was monitored daily in morning and evening by the species. Nest was not used by Indian Giant Squirrel on the very day of completion, but from the next day, it was used by the animal. The total time spent for nest building was approximately 2.5 hours. Indian Giant Squirrel preferred to trees with greater canopy height and canopy contiguity. This could help for easy movement from the nest in all directions, the major advantage to escape from predators and to move to other parts of the home range for foraging and other activities.
The nest of Indian Giant Squirrel was distinct from bird's nest in having leaves of nesting trees interwoven in the middle of the trees. The nest was either round or oval. The entry of the nest was placed horizontal to the ground. The

entrance was around 10 cm in diameter. All nests sighted in the study area were observed east facing that might be for sunlight. Nests were very often found at the highest point on the tree that offered a maximum security and protection to the animal (Pradhan *et al.,* 2012).

CONCLUSION

Indian Giant Squirrel is listed as Least Concern in Red List of IUCN (Rajamani*et al., 2009*), in Appendix- II of CITES and in Schedule-II of Wildlife (Protection) Act, 1972. Locally the trend of incidence of sighting of Indian Giant Squirrel in Kapilash is declining. This is due to the paucity of suitable food and nest plant species both in terms of diversity and richness arising out of loss of habitat and excess anthropogenic pressure (Anon, 2003). As feeding and nesting are two important aspects of animal ecology, the variables influencing these activities should be given more attention. Indian Giant Squirrel in fact requires a diverse range of habitats with good forest quality comprising of trees with greater canopy height & contiguity which are important not only for feeding but also for nesting and movement. Soil erosion is another factor which arises due to lack of plantation in place of felling of old and mature trees due to natural wear and tear. Besides restoration of riverine habitats and similar micro habits associated with streams is another conservation concern as Indian Giant Squirrel requires sufficient moisture for its growth and survival (Datta and Goyal, 1996). The anthropogenic factors include selective felling of matured trees for timber, forest fires in summer and illicit felling of trees by the local tribals while collecting honey, wax and resin. The smuggling and killing of India Giant Squirrel for the purpose of pets and medicinal preparations is also a part of wildlife trade (Farve, 1989). There-fore provision of adequate Forest staff to monitor the animal and a systematic scientific research focusing on an inclusive conservation strategy are matter of urgent need which can not only restore the habitat and control the anthropogenic pressure but also can become helpful for long term conservation and management of the species.

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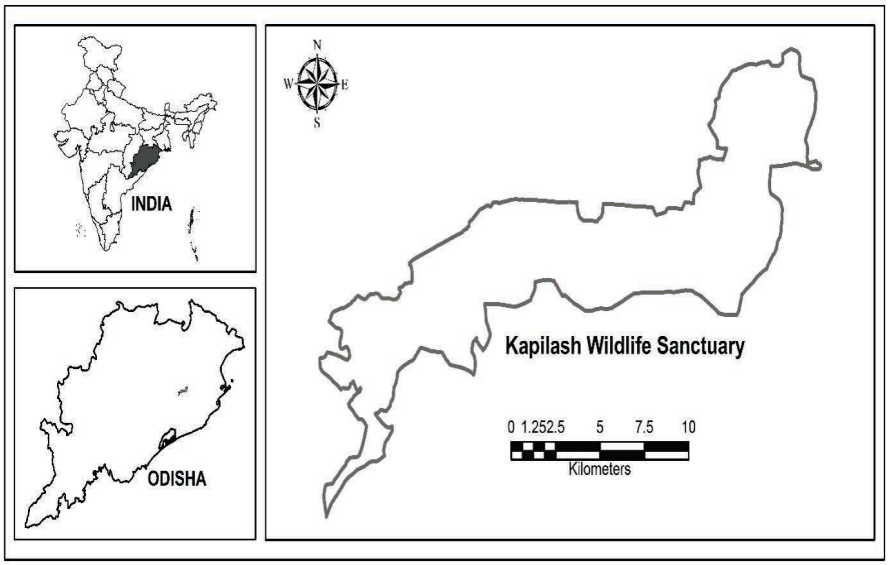

Figure 1. Location map of Kapilash Wildlife Sanctuary, Odisha, Eastern India

Figure 2. Giant squirrel at the time of jumping and nesting on the tree of Kapilash

Figure 3.Giant squirrel at the time of food searching and feeding on the tree of Kapilash.

Figure 4. Photos of fodder plants of *Ratufa indica* in Kapilas

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Synthesis and Characterization of Silica Nanocapsules by using Colloidal Method

Gagan Kumar Panigrahi, M D Siddique and Shraban Kumar Sahoo*

School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received:12 Feb 2020 Revised: 14 Mar 2020 Accepted: 16 Apr 2020

***Address for Correspondence**
Shraban Kumar Sahoo
School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: shraban.sahoo@cutm.ac.in / shrabansahoo26@gmail.com

ABSTRACT

Silver nanoparticles were synthesized by the following two processes; by wet-chemical and microemulsion/reverse micelle methods. Sugar-assisted stable monometallic silver nanoparticles were synthesized by wet chemical method using fructose as reducing agent. Silver nanoparticles were also synthesized by reduction of aqueous silver nitrate solution using sodium borohydride in water-in-oil (w/o) micro emulsions or reverse micelles formed by n-heptane, water and Aerosol OT (AOT). The synthesized silver nanoparticles were coated with silica particles by hydrolysis of TEOS in presence of ethanol and ammonia as catalyst, at RT. The morphology and coating thickness of silica coated silver nanoparticles depends on the molar ratio of TEOS to H_2O. The silica coated Ag nanoparticles (Ag/SiO_2 core-shell) were characterized by UV-vis, XRD, SEM/EDAX and particle size analyzer. From all these measurements it is found that silica is coated uniformly over silver nanoparticles. Then well-defined nanosized hollow SiO_2 capsules were prepared by above two methods by selective removal of Ag-core of Ag/SiO_2 core-shell particles. Due to aggregation of particles, capsule like structure could not be observed in SEM images; however Elemental detection X-ray analysis data (EDAX) shows the presence of only silicon and oxygen in the silica hollow spheres. These silica capsules can be used in drug delivery and cancer therapy, applications.

Keywords: nanoparticles, water, silver nitrate, silica, X-ray.

INTRODUCTION

Nanocapsules have been made for many years, following the example of nature, using molecules called phospholipids, which are hydrophobic (water-repellant) on one end and hydrophilic (water-loving) on the other [1-

3]. When such molecules are placed in an aqueous environment, they can spontaneously form capsules in which the hydrophobic portions are inside, protecting them from contact with water. The fabrication of nanocapsules or hollow nanospheres is currently an attractive area of research due to their applications in various fields like drug delivery, cancer therapy, UV-absorbent, sensing, waste-water treatment, agrochemical delivery etc [4,5]. Because of their specific hollow core structure, high biocompatibility and immunity to the surrounding environment, inorganic nanocapsules can be used as containers for encapsulation of large quanties of guest molecules within the empty core domain, and release them at a later stage in a sustained manner. So far, a number of systems have been explored for carrier or loading of organic molecules such as drug, dyes and biologically active agents and almost all of them are based on silica materials. For example, hollow silica capsules have been used for storage and carrier of dyes, enzymes and drug molecules [1-10].

Coated nanoparticles are essentially defined as the particles containing a core and a shell and have dimensions in the nanometer range. Core-shell/composite nanoparticles often exhibit improved physical and chemical properties over their single-component counterparts, and hence are potentially useful in a wide range of applications. These core and shell nanoparticles have applications in the areas such as microelectronics, quantum dots, optics, magnetic, photoactive devices and so on. The controlled synthesis of novel, uniform and stable core-shell and composite nanoparticles has been remained as a technical challenge for many years. The size, morphology as well as the properties of nanoparticles basically depends on the methods of preparation. All the processes can be broadly divided into two processes, physical methods and chemical methods [10-15].

Physical methods include techniques such as laser ablation, inert gas condensation, sputtering, mechanical ball milling and so on. In Laser Ablation this technique, a focused laser beam irradiates on the target, causing initiation of evaporation. This method is useful for depositing nanocrystalline thin films and powder. Different types of laser can be used in this technique for example, CO_2 laser, ruby laser etc [16,17]. In Inert Gas condensation technique, the atom clusters are generated through gas phase condensation by evaporating a precursor material, either a metal or a compound. The gas is maintained at a low pressure usually less than 1 atmosphere. Sputtering is used to produce nanostructure materials as well as thin films. This technique involves ejection of the atoms or clusters of designated materials by subjecting them to an accelerated and highly focused beam of beam of inert gas such as argon or helium [18,19]. In Mechanical deformation technique, nanoparticles are produced by structural degradation of coarse-grained structure using high mechanical energy. The nano grains nucleate within the shear bands of the deformed materials thereby converting a coarse grained structure to an ultra-fine powder [20,21].

The chemical methods include sonochemical techniques, electrodeposition, reactions in vapor phase followed by aerosol technique, chemical vapor deposition, sol-gel and microemulsion methods. In Chemical vapor deposition technique, nanoparticles are synthesized by thermal dissociation of gaseous reactants on the heated surface. Aerosol Technique technique is mainly used for the commercial production of powder materials and thin films. Condensation of molecules caused due to physical and chemical self-nucleate to form particles. Then, the subsequent collisions and coalescence of the nuclei formed, leads to formation of large particles [10-15]. Sol-gel technique is an useful wet chemical synthesis method used for preparing ceramics, glass, oxide nanoparticles, and nanocomposite materials. Initially, this method involves transition of a system from a liquid sol (mostly colloidal) into a solid gel phase. The starting materials used in the preparation of sol are usually inorganic metal salts or metal compounds such as metal alkoxides [1-5].

Reverse micelle is a thermodynamically stable, single phase, micro-heterogeneous mixtures of oil, water and surfactants, so called w/o microemulsion. The reverse micelle consist of nano-sized water droplets dispersed in a continuous oil medium which are stabilized by surafactant molecules accumulated at the w/o interface. This method has been found useful in preparing different metals, metal oxides, polymers, composite and coated nanoparticles by carrying out the chemical reaction inside the aqueous core of nano-reactors. In Sonochemical Technique technique, nanoparticles are prepared by irradiating the aqueous or organic dispersion of precursor materials using an

ultrasonic probe at room temperature. The size of the particles obtained in this method mainly depends on the solution concentration and the time of sonication [15-20]. In wet-chemical process some natural compounds such as sodium citrate, citric acid and reducing agents are usually used, although the reducing activity is generally low the reducing reaction takes place under higher

The growth mechanism and magnetic properties of SiO_2-coated Co nanocapsules synthesized by the arc-discharge method were investigated by *Z. D. Zhang and et.al.* [17]. Co and SiO_2 micro-powders were used as raw materials. It is found that the Co nanoparticles are uniformly encapsulated with amorphous SiO_2 shells. TiO_2 hollow microspheres were prepared by the reversal micro emulsion by *Wang et.al.* [9]. $TiCl_4$ solution were reacted with ammonia in water/(TX-100+n-pentanol)/cycloheptane. Well-defined nanosized hollow TiO_2 capsules with the diameter of 80-100 nm were prepared by *Ai-Hua et al.* [8] for loading and release of antimicrobial triclosan molecules through aging dissolvation technique. The main objectives of this work are, silica (SiO_2) coated silver particles in nano–sized dimensions by using a combined wet-chemical and reverse micelle techniques and study the formation, stability and characterization of silica nanocapsules.

MATERIALS AND METHODS

Materials

The chemicals used in this experiment are $AgNO_3$ (Merck), Aerosol OT (AOT) (Lobachemie), fructose (Lobachemie), Sodium borohydride ($NaBH_4$) (Sisco Research Laboratories Pvt. Lim.) , n-Heptane GR (Merck), Tetra ethyl orthosilicate (TEOS) (Merck), ethanol solution, 25% ammonia (Merck), concentrated Nitric acid (HNO_3) (Oster). All the chemicals are used as received, without further purification. Double distilled water was used throughout the experiment.

Synthesis of silver nanoparticles

Wet Chemical method

Solution was prepared dissolving 0.2 gm of sugar (fructose) in 3.9 ml water in each set and then 100 µl (10^{-2} M) of the silver nitrate solution was added to it, so that the final volume of the solution is 4 ml. The concentration of the metal salts was 2.5 X 10^{-4} M in the final solution. The solution was heated on a hot water bath. The temperature of the hot water bath was ~70-75°C. After sometime, the solution turned yellow indicating the formation of the corresponding metal nanoparticles. The heating was continued until the solution evaporated to dryness. The total time required to evaporate the solution to dryness take ~ 2 h times. Then 4 ml of water was again added to it and the solution was sonicated for 30 min (Fig.1).

Reverse micelle method

Stock solution (0.1M) was prepared by dissolving 1.33gm AOT in 30 ml n-heptane. 0.1M silver nitrate and 0.05M sodium borohydride solutions were prepared. For R=10, 36 µl (0.1M) solution of silver nitrate and 36 µl (0.05M) solution of sodium borohydride were mixed separately in 2ml of 0.1 M AOT/n-heptane solution and mixed, with the help of cyclomixer, till the solutions became transparent. After sometime, the sodium borohydride solution was mixed with silver nitrate micro emulsion. The solution became deep brown in colour indicating the formation of silver nanoparticles in reverse micelle/micro emulsion process (Fig. 2).

Synthesis of Silica coated silver nanoparticles

Wet-chemical method

The monodisperse uniform sized silica nanoparticles were prepared by hydrolysis of TEOS in ethanol medium in the presence of ammonium hydroxide. Fig 3 is a schematic diagram of the synthesis of silica particles and homogeneous samples were prepared by the following procedure. First, ethanol was taken and kept in a sonication bath. After 10 min, a known volume of TEOS was added while sonicating and after 20 min, 25% ammonia solution was added as a

catalyst to promote the condensation reaction. Solution was stirred for 24 hours to get a white turbid suspension. All the above experiments were conducted at room temperature.

Reverse micelle method

Ag/SiO_2 nanosized particles have been synthesized using a reverse micelle technique combined with metal alkoxide hydrolysis and condensation. The experimental procedure used to prepare Ag/SiO_2 nanosize composite is illustrated in Fig 4. The micro emulsion was mixed rapidly and after 5 min of equilibration, 72 µl water was added to 2 ml of micro emulsion. Then, Tetraethyl orthosilicate (TEOS) (36 µl) was added to the micro emulsion with stirring. 72 µl ammonia solutions was injected into the 2 ml silver nano solution previously prepared by reverse micelle method to accelerate the condensation reaction o metal alkoxide precursors. Then latter solution was added immediately to previous solution. Grayish colour suspension was observed which was then subjected to washing and recovery.

Synthesis of Silica Nanocapsules

Silica coated silver nanoparticles synthesized by above two methods were treated with 0.5 M concentrated Nitric acid to remove the core and to get the hollow capsule.

PRINCIPLE

In the present study, two main types of reactions are involved; (i) silanol groups are formed by hydrolysis and (ii) siloxane bridges are formed by a condensation polymerization reaction:

Hydrolysis: $Si\text{-}(OR)_4 + H_2O \rightarrow Si\text{-}(OH)_4 + 4\ R\text{-}OH$

Condensation: $2\ Si\text{-}(OH)_4 \rightarrow 2\ (Si\text{-}O\text{-}Si) + 4\ H_2O$

RESULTS AND DISCUSSIONS

UV-visible measurements

Silver nanoparticles and silica coated silver nanoparticles prepared by wet-chemical and Reverse micelle methods are characterized by UV-visible spectrometer (Shimardzu UV-160)

Observations

From the UV-visible graphs (Fig.6), it is observed that silver nanoparticles show their characteristic peak around 425 nm and 410 nm in wet-chemical and reverse micelle methods respectively. This result showed that Ag metallic nanoparticles are formed by the above two methods.

The characteristic Ag absorption peak is absent in Ag/SiO_2 spectra. This result explained that the silica nanoparticles are coated on the silver nanoparticles [1-5].

Particle size analysis

Silver nanoparticles and silica coated silver nanoparticles synthesized by wet-chemical method are characterized by particle size analyzer.

Observations

From the particle size analysis (Fig.7), the average size of silver nanoparticles is found to be 25 nm. The average size of silica particles is found to be 619 nm but when silver nanopaticles are coated with silica their size is found to be in 743 nm range.

X-RD Analysis

Silver nanoparticles prepared by reverse micelle method and silica coated silver nanoparticles prepared by both the methods are characterized by X'Pert Philips Analytical X Ray Diffractometer

Observations

From X-RD analysis (Fig.8) it is seen that, silver nanoparticles prepared by reverse micelle method are crystalline in nature and the peak positions are matching with reported literature value. SiO_2 particles are amorphous in nature. As the crystalline peaks of Ag is absent in Fig.8 (a), this result shows that Ag nanoparticles are coated with amorphous silica particles [1,21-23].

SEM/EDAX

SEM/EDAX analysis are done for silica coated silver nanoparticles and silica nano capsules synthesized by wet-chemical and reverse micelle techniques.

Observations

From the EDAX analysis (Fig.9), it is observed that, silica coated silver nanoparticles have compositions of Si and O and a very negligible amount of Ag. After acid treatment of Ag/SiO_2 nanoparticles show the compositions of only Si and O. Here Ag is found to be totally absent. This result might be due to the formation of silica hollow spheres.

However, due to aggregation of particles, SEM image (Fig.10) are found to be not so clear and no capsules like structures are seen in this case.

CONCLUSION

From UV-visible measurements, silver nanoparticles are confirmed showing the characteristics peaks around 410 nm and 425 nm synthesized by wet chemical and reverse micelle methods respectively. As UV-visible graphs of silica coated silver nanoparticles don't show peaks for silver nanoparticles, it may be concluded that silver nanoparticles are uniformly coated with silica. From particle size analysis, the average size of Ag nanoparticles and Ag/SiO_2 nanoparticles are found to be 25 nm and 743 nm respectively. From this it can concluded that, as silica particles are uniformly coated over Ag nanoparticles, this results in increase in size. From XRD analysis it is seen that, Ag nanoparticles prepared by reverse micelle method are crystalline in nature. But Ag/SiO_2 nanoparticles are found to be amorphous in nature from which it may be concluded that amorphous silica is uniformly coated over crystalline Ag nanoparticles. EDAX analysis data of silica coated silver nanoparticles shows the compositions of Si, O and a little Ag. But EDAX data of silica nanocapsules represent the absence of Ag peak and show only the compositions of Si and O. SEM images of silica nanoparticles not showing any capsule like structure and it may be due to aggregation of particles during centrifugation and use of acetone/ethanol during separation.

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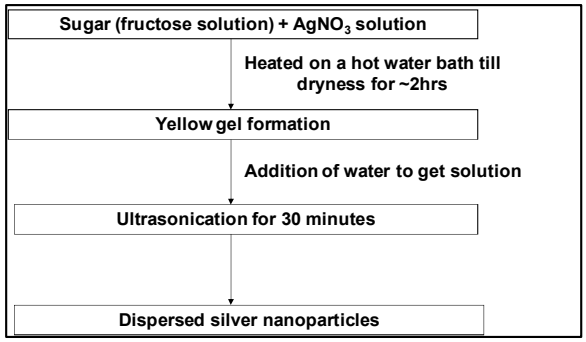

Fig. 1. Schematic flow chart for synthesis of Ag nanoparticles by wet chemical method

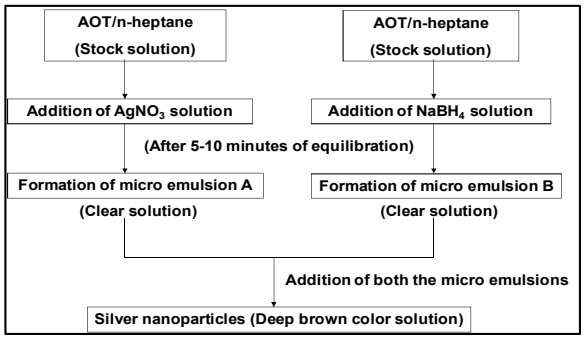

Fig. 2. Schematic flow chart for the synthesis of Ag nanoparticles by reverse micelle method

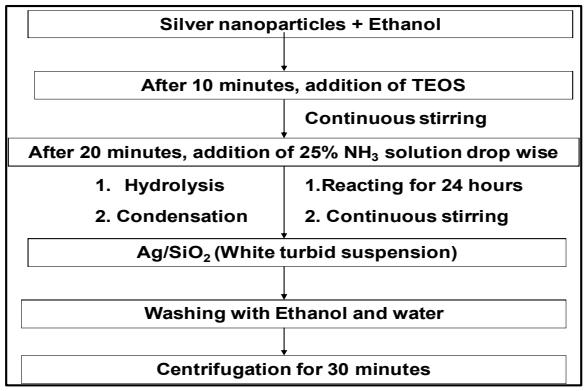

Fig. 3. Schematic flow chart for the synthesis of Ag/SiO_2 nanoparticles by wet-chemical method

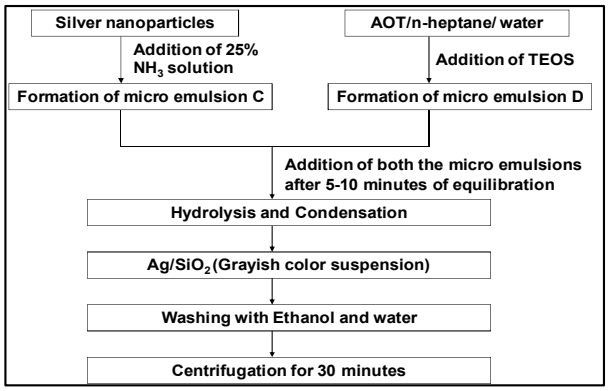

Fig. 4. Schematic flow chart for synthesis of Ag/SiO_2 nanoparticles

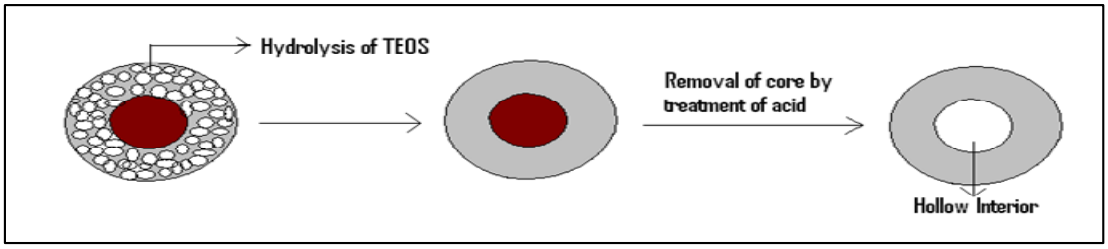

Fig. 5 (Synthesis of silica Nanocapsules)

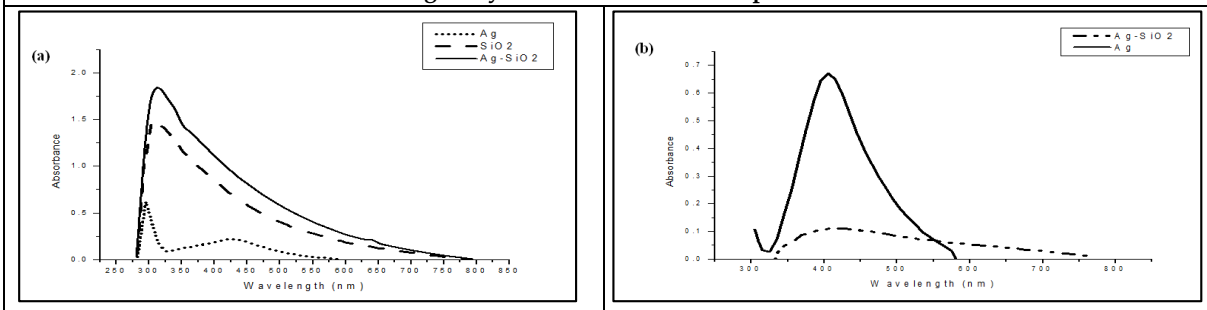

Fig 6. (a) (UV-vis spectra of Ag-nanoparticles, SiO_2 and Ag/SiO_2 prepared by wet-chemical method) and (b) (UV-vis spectra of Ag-nanoparticles, SiO2 and Ag/SiO2 prepared by reverse micelle method

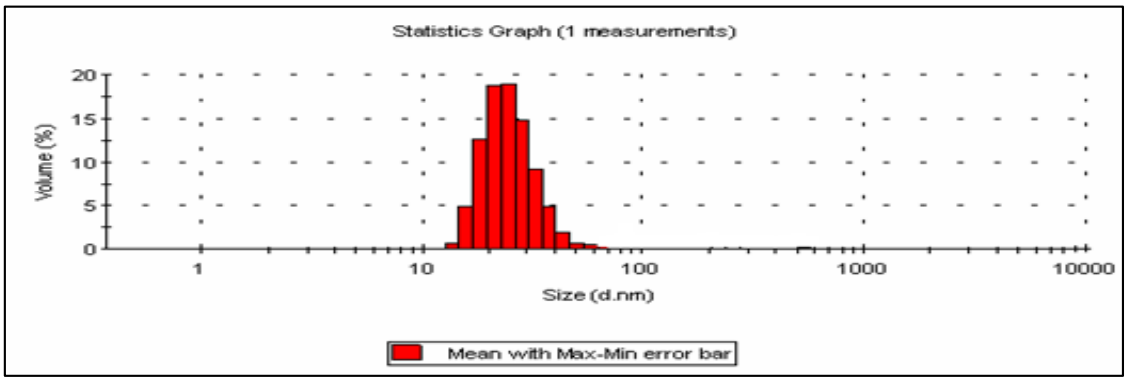

Fig. 7 (a) Ag nanoparticles (wet-chemical method)

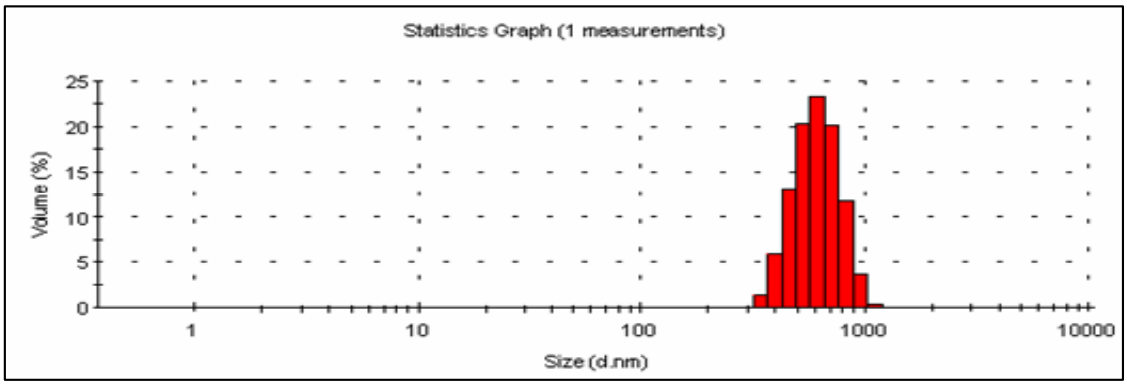

Fig. 7(b) SiO_2 nanoparticles (wet-chemical method)

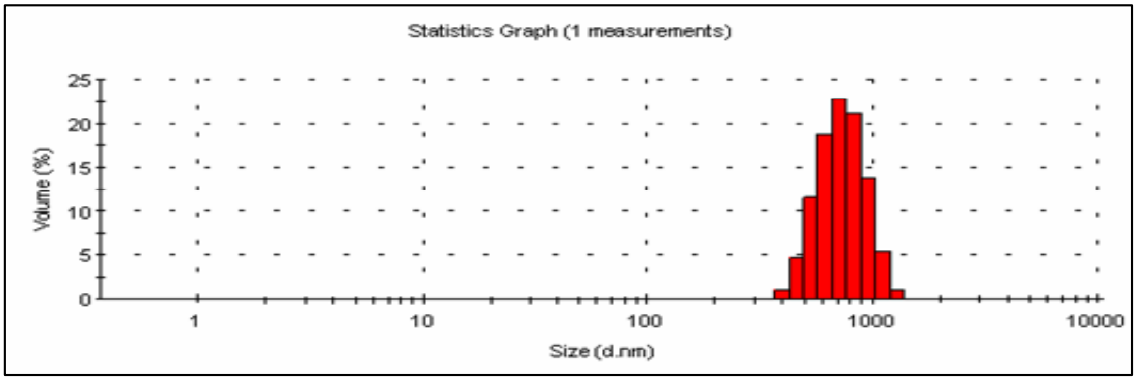

Fig. 7(c) Ag/SiO_2 nanoparticles (wet-chemical method)

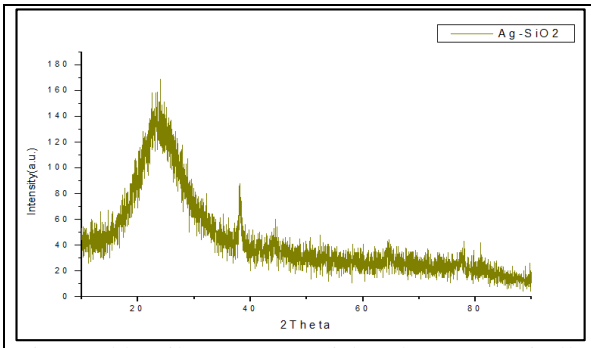

Fig. 8 (a) Silver nanoparticles (Reverse micelle method)

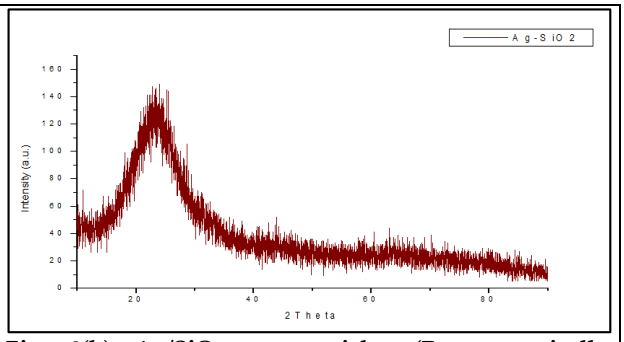

Fig. 8(b) Ag/SiO_2 nanoparticles (Reverse micelle method)

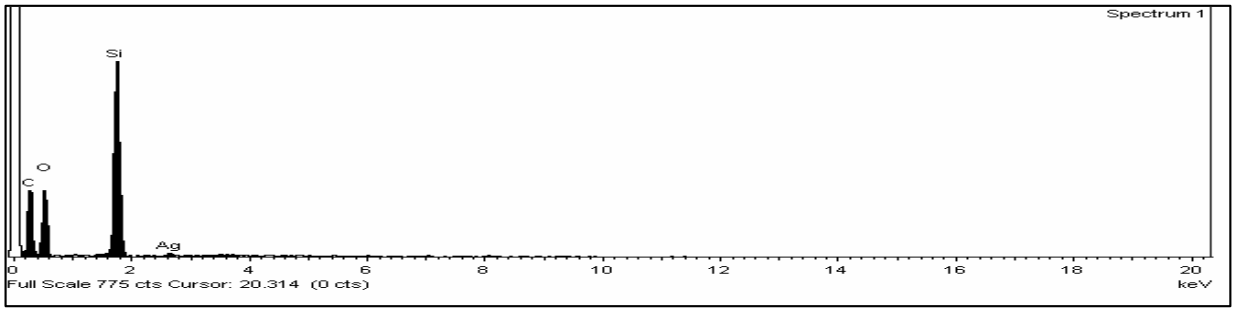

Fig. 9(a) Ag/SiO_2 nanoparticles (wet-chemical method)

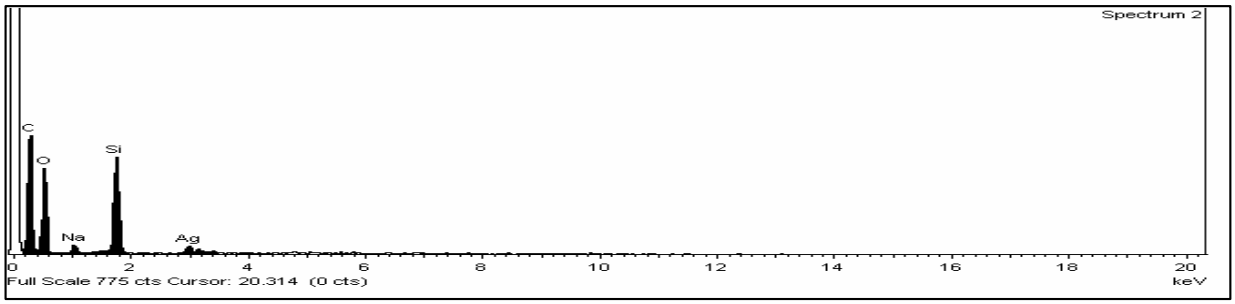

Fig. 9(b) Ag/SiO_2 nanoparticles (reverse micelle method)

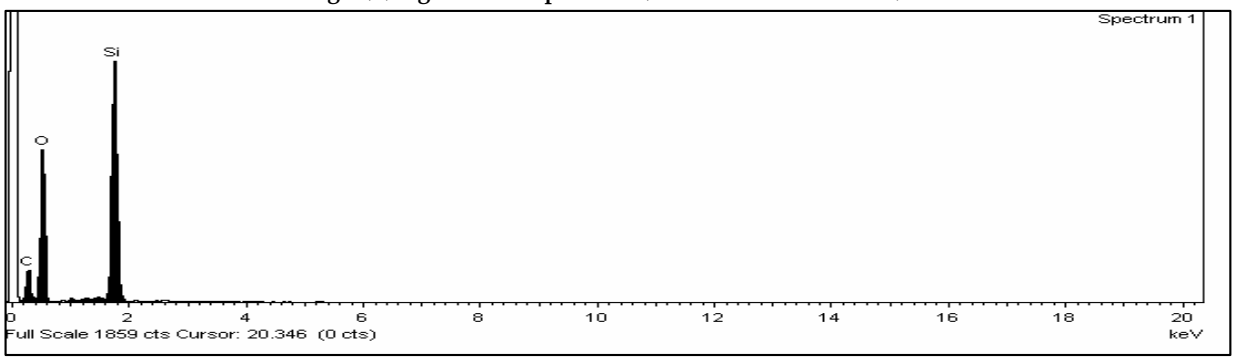

Fig. 9 (c) SiO_2 capsules (Wet-chemical method)

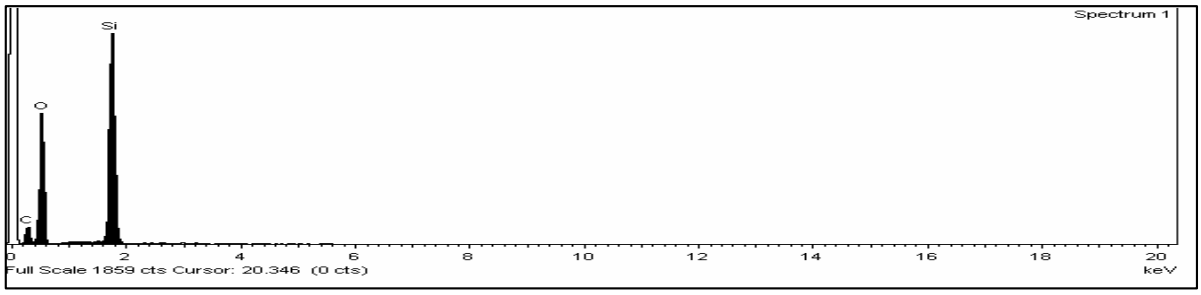

Fig. 9 (d) SiO_2 nanocapsules (Reverse micelle method)

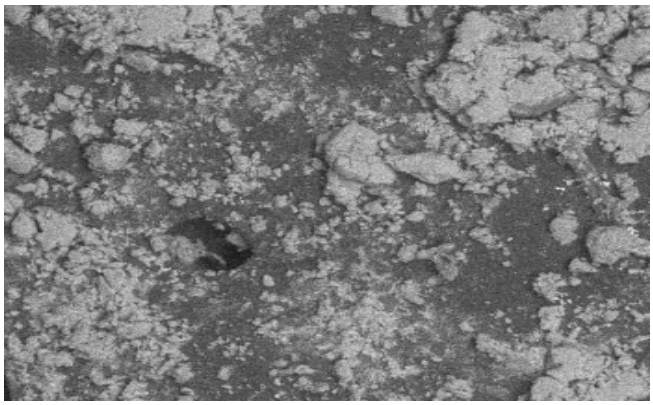

Fig. 10 SEM images of silica nanocapsules

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Biometric Authentication using Internet of Things for the Security Issues

M.Savitha[1]* and M.Senthilkumar[2]

[1]Research Scholar, Department of Computer Science, Government Arts College, Udumalpet, Tirupur, Tamil Nadu, India
[2]Assistant Professor, Department of Computer Science, Government Arts and Science College, Avinashi, Tamil Nadu, India

Received:02 Mar 2020 Revised: 04 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
M.Savitha
Research Scholar,
Department of Computer Science,
Government Arts and Science College,
Udumalpet, Tirupur, Tamil Nadu, India.
Email: savithainmail@rediffmail.com

ABSTRACT

In the recent years, Internet of Things (IoT) has emerged as a vital discipline of research. This technology makes it possible for the network of integrated computing appliances to interact with each other, deprived of the human intervention.It is a worldwide network of physical and virtual elements linked with the internet. IoT is a source which turns up the daily using gadgets to be livelierand makes the daily interactions more instructive. The IoT is believed to be the prospectof the internet and is meant to transform the standard of life and the business structures. Since it connects enormous number of people and devices and the application of IoT devices has amplified, the networks of IoT are more susceptible to several security threats. In the networks, parallel with the development of IoT, quite large volume of risks also emerge together and hence the implementation of effective security and privacy procedures are very much essential for assuring confidentiality, authentication, accesscontrol, and integrity.Though still authentication by means of text passwords are extensively employed, they do not guarantee the maximum security. Thus comes in to play the application of biometric authentication. This paper presents the conceptual idea of securing internet of Things network using biometric authentication

Keywords: Internet of Things,IoT, RFID, security, biometric authentication in IoT, privacy.

INTRODUCTION

For enhancing our life's quality, IoT is unlocking vast number of openings for several new technologies [1]. In the recent past, IoT has attained more attraction from the researchers and experts. The faster progression in the domain of Wireless Sensor Networks, mobile communication, Cloud computing and Radio Frequency IDentification (RFID) has resulted in the much flexible interaction between the IoT devices. The gadgets that plays the role in the domain of IoT are laptops, smart phones, PDAs, tablets and still more devices. For communicating with each other, the IoT devices depends on the economical wireless communication networks and sensors. The information that is transmitted to the integrated system is then dealt with and transferred to the corresponding endpoints [2].

The advancement in the technology of internetmake our day-to-day activities to be focused more on illusory plane of the virtual world. This illusory plane of living is perfectly been incorporated with the real life of people by IoT. It includes both dynamic and static entities of the physical world and the information world that could be recognised and incorporated in to the networks of communication as depicted in the following figure 1. The crucial attributes of IoT comprises of interconnectivity, services like heterogeneity, privacy protection and semantic consistency, massivedegree and provisions fortransformations that are dynamic in the state and the number of devices (Oracevicet al., (2017)). The key objective of IoT is the implementation of a smart system with smart devices. In this manner, devices connected to IoT are more numerous than the number of human beings and this development is anticipated to remain for the future too. In 2015, around 15.41 billion devices are connected with the internet and the IoT associated progressions will make this count to reach about 75 billion by the year 2025 which represents the hike of 487%. Figure 2 gives Usage of IoT-connected devices.

For a good number of industrial IoT systems, RFID tags acts as the vital elements. Thus when the need for those systems endures, the demand for the RFID techniques also will continue which in turn boost up its market value in from $12.6 billion in 2015 to 24.5 billion in 2020. Figure 3 reveals the upsurge in RFID market. As per the report by Caterpillar Inc., it is revealed that the IoT systems that are embedded in the latest vehicles are found to increase the efficiency by 45%. In the field of agriculture too, IoT is finding its extensive application. The energy efficiency of a greenhouse implemented with IoT sensors is 30% higher than that of normal greenhouse. In accordance with the latest survey by Accenture, by 2030, merely the Industrial IoT mechanisms can supplement to the world economy, $14.2 trillion.

The ubiquitous usage of IoT results in major security challenges. The crucial concern for IoT is security and privacy. Authentication is absolutely necessary for a secured communication over the network and thus is the gateway for a system with security. According to the report submitted by Gemalto in 2018, on the State of IoT Security, just 59% of the total companies around the world encrypt the gathered customer data. The distribution is shown in Fig 4. Around 30% of all the person responsible approve that the following are the foremost setbacks in terms of security in IoT based devices:

- Guaranteeing privacy of data
- Handling the huge volume of data collected by the IoT devices
- Maintaining equilibriumbetween the appropriate cyber security and user knowledge

Textual passwords are still employed for instigating authentication which is an insecure option in fact. Biometric authentication is hence the principal concern to focus on. To provide authentication to the IoT devices, Biofeatures are turning out to be the significant means. As a secured method for accessing the systems, physical attributes are employed in Biometric identification in the place of passwords [5]. In the domains where security is of primary importance such as airports, currently Biometric identification is employed [6]. The following sections of the paper is rest of the paper is structured as Section II presents the general aspects of security inIoT applications, Section III describes a brief outlook on the protocols for establishing security in IoT followed by Section IVexplaining in detail

the security threats prevailing in the framework of IoT, Section V offers various kinds of authentication that are needed to handle with the threats, Section VI explainingthe types of biometric authentication available and its process of working and finally the paper is concluded in Section VII.

SECURITY IN IOT

IoT which is an evolving universal technology based on Internet meant for enabling the exchange of services and goods has a strong influence on the security and privacy of the corresponding users [7]. Security in IoT has to be the from the physical, network and application layers [2]. There should be certain methodologies that assures access control, data authentication, resilience to attack and privacy of the client. The fundamental technology has to be taken care by the suitable legal system. In accordance with Ahlmeyer(2016), utilising the principles of security, the design of IoT devices has to be done which includes data capturing sensors, technology for storage of data, micro controller that regulates the behaviour of the device, data processing and creating a network connection. The major difficulty is that the IoT appliances possess the main restriction in comparison to other devices which is the restricted capacity of storage and hence the limited ability of processing. In addition, there exists different type of IoT device configurations and hence a massive difference in the competences of providing security by the devices in IoT.

The connections among the network and the devices also needs to be more secured which happens to be in different arrangements such as from the device to the internet in a direct manner, from the from the device to a gateway, or peer-to-peer between the devices. The device restriction again remains as the major reason for providing a secured network connection among the devices which is again the cause for not able to utilise the standard network protocols. Hence a fresh new set of protocols are established that are meant exclusively for the needed connection and communication between the IoT devices. Finally in addition to all the mentioned necessities, the software applications that are employed to maintain the IoT devices also have to encompass the security aspects which has to be robust enough for ensuring required security. Figure 5 explains IoT Security

IOT SECURITY RELATED PROTOCOLS

As IoT embraces extensive number of applications, the required protocols also gets added on to IoT. Protocols utilised forhigh level are allocated to the specific vendors that offer the space for the choice of variousabilities and characteristics. Following table 1. presents the comparison of IoT protocols.

QUIC (Quick UDP Internet Connections)

User Datagram Protocol (UDP) is applied in this protocol which maintain a set of complex connections among two endpoints. It provides security very much similar to Transport Layer Security. This protocol also has the ability to assess the bandwidth in both of the directions and hence the issue of congestion is much prevented.

DTLS (Datagram Transport Layer)

For UDP, the communication privacy is supported by this protocol. The key issues such as eavesdropping and message tampering could be avoided by this protocol. TLS acts as the underlying protocol for DTLS.

AMQP (Advanced Messaging Queuing Protocol)

For TCP protocol is an open protocol meant fir asynchronous message queuing aimed at message orientation. It offers reliable, rapid and ensured delivery of message by providing a secure connection through message acknowledgements.

SECURITY THREATS IN IoT

Since the IoT devices have limited resources, a full-fledged security sets cannot be provided. A distinct framework of security has to be constructed henceforth. In order to reduce the load on the resources, lightweight solutions have to be suggested. The major security threats in the technologies of IoT is as presented in Table 2. As Internet of Things encompasses wide variety of technologies, it is not possible for a single IoT architecture to be taken in to consideration. Thus IoT does not have a standard architecture and in accordance with the necessity, different architectures are applied. The following table 3. shows the threats of security that occurs in different layers of IoT architecture

TYPES OF AUTHENTICATION

For making available the information only to the authorised users, authentication is the basic prerequisite in any of the information system. Based on the level of expected security, different modes of authentication could be implemented in the corresponding systems as represented in Fig 6. The methods of authentication generally employed are passwords, tokens, secret keys and biometrics. The process of verification is carried out by utilising the credentials like passwords and Personal Identification numbers that we know, cryptographic keys and tokens that we possess, physiological and behavioural attributes like fingerprints, palm prints, iris, face, voice, Electrocardiography (ECG), Deoxyribonucleic acid (DNA) and signature that we are which is depicted in Fig 7.

Biometric Techniques

One of the aspects such as possession, knowledge and inherence is required for the authentication system in case an entity is existing for the evidence. For lessening the challenge of an entity exhibiting a false evidence is the application of various attributes together resulting in a multifactor authentication. Biometric authentication is believedto be the highly robust method when assesses against token or password based authentication [15] since the biometric features of each human are distinguishable uniquely, non-reproducible and non-transferable. Single factor authentication is slightly weaker than the multifactor authentication. Static and continuous authentication techniques are the two different classifications of authentication mechanisms [16]. The former method initially authenticate the person whereas it doesn't observe in after this to confirm whether it is the same user [17]. In contrast, the later method performs a continuous observation for the whole session in order to verify the accessing user [18].

Radio Fingerprinting Technique

For implementing unique identification, the radio fingerprinting technique utilises the wireless devices' hardware properties and their signal qualities. By assessing the characteristics of the radio signal, the radio fingerprints are generated which are then verified by means of extracting the attributes that are device particular [19].

BIOMETRIC AUTHENTICATION

Biometric authentication is believedto be the highly robust method when assessed against token or password based authenticationsince the biometric features of each human are distinguishable uniquely, non-reproducible and non-transferable. Though textual passwords are still utilised in implementing authentication, it is actually a choice. Thus comes in to play the Biometric authentication. For providing authentication to the IoT devices, Biofeatures are turning out to be the most significant mechanism. As a secured method for accessing the systems, physical attributes are employed in Biometric identification in the place of passwords.In the domains where security is of primary importance such as airports, currently Biometric identification is employed.

Over the rest of the authentication systems, Biometric systems extend apparent improvements. Since they cannot be misplaced or over looked, they are fundamentally more trustworthy than password-based authentication. Further more, biometric characteristics are exceptionally challenging to duplicate, circulate, copy and share and it is suspectfor a user to disclaimafter gaining access toa specific content employing Biometrics. Above all, every user enjoys the impartiality in the level of security.Consequently, Biometrics-based authentication could be utilised in the place of password-based authentication [21]. Table 4 reveals the biometric features for authentication

As already mentioned, various physiological and behavioural traits are applied in biometric authentication. The type of the biometric to be employed for a particular application is based on the level and nature of authentication needed. For instance, the in implementing security aspects in mobile applications, voice biometrics is much applicable as themechanismthat recognisesthe vocal sound is embedded earlierin the mobile phone, andthe major role of biometric authentication in IoT is identifying the personwho has not been registered in the system yet attempts to access the system. The following table 5 presents a comparison of various biometric systems employed in IoT

As shown in the following fig 8, a common biometric system comprises of five components, such as Sensor, feature extractor, template database, matcher, and decision module [23]. Fig. 8 shows a basic block diagram of a biometric system. As represented in the figure, the biometric templates are first subjected to processing and are then stored in the database in the enrollment phase which is then followed by the verification phase where in the biometric query obtainedfrom the user is compared with the one that is stored previouslyin the database. In case the comparison processis successful, the identity of the user isproved or else the user is prohibited.

The likely threats at various stages of biometric system is detailed in fig 9. Attacks such as collective attack, DoS, spoofing attacks etc., happens at the sensor level, at the feature extraction stage, eavesdropping, replay attack, man-in-the-middle attack etc., occurs. Replacing template attack, reading templateetc., strikes the storage data. Atthe matching segment, the attacks that transpiresare component replacement, imposter data, hill climbing and so on and again during the course of biometric datatransmission from data storage to the matching block, Eavesdropping attack, reply attack, and man-in-the-middle attack hits. Furthermore, following the decision transmission too, attacks like component replacement, hillclimbing, and manipulation of decisioncan happen [26].

ADVANTAGES OF BIOMETRICS IN IOT

In all the applications of IoT, biometric security approaches can be employed such as Smart home, Healthcare, Transport systems, Agricultural domains and still more. Though all the authentication methodologies have their own benefits and drawbacks too, the biometric techniques when compared to those approaches, is considered to be the safer and promising choice. This is shown in table 6.

CONCLUSION

It is very much evident that the primary element of future internet is IoT. Inspite of its efficiency in prevailing as the connecting bridge between the real and virtual world, quite enormous count of security and privacy issue comes in to view that has to be dealt with appropriately. The core objective of this paper is to focus mainly on the security threats in IoT and the biometric authentication as its solution since many of the existing standard cryptosystems undergo the key management issue. The bit length and the storage of the password based authentication are also the challenging part in providing security and privacy of the data. Taking in to consideration, the security in IoT systems, it is highly significant to implement a more powerful security mechanism. Thus biometric system of authentication proves to be more successful in offering a secured environment for the IoT applications.

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Table 1: IoT Protocols associated with Security [10]

Features	QUIC	DTLS	AMQP
Layer	Transport	Transport	Application
Security	Yes	Yes	Yes
Interoperability	Yes	Partial	Yes
Manageability	Yes	No	Yes
Objective	Composite connections	Communication privacy for UDP	Message Orientation
Delivery	Not guaranteed	Not guaranteed	Guaranteed
UDP/TCP	UDP	UDP	TCP

Table 2: Security Threats in technologies of IoT [11]

	Threats	Key Components	Security Need
RFID	DoS Attacks	RFID Tags and Reader Communications	Encryption
	Eavesdropping	User Private Data	Encryption
	Skimming	User Private Data	Blocking Tags
	Relay Attack	Authentication Result	Synchronization
	Side Channel Attack	User Private Data	Authentication
	Hardware Destruction	Tags	Protective Electronic Component
NFC	Phishing Attack Interfaces	Application Processor	Authentication
	User Tracking	User Privacy	Random UIDs
	Relay Attacks	Tag / Reader	Synchronization
	Data Forging Attack	User Data	SSL Communication
WSN	Wormhole	Multi-hop Wireless Network	Time limit on Packets Delivery
	Neighbor Discovery	Network Discovery Protocol	Authentication Supported Protocol
	Spoofing	Wireless Network Packet	Authentication
	Ping Flood, ICMP Flood, Syn Flood	Network Nodes	Use of IDS

Table 3: Security Threats in different layers of IoT architecture [11]

Layer	Threat type	Mitigation
Physical	Tampering	tamper-resistant packaging
	Eavesdropping	encryption, authorization
	Denial of Service	spread-spectrum techniques
Networking	Exhaustion	active firewalls, passive monitoring (probing), traffic admission control, bi-directional link autentication
	Collision	
	Unfairness	
	Spoofing	
	Selective forwarding	
	Sinkhole	
	Wormhole	
	Sybil	
	Flooding	
Data processing	Exhaustion	traffic monitoring
	Malware	malware detection
Application	Client app.	anti-virus filtering
	Communication	
	Integrity	testing
	Modifications	validation
	Multi-user access	process planning and design
	Data access	Traceability

Table 4: Biometric features for authentication [22]

Biometrics	Identifying Features	Error Correction
Keystroke	Duration, latency: a computer user's typing patterns consist of durations for each letter typed and latencies between keystrokes	Discretization
Voice	Text-dependent or text-independent speaker utterance units	Discretization
Signature	Dynamic signature features, such as pen-down time, max forward *Vx* (Velocity in x direction), max backward *Vy* (velocity in y direction), time when the last peak of *Vx* or *Vy* occurs, pressure, height-to-width ratio, and so on.	Averaging
Face	Facial features: positions, sizes, Angles, etc	RS code
Iris	Digital representation of iris image processed with Gabor wavelet	RS code Hadamard
Fingerprint	Minutiae points: ridge ending and ridge bifurcation	Quantization
Palmprint	Unique and stable features such as principal lines, wrinkles, minutiae, delta points, area/size of palm	RS code
Head	Acoustic signals modulated by physiological structures of human head	Neural-network
Mouse	Types of mouse actions, such as mouse-move, drag-and-drop, point-and-click, and silence; traveled distance (in pixels); elapsed time (in seconds); and movement direction	Neural-network

Table 5: Comparison of common Biometric techniques [25]

Biometric Technique	Accuracy	Usability	User acceptance	Cost	Belief on implementation
Fingerprint	High	Medium	Low	Medium	High
Hand Geometry	Medium	High	Medium	High	Medium
Voice	Medium	High	High	Low	High
Iris	Medium	Medium	Medium	High	Medium
Retina	High	Low	Low	Medium	Low
Face	Low	High	High	Low	Medium
Hand writing	Medium	Medium	High	Medium	Low

Table 6: Comparison of Authentication approaches [26]

AUTHENTICATION METHODOLOGY	BENEFITS	DRAWBACKS
Handheld tokens – ID, cards, passport	-Possible to generate a new one -Same facilities could be enjoyed at different countries as they are standard	- Could be stolen - Duplicate could be created - Could be shared - Different identities could be used for registering
Knowledge based – Password and PIN	-Low cost -Manageable -Easily replaced with new one	- Could be guessed - Tough to remember complicated passwords - Different identities could be used for registering
Biometrics	-Cannot be stolen, lost, forgotten or guessed -Easy to identify the user with several identities -Greater level of security than other approaches	- Replacement is not feasible

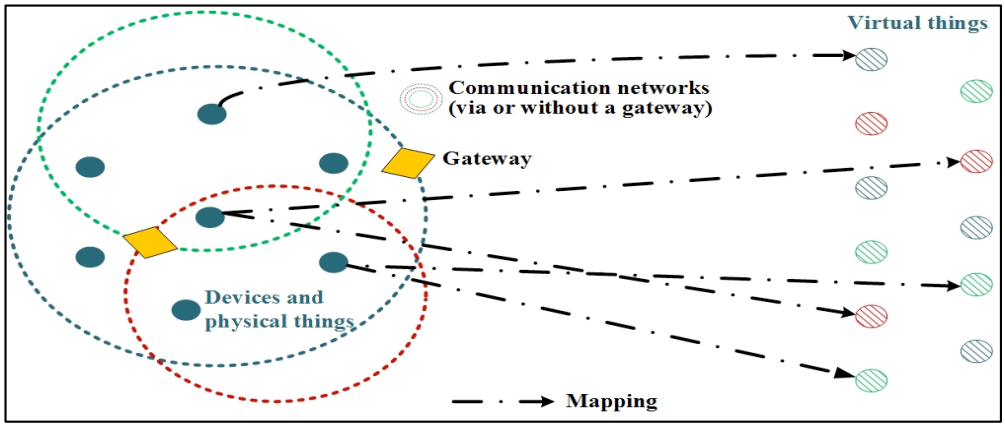

Fig 1. Technical Outlook of IoT(Source: Oracevic at al (2017))

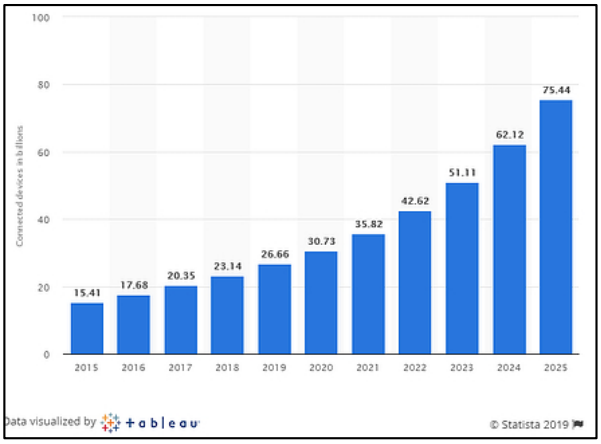

Fig 2. Usage of IoT-connected devices [4]

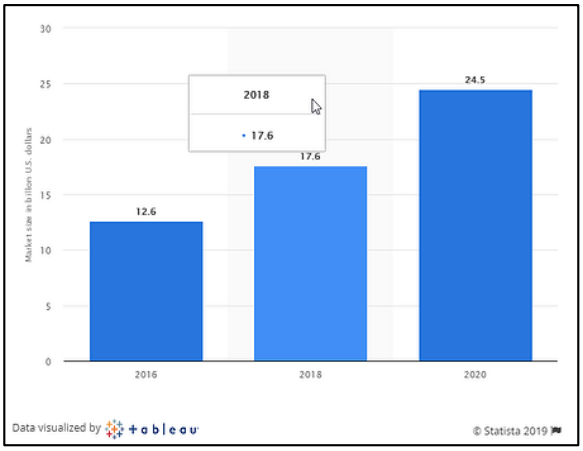

Fig 3. Upsurge in RFID market [4]

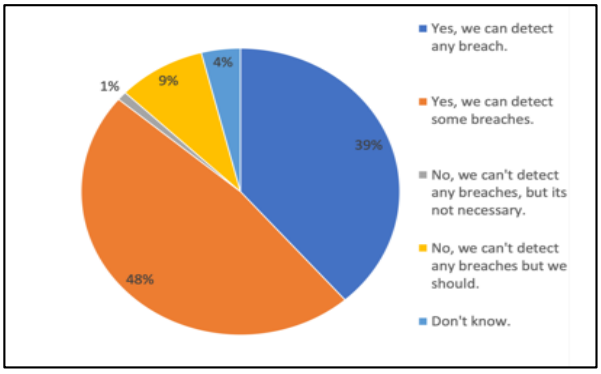

Fig 4. Data on security implemented by the companies worldwide [4]

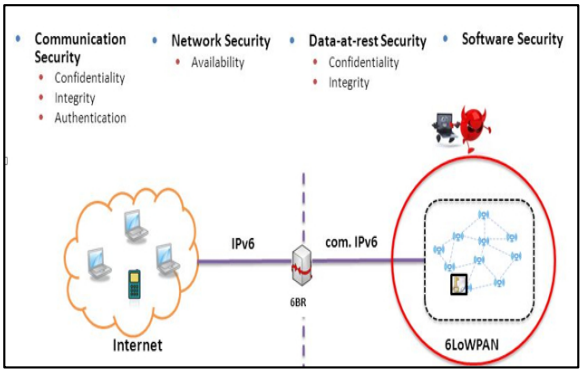

Fig 5.IoT security [9]

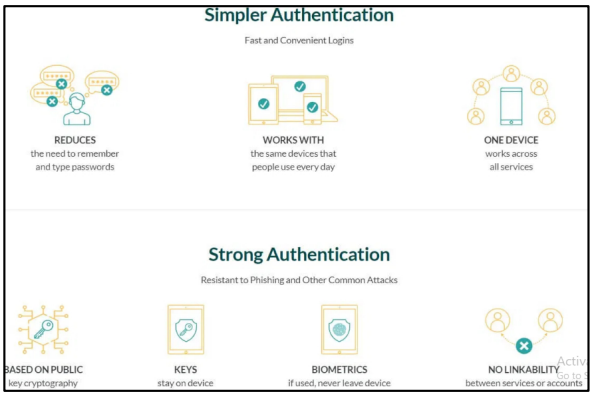

Fig 6. Authentication in IoT security [12]

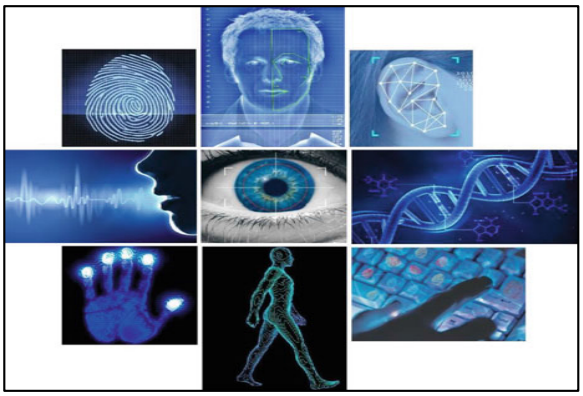

Fig 7. General Physiological and Behavioural biometrics in IoT [20]

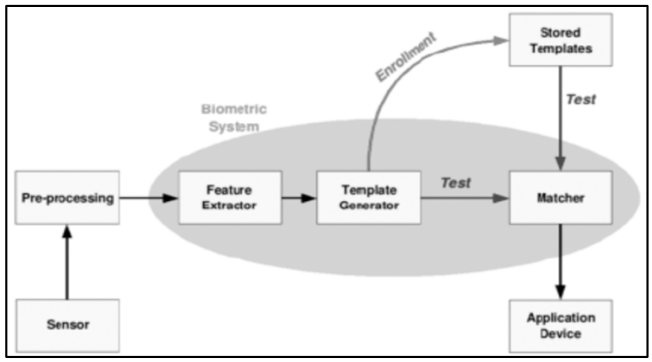

Fig 8. Biometric system – Fundamental Block diagram [24]

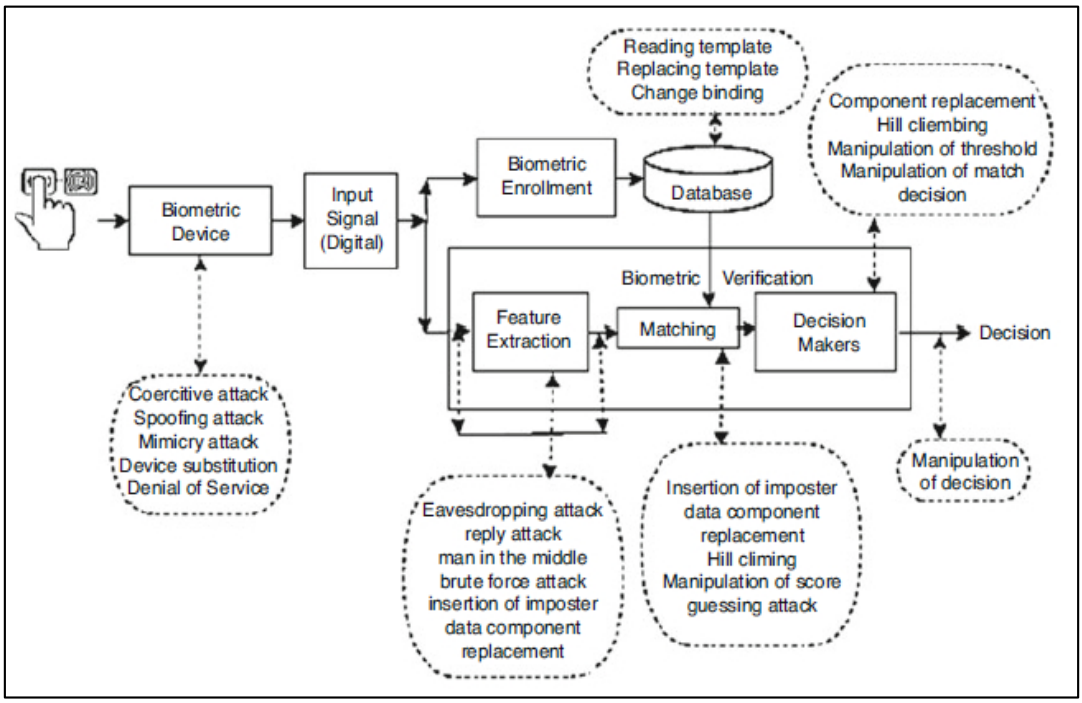

Fig 9. Security threats at various stages of biometric system of security [26]

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Classification of Tomato Leaf Diseases using Image Processing and Machine Learning Techniques

Rohit Kumar, Manjeet bhardwaj, Manoj Kumar Behera, Debases Das and S. Chakravarty*

Centurion University of Technology & Management, Bhubaneswar, Odisha, India

Received: 10 Mar 2020 Revised:12 Apr 2020 Accepted: 14 May 2020

***Address for Correspondence**
S.Chakravarty
Senior Member IEEE
Centurion University of Technology & Management,
Bhubaneswar, Odisha, India
Email: sujata.chakravarty@cutm.ac.in

ABSTRACT

Crops are very essential for human life growth. Crop diseases are key crisis for food guarantee, but their immediate recognition is still problem in many parts of the world due to the lack of the necessary infrastructure. In this paper, we are going to illustrate how the wide scale vogue of diseases in tomato crop disturb the yielding quality and capacity. In order to check the dilemma early diagnosis of diseases using a fast decisive non-destructive technique will help the farmers. In this study, a dataset containing 18,200 images of tomato leaves both diseases and healthy typesare collected from Plant Village repository used as input. For feature extraction, methods like shape based features, color based features and texture based features are used on the dataset and results are stored in a CSV file. Then different machine learning algorithms like Linear Regression, Decision Tree, Random Forest and Support Vector Machine (SVM) are used for tanning and testing the model. Amongst all SVM is fitting very well with the underlying dataset and producing a classification accuracy of 98.2%.

Key words: Feature extraction; Linear regression; Decision tree; Random forest; Support Vector Machine (SVM)

INTRODUCTION

.India is a country where greater number of population depends on farming.Tomato is grown all over the India. It consists of three antioxidants those are vitamin C, vitamin E and beta-carotene. Potassium is a very important mineral present in Tomato that helps in good health. Tomato crop farming area in India is around 3, 50,000 hectares approximately and 52, 00,000 tons of Tomato is produced every year [1]. India is third largest country to produce tomato in world. Due to disease affected plants 10-25% of the total crop are loosed every year. Recognition of such diseases in Tomato plant is very necessary so that losses of crop should be stopped and increase the production.

Detection and identification of plant diseases manually is very difficult work due to its complexity and also time consuming [2]. Decision making capability of farmer also depends on his/her physical condition, such as Eyesight, work pressure, improper working conditions such as improper lighting, climate etc. Hence steps taken by farmer to prevent plant diseases may be indecisive. Usually farmers have no expert advice to know how to deal with their crop diseases [3]. There has been cases where due to lack of knowledge or due to some misconception related to intensity of disease, crops are damaged because of over-dosage or under-dose. And this is the main motive of this research to detect diseases accurately and classify diseases of Tomato plant. A fast and more accurate way for disease detection can be possible by using image processing and machine learning techniques [4].This system has low cost and provides easy classification of leaf diseases.

The main focus of this paper is to develop a classification model that can be helpful for detecting common diseases of Tomato plant leaf like Septorial leaf spot, Bacterial leaf spot, leaf mold, target spot etc. [5]. In this field various researches are going on to make the plant diseases detection fully automatic. Despite many techniques have been suggested and tested, still those techniques have their own conditions and limitations. It is obvious that some techniques are found to be inefficient, mainly because of the selection of the wrong selection of dataset, lack of understanding in features those are responsible for the disease as well as the techniques those used to develop the models. In this Paper, a dataset containing 18,200 images of tomato leaves those classified in 10 classes (9 diseases and a healthy class) collected from Plant Village repository used as input. For future extraction, methods like shape based features, color based features and texture based features are used on the dataset and results are stored in a CSV file. Then different machine learning algorithms like linear regression, Decision tree, Random forest and Support Vector Machine (SVM) are used for tanning and testing the model. Among all SVM is fitting very well with the underlying dataset and producing a classification accuracy of 98.2%.

Related Work

Previous research work is important to know best methodology and carry the research in right direction. Number of researches has been done by different researchers on Plant leaf disease detection. In this section, most integrated methods that were explained by many paper is discussed. In reference [6] 5 basic features that can be used to identify a plant disease as stated by Wu et al. (2007) are used and these features are basic geometric features like physiological length, physiological width, diameter, leaf area and leaf perimeter. Other than that, there are 12 digital morphological features that are based on the basic geometric features that was explained in [7] by Hossain and Amin, 2010. In another article [8], leaf features of plant are divided into 2 categories which are general visual features and domain related visual features. The normal visual features are dwell of texture, colour and shape. These features were known as common features on images and no alliance with other type and content of images. Visual features that are Domain-related mixed with morphology character of a leaf are shape, width and vein. Also domain-related visual features are necessary for feature extraction process.Local descriptors and Global features are 2 groups , which are derived from common features as explained by [9] Shabanzade et al. (2011). generally the global features are properties that describe a leaf shape, such as width, leaf area and length. Local descriptors explain leaf details such as correlation, homogeneity, contrast and texture. The skeleton, colour and shape are most important features for plant classification. In their publications Valliammal and Geethalakshmi had declared that leaf image could be classified on the basis of colour, shape, texture or combination of all properties. Were Zhang (2008) added some features such as surface perimeter, surface area and variance of green, red and blue channels that belongs to colour features and some texture features like texture entropy, texture energy and texture contrast [10]. Hossain and Amin (2010) had done research on correction of previous shape feature extraction method. They explained some features that are shape feature properties like major axis, perimeter, eccentricity, convex area, extent, and equivalent diameter [11]. Li et al. (2005) and Fu and Chi (2003) researched on leaf vein and explained some vein features such as vein pixels and its width. The feature extraction is a decisive engineering process, because it is the main report about the raw data that the algorithm classify. Choosing the most essential features is a crucial step in

the process of classification problems because, it is important to find all probable feature subgroup that can be formed from the initial set of data [12, 13]. Every feature is meaningful for at least some of discriminations, andVariations within interclass and between inter-clagaussiansses is not too much high. The chosen set of features should be a small set and values accurately segregate among patterns of different classes, but are similar for patterns within the same class [14]. Features can be classified into two categories: Global features, which are usually topological or statistical and local features, which are usually geometric**.** There are three categories of Feature Extraction algorithms. Statistical Features: From statistical distribution of points features are derived, resulting in high speed and lower complexity features. There are various statistic features like zoning, characteristic loci and crossing and distance [15]. Series Expansion and Global Transformation Features, These features are equal to global deformations like rotation and translation. A continuous signal contains sufficient information to be classified linearly. Some examples are: Fourier Transform, Rapid Transform, Hough Transform, Gabor Transform, Wavelets, Moments Topological and Geometrical Features**.** These features may show local and global properties of characters and have high tolerances to distortions and style variations.

METHODOLOGY

There are four important stages that are proposed in this model: Data acquisition, Image processing and Image segmentation, Feature extraction and the last Classification as shown in [Figure-1].

Designing the Classifier

To design the classifier different ML techniques are used like linear regression, Decision tree, Random forest and Support Vector Machine (SVM). Where among all SVM is a power full method for the construction of the model. In [8] this methodology, SVM is used as classifier. A Support Vector Machine (SVM) is a supervised machine learning algorithm and it can be used for both regression purposes and for classification. SVMs are more commonly used in classification problems and as such, this is what we are focusing in this research. SVMs divides a dataset into two or more classes by finding a hyperplane as shown in [Figure-3]. Support vectors are the data points adjacent to the hyperplane, the points of a data set that, if removed, would alter the position of the dividing hyperplane. That's why, they are treated as the critical elements of a data set. Where hyperplane is decision boundaries that help classify the data points. Data points laying on either side of the hyperplane can be associated to different classes. In simple term, it is the ability of your machine learning model to correctly classify between different groups of data. To find right hyperplane model select a hyperplane having greatest possible margin between the hyperplane and any point belonging to the training set, giving a greater chance of new data being classified correctly.

The Support Vector Machine is apparently preferable machine learning model having more accuracy in pattern recognition. SVM is exclusively found beneficial for classification of high-dimensional datasets and has been found better in comparison to other machine learning algorithms.

Algorithm

STEP I: After retrieving images from dataset, each image went through following pre-processing process like (Resize image size to 512*512, converting image to grayscale, Smoothing image using Gaussian filter, thresholding, Boundary extraction using contours)**.**
STEP II: Extraction of features in leaf image using several feature extraction methods such as: shape based features(aspect ratio, rectangularity, circularity), colour based features(red mean, green mean, blue mean), texture features(contrast, correlation, inverse difference moments) andSaved into comma separated values (CSV) file.
STEP III: After saving features into CSV file, labeling has been done depending on the images to their respective class (one healthy class, nine diseases class) with values from 0 to 9.

STEP IV: Modeling the classifier by using training dataset (80% of the data from the CSV.file), by the help of different Machine learning techniques like linear regression, Decision tree, Random forest and Support Vector Machine

STEP V: Validating the model Using Testing dataset (rest of the 20% data) and Comparison of result

Data Acquisition

The images of tomato leaf disease have been collected from Plant Village repository. The collected dataset has almost 18200 images that belongs to 10 various classes [Figure-2]. It include images of all dominant types of leaf diseases that occurs in tomato plant. Each and every downloaded images are in the RGB color space and were saved in the unzipped JPG format. The details of dataset provided in [Table-1]

Data Pre-Processing

The collected dataset contain images having minimum noise and therefore there is no need to remove of any noise. Images of datasets were resized into 512*512 resolution so that the training process of model should be increased and beneficial for the computation. The importance of normalizing either input or output variables lean or needed to increase the training process speed. It is done by improving the numerical conditions of the normalization problems. Normalization also helps to get all pixels values of images in a particular range by using the standard deviation and mean value. Smoothing of images by using Gaussian Filter. A Gaussian filter is a linear filter. It's usually used to reduce noise or to blur the image. If is also used for edge detection. The Gaussian filter is helpful to blur reduce contrast and edges. Adaptive image thresholding using Otsu's thresholding method. Image thresholding is a simple, effective way of partitioning an image into a background and foreground. This image analysis method is a type of image segmentation that segregate objects by transforming grayscale images into binary images.Closing of holes using Morphological Transformation. Were morphological transformations are some simple operations based on the image shape. It is normally performed on binary images. It needs two inputs, one is our original image, and second one is called kernel or structuring element which decides the nature of operation.

Feature Extraction

In this section Image processing, algorithms are used to detect and isolate various desired portions or shapes (features) of digitized Image. In this method various features of plant leafs were used like: shape features, colour features, texture features. Shape feature include features like Surface area, Surface Perimeter, Disfigurement. Shape features are essential as they provide different methods to define an image, using its most essential characters and diminish the amount of data stored. Shape feature can be extracted using contour method. Colour feature includes variance of red, green and blue. Using colour features, model can classify images easily. The number of pixels that have the same colour value is computed for each image. Therefore, it is common to use colour features for image classification. Colour features can be extracted by using red, green and blue channels of image respectively. Texture feature might be useful to depict certain repeated local patterns and arrangement regularity in specified regions of images, could be used to describe local characteristics of images, and could provide characteristics metrics such as contrast, correlation and homogeneity. Where texture features can be extracted by using mahotas method. Feature extraction is particularly important in the area of optical character recognition or classification.

RESULTS AND DISCUSSION

To analyze the performance of the defined models based on the input extracted feature set, Overall curacy has been considered and listed in [Table-2]. The best classification accuracy of 98.2% is achieved by the 4th model using SVM that is shown by red color in bar graph [Figure-4]. The other models like Linear Regression, Decision Tree and

Random Forest that are used here to compare classification accuracy are also performing well on the underlying dataset.

CONCLUSION AND FUTURE SCOPE

An Automatic Model for identifying and detecting tomato leaf diseases is elaborated in this paper. A set of machine learning techniques are used to achieve the same, out of which SVM fits better with the set of extracted features in comparison to others with a classification accuracy of 98.2%. The model is robust and accurate as it trained and tasted with a large size dataset with almost 18,200 images. The accuracy of the classifier can further improved by using deep learning technique. In future, this method also can be used to detect the diseases of other plant leafs like potato.

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Table-1 Dataset

DATASET	Information
Collected from	Plant Village Repository
Format	JPG
Total Images size	18200
Training size	14526
Testing size	3674

Table-2 Overall accuracy of different models

S.No.	Model	Accuracy
1	Linear Regression	75.6%
2	Decision Tree	60.1%
3	Random Forest	82.4%
4	SVM	98.2%

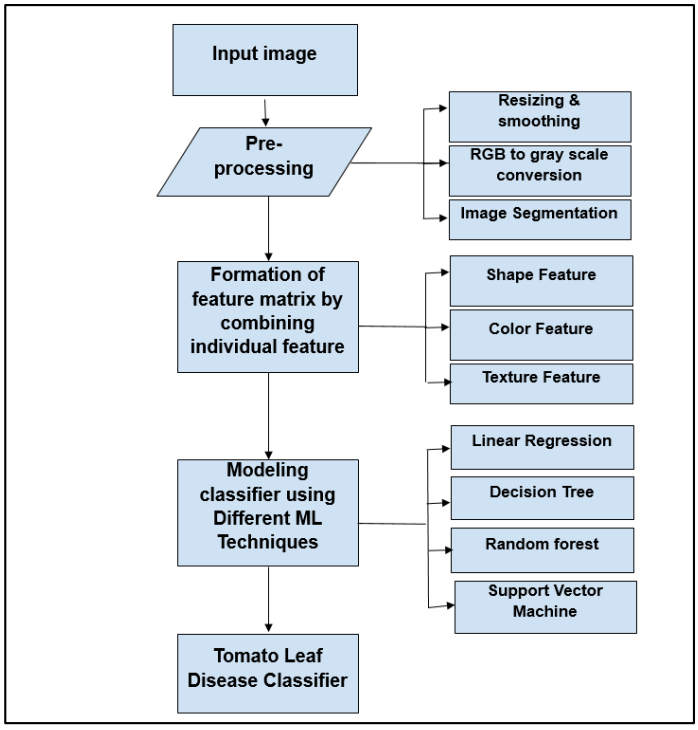

Figure1. Flow Diagram of the Model

Figure 2 .(a) Healthy; (b) Late blight; (C) Leaf mold; (d) Two-spotted Spider mite attack; (e) Target spot; (f) Tomato mosaic virus disease; (g) Tomato yellow leaf curl virus disease (h) Spider mites Two-spotted spider mite;(i) Early blight (j) Bacterial Spot

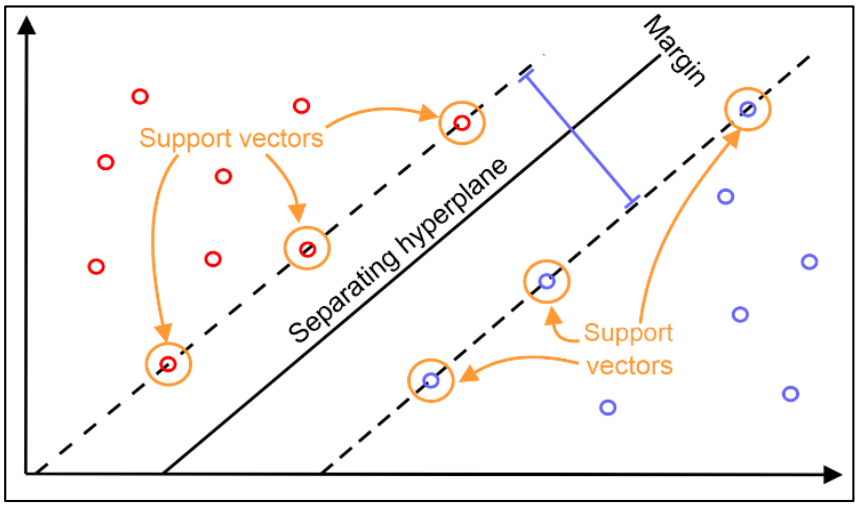

Figure 3. Support Vector Machine (SVM)

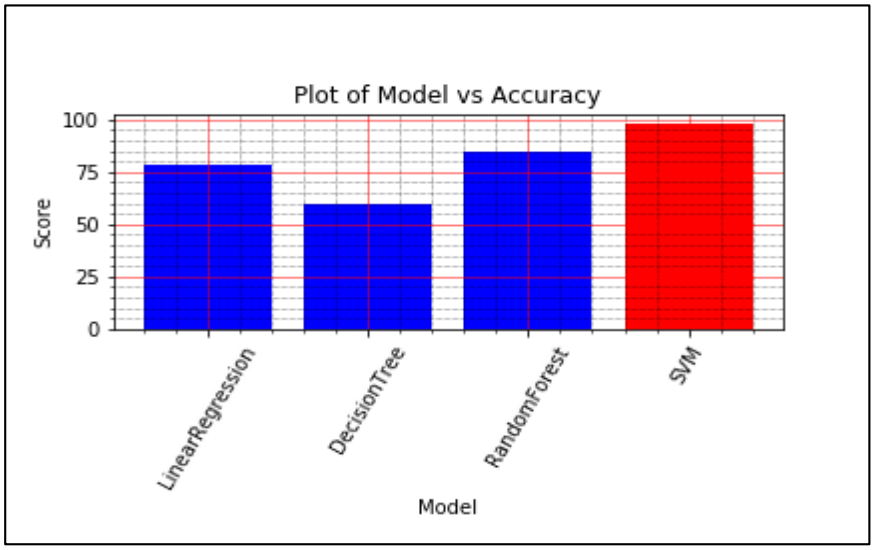

Figure 4 .Accuracy Comparison plot.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Comparative Analysis of Protein Content of *Oreochromis mossambicus* and *Oreochromis aureus* Muscle

Sushree Sangita Das and Pradip Kumar Prusty*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Odisha,India.

Received: 02 Mar 2020 Revised:04 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
Pradip Kumar Prusty
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha,India.
Email: pradipkumar.prusty@cutm.ac.in

ABSTRACT

Attempt was made in this research to observe and compare the content of protein present in the flesh of two species of tilapia fish; *Oreochromis mossambicus* and *Oreochromis aureus*.Aim of the research was to determine which fish out of two is richer in protein. For this experiment fish flesh was taken after removing head, fins, scales,tail and dried in Hot air oven at 100°c and then grinded to make powder form. Protein was observed by using Lowry method to know about the amount of protein quality of the fish species. Result obtained clearly shows that *Oreochromis mossambicus* is more rich in protein than *Oreochromis aureus*.

Keywords: *Oreochromis mossambicus*, *Oreochromis aureus*, protein, fish, powder.

INTRODUCTION

Fish is a highly nutritious food which provides the most affordable dietary animal protein (Katola, A. and Kapute, F.).*Oreochromis mossambicus* and *Oreochromis aureus* are two species of cichlid family, which is commonly known as Tilapia fish. Tilapias are widely cultured in the tropical and subtropical regions of the world and constitute the third largest group of farmed finfish, only after carps and salmonids, with an annual growth rate of about 11.5 %(Abdel-Fattah M El-Sayed).The common name for nearly a hundred species of fresh water and some brackish water cichlid fishes belonging to the three genera i.e. Tilapia, Sarotherodon and oreochromis, which include more than 70 species. *Oreochromis mossambicus* (Peters, 1852) belongs to the cichlid family of class Actinopterygii has spread worldwide through introductions for aquaculture. It is widely present in India through introduction (Pullin et al. (1997); Froese and Pauly (2004).It is known as Mozambique mouth-breeder. Other name of this species is *Sarotherodon mossambicus*, *Tilapiamos sambica*, Largemouth kurper, Mozambique mouth brooder, Javatilapia. It is omnivorous and feeds on almost anything, from algae to insects. These are easy to keep and breed in captivity. Size of *Oreochromis mossambicus*

is about 23-39cm in standard length and body weight up to 213gm-1.1kg.This species have 28-31 vertebrae; dorsal spines xv-xvii,total dorsal rays 26-29;30-32 lateral linescales;anal spinesIII,fine pharyngeal teeth; breeding males black with white parts on head; red dorsal and caudal fin margins; Jaw of adult males greatly enlarged, caudal fin not densely scales. The mouth brooding habit of this species allows it to nurture and carry its young long distance to invade habitats far from the original site of introduction (costa-pierce, 2003).Size and age of sexual maturity varies according to environmental conditions. In natural conditions sexual maturity at greater age and size.*Oreochromis mossambicus* is considered as very hardy species and tolerates the high salinities of atoll lagoons, such as that at Fanning Atoll (Lobel, 1980).Reproductive performance of tilapias is affected by salinity, which suppresses the aggression of dominant males.

Oreochromis mossambicus can reproduce at 35 and 49 ppt (Bhujel, 2000).Its survival upto120 %(Brock 1954; Dial and Wainright 1983; Stickney 1986).The Mozambique tilapia does not survive temperatures below about 10°c (Talwar and Jhingran 1992).True detritivore,with the ability to assimilate free nonprotein amino acids directly from detritus (Bowen 1980).Mozambique tilapia are maternal mouth breeders, the malefertilizes the eggs and female picks the eggs up and incubates them in her mouth. In the lower Shire valley area, the commonest consumed fish species is *O.mossambicus* which forms a significant proportion of the catch and is usually smoked before marketing and consumption (Chimenya et al., 2013; personal observation, n.a.)The need for consumers to have knowledge of proximate profiles in food is necessary to ensure that these are within the range of dietary requirement (Fawole et al., 2007). *Oreochromis aureus* (Steindachner, 1864) commonly called as Blue tilapia. Which is also known as Sarotherodon aurea, Israeli tilapia, Tlapia aurea. Blue Tilapia is closely related to and often confused with Nile Tilapia *(Oreochromisniloticus)*. Size of this species is13-26.5cm in length, 9.8cm in breath and the weight is about 485gm-2.7kg.Number of dorsal spines are 15-16, 27-30 total dorsal fin rays.Adults are grey-blue shading lighter towards the belly.

This species is a fresh water fish native to Tropical and Subtropical Africa, and Middle East. Native range includes Senegal, Niger, and many smaller drainages and lakes in Africa and Middle East (Trewaves 1983; Skelton 1993).
It has been used widely in aquaculture and is able to live and reproduce in brackish water with a minimum temperature of 20°c.It remain protected in their mother's mouth until they are about 1cm.This species is used as a food fish and introduced around the world. Due to the inadequate supply, high price and prolific breeding habit and high growth rate, makesthese species suitable for aquaculturist to culture.
These are also known as a protein rich fish to consume. Mainly muscles of fish contain high protein,carbohydrate and other components.

MATERIALS AND METHODS

Study area

Collection of samples

*Oreochromis mossambicus*was purchased from the local fresh water market in Jaydev vihar,Bhubaneswar, and *Oreochromis aureus* was taken from CIFA, Kausalya Ganga, uttara, Odisha. Then fishes were measured using the thread and measuring scale. Then the fishes were beheaded, flesh removed by dissecting the fish and the flesh was measured by weighing machine. Then flesh sample was dried inside stainless steel withthe help of Hot air oven for 3days at 100°C, in the School of Applied Science, Zoology laboratory of CUTM Bhubaneswar, Odisha. After drying further impurities like skells and small bones were removed and dry weight wasnoted down usingweighing machine. Then all the driedflesh was powdered with the help of mortar and pestle, and then fish powder is preserved in an air tight glass container to avoid contamination.

Laboratory Experiment
Estimation of protein

The protein was estimated by Lowry method (Lowry, O.H.et.al, 1951).The stock solution was prepared from egg albumin the day before experiment. The stock solution mixture was prepared by adding 10ml of egg albumin and 10ml of distilled water. Then 10ml solution was taken from that mixture to preparestandard stock solution by adding 50ml of distilled water.Then it was kept for 1 day after stirring well. Then in the day of experiment first the buffer solution was prepared by adding one 9.2PH buffer capsule in 100ml of distilled water.

Then 6 tubes were taken for experiment.
In 1sttube, only 1ml of distilled water was taken.
In 2nd tube, 0.8ml of distilled water and 0.2ml of stock solution were taken.
In 3rd tube, 0.6ml of distilled water and 0.4ml of stock solution were taken.
In 4th tube, 0.4ml of distilled water and 0.6ml of stock solution were taken.
In 5th tube, 02ml of distilled water and 0.8ml of stock solution were taken.
In 6th tube, 1ml mixture of 0.5ml sample powder and 10ml buffer solution were taken.
Then the mixture of 6th tube was taken in centrifuge tube for the centrifugation for 20min at 8000 RPM.

Preparation of Fehling's solution; 60ml of solution was prepared by adding 58.95ml Fehling A and 1.05ml of Fehling B reagent, then stirred well. Then 5ml of that mixture was added to each tube. All the tube were kept on oven for 15min at 35°cThen the FCR was prepared by adding 2ml of Reagent D and 2ml of distilled water. Then 0.5ml of FCR mixture was added in each tube and all the tube were again kept in oven for 30min at 37°c.Then the O.D was measured of each tube by Spectrophotometer at 640nm.

RESULT AND DISCUSSION

Two species of tilapia fish i.e. *Oreochromis mossambicus* and *Oreochromis aureus* were collected to ensure that flesh of which species is more rich in protein. The experiment on protein was done by using Lowry method and experiment on carbohydrate was done by using Hedge and Hofreiter method. After 3 to 4 times of experiment, several optical density of sample was observed. Finally it is observed that the protein value of *Oreochromis mossambicus* is 1.9715±0.38950446 and for *Oreochromis aureus* protein value is 0.698±0.37405011 according to the mean and standard deviation value. (Table 1,2)

CONCLUSION

From the above experiment, it is concluded that the *Oreochromis mossambicus* contains more protein than that of *Oreochromis aureus* flesh.

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Table1. OD value of *Oreochromis mossambicus*

SL.NO.	OBSERVATION	1ST OD	2NDOD	3RDOD	4THOD	MEAN	S.D
1	00ML	0	0	0	0	0	0
2	0.2ML	0.347	0.215	1.683	1.213	0.8645	0.60849219
3	0.4ML	1.313	0.194	2.637	2.302	1.6115	1.09952247
4	0.6ML	1.658	0.011	2.637	2.367	1.67725	1.03005252
5	0.8ML	1.927	0.054	3.114	3.035	2.0325	0.26572226
6	1ML(SAMPLE1)	2.073	0.941	2.637	2.235	1.9715	0.38950446

Table 2. OD value of *Oreochromis aureus*

SL.NO.	OBSERVATION	1ST OD	2NDOD	3RDOD	4THOD	MEAN	S.D.
1	00ML	0	0	0	0	0	0
2	0.2ML	0.347	0.215	1.683	1.213	0.8645	0.60849219
3	0.4ML	1.313	0.194	2.637	2.302	1.6115	1.09952247
4	0.6ML	1.658	0.011	2.637	2.367	1.67725	1.03005252
5	0.8ML	1.927	0.054	3.114	3.035	2.0325	0.26572226
6	1ML(SAMPLE2)	0.256	0.747	1.003	0.786	0.698	0.37405011

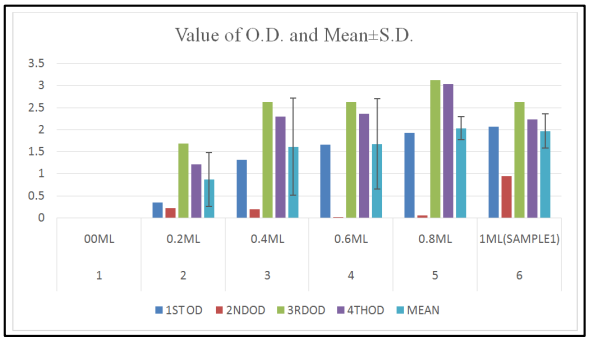

Figure 1. OD graph of *Oreochromis mossambicu*

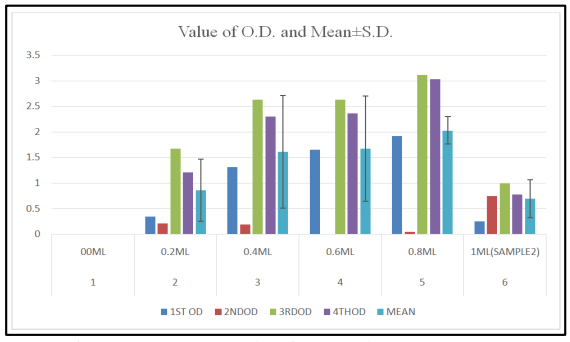

Figure 2. OD graph of *Oreochromis aureus*

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Histological Localization of Aluminium and Its Effect on Mineral Uptake in *Zea mays*

A.K. RATH

Centurion University of Technology and Management, Odisha, India.

Received: 01 Mar 2020 Revised:03 Apr 2020 Accepted: 05 May 2020

***Address for Correspondence**
A.K. RATH
Centurion University of Technology and Management,
Odisha, India.
Email: akrathbotany@gmail.com

ABSTRACT

Most of the aluminium in plants is located in the root zones. Significant decrease in root length is one of the most important early visible symptoms of aluminium toxicity. Developing root zones of plants exposed to Al exhibited considerable hematoxylin staining in the cortical cells and in some root hairs. Aluminium also adversely affects the entry of cations into the plants. However, it is still not clear how aluminium interferes or blocks the entry of cations into the plants, although the visual symptoms are typical of mineral deficiency. Aluminium induced blockage by affecting uptake and/or transport of minerals differently at different time intervals in *Zea mays*. The study revealed that P and Mn were blocked earlier to Fe and K, while Ca, Mg, Zn and Cu remained unaffected.

Key-words: aluminium, aluminium toxicity, hematoxylin, mineral transport, *Zea mays*

INTRODUCTION

Elevated aluminum (Al) level in acid mineral soils is considered as an important stress factor for plants [1]; as well as one of the major constraints to crop yields worldwide [2]. Phytotoxicity of Al is characterized by inhibition of root elongation and decrease in the uptake of nutrients [3,4]. It is a complex disorder, which may be manifested as alteration in nutrient levels such as N, K, Ca, Mg, and P affecting many other processes as well [5]. At low pH, toxic species of Al^{3+} are formed; it ligands with a number of groups such as carboxylate, phosphate and sulfate in soil solution and root cells, and blocks cell elongation, cell division and absorption of essential cations such as K^{+}, Ca^{2+}, and Fe^{2+} and phosphate anions [6], with expression of abnormal symptoms consequent upon the deficiency of essential nutrients [7]. Within minutes after exposure to Al^{3+}, the toxic symptoms in the form of retardation of root growth and/or decrease in water and mineral uptake start appearing in roots [8]. Agreed upon the interaction of Al with essential minerals, an organ specific study was undertaken to understand the sequence of blockage of uptake

and/or transport of eight important minerals in a locally cultivated cash crop, *Zea mays* L. var. MRM 3824 (monocot) grown in nutrient solutions exposed to low dose Al.

MATERIALS AND METHODS

Plant material and treatment procedure

Grains of *Zea mays* were germinated between layers of filter paper moistened with 0.5mM $CaSO_4$ for 4 days. Then the seedlings were transferred to plastic pots (2.5l capacity) filled with continuously aerated nutrient solution (pH 4.4) of the following composition in μM: 200 $CaSO_4$, 100 $MgSO_4$, 400 KNO_3, 300 NH_4NO_3, 15 $MnSO_4$, 0.38 $ZnSO_4$, 0.16 $CuSO_4$, 10 Fe-EDTA, 5 NaH_2PO_4, 16 H_3BO_3, 0.06 $(NH_4)_6Mo_7O_{24}$ [9], where they were grown for 3 days. Half of the maize plants i.e. 5 pots; 25 plants per pot (5 replicates) were allowed to grow in the nutrient solution. Each of the other 5 pots was exposed to the solution to which 50 μM Al as $AlCl_3$ was added. According to GEOCHEM speciation[10] the free Al^{3+} activities in the solutions were 17.3 μM. Experiments were conducted in a growth chamber under controlled environmental condition of photon flux rate 230 μmol $s^{-1}m^{-2}$; 16/8 h day/night cycle; 28/20°C day/night temperature and 80% relative humidity. The treatment solutions were freshly prepared and renewed every day and solution pH was adjusted to 4.4 daily with 0.1N HCl.

Six seedlings were harvested from each pot (control and treated) maintaining best possible visual uniformity on growth (2 each from above average, average and below average types) on days 2, 4 and 6; half of them were used for shoot and root dry weight and other half were separated into root, stem and leaf for analyses. The plants/ parts were washed with deionised water and dried in an oven at 80°C for 72h for estimation of dry weight and analyses. During the harvest the length of the longest roots in all the plants was measured and averaged.

Analysis of elements

Dried plant samples were digested following the method of [11] using diacid HNO_3: $HClO_4$ (3:2 v/v) and diluted to suitable volumes after filtration. This stock solution was used for measurement of Ca, Mg, Fe, Zn, Mn and Cu by atomic absorption spectrophotometer (ECIL AAS 4129, India), K by flame photometer (Elico CL 360, India) and P by vanadomolybdophosphoric acid yellow colour method [12].

Visual detection of Al in maize root

Al in the root tissues was visualized on day 2 by hematoxylin staining [13,14]. One seedling per replicate from the control and the treated were placed in flasks containing deionised water and washed for 30 min in a horizontal shaker, and stained with hematoxylin solution (2 g/l of hematoxylin and 0.02 g/l of KIO_3) for 15 min. The seedlings were washed again for 20 min in deionised water to remove excess of stain. After 2 days of the exposure, the distribution of aluminium in developing root zones (approximately 4.5cm from the tip) was observed in free-hand cross sections from unstained roots that previously were thoroughly washed with deionised water. The sections stained with hematoxylin [15] and mounted with 70% glycerine, were observed and photographs were taken with an optical microscope (45x magnification) using CCD camera.

Statistical analysis

Results represent means ± SD. Data were analysed by the analysis of variance. The significance was tested at 0.05 level.

Relative values (R_V) were calculated by:

$R_V = [T_V / C_V] \times 100$

T_V is the value in the Al treatment; C_V is the value in the control.

RESULTS AND DISCUSSION

Root tips of control maize plants did not stain with hematoxylin while those of Al-treated exhibited intense colouration (Fig. 1). Zone of root hairs with developing cortex exposed to Al, exhibited considerable hematoxylin staining in the cortical cells (Fig. 2a) with traces of stain in root hairs also (Fig. 2b). Al stress did not significantly influence the dry mass of shoot and root from day 2 till day 6. But, in the case of root length significant decrease was noted on day 4 and 6 (Fig. 3).

In maize, aluminium treatment did not influence the concentration of any of the nutrient tested on day 2 except that the concentration of Mg was more in the root. On day 4, significant decrease of nutrients occurred with P in the stem and Mn in the stem and leaf. On day 6, significant decrease of K (root, stem and leaves), P (stem and leaves), Fe (root) and Mn (root, stem and leaves) were noticed, but there was significant increase in Ca (stem) and Mg (root) (Table .1).

Critical analysis

Inhibition of root elongation or root growth is a foremost sign of aluminium toxicity [16,17]. Though it is not sure whether Al primarily interferes with processes related to cell division or cell elongation [18], it is believed that cell elongation in the elongation zone of the root is the major target for the inhibition of root elongation [19]. Present short term study with maize showed decrease of root length with no significant decrease in dry weight of root/seedling (Fig.3) specifying the probable negative influence of Al on the root-cell elongation rather than root-cell division, at least, at the early stage of exposure.

The interaction of Al with plant uptake and use of other elements have been reported by many researchers [2,19,20,21]. Several of the biochemical effects of Al in plants are probably due to changes in the structure and function of root membrane [22]. The binding capacity of plasma membrane of Al^{3+} is ascribed to the negativity of carboxyl groups and phosphate groups in the plasma membrane [23], affecting membrane electrophysiological properties of plant species [24]. Aluminium injury has been associated with displacement of Ca and Mg from roots and with the decreased uptake of Ca, Mg from roots in tree species [25]. Also it was reported that Ca^{2+} influx was inhibited rapidly at the root apex of winter wheat correlated with the inhibition of root growth [26,27]. A reduced Ca, Mg and K uptake is explained by the fact that Al occupies absorption sites in the free space [28]. Further, aluminium toxicity and phosphorus deficiency often coexist, limiting crop growth and production [29,30]. Foliar symptoms after Al stress resemble those of phosphorous (P) deficiency and in some cases, as induced calcium (Ca) deficiency or reduced Ca transport problem or even induces iron (Fe) deficiency symptoms [31]. It is generally believed that cell physiological changes involving Al-induced processes are caused by blockage of Ca homeostasis [32].

Though literatures speak with one voice regarding the blockage of uptake and/or transport of Ca and Mg by aluminium, the experiment revealed significant increase of Mg in root as early as day 2 and Ca on day 6 in the stem of maize (Table 1), So blockage of Ca-channel by Al occurring rapidly in *Amaranthus* [33] has not operated here. Rather, it was known that while Ca and Mg were significantly high, Cu and Zn remained unaffected up to day 6.

For other four tested nutrients viz. K, P, Fe and Mn, the negative Al-element interaction was evident in which P and Mn were affected earlier to the induced deficiency of K and Fe. Further, reduced concentrations of P and Mn in the shoot part (s) of the exposed plants in day 4 showed the disruption of the transport channels of these elements by aluminium could be one of the initial affects of its phytotoxic nature. The affects got aggravated on day 6 with the blockage of both uptake and transport of K and Mn as expressed by their significant reduction in both root and shoot parts. While for P the blockage in its transport but not the uptake was observed, for Fe, it was just the opposite. Thus, there were interesting differences in Al interactions with nutrients indicating Al-P and Al-Mn interactions started earlier to other six nutrients studied during the experiment (Table 1).

Aluminium did enter into the plant revealed from the staining experiments of its root, where it was concentrated mostly in the root tip zone (Fig. 1). Presence of Al in the root hairs clearly illustrates its entry through the region where the mineral uptake is greatest (Fig. 2b). In all probability, both, the blockage of minerals and the reduction in root length are due to Al alone, since the presence of Al is clearly marked out by the hematoxylin stain in the developing root zones (Fig. 1 and Fig. 2a). The finding more or less supports that of Horst [34], who proposed Al binding rapidly to the negatively charged binding sites in the cell wall, altering cell wall properties and thus affecting root growth after its accumulation in the apoplast of the root tip.

CONCLUSION

Al appears to behave deferentially with different minerals affecting either their uptake and/or transport. Present study showed that P and Mn were blocked earlier to Fe and K, while Ca, Mg, Zn and Cu remained unaffected. Also it appears Al interaction differs with the plant species, but it was evident from the histo-chemical study that it did enter into the plant. Acidification of soil being a natural process in the tropics and subtropics [5], these areas may be unknowingly vulnerable to aluminium toxicity. Therefore, it will be of interest to study a lot more plants to understand the Al-induced basis of nutrients uptake and transport.

ACKNOWLEDGEMENTS

The author is indebted to Dr. B. N. Behera, Former Reader in Botany, Rajendra College (Auto.), Bolangir, Odisha, India for his all round support during the project. The author is thankful to Mr. B. N. Mishra, Sr. Soil Chemist for his kind help in the chemical analyses of the materials.

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Table 1. Effect of 50µM Al (pH 4.4) on Ca, K, P, Mg, Fe, Zn, Mn and Cu content of *Z. mays*.

MINERALS ORGANS	CONTROL TREATED	DAY 2		DAY 4		DAY 6	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
Ca (mg g^{-1}DW) Leaves	Cont	8.6	1.1	8.8	0.8	6.9	0.1
	Al	8.9	0.6	8.9	0.7	8.1	0.9
Stem	Cont	26.1	2.0	19.1	1.8	15.9	2.1
	Al	25.8	2.4	19.1	2.1	22.9*	2.4
Root	Cont	3.1	0.1	3.4	0.3	2.7	0.1
	Al	3.3	0.4	3.3	0.6	3.2	0.1
K (mg g^{-1}DW) Leaves	Cont	32.5	2.4	34.2	4.8	34.2	3.5
	Al	32.4	3.0	32.0	2.7	17.9*	2.1
Stem	Cont	19.2	2.3	17.5	2.1	18.7	0.9
	Al	19.2	1.6	18.7	2.3	11.3*	1.6
Root	Cont	4.6	0.5	5.0	0.8	4.9	0.2
	Al	4.8	0.3	5.1	0.5	2.7*	0.2
P (mg g^{-1}DW) Leaves	Cont	5.0	0.2	3.0	0.3	4.3	0.3
	Al	5.0	0.6	2.6	0.1	2.5*	0.2
Stem	Cont	4.4	0.7	4.5	0.3	5.1	0.7
	Al	4.1	0.4	2.9*	0.3	2.1*	0.3
Root	Cont	2.8	0.1	4.6	0.2	3.5	0.1
	Al	2.9	0.3	3.9	0.1	3.2	0.4
Mg (mg g^{-1}DW) Leaves	Cont	33.5	5.1	31.3	2.0	37.2	5.5
	Al	34.9	3.9	29.6	4.1	28.5	4.2
Stem	Cont	41.2	3.6	44.4	7.2	46.6	2.9
	Al	47.3	4.8	44.6	5.2	43.6	4.1
Root	Cont	14.1	2.3	17.2	1.8	11.0	2.0
	Al	21.6*	3.5	20.8	3.3	27.2*	3.6
Fe (mg kg^{-1}DW) Leaves	Cont	1051.5	205.4	1104.7	211.1	1043.8	109.9
	Al	1066.3	163.5	1100.9	184.5	921.5	95.6
Stem	Cont	1555.0	171.8	1475.2	111.7	1480.1	146.0
	Al	1552.6	101.0	1525.7	152.8	1776.0	234.4
Root	Cont	422.4	56.1	381.8	39.2	417.0	61.2
	Al	401.5	40.2	291.1	20.6	206.4*	30.5
Zn (mg kg^{-1}DW) Leaves	Cont	400.7	24.5	385.4	39.7	403.6	47.3
	Al	394.8	46.9	390.9	21.7	394.4	22.2
Stem	Cont	812.2	100.0	749.1	69.8	750.6	29.0
	Al	827.6	85.2	811.0	58.8	843.9	46.6
Root	Cont	121.2	10.6	128.3	12.3	137.1	21.8
	Al	126.4	10.9	126.9	23.6	127.2	20.6

Mn(mg kg^{-1}DW) Leaves	Cont	33.3		5.1		30.4		2.6		35.8		3.4
	Al	32.0		2.9		20.8*		3.1		11.5*		1.2
Stem	Cont	79.8		8.8		76.6		6.0		82.6		10.1
	Al	70.1		9.2		48.1*		5.4		40.2*		5.6
Root	Cont	27.5		1.6		31.2		4.2		28.9		3.7
	Al	22.2		2.0		24.4		3.9		16.7*		2.9
Cu (mg kg^{-1}DW) Leaves	Cont	70.0		9.9		63.6		8.0		63.9		3.4
	Al	68.4		6.9		60.7		5.2		45.0		4.5
Stem	Cont	99.1		10.4		87.3		10.2		124.5		18.6
	Al	100.3		20.3		82.2		11.9		92.0		9.9
Root	Cont	15.6		1.7		14.7		1.6		15.5		2.0
	Al	15.2		1.1		14.8		2.0		19.6		3.3

Values are means of 5 replicates.
* indicates significant difference between the Al-treated plant and the control at 5% P level.

Figure 1. Hematoxylin staining of the root tips of *Z. mays* (a) control (b) exposed to 50µM Al.

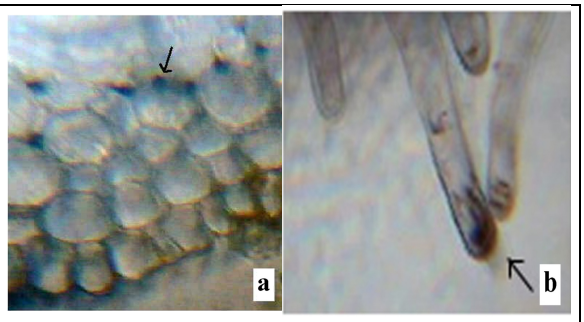

Figure 2. Hematoxylin staining of free hand sections of mature root zones of maize exposed to 50µM Al on day 2 showing Al staining in cortical cells (a) and root hair (b).

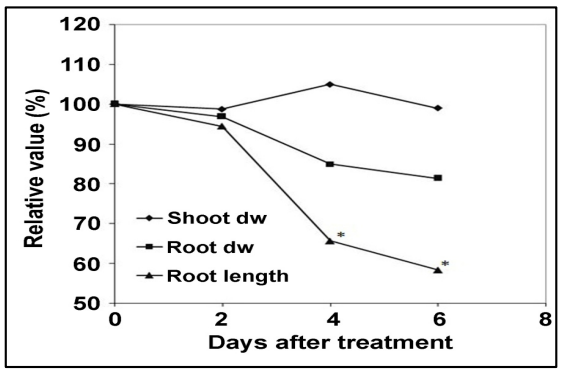

Figure 3. Effect of 50µM Al (pH 4.4) on the shoot and root dry weight and root length (cm) of *Z. mays*. Relative values are values of Al-treated plant relative to the control. Values are means of 5 replicates. * indicates significant difference at 5% P level

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Random Forest Frame Work for Crop Yield Prediction

Goutam Sahu , Manoj Kumar Behera, Rakesh Ray and S. Chakravarty*

Centurion University of Technology & Management, Bhubaneswar, Odisha, India

Received: 10 Mar 2020 Revised:12 Apr 2020 Accepted: 14 May 2020

***Address for Correspondence**
S.Chakravarty
Senior Member IEEE
Centurion University of Technology & Management,
Bhubaneswar, Odisha, India
Email: sujata.chakravarty@cutm.ac.in

ABSTRACT

Agriculture is one of the major revenue producing sectors of India and a source of survival. But there are many issues due to which Indian farmers are reluctant towards agriculture, one of the major challenging issues is Crop yield prediction. An Indian farmer is always interested to know whether and how much yield he/she is about to produce at the end of the season, In the past times, Predictions of crop yield was performed by considering farmer's experience on specific field and crop. The crop production is effected by variegated seasonal, biological and economical constituents but unforeseeable changes in these constituents lead to a huge loss to farmers. These risks can be minimized when significant mathematical or statistical methodologies are applied on data related to soil, weather as well as past yield. With the help of Machine Learning algorithms, crop yield can be predicted in a more effective and corrective waythat helps the farmers to take percussive measures during farming to get maximum profit. This research focuses on different Machine Learning models (Linear regression, decision tree, Random Forest), those employed to predict the crop yield for a particular region "Telangana, India" based on data collected from 23 different districts. The simulation results show that proposed work efficiently predicts the crop yield production.

Key words: Yield; Linear regression; Decision tree; Random Forest

INTRODUCTION

Agriculture occupies a major role within the development of India. Not only for its economy however conjointly for the amount of individuals who are directly or indirectly related to it. India's agriculture consists of the various types of crops, with the foremost food staples being wheat and rice. Indian farmers collectively grow pulses, potatoes,

sugarcane, oil seeds, and such non-food things such as cotton, tea, coffee and jute. Over 70% of the agricultural households depend upon agriculture. Agriculture contributes close to 17% to the total GDP and provides employment to over 60 percentage of the population [1, 2].

Over 60% of India's land areas units are cultivable making it the second leading nation in terms of total cultivable land. Agriculture merchandise of vital economic value include rice, wheat, potato, tomato, onion, mangoes, sugarcane, beans, cotton, etc. The rank of India is among the top five producers of many agricultural things like coffee, cotton, etc. It ranks the second biggest manufacturer of wheat and rice within the world whereas India is the largest manufacturer of things like milk, several contemporary fruits, spices, jute, wheat, rice, etc., it's one among the largest producers of sugarcane within the world [3]. In India, the bulk of the farmers aren't receiving the calculable crop yield because of many reasons. Each cultivator thirstily waits for the harvest that depends on a variety of things. In the ancient times, agricultural yield forecast was gathered by farmer's earlier expertise with the crop. The quantity of data is massive in Indian agriculture. In India, the agricultural yield mainly depends on the climate conditions. The dependence on climatic situation, type of land, resources available leads to unpredictable crop yield. Thus scientists and researchers are exploring strategies of crop yield prediction, which will able to warn farmers on the premise of the information collected and strategies developed by scientists. However, maintaining land for agriculture involves a variety of things like social, political, economic and ecological factors. It also includes the number of individuals managing the farm, kind of farm, policies of that space, resources and most significantly the atmospheric condition. Only by systematic study of strategies like planting, fertilization, irrigation, cultivation, climatic conditions crop prediction are often created doable [2, 4].

Crop yield prediction is a vital agricultural drawback. Every farmer is usually tries to grasp, what proportion yield can get from his expectation. In the past, yield prediction was calculated by analysing farmer's previous expertise on specific crop. The Agricultural yield is primarily depends on climatic conditions, pests and coming up with harvest operation. Correct information concerning the history of crop yield is a vital factor for creating decisions related to agricultural risk management [5]. To accomplish that, real-time data are collected from districts of Andhra Pradesh (Before Partition of Andhra Pradesh and Telangana). The proposed system aims at predicting the crop yield by collecting the past agricultural data of the farming land. The system builds a predicting model by considering various factors such as area, production, yield and other entities using machine learning techniques. Here, we make use of different machine learning techniques such as Linear Regression, Random forest Regression, Decision Tree Regression. The aim of the article is to predict the crop yield of an area by considering dataset with the importantfeatures that are essential to crop production like area and the real production. To predict a continuous value, various regression models are used. Regression is a supervised technique. Here, the coefficients are pre-processed and fit into the trained data during training and the regression model is constructed. This technique focuses on reducing the cost function by finding the best fit-line.

Choosing appropriate dataset is a crucial task. In India, the agricultural yield principally depends on the atmospheric conditions. The dependence on weather condition, land type, resources available in the market leads to unpredictable crop yield. Maintaining land for agriculture involves variety of things like social, political, economic and ecological factors. It also includes the number of people managing the farm, type of farm, policies of that area and resources. Keeping a data of all these things is not possible. That is why in this study, only the important features are taken into consideration.

Related Work

Aakunuri Manjula, G. Narsimha-2015 [1] describes about framework of crop yield prediction in which there is an investigation for crop yield prediction requirement and different systems have been utilized and finally it results in a framework which is flexible for predicting accuracy.A.A. Raorane, R. V. Kulkarni-2012 [2] uses Data Mining as an

effective tool and focuses on modelling some of the important inputs which plays a major role in the collected dataset and to derive a strong relationship between the variables. Support Vector Machine and k-means clustering algorithms are used to accustomed forward pollution from atmosphere and conjointly to classify between soil and plants.D. Ramesh, B. Vishnu Vardhan-2015 [3] describes about Analysis of Crop Yield Prediction which used various data mining algorithms like Naïve Bayes and KNN to predict the class of analysed soil dataset. The soil is classified into high, medium and low. By doing this, the farmer and the soil analyst gets the prior knowledge about the land. At the meantime they will decide that which crop most closely fits to sows. The results in-turn will help in predicting the crop yield.Monali Paul, Santhosh K. Vishwakarma, Ashok Verma-2015 [4] focuses on Predicting Crop Yield using Data Mining approach. The interest existing in the rural economy is not considered by the system which is a drawback and it overcomes the drawback by considering the demands based on the market price crops and it is recommended to the farmers for better growth.TngZhang-2015 [5] describes about linear prediction algorithm in order to improvise the value and gain of farming area. Feasible suggestions to farmers and meeting the current demands are not provided by this system which serves as a drawback here.J.iajunZong, Quanyin Zhu-2012 [6] describes about Grey prediction system which gives an excellent prediction accuracy of price forecast in production market. This forecast structure is employed to predict the market prices of various yields. By implementing demand grade for every crop, the real downside of this framework is destroyed i.e., value of the crops won't be stable all the days.

METHODOLOGY

Machine Learning Techniques are widely applied to agricultural fields. It is used to analyse large data sets and find the impartment patterns present in the data sets. The main goal of this method is to extract the data from a knowledge set and rework it into apprehensible structure for additional use. This paper analyses the crop yield production based on available data. This technique was used to predict the crop yield for maximizing the crop productivity.

Proposed Framework

This Research Project on Crop Yield Prediction focuses on Machine learning Techniques which includes different Regression models. The [Figure-1] shows the architectural design of proposed system of the project.

The architectural design clearly explains about the total process of the project starting from collecting the agricultural dataset to getting the predicted accuracy at the end. This Framework shows the Process of predicting Crop Yield. This model gives clear picture of collecting huge amount of agricultural data and then pre-processing of dataset to remove the noise and missed values such as NA values [7]presented in it. After pre-processing step, the dataset is split into training and testing dataset by Train_ Test_ Split function. Here we make use of different machine learning techniques such as Linear Regression, Random forest Regression, Decision Tree and finally compared.

Machine Learning Algorithms

The proposed article contains regression analysis which is a form of predictive modelling technique which investigates the relationship between a **dependent** (target) and **independent variable** (predictor). This system is employed for forecasting, time series modelling and finding the casual effect relationship between the variables. Regression analysis is a crucial tool for modelling and analysing data. In linear regression, a curve / line is drawn to the data points, in such a manner that the differences between the distances of data points from the curve or line is decreased[8-15].

Linear Regression

Simple regression is the mostly used for regression and forecasting. Here, the dependent variable is continuous, independent variable(s) can be continuous or discrete, and nature of regression line curve is linear. Linear Regression establishes a relationship between dependent variable (Y) and one or manyindependent variables (X).

Decision Tree

Decision Tree is a decision-making tool that uses a flowchart-like tree structure or is a model of decisions and all of their possible results, including outcomes, input costs and utility. Decision tree regression looks the options of an object and trains the model within the structure of a tree to find information in the future to provide continuous output. Continuous output means that the output/result is not separate, i.e., it's not represented just by a discrete, known set of numbers or values.

Random Forest Regression

A Random Forest is an important technique capable of performing regression tasks with the utilization of multiple decision trees. Random forest model collects trained data from all the tree nodes and separates the weaker nodestraining data to get better predictions. The basic idea behind this is to combine multiple decision trees in determining the final output rather than relying on individual decision trees.

Dataset Overview

The data used for this work are obtained for the years from 1998 to 2012 for districts of Andhra Pradesh (Before Partition of Andhra Pradesh and Telangana) in India. The preliminary data collection is carried out for districts of Andhra Pradesh in India. The data has 8 input variables. The variables are State, District, Crop, Year Season, Area, Production and Yield, where first seven are independent variables and the last '' Yield' is the dependent variable. The [table-1] shows the description of each variable present in dataset.

Area of Study

The data is collected from 23 districts of Andhra Pradesh in India as shown in [figure-2] (Before Partition of Andhra Pradesh and Telangana) from 1998 to 2012.

Sample Dataset

A sample of compiled data is shown in [Table-2] using head function on total dataset, collected from 23 districts.

Data Exploration

Data Exploration is an important step before we proceed to machine learning or modelling of our data. It provides the context required to develop an acceptable model – and interpret the results properly. For Data Exploration, We used Scatter Plot because it is a Special type of Graph which is designed to show the relationship between the two variable area vs. production as shown in [figure-3].

RESULTS AND DISCUSSION

The experimental results are based on agricultural data, which is collected from 23 districts of Andhra Pradesh in India (Before Partition of Andhra Pradesh and Telangana) from 1998 to 2012.We have implemented different Machine Learning models like Linear Regression, Decision Tree and Random Forest for predicting Crop Yield. We initially started with Data Exploration to know the Relation between the variables and to develop an appropriate model. The proposed model contains two phases: Training Phase and Test Phase. We have taken 70% of Data for training the Dataset and the remaining 30% for testing the Dataset. The Splitting of Dataset is done by Train_ Test_ Split function which splits the data arrays into two subsets that is training data and testing data. We don't need to divide the dataset manually. Train_ Test_ Split function will make random partition for two subsets. Then it will create A Regression Object. In the training set, the data was collected. After that, regressor.fit () is used to train the model using the training set. Then regressor. predict () is used to make predictions using testing set. Then finally, regressor. score () is used to understand how the model is making predictions and to calculate the prediction accuracy.

Accuracy assessments

The accuracy of different machine learning techniques used for the model are listed and compared.

Linear Regression

In Linear Regression, The expected Output is continuous and has constant slope. It is used to predict values among a continual vary. The Variables like Area and Productionare inputs to the Linear Regression model. For the given data set, predictionaccuracy of crop yield using Linear Regression Model is 91.90% as shown in [Figure-4].

Decision Tree Regression

Decision tree builds regression models within the type of a tree structure. This splinters a data set into different subsets whereas at an equivalent time an associated decision tree is incrementally constructed. The variables like area or space and productionare inputs to the Decision Tree Regression model. For the given data set, The Prediction Accuracy of Crop yield using Decision tree Model is 99% as shown in [Figure-5].

The basic idea behind this is often to mix multiple decision trees in determining the final output instead of looking forward to individual decision trees. The Variables like Area and Productionare inputs to the Random Forest Regression model. For the given data set, theprediction accuracy of crop yield using Decision tree Model is 97.86% as shown in [Figure-6].Finally the accuracy of different algorithms are compared using a bar plot as shown in [Figure-6].

CONCLUSION AND FUTURE WORK

The aim of this research is to predict the crop yield production from for different districts of Telangana, India. Different machine learning techniques like Linear Regression, Decision Tree and Random Forest algorithm have been used for the prediction.All of them are responding well for the underlying dataset but out of this all the regression model using decision tree is producing better accuracy, which is 99%. In future this model can be enhanced by adding more feature into account like type of soil and values of different soil nutrients present in the soil. Again the proposed work can be extended using more powerful machine learning technique like deep learning.

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Table-1: Different variables present in the dataset

VARIABLE	DESCRIPTION
State	Area of Study is Andhra Pradesh (Before Partition of Andhra Pradesh and Telangana)
District	The data was collected 23 districts of Andhra Pradesh in India (Before Partition of Andhra Pradesh and Telangana).
Crop	Crops like Paddy from particular area
Year	The data was taken from the year 1998-2012
Season	It Specifies the Cropping Season whether it is Kharif or Rabi
Area	The total space of agriculture plants region in Hectares.
Production	The production of crops in Metric Tons
Yield	It is Specified as Production per Area and the Unit is Metric ton per Hectare

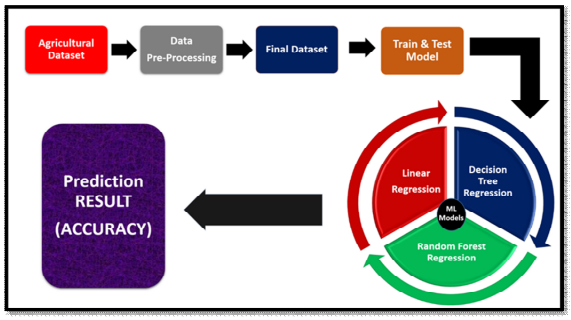

Figure-1: Architectural design of proposed system

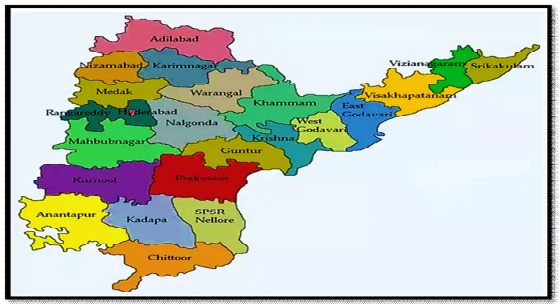

Figure-2: Data Collection Area

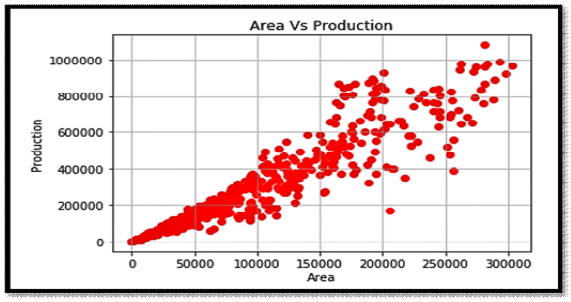

Figure-3: Data Exploration using Scatter Plot

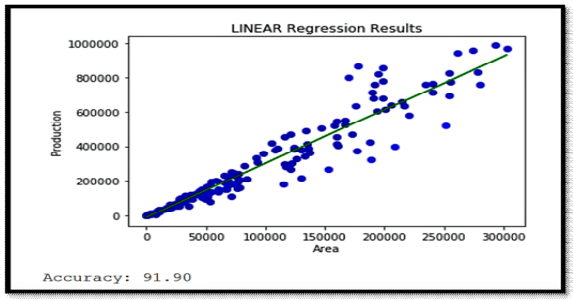

Figure-4: Result of linear regression for given dataset

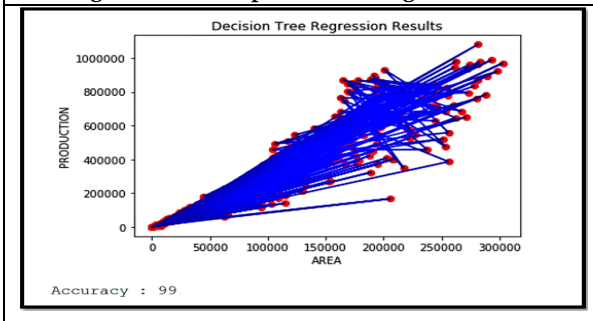

Figure-5: Result of Decision tree Model for given dataset

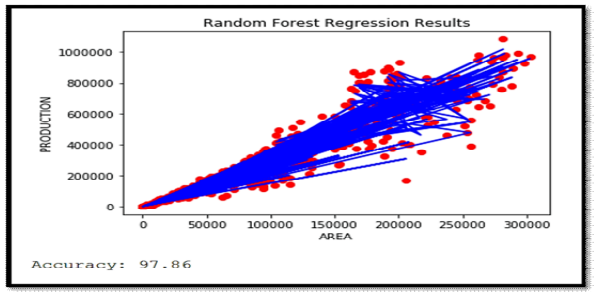

Figure-6: Result of Random Forest regression Model for given dataset

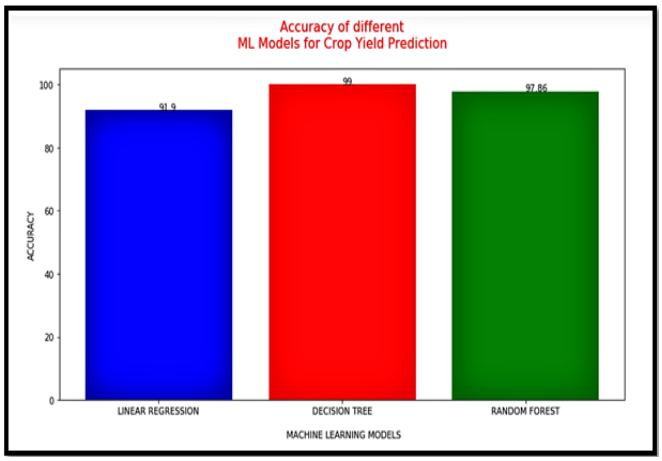

Figure-7: Accuracy Comparison plot

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Studies on Quantitative Analysis of the Survival Rate of *Carassius auratus* by Taking Three Different Sources of Water.Tap Water, River Water and Underground Water

Leepsa Priyadarshini and Pradip Kumar Prusty*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Bhubaneswar, Odisha, India.

Received: 02 Mar 2020 Revised:04 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
Pradip Kumar Prusty
Department of Zoology ,School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: pradipkumar.prusty@cutm.ac.in

ABSTRACT

In the present study,the impact of different sources of water on the survival rate of goldfish was investigated.For this aim,three different sources of water that is tap water,river water and underground water were used.The test consisted of analysis of the three different sources of water by taking certain water parameters which includes pH,conductivity,temperature,hardness, Dissolved oxygen and Turbidity. After analysis of water,water from three different sources was taken in three different containers. Then the goldfishes were allowed into the three different containers followed by feeding and change of water at regular intervals.The survival rate of the goldfish is then observed for about 27 days. Significant differences were found in the survival of the goldfish in three sources of water. The survival rate of goldfish was found to be more in river water as compared to tap and underground water.

Keywords: Goldfish, Survival, Physico-chemical analysis, Growth, Feeding

INTRODUCTION

The most popular pet fish that is goldfish and human communities in the world dates back to 1600 years(Huang*et al.*,1997).Millions of fish and goldfish are sold to the public, zoos and pet stores (Stone *et al.*,2002). In 1997 Goldfish *Carassius auratus* was the third most popular imported species of fish into the United States (Chapman and Fitz-Coy,1997). Gold fish *Carassius auratus* is a fresh water ornamental fish. It is among one of the most commonly kept aquarium pet fish.It possesses elongated and stocky body. Gold fish are among one of the earliest fish to be domesticated as pets, and the well-known bright gold color is not possessed by all individuals. Color in wild populations may vary from gold to

olive green or even creamy white. Gold fish obtains its gold color after few months of hatching, newly hatched ones are greenish bronze in color. They eat earthworms, bloodworms,flakes etc.They are generally peaceful in nature. They have a long dorsal fin with 15 to 21 rays and a hard-serrate spine at the beginning of the dorsal and anal fins. Lateral line in them is complete,with 25 to 31 scales placed in lateral series (Robison and Buchanan, 1988; Page and Burr,1991). The anal fin of the female is convex and the male is concave.When they are viewed from the above the females are seen with bulged abdomen. Small white spots are developed on the gill cover and head of the male during the spawning time.The basic life span of gold fish is 6 to 7 years but 30 years were recorded as maximum (Robison and Buchanan,1988; Carlander,1969).In normal length of the gold fish is about 120 to 220 mm but a maximum of 410 mm was recorded(Page and Blurr,1991). Its body weight in normal is about 100 to 300 grams but it can reach up to 3.0 kg.

Goldfishes were originated from china to Eastern Europewhere they were made to bred to get a varied range ofshapes, sizes and colors (Scott and Crossman,1973).Now the goldfishes are widely distributed throughout the world. Goldfish is a member of the carp family.It was popularlyraised carp in ornamental ponds and water gardens during the year 618 to 907.The gold coloration or yellowish orange color rather than silver was actually produced by a genetic mutation. Instead of the silver one people started to breed the gold variety to keep them in water bodies.During 960-1279, the Song Dynasty who was the ruler of china established the domestification of goldfish (Smartt,2008).

MATERIALS AND METHODS

STUDY AREA

The study was conducted from February, 1st 2020 to February, 27th 2020 in the Department of Zoology,Centurion University, Bhubaneswar,Odisha,India.Three sources of water were selected for the experiment that is tap water, River water and Underground water. During the study period, feeding,growth performance,survival rate and water analysis were done very carefully.

METHODOLOGY

Water samples were collected from three different sources of water that is Dayanadi river (Bhubaneswar), Tap water(Centurion University) and Underground water(Khandagiri,Bhubaneswar). All the water wasanalyzed to find out different parameters of water that is temperature,pH, conductivity,dissolved oxygen,hardness and turbidity. Then three goldfishes along with three fish bowls and fish feed were purchased from Aquarium Pet Planet shop, Jatni, Khurda, Odisha.Three different water samples that is river water, tap water and underground water were taken in three fish bowls. Then the goldfishes were allowed or put into the containers containing water samples. The goldfishes were provided with fish feed at proper intervals followed by regular change of water, once in two days. Thereafter, the survival rates of goldfishes in three different fish bowls containing three different water samples were observed.

RESULTS AND DISSCUSSION

The present study revealed that, after analyzing the mentioned parameters of the water sample. It was found as follows Table.1.

From this study it was found that the goldfish that was under tap water survived for 21 days,that was under underground water survived for 25 days and the one under the river water is still alive.

CONCLUSION

So from this it is concluded that the river water is best for the survival and healthy growth of goldfish. As it is made clear from the water analysis that the river water contains appropriate values of pH, conductivity, temperature, hardness, dissolved oxygen and turbidity that is required for the growth and survival of the goldfish.

ACKNOWLEDGEMENT

The authors are thankful to Dr. Yashaswi Nayak, HOD and Dr.Siba Prasad Parida (Assistant Professor),Department of Zoology, Centurion University, Bhubaneswar, Odisha.

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Table-1 Water Analysis

WATER PARAMETER	DAYANADI RIVER WATER	TAPWATER(CUTM)	UNDERGROUNDWATER (KHANDAGIRI, BBSR)
pH	8.1	5.96	6.04
CONDUCTIVITY	0.22m	0.231m	0.205m
TEMPERATURE	23.33 ^{0}C	29 ^{0}C	17 ^{0}C
HARDNESS	178.92ppm	134.80ppm	113.97ppm
DISSOLVED OXYGEN	10ppm	14.06ppm	10ppm
TURBIDITY	0.0537ntu	0.037ntu	0.0349ntu

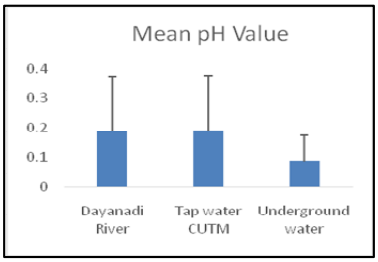

Fig-1 pH of water

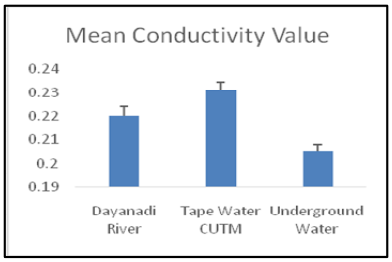

Fig-2 Conductivity of water

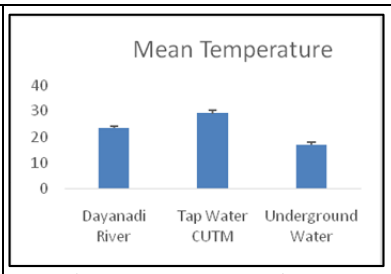

Fig-3 Temperature of water

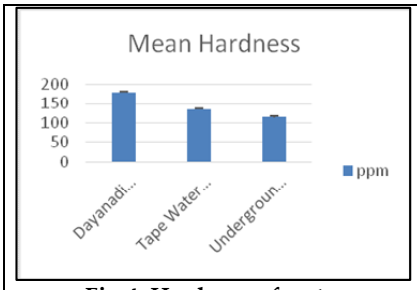

Fig-4. Hardness of water

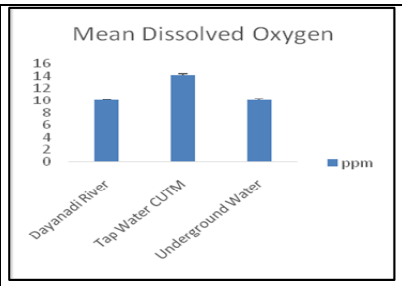

Fig-5. Dissolved oxygen of Water

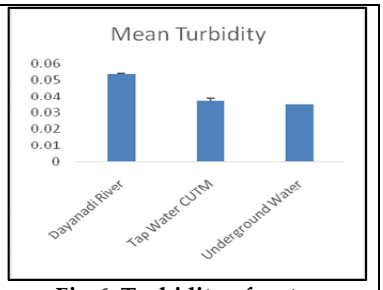

Fig-6. Turbidity of water

Fig-7. *Carassius auratus*

Fig-8.Gold fish in 3 different sources of water

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Behavior of Pigments Extracted from Orange Peel Waste and Pomegranate in Deep Eutectic Solvents

Premamanjari Pradhan, Jyotirmayee Sahoo, Pramita Priyadarshani Panda, Bikash Pradhan, Pankaj Das, Laxmipriya Dhal,Srikanta Sahu, Susanta Kumar Biswal and Pratap K. Chhotaray*

Department of Chemistry, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 13 Feb 2020 Revised:15 Mar 2020 Accepted: 17 Apr 2020

***Address for Correspondence**
Pratap K. Chhotaray
Department of Chemistry, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: pratap.chhotaray@cutm.ac.in

ABSTRACT

Orange peel, a waste biomass accounts for more than million tons and pomegranate, a fruit that is extensively produced in India is used in this work to extract pigments. As per the literature, both the commodity contains several important compounds starting from poly phenols, flavonoids, vitamins, phytochemicals, and so on. These chemicals can be used for an array of applications in food industry, pharma industry and others. Before it can be used for any applications, its behavior need to be explored and investigated extensively. In this work we have investigated the behavior of extracted pigments in three different deep eutectic solvents (DES). The three component DESs lactic acid-citric acid-water, citric acid-glucose-water, and lactic acid-glucose-water were prepared by using these components in a molar ratio of 1:1:4. Both the extracted pigments have shown two major absorption peaks. For orange peel extract, in all the three DESs, one peak is bathochromically shifted and the other peak is hypsochromically shifted. However, for pomegranate extract, there is no particular trend of spectral shift is observed for the investigated DES. From the obtained results we may conclude that, the acidic environment of DES is affecting the structural arrangements in pigments thereby resulting the spectral shift. The information obtained from this work can be used to explore the possibility of using the natural pigments as a photosensitizer along with DES as an electrolyte for improving the efficiency of dye sensitized solar cell.

Keywords: Deep Eutectic Solvent, Pigment, Anthocyanin, Hesperidin, Waste Biomass, Orange Peel, Pomegranate.

INTRODUCTION

As we continue to live in twenty-first century, the living style as well as the food practice is also shaping in a different way that has not been observed as before. People are more conscious about taking nutritious food in the form of fruits and vegetables. As the fruit industry grows up, so as the generation of waste biomass. The waste biomass could be in the form of peel, residual pulp, seed, and so on. These fruit waste are generated during processing, preparation, storage, handling, selling etc. These waste materials contain many beneficial entities in the form of nutrition, dietary fiber, bioactive molecules, color pigments, essential oils to name a few. These vast amount of waste products have negative implication on natural resource conservation and should be value added formyriad of useful applications. Orange is considered as one of the top five fruit commodity that is being consumed globally.[1] Approximately, 15 to 25 million tons of solid waste produced per year from orange juice production center.[2] It has been established by several researcher that these peel waste can be used for the production of flavonoid, pectin, fiber, animal feed, biogas and so on.[2,3] Particularly the bioactive compounds present in orange peel has several industrial applications ranging from nutraceuticals, food sector, chemical industry etc.[1] Similarly, another fruit Pomegranate known as a super food has several salient feature to its credit. This exotic fruit has several nutritional and therapeutic values due to presence of bioactive compounds. It is rich in active phytochemicals, flavonoids, polyphenols, vitamins to name a few.[4] Due to presence of these components, pomegranate extracts can be used as antioxidants, anticancer agents, can improve cardiovascular health, and other physiological functions.[5–7] Moreover, India is one of the leading countries in production and export of pomegranate fruit.[4] Therefore, in this scenario it is imperative to understand and explore the behavior of both orange peel extract and pomegranate juice extract in different chemical environments/solvents in order to expand its application horizon and usefulness.

Solvent play a crucial role both in laboratory research as well as industrial production. Therefore, a good solvent is always a better option for the best of our future generation. Ionic liquids and deep eutectic solvent (DES) are the two types of green solvents resulted from relentless efforts by world scientific community.).[8–10] DES is a eutectic mixture composed of hydrogen bond donor (HBD) and hydrogen bond accepter (HBA) and generally are liquid at room temperature.[9,10] DES could be of two component system or many component system. Furthermore, the same components can be used with different molar ratio to generate different DES.[11] The charge delocalization occurs between HBD and HBA through hydrogen bonding network is playing a role in reducing the freezing point of DES.[9] Since beginning, DES have demonstrates remarkable possibility in several applications starting from nanotechnology, enhanced oil recovery, electrochemistry, metal processing applications, separation technology and so on.[12,13,14,15] Moreover, DES involves with simplified synthetic procedureand does not require sophisticated purification which enables them to be considered as alternative green solvent for large scale industrial production.[16] As a novel green solvent system, more solute-solvent understanding is necessary to exploit the potential applicationsof both solvent and solute.

Along with several other chemical compounds, both orange peel extract and pomegranate juice contain coloring pigments that give color to the respective commodity. These color pigments from orange peel extract and pomegranate juice are known to harvest energy for dye sensitized solar cell (DSSC).[17–20] The advantages of using these pigments in DSSC are based on its easy availability and low cost.[21] DESs have been successfully used as a potential electrolytethat play a significant role in determining conversion efficiency and stability of DSSC.[22,23] In addition to that, DESs have also been used for the color pigment extractions from various fruits and vegetables.[24–26] At this juncture we are intended to explore how the color pigments extracted from orange peel and pomegranate juice behaves in DES under UV-Visible radiation. This preliminary information would be useful to combine DES and natural color pigments for DSSC applications.

MATERIALS AND METHODS

Materials

AR grade of acetone, lactic acid, citric acid having purity more than 99 % were purchased from Pallav chemicals. D-fructose (AR grade), Glucose (LR grade) were purchased from CDH. Ethanol (99%) was purchased from Merck. All the chemicals were used without any further purification. Distilled water used for this work was obtained from in-house set up in the department laboratory.

Instrumentation

Labman UV-Visible spectrophotometer (LMSP-UV 1900) was used to record UV-Visible spectrum of samples. The double beam spectrophotometer has wavelength range of 190-1100 nm. Ethanol and respective DESs were used as reference while measuring samples UV-Visible spectra.

Preparation of DES

Three DESs were prepared as per the procedure described elsewhere.[27] In brief, three component DES (Citric acid-Glucose-Water) was prepared with a molar ratio of 1:1:4 and is termed as DES 1 for the sake of convenience. The two solid components citric acid and Glucose(1:1 molar ratio) were grindedfirst using mortar and pestle to make a homogenous mixture. The measured amount of water (with 4 molar ratio) was then added to solid mixture. The resultant mixture was then heated at 70 □ for one hour to get the transparent liquid DES 1. DES 2 (Glucose-Lactic acid-Water) and DES 3 (Lactic acid-Citric acid-Water) were prepared by mixing all the three components in the above mentioned ratio and then was heated at 70 □ for one hour to get the transparent liquid DES. As the prepared DES are already investigated and established, further characterization has not been carried out rather been used directly for UV-Visible study.[28,11] The prepared DES details are illustrated in Table 1.

Pigment extraction

Waste peels of orange fruits were collected from juice center of our Bhubaneswar campus. The peels weremade into small pieces and washed with distilled water to remove any unwanted materials. The orange peels were then air dried for one hour to remove excess water. The known amount of orange peels sample was then transferred to a round bottle flask. Given amount of ethanol was added into the flask and reflux condenser was connected to it in order to prevent the evaporation loss of ethanol. The heating was continued at 50 □for about two hours with continuous stirring. After completion of 2 hours,the round bottom flask with sample was removed from the set-up and was kept for some time to get it cooled. The sample was then filtered by using whatmann filter paper (no. 1). The excess amount of ethanol and water present in filtrate was then removed by using rotatory evaporator to get the pigments in a thick and viscous solution of ethanol. The pigment from pomegranate fruits were extracted by adopting similar procedure.[29,30] The juicy pomegranate sacs were removed by hand from pomegranate fruit and the sacs were then pressed gently using mortar and pestle without crushing the seeds. The fractured sacs were then transferred to round bottom flask and the similar procedure was followed as mentioned above to extract the pigments.

RESULTS AND DISCUSSION

The UV-Visible study in ethanol solvent was carried out by diluting the viscous pigment extracts. For pigment study in DESs, little amount of viscous pigment extract was transferred to sample vial and then N_2 gas was purged to remove the excess ethanol. Known amount of DES was added to the dried pigment sample and sonicated for 10 minutes to make a homogeneous solution of pigments. The samples were then used for UV-Visible study.

UV-VisibleStudy of Orange Peel Extract

Orange, which is consumed worldwide has the waste biomass as peel and accounted for almost one fourth of the fruit biomass. This waste biomass need to be value added for sustainable development. Orange peel contains several bioactive compounds such as carotenoid, vitamic C, phenolic compounds, and antioxidants.[31–33] Among these, phenolic compounds concentration is more as compared to other components.[32] It has been established that, the color of orange peel is primarily due to presence of phenolic compounds.[33] Moreover, it is the hesperidin that is present as the major constituent among the other phenolic compounds.[32]. Hesperidin is a flavonoid having hesperitin as aglycone. Typically, there are two major absorption peaks observed for hesperidin. One peak is around 280 nm (referred as band II in flavonoids) and the other is observed around 330 nm (Band I).[31] As can be seen from Figure 1, we also observed peaks at similar positions one at 274 nm and the other is at 329 nm in ethanol. The absorbance at lower wavelength (274 nm) is believed to be due to the benzoyl ring.[34] We have investigated the absorbance of orange peel extract in three different DES. The DES 1, that is composed of lactic acid-citric acid-water is presumably providing an acidic environment to the hesperidin pigment due to the inherent acidic nature of DES 1 components. However, the same acidic environment seems to affects the hesperidin structure differently and in such a way that, at lower wavelength we observed a hypsochromic shift to 253 nm and at higher wavelength a bathochromic shift to 337 nm (Figure 1). Almost exact spectral observation has also been noticed for DES 2, that is

composed of citric acid-glucose-water. DES 3 composed of lactic acid-glucose-water also shows similar spectral behavior as that of DES 1 and DES 2. However, for DES 3 a new peak has also been observed in the visible region at 543 nm. The peak at 543 nm could be attributed to the presence of carotenoid in the orange peel.[35] This indicates that, the components of DES 3 is presumably providing a favorable environment to carotenoid pigments for structural changes that leads to absorbance in visible region. Further, the extracted pigments produce similar spectral signature in both DES 2 and DES 3. Therefore, we may conclude that citric acid which is present as a common component in both the DES is probably playing a major role in deciding the spectral behavior.

UV-VisibleStudy of Pomegranate Extract

The pigments extracted from pomegranate is rich in Anthocyanin (ACN).[30,36] ACN pigment belongs to flavonoids family andchemically ACN is a glycoside of anthocyanidin. The predominant sugar substituents in ACN includes glucose, xylose, arabinose, galactose, and rhamnose.[37] The C6-C3-C6 backbone is mainly responsible for strong UV-Visible absorption of ACN.[38] However, the different substituents attached to the flavonoid base play a crucial role and decide the spectral shift in the UV-Visible spectrum. The spectral characteristics of ACN are hugely complex and depends upon several factors such as concentration, pH of the medium, temperature, solvent type and so on. Herein, we have investigated the ACN's spectral behavior in a common solvent ethanol and in three prepared DESs. In general, there are two absorption maxima peaks observed for ACN, one is between 270-290 nm (UV-B region) and the other is in visible region of 500-550 nm.[38]

As can be seen from Figure 3, the λ_{max} observed for ACN pigment in ethanol was 276 nm and 526 nm. The peak at 276 nm is more intense than the peak at 526 nm. However, ACN extracted from S. luehmannii and S. wilsonii shows more intense peak at 526 nm that correspond to malvidin-3,5-diglucoside.[39] This observation suggest that, aglyconemalvidin content is less in pomegranate. However, if we look at the spectrum of ACN in DES 2, both the peaks at UV-B region and visible region have almost equal intensity. This observation suggests that, aglycone responsible for absorption in UV-B region has undergone structural changes in the DES 2 environment that composed of citric acid-glucose-water. Furthermore, both the peaks have undergone bathochromic shift (282 nm, 529 nm) in DES 2 solvent environment as compared to ethanol. Furthermore, in DES 2 solvent there exist a shoulder peak near about 615 nm which is not observed in ethanol. In DES 1 solvent that is composed of lactic acid-citric acid-water, both the peaks were shifted hypsochromically towards lower wavelength (271 nm, 521 nm) compared to ethanol environment. Kammerer observed that pH has the effect upon the ACN absorption.[40]. Therefore, we may

infer that presence of two acids in DES 1 may be playing a role in hypsochromic shift of ACN in this green solvent. Furthermore, the absorption intensity at UV-B region and visible region are almost similar suggesting that aglycone content correspond to UV-B region has been reduced in the presence of acids of DES 1. In DES 3, that is composed of lactic acid-glucose-water, the ACN shows almost equal intensity peaks at both the UV-B region and visible region. Moreover, the peak at visible region does not show any appreciable shift whereas UV-B region peak shows significant bathochromic shift (294 nm). Emergence of another new peak in DES 3 environment at 369 nm can also be seen from Figure 3. This may suggest that, one of the aglycone which was suppressed in other chemical environments has emerges in this favorable chemical environment of DES 3. One common trend of ACN behavior in all the investigated DESs is intensity at both UV-B region and visible region are almost similar as opposed to ethanol where UV-B region peak is more intense. Furthermore, all the three investigated DESs provides almost similar chemical environment as there was not significant shift in both the peaks for ACN with an exception of DES 3 where a significant shift in UV-B region is observed.

CONCLUSIONS

In this work we have investigated the behavior of extracted pigments from orange peel and pomegranate in three DESs. The three component DESs lactic acid-citric acid-water, citric acid-glucose-water, and lactic acid-glucose-water were prepared by using these components in a molar ratio of 1:1:4. Both the extracted pigments have shown two major absorption peaks. For orange peel extract, in all the three DESs while the peak at lower wavelength shows hypsochromic shift, the peak at higher wavelength shows bathochromic shift. Moreover, for DES 3 there arises an extra peak in visible region. For pomegranate, while DES 1 shows hypsochromic shift in the UV-B region, DES 2 and DES 3 shows bathochromic shift. Furthermore, in visible region while the DES 2 shows bathochromic shift, DES 1 and DES 3 shows hypsochromic shift for the pigments. As observed for orange peel extract, pomegranate extract also shows an extra peak in DES 3 environment. From this observation, we may conclude that DES 3 which is composed of lactic acid, glucose and water is somehow favoring the pigments in their structural arrangements thereby resulting the spectral shift and emergence of a new peak. The information obtained from this work can be used to explore the possibility of using the natural pigments as a photosensitizer along with DES as an electrolyte for improving the efficiency of dye sensitized solar cell.

ACKNOWLEDGEMENT

We are thankful to Department of Chemistry, School of Applied Sciences, Centurion University of Technology and Management, Odisha for their generous research support

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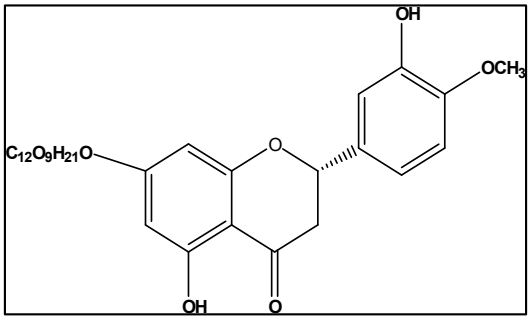
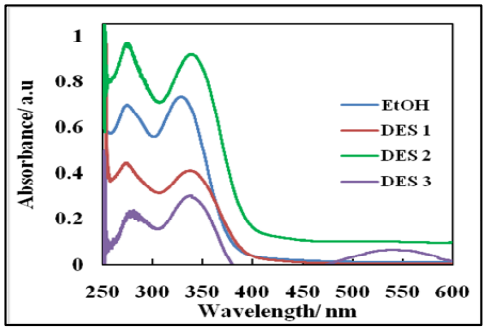
Table 1: Components of prepared DESs along with their respective molar ratio

DES	Combination	Molar ratio
DES 1	Lactic acid-Citric acid-water	1:1:4
DES 2	Citric acid-Glucose-water	1:1:4
DES 3	Lactic acid-Glucose-water	1:1:4

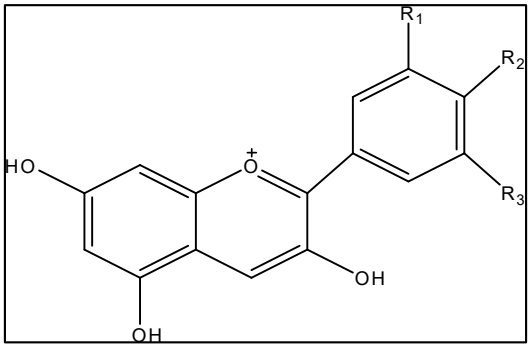


(a)



(b)

Figure 1: (a) Hesperidin chemical structure, (b)UV-Visible spectrum of pigments (extracted from orange peel) in different solvent systems



	R_1	R_2	R_3
Pelargonidin	H	OH	H
Cyanidin	OH	OH	H
Delphinidin	OH	OH	OH
Peonidin	OCH_3	OH	H
Petunidin	OCH_3	OH	OH
Malvidin	OCH_3	OH	OCH_3

Figure 2: Structures of the commonly occurring anthocyanidins

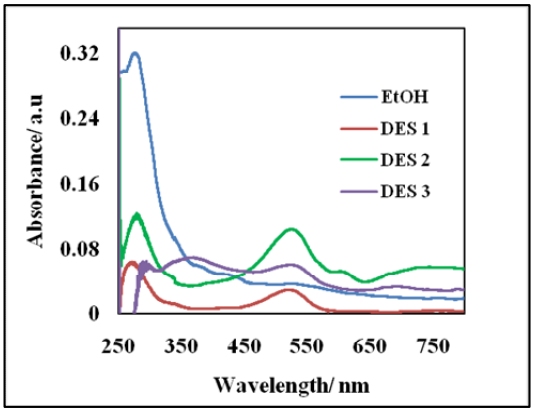


Figure 3: UV-Visible spectrum of pigments (extracted from pomegranate) in different solvent systems

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Parameter Selection in MMAW for Reduction in Power Consumption

Sudeep Kumar Singh*, A. M. Mohanty and R.C.Mohanty

Department of Mechanical Engineering , Centurion University of Technology and Management, Odisha, India.

Received: 01 Mar 2020 Revised:04 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
Sudeep Kumar Singh
Department of Mechanical Engineering ,
Centurion University of Technology and Management,
Odisha, India.
Email: sudeep.singh@cutm.ac.in

ABSTRACT

Selection of optimum input parameters in joining processes has a crucial impact on the intended joint quality and resource consumption,e.g., power. The Manual Metal Arc Welding (MMAW) of mild steel is most popular among all welding processes, as it provides a low-cost solution, finds extensive application in structural work, repair & maintenance. The present study focuses on the selection of optimum joint parameters in MMAW of low carbon alloy steel, considering joint quality parameters and power consumption during the welding operation. The experimentsconducted are designed using Minitab 18 software. The transverse tensile strength of the joints and the impact energy of the joint area are measured as quality parameters of the welded joint. Measurement of power has been performed using a power analyzer. Artificial Neural Network is employed for training the data obtained from the experiments conducted using Bayesian regularization 'trainbr' learning function. The regression analysis model was implemented in MatlabR2019a to establish a relationship between the input and output variables to help predict the best possible combination of joint input parameters.

Keywords: MMAW, Arc Welding, ANN, Taguchi, Mild Steel.

INTRODUCTION

Shielded Metal Arc Welding (SMAW) aka Stick welding of Low carbon alloy also termed as Mild Steel (MS)finds wideapplication in structural frames, pipelines, visually aesthetic designs, and repair due to its high ductility and weldability properties [1, 2, 3]. Welding remains the most widely adopted joining process in the industry despite its high energy-intensive property. Selection of proper welding parameters is very important in a multi-input multi-output process like welding [4, 8]. The mechanical properties of welded joints largely depend on process parameters used in the manufacturing process [5]. The welder generally focuses on the quality aspects of the produced joints and pays lesser attention towards the process parameters. In practice, the process parameters selectedimpartslarge

influence on the resources consumed like welding quality, percentage of rework/rejection, and energy consumed. Power consumption is one among many factors responsible for the negative environmental effects generated from welding operation, raising the need for characterization of the SMAW process considering sustainability aspects [3, 6]. Thus the present study intends to draw a relationship between the fourinfluential input parameters and the three output parameters adopted for investigation.

Adnan et al. [4] carried out Pareto Analysis to find uncontrollable input parameters of GMAW welding process. They developed three different ANN models for input, output parameter prediction and classifying products. ANN was also employed for investigating the effects of process parameters in laser welding of AA5754 aluminium alloy [7]. Two parameters welding speed and shielding gas were varied,and the optimization process was implemented using an Excel add-in named Neural Tools. In yet another study, authors developed two different ANN models one for classification of defective products and other for prediction of input parameters [8]. Welding processes havea poor environmental image for which optimization of key welding parameters is very crucial. A hybrid approach involving neural network and fuzzy logic is used for optimizing SMAW process parameters from sustainability approach [6]. Current, voltage and welding speed are considered for analysis. Welding of dissimilar metals involving Al alloy and stainless steel has been studied using laser-arc welding technique [9]. Taguchi is used for studying the effect of various welding parameters to get optimum parameters of angular distortion in SMAW [10].TIG welding parameter has been optimized using response surface methodology (RSM), central composite design on mild steel [11], and grey wolf optimizer [12] on high strength low alloy 15CDV6 steel. RSM has also been adopted for optimizing GMAW parameters for welding Mild Steel IS:2062 [13]. Authors [14] have developed model for prediction of mechanical and microstructural properties of copper plate welding using Friction Stir Welding. RPLNN and GA have been used involving three input and two response parameters.

Weld quality considering tensile properties and microstructure were analyzed based on power distribution using an arc assisted fiber laser welding of Al-Mg alloy [15]. Tensile and impact properties in multi-pass SMAW have been investigated by Saxena et al. for determining the influence of welding consumables in Armox 500T alloy [16]. Mechanical properties and microstructure of MS welded parts under varying current was analyzed using E7016 electrode [1]. Highest tensile strength was obtained at 75A with minor welding defects. Sheets of different thicknesses welded using SMAW and GMAW were investigated for finding a new set of welding parameters for structural grade steel welding in [5]. The main aim of the current research work is to study the influence of varying input parameters on the output quality of the joint. The arrangement of the paper is as follows. The experimental procedure is explained in section 2. Next section discusses the outcomes of the experimental and test results. The fourth section presents conclusions obtained from the analysis and also provides directions for future scope.

EXPERIMENTAL PROCEDURE

The present researchfocusses on Arc welding of Low carbon alloy steel. The plan of the experiments is presented in the form of a flow chart in figure no 1. Mild steel plates of different thicknesses 3mm, 5mm, and 10mm (three levels) were utilized in the welding process. The welding parameters; current, joint gap and face width were also varied during the experiment. The input parameters considered in the investigation are welding current plate thickness, root gap, face width, and the output parameters are Ultimate Tensile Strength (UTS), impact energy, and energy consumption. The input parameters (factors) involved in the study are presented in table no 1. The raw materials were first cut to a rectangular shape havinglength 200 mm and width 100 mm. One longitudinal edge of each plate was beveled to produce a single. V-groove butt joint. The including the angle of the V-shaped joint is60^0 for all the MS plates used. The chemical composition of the plates was tested using XRF spectrometer,and the obtained values are tabulated in table no 2.

The data in table no-2 displays close conformance of iron percentage in both the workpiece and filler. The filler rod used in the welding process is 3.15 mm diameter Superweld E6013 manufactured by ESAB. The XRF samples for both the types were prepared by grinding on a surface grinder. The plates were cleaned properly using a solvent to remove all dirt, rust present on the surface of the material to be welded. It is followed by welding the plates using process parameters obtainedfrom TAGUCHI orthogonal array design presented in table no-3.

The SMAW process

Similar to the raw material of three different values the input current has also been varied to three different current values were adopted for the experiments as 90, 110, and 130 amperes. Remaining two input variables are root gap and face width. Three different values were considered for both the variables as 0, 1 and 2. All the varying parameters taken together including theplate thickness values, the total number of factorsinvolved in the experimental design becomes four.The number of levels for each factor is three. Thus if the full factorial design of experiments were to be considered, the total number of experiments calculated becomes 27. To reduce the number of experiments Taguchi Design of Experiment (DoE) method was adopted. Using L9 Taguchi orthogonal array design for a four-factor and three-level experimental design, the total number of experimental runs were reduced to nine. The experimental design adopted for the experiments is presented in table no 3. The welding process was carried out by usingRS400 a Thyristorised MMA welding machine manufactured by ESAB India Ltd. The machine is equipped with 50 Hz 3-phase power supply with an input voltage of 415 volts and 27-ampere current. The welding runs were carried out using the AC power supply.

A 3-phase power analyzer, model no DPATT-3Bi, manufactured by Uma Electronics Enterprises, Jaipur India,was used for measuring the instantaneous power consumption values during the arc welding process. A three-phase four-wire connection was used in the process of measurement. Table 3 presents the four factors and the values of the three levels of process parameters adopted in the experimental runs. It displays the values of different process parameters used in the welding process. Four different parameters; welding current, plate thickness, root gap, and face width are used for designing nine number of experiments. The welding speed was considered constant throughout the experiment. The platesof 3 mm thickness were welded usingsingle pass of welding, but multiple runs were necessary for plates with 5 mm and 10 mm thickness. The former was welded with two passes, and for the later three number of welding passes were used. In total nine number of welding joints were produced and processed further for preparing test samples for tensile and Izod impact test conducted. The details of the test procedure and results have been explained in the next section.

Testing

The mild steel plates after welding were properly cleaned to remove the slag deposited during welding by using chipping hammer and wire brush. Tensile test and Izod test specimens were extracted from the welded plates of different thicknesses with the respective dimensions, presented in figure-2 and figure no-3 respectively. Welding beads were removed by grinding from the welded surface for both the tests Tensile testing was conducted on a Universal Testing machine manufactured by Blue Star Engineering & Electronics Ltd., having a maximum capacity of 1000kN. The test specimens made to undergo the tensile testing procedure, and the Ultimate Tensile Strength values for each test specimen was noted. The samples prepared for Izod test were tested using Impact test machine and values of energy absorbed before failure for individual specimen were recorded. The values of UTS and Energy absorbed has been presented in table no. 3 under respective columns. Figure no. 4 displays the phases of sample preparation for tensile testing and the broken samples after conducting the tensile and Izod tests.

Artificial Neural Network modeling

Neural networks find a wide application and recognized as efficient solvers of non-linear problems. Successful applications have been reported in literature containing real-world problems. Thus ANN has been selected for finding optimum input parameters for SMAW in the present study. The architecture for the employed neural net is presented in figure no 5.

An Artificial Neural Network was modelled for training using the data collected from the conducted experiments. Bayesian Regularization backpropagation method is used for the construction of the network. This method is generally used for difficult, small and noisy datasets. In the current construction, the data set is small and prone to noise in the measured value; thus,the application of Bayesian Regularization fits our requirement. '*trainbr*' learning function is used in the Matlab R2019a platform. The network takes 70% of data for training, 15% for validation and 15% for testing. The ANN model developed in this study involves an input layer, one hidden layer, and one output layer. The input layer consists of 3 neurons; each neuron corresponding to individual input parameters and the output layer containing 4 neurons, representing one output parameter each. The hidden layer employs 50 neurons. The most promising network architecture is based on trial and error method for which many trials have been conducted to arrive at the best combination. The performance of the network has been discussed in detail in the conclusion section.

Figure nos. 6-10 present the performance output of the designed neural network. Figure no. 6 network training regression plot for all the three phases of training, validation, and testing. Network training error histogram is presented in figure no. 7. Network training state in figure no. 8. and figure no. 9 network training performance. The final figure no. 10 presents the overview of network performance.

The trained network consisted of three segments; the first is the training phase, in which the 70% of data is used for training. This phase establishes a suitable relationship between the input and output values by adjusting the weights assigned to the neurons. The next phase validates the training using 15% data. The remaining data is used for testing the network. As a result the network becomes capable of finding suitable input parameters (current, plate thickness, root gap, face width) for arc welding for any given set of desired output (instantaneous power consumed during welding, UTS of the joint and impact energy absorbed by the joint).

CONCLUSION

The current work involves four input and three output variables for SMAW welding of structural grade mild steel. The quality of the welding has been tested by measuring UTS of the welded joint by applying load in transverse direction and measuring the energy absorbed by the joint before fracture through Izod impact test. The input and output were fed into an ANN network suitably designed for the purpose. The data showed best parameter set converging at 493 iterations. The modeled network is capable to select all the four types of input parameters considered in the present work based on desired values of output parameters like energy consumed, UTS and impact energy. This work can be extended to other welding methods. Other crucialvariables not considered in the present work may be considered as future research scope.

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Table 1: Input Parameters

Sl. No.	Factors	Level 1	Level 2	Level 3
1	Plate thickness	3mm	5mm	10mm
2	Welding current	90A	110A	130 A
3	Root gap	0mm	1mm	2mm
4	Face width	0mm	1mm	2mm

Table 2: XRF result for Base metal and filler wire

Sl No.	Base material	Si	Mn	S	P	Fe
1	Mild Steel plate	0.720	0.709	0.132	0.029	96.840
2	Filler wire	1.451	0.437	0.125	0.034	96.115

Table 3: Joint parameters based on Taguchi

Sl. No.	Current (A)	Plate thickness (mm)	Root gap (mm)	Face width (mm)	Power (in kW)	UTS (in MPa)	Impact energy (in Joule)
1	90	3	0	0	3.88	481	38
2	90	5	1	1	4.36	411	48
3	90	10	2	2	4.42	305	51
4	110	3	1	2	4.66	295	32
5	110	5	2	0	5.09	501	35
6	110	10	0	1	5.43	406	40
7	130	3	2	1	5.47	458	35
8	130	5	0	2	5.97	362	42
9	130	10	1	0	6.49	329	60

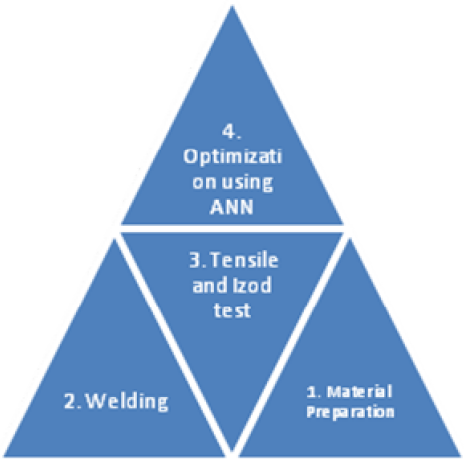

Figure 1: Experimental Procedure

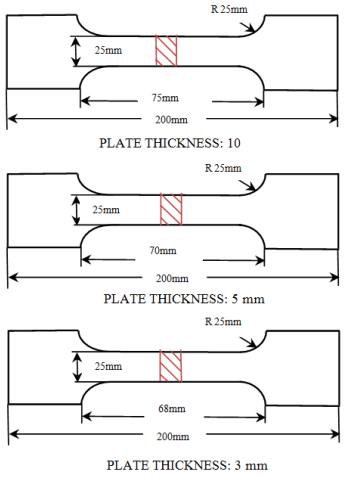

Figure 2: Tensile test sample dimensions

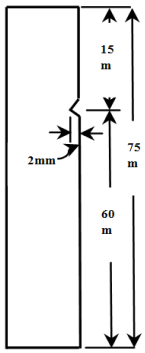

Figure 3: Izod test sample dimensions

Figure 4: (a)Preparation of tensile test sample

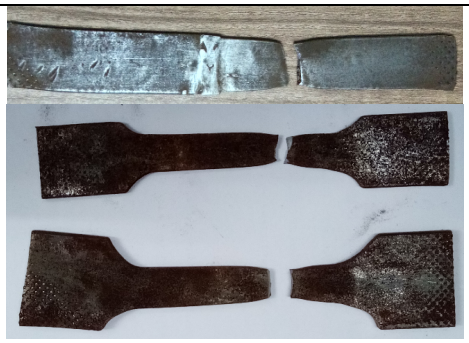

Figure 4. b)Tensile test sample after fracture

Figure 4. (c) Izod samples after failure

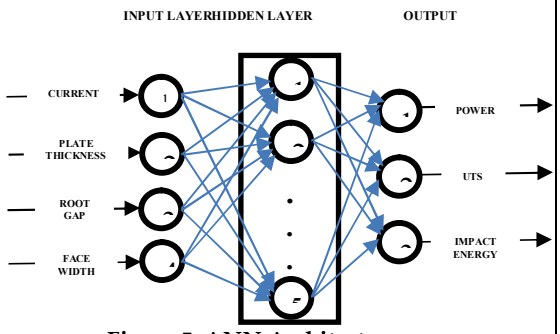

Figure 5: ANN Architecture

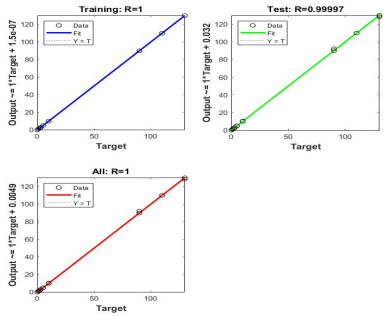

Figure 6: Regression Plot

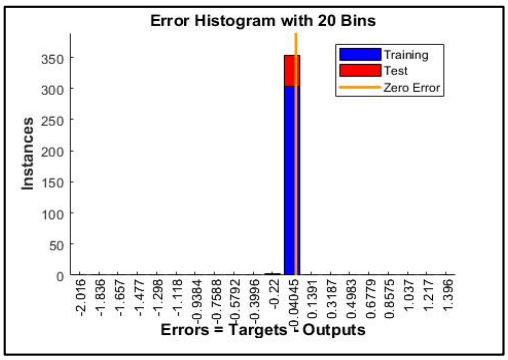

Figure 7: Error histogram

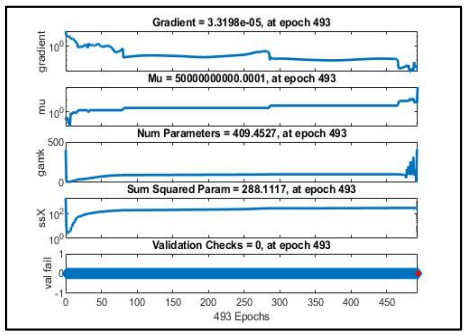

Figure 8: Training state

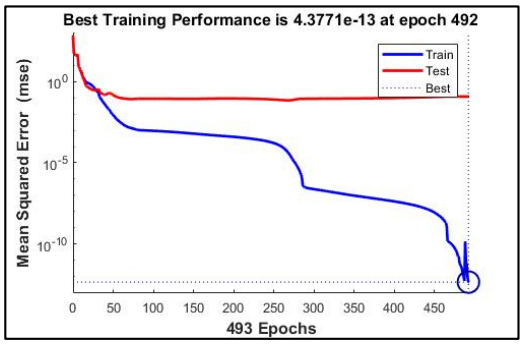

Figure 9: Training performance

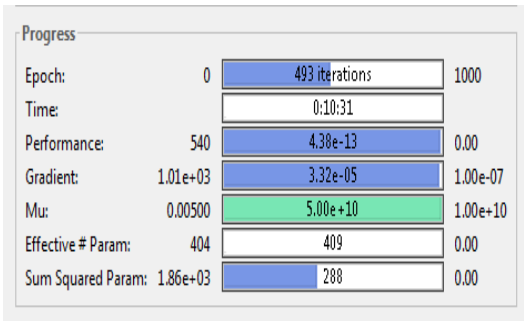

Figure 10: Network Training progress

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Reverberation of Physico Chemical Factors on Marine Macro Algal Diversity, Karwar Coastal Area, Arabian Sea, India

Gulnaz Qureshi* and J.L.Rathod

Department of Studies in Marine Biology, Karnatak University, Post Graduate Centre, Kodibag, Karwar, Karnataka, India.

Received: 17 Feb 2020 Revised:20 Apr 2020 Accepted: 22 May 2020

***Address for Correspondence**
Gulnaz Qureshi
Department of Studies in Marine Biology,
Karnatak University, Post Graduate Centre,
Kodibag, Karwar, Karnataka, India.
Email: Afreensyed115@gmail.com

ABSTRACT

The present study investigates the seasonal variation between physico-chemical parameters and seaweeds diversity with its abundance profile of Majali Beach,West coast of India. Quantitative samples were collected on fortnightly basis from Jan 2018 to Jan 2019 at Majali Beach. Stastistical analysis of correlation were performed on physico- chemical parameters such as salinity, dissolved oxygen, pH, Air temperature, water temperature, other nutrients (nitrate, nitrite, ammonium and phosphate) and abundancy of seaweeds between different seasons. A total of 39 species were identified influenced by environmental parameters of which 14spp belongs to Chlorophyta,10spp belongs to Phaeophyta and 15 sppto Rhodophyta. Throughout study period, the occurrence and abundant species of seaweeds were observed in pre-monsoon and postmonsoon.The seaweeds species showed significant changes according to seasonal variation as well as the nutrient availability. The performed statisticalanalysis on seaweeds diversity depicts the Shannon and Weiner diversity index, Margalef's richness index, Pielou'seveness was found to be higher in Pre monsoon and lower in Monsoon.The canonical correspondence analysis (CCA) was used to strength the seasonal relationship between seaweeds diversity and physico -chemical parameters.Hence the excecuted correlation ($p<0.05$) and CCA results revealed a strong connection of environmental parameters on seaweeds diversity both positive and negative.

Keywords: Environmental parameters, Seaweeds ,Abundance, Correlation,CCA

INTRODUCTION

Seaweeds are multicellular benthic marine macro algae which are gigantic, complexed differentiated thallus attached forms that show high diversity on rocky shores where they are subjected to tides and waves[1]. Seaweeds are

valuable renewable marine living resources which are classified based on pigments, morphological and anatomical characters into green algae, brown algae and red algae[2]. Seaweeds are key space occupiers ofrocky shores called as ecological engineers and economical resources which provide substantial support to primary production, plays central role in coastal and marine biodiversity [3];[4];[5];[6]. Seaweeds are excellent Bioindicators of eutrophication, biological processes, mineral detectors and anthropogenic impacts on communities in coastal areas helpful in studying diversity patterns of conservation, sustainable use of marine resources and climatic conditions.[7];[8].

Seaweeds generally grow abundant and nuture in hospitable environment wherever suitable substratum for attachment, adequate illumination optimal temperature for growth and reproduce with constant supply of inorganic nutrients which aid in flourishment of macroalgae. The assessement of ecological requirements such as rhythms in response to temperature changes,light may affect the behavior throughout their life history from juveniles to developmental mature stages.One set of harsh environmental factors may suffice the juvenile stages and hindrance to the upcoming phases in their life history leading to sterile distribution in their forthcoming successions[9]. Spatial and temporal variation in seaweeds distribution are affected widely by physico-chemical environmental parameters which alters species composition and diversity of seaweeds in marine coastal areas.Generally the seasonal fluctuations among variables brings in substantial changes in nutrient cycle by various abiotic processes, upwelling, regional rainfall and tidal amplitude.

The present study aims to determine the species diversity of marine macro algae present in intertidal area of coastal shoreline by biomonitoring the physico chemical characteristics of coastal marine ecosystem.The study will also aid in creating a new baseline record for future biomonitoring studies in this coast by assessement of relationship of physico chemical characters with marine macro algae of marine coastal area of Karwar for a period of thirteen months from Jan2018 to Jan2019.

MATERIALS AND METHODS

Description of study area

A survey of study area of Karwar coast (Fig 1) ,Majali (Lat:14^{o}53′54.42″ N Long:74 ^{o} 05′ 45.65″ E) was carried out in order to know the relationship between diversity of Marine macro algae influenced by physico chemical parameters for about thirteen months from Jan 2018 to Jan 2019.

Sampling

On fornightly basis seaweeds were handpicked from Intertidal region during low tide using random sampling quadrant technique and brought to Laboratory in polythene bags.Samples were carefully washed and were used for Herbarium preparation , left over samples preserved in buffered formalin (4%). Authentication of samples were done through standardized Taxonomical Keys Manuals[10];[11];[12];[13]and www.agalbase.com. The monthly physico chemical parameters analysis such as Temperature was done by Thermometer ,Salinity Using Refractometer, Dissolved Oxygen using hand held DO meter((HACH), pH by pH meter on site itself, Nitrate, Nitrite and Ammonium nutrients were analysed insitu by using NICE Marine water analysis Kits which is improvised method concerned to nutrient analysis [14]. Occurrence of seaweeds and seasonsclassified as Pre Monsoon (Feb-May),South West Monsoon (Jun-Sep) and Post Monsoon(Oct-Jan) were represented in Table 1.

Statistical analysis Canonical Correspondence Analysis and Correlation were used to determine relationship between environmental parameters and seaweeds diversity(fig 4 and 5).Ecological diversity indices that is Shannon index(H),Species Richness (Margalef's index) and Pielouseveness(J) were calculated by using PAST Software (fig 2).Seasonal variations in physico chemical parameters and seaweeds diversity were depicted by lines and circular diagrams using PAST Software(fig2 and 3).

RESULTS AND DISCUSSIONS

Assessment of physico chemical parameters of water

The variation, distribution and diversity of seaweeds in marine ecosystem were influenced by seasonal changes in environmental parameters like light exposure, seashore characters and temperature[15].It is important to study the hydrological parameters to distinguish the differences in seaweed diversity on seasonal scale which aid in abundant luxuriant growth of seaweeds in hospitable environment with adequate illumination, substratum, optimum temperature, nutrients, salinity and tidal amplitude [16]. The environmental parameters which influenced the succession of seaweeds diversity were depicted seasonally (fig 3). Physicochemical parameters showed both positive and negative correlation ranged between +1 to -1,the intensity of correlation were depicted by circumference and size of circle which turns feeble with weak correlation(fig4).The shaded circles in (fig 4) describes $p < 0.05$,showing positiveand negativerelation between environmental parameters and seaweeds abundancy. Labels in the figure is referred to (table1).

Temperature is an important factor for marine environment as it influences the life of organisms living in marine ecosystem [17].Air temperature varied from 25.1^0C -30.6^0C, with mean of 28.52^0C.Water temperature ranged from 24.3^0C -29.0^0C,with mean of 26.7^0C. Seasonal variation in temperature may be attributed with wind force, rainfall, tidalamplitude, and wave currents of respective coast.The often variation noticedin water temperatures are mainly due to seasonal changes and rainfall [18]both water and air temperature fluctuations results due to topography of the location and differ from seasons to seasons [19].The low temperature could be attributed due to heavy rainfall received during monsoon season. Temperature reduction of water depends on rainfall and fluctuation in air temperature.

Salinity

Salinity ranged from 15ppt to 35ppt with mean range of 29.84ppt. Salinity plays a major role aslimiting factor since it controls the faunal and floral diversity of coastal ecosystems [20];[21].Generally higher intensity of solar illumination during summer results in higher salinity due to water evaporation in rocky pools and reduced salinity during monsoon is result of heavier rains and fluctuations in tidal amplitude[22];[17]. pH is variable in water quality assessement in aquatic ecosystems influenced by many chemical and biological processes.Acidification of seawater occurs when atmospheric carbondioxide released via man made anthropogenic activities results in lower pH levels in sea waters during monsoons altering biological systems [23].Variation in pH occurs due to rainfall,rate of evaporation of water increasing salinity and other biological processes. Dissolved oxygen ranged from 4.2mg/L to 6.6mg/L,with mean of 5.53mg/L. Dissolved oxygen is a major component which depicts the water quality and aquatic life supporter .Higher Dissolved oxygen and fluctuating range is due to wave currents refilling deficient oxygen in water ,oxygen dissolved from atmosphere and higher tidal amplitude. Duringpre monsoon the dissolved oxygen was recorded to be least in measurement due to high levels of temperature ,salinity and biological activities[24];[25]whereas higher in monsoon as a result of variation in seasonal impact across coastal areas .

Nutrients

Substantial nutrient variations occurs in nitrate, nitrite and ammonium due to factors like rainfall, tidal ingress and anthropogenic activities(heavy sewage water inflow). Nutrients ranged in variable amount, nitrate from 2 to 4.3mg/L,Nitrite from 0.1 to 0.5mg/L,ammonium from 0.3 to 1.9mg/L and lastly phosphates from 0.2 to 1.7mg/L.Higher concentrations of nutrients during premonsoon and monsoon due to anthropogenic activities contamination, heavy rainfall, upwelling, storms, cyclones, high rate of biological production, oxidation of ammonium ,reduction of nitrate and vice versa interlinked nutrient cycles[26];[20].

Seaweed composition and diversity

Seaweed composition, diversity and its proliferation, development and quantification are majorly determined by physico chemical parameters of coastal area. A total of 39 species of seaweeds were recorded belonging to 3 phyla:14 species belongs to Chlorophyta,10species to Phaeophyta and 15 species to Rhodophyta influenced by environmental parameters. Species composition and abundancy was more for Class Phaeophyta and Rhadophyta in pre monsoon and post monsoon where as balanced species composition of Chlorophyta occurred in all three seasons, highest for *Ulva* species in monsoon. The species composition and its abundance recorded is presented in(table1). Seasonal variation in seaweed species diversity index and eveness is illustrated in (fig 2).The seaweed species diversity ranged from 2.26 in premonsoon to 2.10 in postmonsoon where as Pielou'seveness ranged from 0.87 in premonsoon to 0.84 in monsoon as depicted in (fig2) .

Canonical correspondence (CCA) of seaweeds and Environmental parameters

CCA was performed to find out relationship between environmental variables and seaweeds abundance. Similar CCA was performed between environmental parameters and seaweeds distribution [27];[28]. Important environmental parameters communicating relationship with seaweed abundancy were identified with CCA and represented in (fig5). Environmental parameters are depicted by line arrows extending at variable lengths.During season variations from premonsoon to post monsoon axis 1 and 2 in CCA depicts 75.15% and24.85% of variability in species environment triplot (fig5). *Ulva* species show positive relation with axis 1 and negative relation with axis 2, which states that phosphate and nitrate aid in abundancy of family Ulvaceae and parameters like salinity, temperature and ammonium in decreased amount promote the growth.FamilyCladophoraceae ,some species shows negative relation with axis 1 where as positive with axis 2 and vice versa which showed these require optimum environment parameters to flourish. Maximum species diversity of seaweeds recorded during Pre monsoon and Post monsoon which attributed to favourable hospitable environmental conditions with respect to variable parameters like temperature, salinity,nutrients, fluctuation in dissolved oxygen similar results were put forth by [29] surveying the Bhimili east coast of India,[30]depicted in seaweeds resources of India,[13] studying the environmental parameters of Karwar bay and [31] studying the Malvan andKunakeshwar in Sindhudurg district of Maharashtra. In current studies the maximum diversity of seaweeds were recorded in premonsoon and post monsoon season for Phaeophyta and Rhadophytawhere as Chlorophyta especially family *Ulvaceae* flourish in monsoon. Suitable pH range for growth is 6.8-9.6[32], optimum salinity range is 30-35 ppt [32];[33].The amount of nutrient materialscontrol the algal population.[34] described the food consumption ability of algae on soluble nitrogen,phosphorus,posstasium and other compounds in waters.

From CCA it is understood that in premonsoon,airtemperature,watertemperature,ammonium,pH and salinity are negatively correlated to the abundancy of species as parameters decreases abundane,patchiness and distribution increases.species like *Chaetomorpha antennina, Gracilaria corticata* and *Cladophora sercenica* grows good at high temperatures. [35] stated that the amount of algal flora may be extensive or small depending on temperature, concentration of nutrients and light exposure.Saliniy influences *Cladophora sercenica* requires optimum salinity regime where as *Chaetomorpha antennina, Gracilaria corticate* grows at high salinities. *Ulva* species proliferate at different fluctuating salinities. Salinity acts as a major ecological parameters for living and distribution , variation in dilution and evaporation has greater impact on floral and faunal coastal ecosystems[36]. *Acanthophora muscoides, Acanthophoa spicifera* requires optimum ammonium and were abundant in pre monsoon and post monsoon,similar results were depicted by[31].

In Monsoon,positive correlation were noticed in Dissolved oxygen,nitrate and phosphate and negative with salinity ,nitrite and temperature which aid few species survive and grow with changes in salinity regimes. mostly *Ulva compressa ,Ulva clathrata, Ulvaprolifera* and *Ulva flexuosa* flourish in monsoon with high dissolved oxygen,nitrate and phosphates with salinities fluctuating from 15 to 35ppt.similar reports were countered by [37] for *Ulva compressa* species with high tolerance of salt and regime upto 0 to 34psu, development of species is restrained in low concentration of chlorides most effective 6-8psu.Increased rate of phosphates in monsoon corelates with

photosynthetic rate in *Ulva compressa* positively and increased growth of thalli[38].Salinity is negatively correlated with thalli mats and thalli length of macro algae.Higher salinity inhibited the thalli elongation and development led to decrease in young algae thalli abundancy,similar observation in current study in *Ulva clathrata.* [27]performed PCA on *Ulva* species and concluded salinity affects morphological characters of *Ulva*.In post monsoon species from Sargassaceae and Sphacelariaceae families flourished , rejuvenate and developed well. From Rhadophyta *Hypnea musciformis, Hypnea valentine, Centroceras clavulatum,* and *Grateloupia lithophila* were abundant with optimum environmental parameters .In Chlorophyta *Rhizoclonium ramosum* and *Rhizoclonium tortuosum* flourished with suitable changes in nitrate and phosphates .Therefore it is evident from CCA executed results that environmental parameters played a important role in species composition as well as species abundancy with different seasons in scenario.

CONCLUSION

The present investigation summarizes the seasonal fluctuations in physico chemical parameters and seaweeds diversity at Majali ,West coast of India.Majali coastal area is highly subjected by sewage inflow and engraving with rough sea water surface forces thus the species to be put in' scenario of survival of fittest'. It is clearly evident from study of correlation as wellas CCA that there is relation both positive and negative between the environmental parameters and seaweed composition and abundancy with major contribution by nitrate, phosphate and dissolved oxygen.Negatively correlation with air temperature,water temperature, ammonium,nitrite and salinity but differ with individual species composition and abundancy. In Chlorophyta the *Ulva*s pecies preferred nitrate,phosphate and minimal temperature for photosynthesis to thrive where as Phaeophyta and Rhadophyta requires salinity ,air temperature,water temperature and optimum dissolved oxygen.Thus it can be outlined from over all study that each family ,each individual species has different preference for environmental parameters and hence the study reveals the ability of species to withstand with probable fluctuations in coastal environment and survive.

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Table 1 Representing species composition and abundance accounting different seasons of Majali Rocky shore of year 2018 to 2019.

Marine Algae	Pre Monsoon	Monsoon	Post Monsoon
Chlorophyta			
Family Ulvaceae			
Ulva intestinalis (UI)	+	+	+
Ulva clathrata (UC)	+	+	-
Ulva lactuca (UL)	+	+	+
Ulva compressa (UCM)	+	+	+
Ulva flexuosa (UF)	-	+	+
Ulva prolifera(UP)	+	+	+
Ulva rigida (UR)	-	-	+
Family Cladophoraceae			
Chaetomorpha antennina (CAN)	+	-	+
Chaetomorpha linum(CL)	+	-	-
Cladophora vagabunda(CV)	+	+	+
Cladophora rupestris (CR)	+	+	-
Cladophora sercenica (CS)	+	+	+
Rhizoclonium ramosum (RR)	-	+	+
Rhizoclonium tortuosum(RT)	-	+	+
Phaeophyta			
Family Dictyotaceae			
Dictyota dichotoma (DD)	+	-	+
Padina tetrastromatica(PT)	+	-	-
Spatoglos sumasperum(SA)	+	-	-
Stoechospermum polypodiodes(SP)	-	-	+
Family Sargassaceae			
Sargassum cinereum (SC)	-	-	+
Sargassum swartzii (SS)	+	+	-

Sargassum ilicifolium (SI)	+	+	+
Sargasssum polycystum(SPO)	-	-	+
Sargassum tenerrium(ST)	+	+	+
Family Sphacelariaceae			
Sphacelaria tribuloides (STR)	-	-	+
Rhadophyta			
Family Rhodomelaceae			
Acanthophora muscoides (AM)	+	-	+
Acanthophoraspecifera (AS)	+	-	+
Family Ceramiaceae			
Centroceras clavulatum(CCL)	-	-	+
Family Gelidiaceae			
Gelidium pusillum(GP)	+	-	+
Family Gelidiellaceae			
Gelidiella acerosa(GA)	+	-	-
Family Lithophyllaceae			
Amphiroa fragilissima(AF)	+	-	-
Family Corallinaceae			
Jania spectabile(JS)	+	-	+
Family Halymeniaceae			
Grateloupia lithophila (GLI)	-	+	+
Family Gracilariaceae			
Gracilaria corticata(GCO)	+	-	+
Gracilaria folifera(GFO)	+	-	+
Gracilaria gracilis(GG)	+	+	+
Family Cystocloniaceae			
Hypnea valentine (HV)	+	-	+
Hypnea pseudo musciformis (HP)	+	-	+
Hypneamusciformis (HM)	+	-	+
Family Lomentariaceae			
Cerato diction intricatum (CIN)	+	+	-

+ Present, - Absent

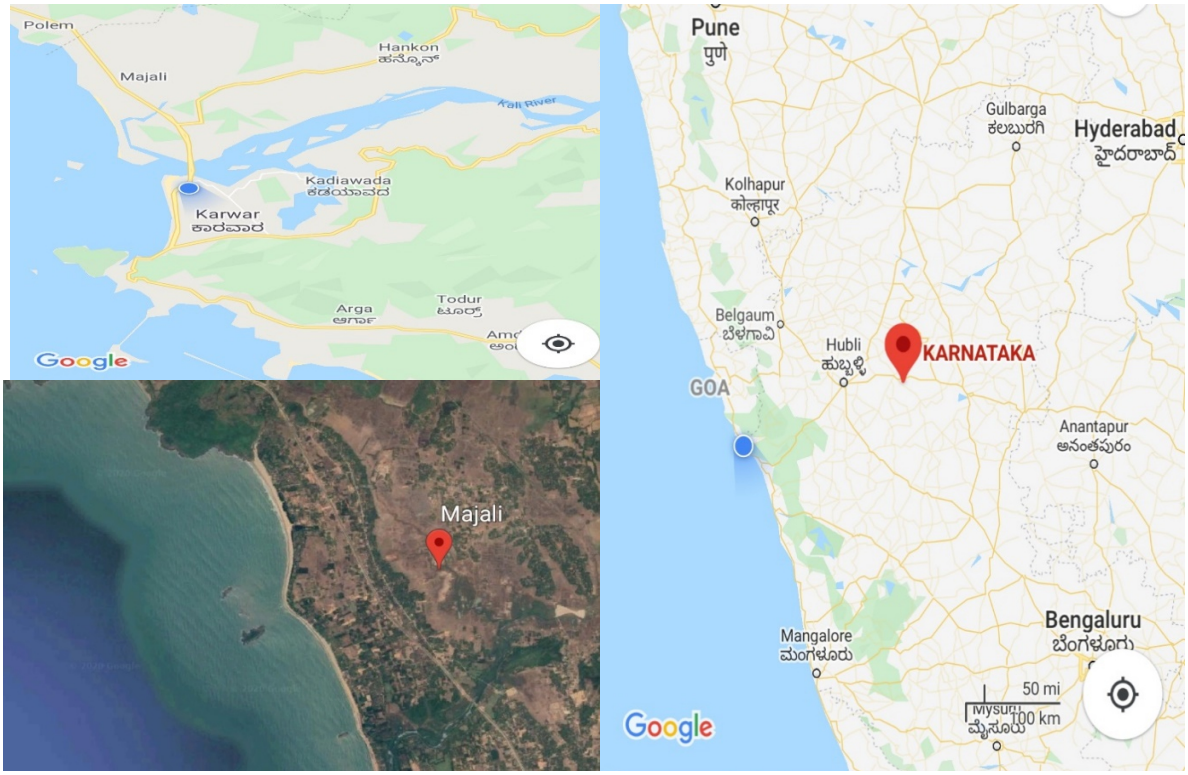


Fig.1 A map showing the study site MajaliBeach,Karnataka ,West coast of India

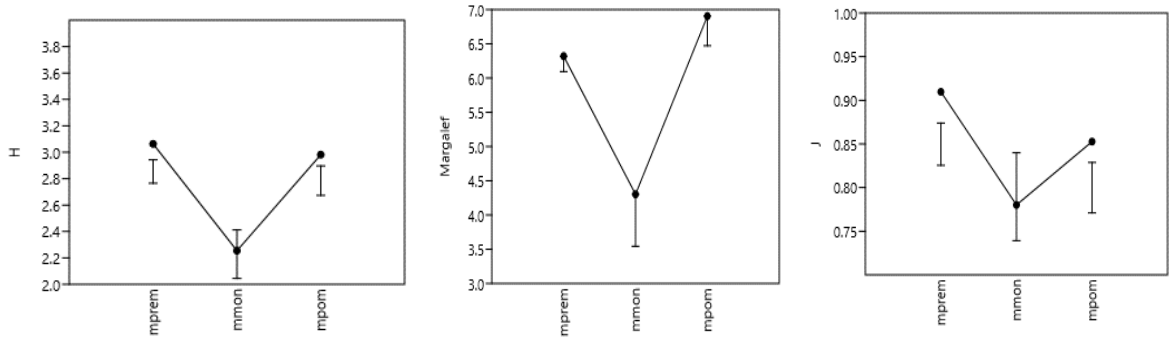
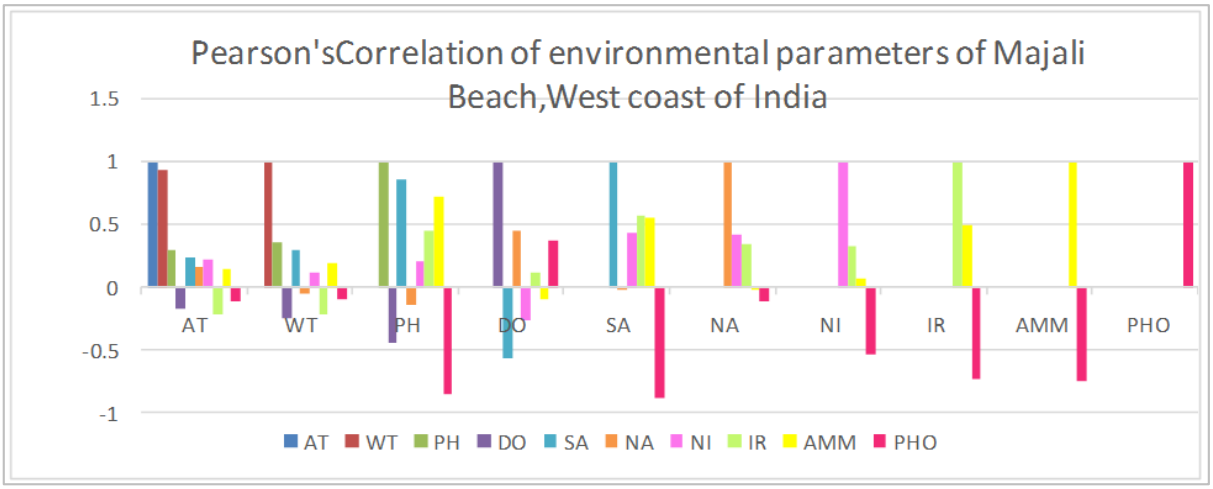


Fig.2.Various Ecological Diversity indices of species[Shannon index(H),Species Richness(margalef's index) and Pielouseveness(J)] in different seasons,Majali,West coast of India



AT-air temperature,WT-water temperature,PH-[H+],DO-disssolved oxygen ,SA- salinity,NA-Nitrate,NI-Nitrite,IR-Iron,AMM-ammonium ,PHO-Phosphate

Fig. 3. Depicting environmental parameters influencing on seaweeds diversity,Majali(Perason's Correlation)

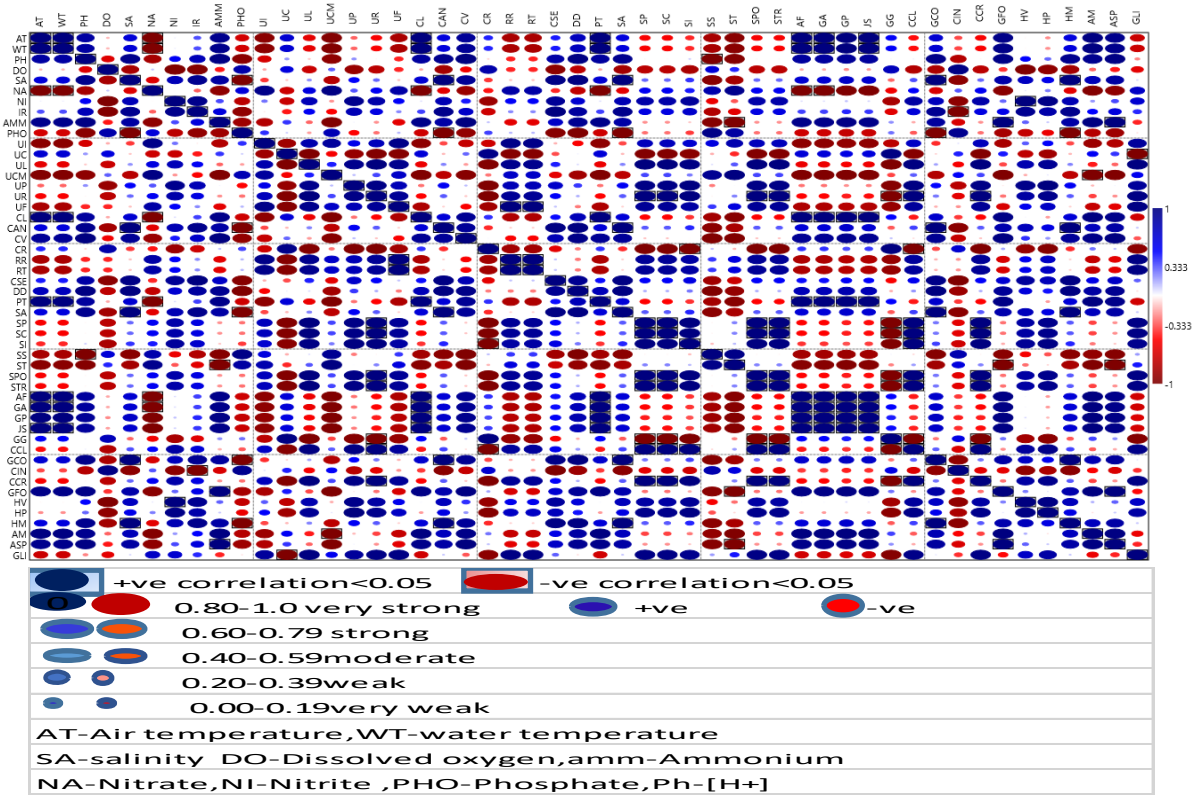
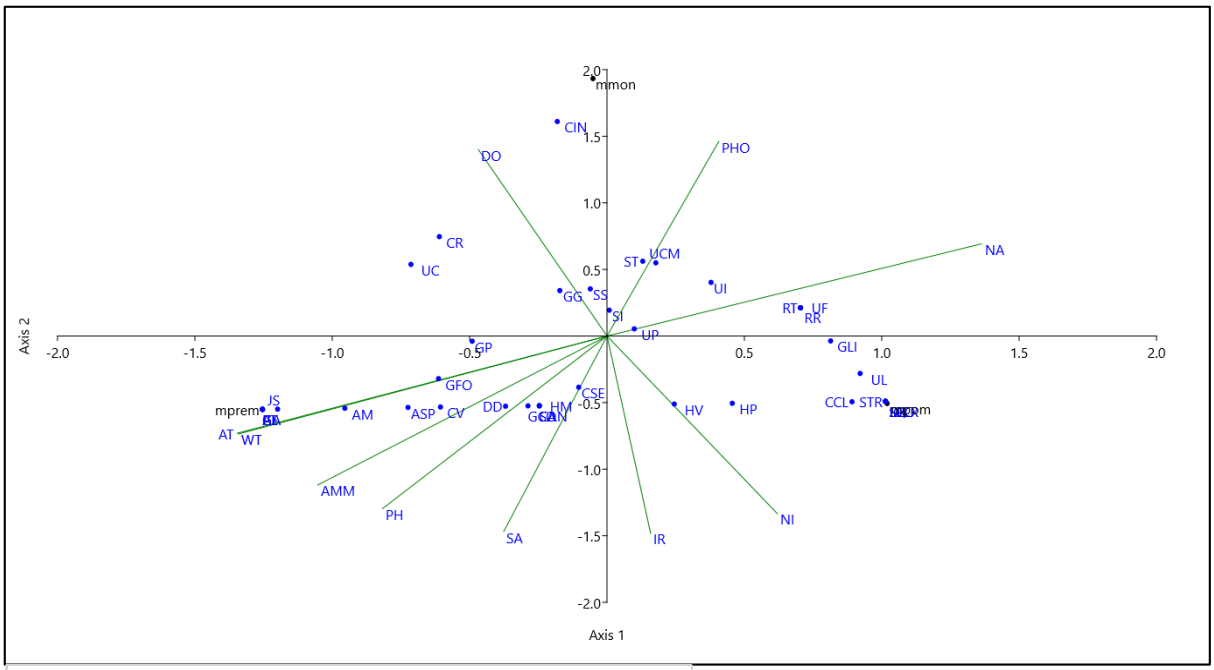


Fig 4 Pearson's Correlation between physicochemical parameters and seaweeds abundancy of Majali,West coast of India with pearson's correlation coefficient 'r' value range



m- majali ,prem-premonsoon,mon-monsoon,pom-postmonsoon

Fig. 5. CCA Triplot showing the seasonal variation between seaweed species and environmental parameters. Environmental parameters are depicted by long arrows referring (fig 3) and species are given in code words reference to table 1.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Bioaccumulation of Heavy Metals in Water and Some Tissuses of Fish *Carangoides malabaricus* of Penthakata, Odisha

Subhasmruti Satapathy and Pradip Kumar Prusty*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 02 Mar 2020 Revised:04 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
Pradip Kumar Prusty
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: pradipkumar.prusty@cutm.ac.in

ABSTRACT

The accumulation of heavy metals on fish and water has been extensively studied and well documented. However, the research has been mainly focused on the heavy metal's accumulation on the fish tissue and water. The water and fish sample can be collected from Penthakata sea, puri then analyzed the heavy metals like Ca, Zn, Cl, Si, S, P, Fe, Ti, Mn, Cu, Pb, Sn, on some tissues (Liver, Gills, Flesh) of fish and water sample and also determined some physicochemical parameters of water. Cl is highly present in flesh (44700ppm), then gill (10350ppm), and lowest concentration in liver (2560ppm). Cu concentration were lowest in liver (23. 4ppm) and gill (79.2ppm) and highest in flesh (290.4ppm). Similarly, the Fe concentration were highest in gills (5550ppm) and flesh (5060ppm) and lowest in liver (23.1ppm) Zn was also low in liver (2.4ppm) but highest in flesh (2620ppm) then gills (955.9ppm). Si levels were highest in gills (17600ppm) then flesh (11290ppm) and lowest in liver (454.6ppm). Liver tissue contained lower concentration of S (410.3ppm) and higher concentration in flesh (309910ppm). Particularly the gills, which contained also higher concentration of Ca and Ti (609220 and 816 ppm, respectively) compared to the flesh (361370 and 571.5ppm). And also, Sn present in liver, Pb present in flesh and Mn present in gills. Water sample contained a different type of heavy metals like Cl, S, P, Ca, Fe values were described below in Table 1. The physicochemical parameters of water, pH is 8.3, total dissolved solid is 155mg/l, hardness is 4.700ppm, alkalinity is 500ppm, DO is 0.2 gm of O_2.

Keywords: Bioaccumulation, Physicochemical parameters, Heavy metals, Fish (*Carangoidesmalabaricus*), Penthakata sea.

INTRODUCTION

The universal problem is the environmental pollution and important pollutants are the heavy metals in aquatic network because of their toxicity, accumulation and biomagnification by marine creatures. Domestic, industrial and anthropogenic activities may broadly become the source of natural aquatic systems contamination of heavy metals

[Velez D, Montoro R (1998), Conacher H, Mes J (1993)]. Water is important for all forms of life. Clear, clean and odorless fresh water used for drinking and other domestic purposes is the gift from the nature. Approximately 97% of water consist of seas and ocean while as fresh water resources contribute only 3% of water [Shrestha et al., 2017]. Life cannot be sustained more than few days without water, so the continuous of supply of water may change the pattern of distribution of organisms as well as of human beings. But due to anthropogenic activities, the water necessary for our survival is becoming hazardous every day [Rao et al., 2018]. Heavy metals containing pollutants besides poses serious water pollution due to their toxicity, persistence and bioaccumulation, also accumulate in tissues of plants and animals leading to toxicity in aquatic biota [Chopra et al., 2011: Pandey et al., 2014]. Fishes and human beings the top consumers of aquatic ecosystem and food chain are badly affected through the accumulation of this heavy metals [Afshan et al., 2014]. Heavy metals are the metallic elements which are dense and heavy and are present in trace amount [Singh et al., 2018].

The pollution caused by heavy metals might have heavy metal pollution may have dreadful effects on the ecological equilibrium and variety of aquatic entities [Akinmoladun A.C, et al., 2007, VosylienAMZ, JankaitA A (2006)]. Accumulation patterns are more in some fish species than others because of the ability of fish to bioaccumulate metals [Adeyeye E 1996]. Heavy metals in fish come mainly from their diet, and levels of bioaccumulation of contaminants are higher in fish which comes higher in food chain [EFSA, (2005)]. In the study, the levels of heavy metals i.eCa, Cl, Zn, P, S, Si, Pb, Mn, Sn, and other heavy metals has been determined from the fish tissues, and water samples. The patterens of bioaccumulation of heavy metals are determined by the absorbance and excretion rates of fish. Different factors such as physical and chemical properties of water as well as seasonal changes are the reason of significant augmentation go metal in different fish tissues [Pandey S. et al.,2008, Romeo M et al., 1999]. Heavy metals occur naturally in aquatic ecosystem in very low concentration [Saad et al., 1981]. Mining of metals, geochemical structure, industrial wastes, untreated effluent, harbor activities, urban and agricultural runoff along major rivers and their tributaries, estuaries and bays creates a potential source of heavy metals pollution in aquatic environments [Dalman et al., 2006].

Heavy metals are potentially accumulated by marine organisms through three possible ways including respiration, adsorption and ingestion [Zhou et al., 2001]. The Penthakata sea is one of the most important buy in Puri and situated on the Bay of Bengal,Puri 60km away from the capital city of Odisha. Along the Penthakata sea, there are many hotels and fisherman villages and some industries take place. Penthakata sea is polluted by domestics wates water, Puri is the tourist place or otherwise called as Jaggarnathdham so, many people can visits from this place and polluted it, agricultural activities and marine transport. Total population of Puri town is 201,026 (According to the 2011 census of India, Puri is an urban agglomeration governed by the Municipal Corporation in Odisha state). Because of hoge tourist activities. This increase of population in winter has caused significant pollution in Penthakata sea Puri. Fish are generally one of the main protein sources for humans [ELETTA O.A.A et al.,2003] and a useful bioindicators for the determination of heavy metals pollution in aquatic ecosystems [CHOVANEC A., et al.,2003, LAMAS S et al., 2007]. To be a good indicator, fish must be long living and inhabit water, making continuous monitoring of the presence of pollutants and sampling easy [FARKAS A et al., 2003]. The concentration of heavy metals in the water column depends on some physical and chemical factors like Temperature, pH, Dissolved oxygen, Conductivity, Alkalinity etc. [GOKSU L.Z. 2003].

“Toxic metals, including “Heavy metals,” are individual metals and metals compounds that have been shown to negatively affect people’s health. In very small amounts many of these metals are necessary to support life. However, in larger amount they become toxic. They may build up in biological systems and become a significant health hazard” [OSHA,2004]. Heavy metal pollution is known to be the cause of various diseases globally, such as the Minamata disease (organic mercury poisoning), arenous acid poisoning, and air polluted-related asthma [Matsuo, 2003]. The consumption of fish worldwide has increased speedily in recent years particularly with the awareness of its nutritional and therapeutic benefits. In addition to being important source of protein, fish are enriched with

essential minerals, vitamins, and unsaturated fatty acids [Moselhy k ,2000]. The American heart Association recommended consumption of fish at least twish per week in order to reach the daily intake of omega-3 fatty acids [Kris-Etherton P.M. et al., 2002]. However, fish normally accumulate heavy metals from food, water, and sediments [Yilmaz F. et al., 2007 and Zhao S. et al., 2012] and this is a good indicators of heavy metals contamination in water [Voegborlo B.R. et al., 2012].

The presence of toxic heavy metals in fish can invalidate their beneficial effects. Several unfavorable effects of heavy metals to human health have been known for long time [Castro-Gonzalez and Mendez-Armenta, 2008]. This includes serious threats like renal failure, liver damage, cardiovascular diseases and even death [Busaidi-AL M. et al., 2011 and Rahman S.M. et al.,2012]. Thus, many local and international monitoring programs have been established in order to assess the quality of fish for human consumption and to monitor the health of the aquatic ecosystem [Meche A. et al., 2010].

MATERIALS AND METHODS

Study area

The water and fish sample were collected from Penthakata sea beach situated on the Bay of Bengal, Puri, 60km away from the capital city of Odisha (Figure.1).

Collection of fish and water samples

The water sample was collected from the sampling sites in sampling bottles. The bottles were first rinsed with nitric acid then with water from the sampling site and after that it was dipped into about 20 cm below the water to collect the water sample. The collected sample was then taken to the laboratory and 5 ml of nitric acid was added to it to observe different physiological parameters. The fish sample was collected from fisherman near Penthakata sea beach, Puri. The collected sample was then kept in an ice box and taken to the laboratory. The fish was then washed with water to remove the mud from the water body and identified taxonomically. Fish length is 18.7 cm and weight 42.5gm.

Sample preparation for heavy metals determination

In the laboratory the fish sample was dissected with sterile scissors to remove gills, muscles and liver which were further dried separately in oven at 120º C for 3 days. The dried sample was crushed to powder form using ceramic mortar and pestle and were weighed. 0.5gm of each tissue sample were digested with a mixture of nitric acid and perchloric acid in a ratio of 3:1. Then the digested samples were diluted with distilled water and the volume was adjusted to 25 ml. (Tabassum et al., 2016). Then the converted liquid fish sample as well as the water sample were analyzed for the presence of heavy metals on fish tissues using XRF spectrophotometer.

Analysis of Physicochemical Parameters

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physio-chemical parameters. Some physical test should be performed for testing of its physical appearance such as pH, Temperature, TDS etc. while the chemical tests should be performed for its dissolved oxygen, alkalinity, hardness and other characters [Patil.P.N. et al. 2012]. A centigrade thermometer measured temperature of water. Total alkalinity was estimated by using phenolphthalein and methyl orange indicator method [Welch, 1948]. Hardness was determined by EDTA titrimetric method [APHA, 1995]. HACH test kit [Model-FF-2, USA] was used to measured pH, dissolved oxygen (DO). TDS and conductivity were measured by EC meter [HANNA instruments: H19143]

RESULT AND DISCUSSION

Table 1. Physicochemical parameters of Penthakata sea water, Puri.

Water Parameters	Test Value
pH	8.5
Temperature	28ºC
Conductivity	1050µmhos cm-1
TDS	155mg/l
Alkalinity	500ppm
DO	0.2gm of O2
Hardness	4.700ppm

Analysis of Heavy Metals in Water and Fish Tissues

Table 2.Concentration of heavy metals in water sample

Heavy metals	Water(in ppm)	Gill(in ppm)	Flesh (in ppm)	Liver(inppm)
Si	450.3	17600	11290	454.6
P	576.6	240480	129230	520.7
S	784.4	88130	309910	410.3
Cl	19840	10350	44700	2560
Ca	561.6	609220	361370	180
Mn		454		
Fe	23.4	5550	5060	23.1
Sn				44.6
Ti		816	571.5	
Cu		79.2	290.4	23.9
Zn		955.9	2620	2.4
Pb			18.3	

DISCUSSION

In this study, to check and measured the physicochemical parameters and heavy metals concentration in water and fish tissues (liver, gills, and flesh) samples collected from the Penthakata sea Puri. The presence of heavy metals in aquatic ecosystem causes various harmful effect to all the organisms. The amount or concentration of this heavy metals increased due to the anthropogenic activities, now a day's water is the important natural sources. The industrial and other wastes are discharged into the water, which causes pollution and eutrophication take place in the sea. The water pollution affects the natural ecosystems and society directly or indirectly. Due to the water pollution its causes water losses its properties and variation of physio-chemical parameters such as pH, temperature, Conductivity, Hardness, Alkalinity, dissolved oxygen, Total dissolved solid etc. This causes decrease the growth and development of aquatic organism. Fish is the most important food sources and biological indicators for aquatic ecosystem. So, this causes pollution rate in aquatic ecosystem can be easily detect and decrease the pollution rate of the water and increase the public awareness to prevent the discharge of industrial pollutant and some other heavy metal sources in to the water ecosystem.

Accumulation of heavy metals in fish causes harmful effect to the ecosystem and human health. In this place (Penthakata sea, Puri) various industries, hotels and some fisher man villages are found this causes discharge of heavy metals can be accumulated in the water. The heavy metals like Mn, Cl, Pb, Ti, S, P, Zn, Fe, Sn and some other heavy metals can absorb in this marine ecosystem. In my project work, collected water and fish sample obtained various heavy metals and show the result i.e concentration of the heavy metals in water and some tissues (Liver, gills, and flesh) of fish.

Water accumulates the heavy metals i.e. higher concentration of Cl and lower concentration of Fe, and other heavy metals Cl > P> Ca> Si> Fe were measured and given in Table 2. The length of the fish ranged of 18.7cms and weight is 42.5gms. The variation of heavy metals levels are, in muscle, liver , and gill of *Carangoidesmalabaricus* from Penthakata sea , summarized in Table3, 4,and 5. Gills accumulates the heavy metals i.e. higher concentration of Ca and lower concentration of cu, i.e. Ca > P > S> Si > Cl > Fe > Zn > Ti >Mn>Cu Liver accumulates the heavy metals i.e. higher concentration of Cl and lower concentration of Zn i.e. Ci> P> Si> S> Ca> Sn> Cu> Fe> Zn. Flesh accumulate the heavy metals i. e higher concentration of Ca and lower concentration of Pb i.e. Ca> S> P> Cl > Si> Fe> Zn> Ti > Cu>Pb. Physicochemical parameters measured in the water sample from the Penthakata sea during the study period are represented in Table 1. Temperature is ranged of 28º C, pH values are 8.3, CO2 and pH values have negative correlation each other. When CO2 levels decrease pH value increase (Tanyolac, 1993).Dissolved oxygen ranged from 0.2gm of O2, TDS (Total Dissolved Solid) ranged from 155mg/l, Alkalinity of water is 500ppm and conductivity is

CONCLUSION

The result showed that heavy metal accumulation varied depending on species-specific factors; other are feeding behavior. Variation in metal concentration were recorded in the internal organs of the studied fish species. Metal accumulation were higher in the gills followed by flesh and liver. Health risk analysis of heavy metals is the edible parts of the fish indicated safe levels for human consumption and concentration in the flesh are generally accepted by the international legislation limit for essential (Zn and Cu) and non-essential metal (Cd) .This species (*Carangoidesmalabaricus)* accumulate high amount of Ca in body, hence it is safe for consumption.[Bawuro et al.,2018] .The objectives was to detect the presence of heavy metals in fish tissues to detect and decreased amount of heavy metals in fish from the water sample. The value detect and unit used here is Parts per Million that represent the presence of heavy metals in Penthakata sea Puri. And if the heavy metal present is in convenient amount except the harmful or Red listed heavy metals then the fish consumption from this area won't affect the food chain vigorously. The heavy metals obtained iron and calcium in a permissible amount so it won't affect the human source food chain lot.

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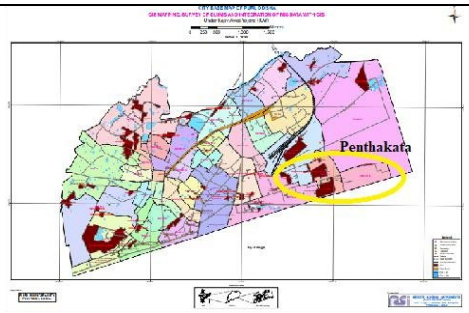

Figure 1. Location of the study area

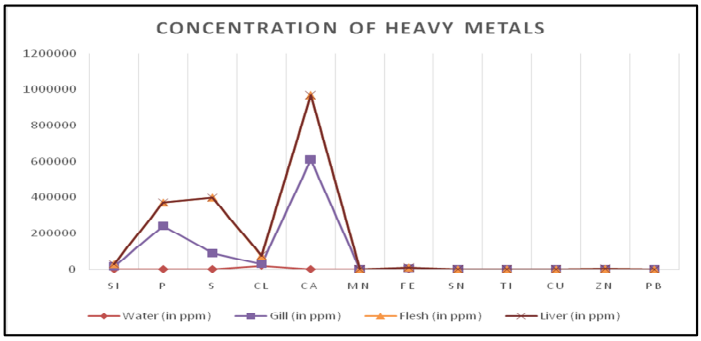

Figure 2. Showing heavy metal concentration in water and fish tissues discharge.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Prediction of Glaucoma from Retinal Fundus Images using Support Vector Machine

Shanti Darshan Ray , Satya Naryan Pati , Prashant Kumar , Manoj Kumar Behera and S. Chakravarty*

Centurion University of Technology & Management, Bhubaneswar, Odisha, India

Received: 09 Mar 2020 Revised:11 Apr 2020 Accepted: 14 May 2020

***Address for Correspondence**
S.Chakravarty
Senior Member IEEE
Centurion University of Technology & Management,
Bhubaneswar, Odisha, India
Email: sujata.chakravarty@cutm.ac.in

ABSTRACT

Glaucoma is a silent thief of peripheral vision. It's the second most cause of vision impairment. As it is incurable and the vision loss due to this can't be restored, early detection is the only way to prevent it. In this disease, the aqueous humour drainage channel gets blocked and leads to intraocular hypertension that causes severe damage to the optic nerve and ciliary body. In this literature, An Automatic model is developed for detection of glaucoma using machine learning and image processing techniques. To build the model a set of retinal images captured through a fundus camera are taken as inputs, which consists of the images of two types of retina healthy and glaucoma affected. From each input retinal image a set essential features are extracted like Optic disc and blood vessels, using different image processing techniques like image Filtration and segmentation. These set of extracted features are used to define the classifier by using a well-known machine learning technique Support vector machine (SVM). The model trained and tested using a dataset of size 1050 with a ratio 80:20 and produces an overall Accuracy of 95.83%.

Key words: Optic disc; blood vessels; segmentation; Support Vector Machine (SVM).

INTRODUCTION

Glaucoma is the second most leading eye disease which causes irreversible vision loss. According to a survey conducted in 2019, 70 million people are affected by glaucoma [1]. It is a group of heterogeneous eye disease in which loss of retinal ganglion cells occurs. It's started with no pain and slowly from peripheral vision loss to permanent blindness. Glaucoma is the cause of 85% blindness all over the world [2]. Among the retinal diseases 13% of cases are affected by glaucoma. 0.5% of people aged 40 and 10% of people who are above 80 are affected by glaucoma.

In a healthy eye, a liquid called the aqueous humor is continuously produced by epithelium of the ciliary body to nourish the cornea and lens and drain out through a mess like a channel called canal of Schlemm. In glaucoma this fluid builds up which results in an increase in IOP (Intraocular Pressure) restricting the blood flow and severely damaging the optic nerve. IOP of normal eye range between 12 to 22 mmHg, but in glaucoma condition IOP is higher than normal. Moreover the things that make more prone to this disease are [3] A) External damage or hemorrhage, B) Genetic Component , C) Diabetic Patient,D) Being short-sighted.

Glaucoma is mainly classified into two types' i.e. open-angle glaucoma and angle-closure glaucoma [4] as shown in Figure-1 and Figure 2.Open Angle Glaucoma: Primary Open angle glaucoma is also known as chronic glaucoma, a common form which occurs in 90% of cases. Here, the angle between cornea and iris is increased. But due to clogging on the drainage canal the fluid is not drained out. It develops the intraocular pressure (IOP). This type of glaucoma responds well to medications if detected at an earlier stage.Angle Closure Glaucoma: Angle closure glaucoma is also called acute angle glaucoma, which occurs in 10% of cases but comparatively more hazardous than open angle glaucoma.

Glaucoma mainly affects the optic nerve, major branches of the retinal vein, artery, ciliary body, and angle of the anterior chamber. It has been suggested that the diagnosis of glaucoma can't be certain until the progression has been demonstrated. Hence the correct diagnosis is required only at initial visits. There are different parameters to confirm that a patient has been correctly diagnosed with glaucoma or not [4].They are:
A) Increase in IOP (Intraocular Pressure)
B) Definite visual field progression in at least one eye
C) Optic disc hemorrhage
D) Abnormal CDR

In this paper, An Automatic model is developed for detection of glaucoma using machine learning and image processing techniques. to build the model a set of retinal images captured through a fundus camera are taken as inputs, which consists of the images of two types of retina healthy and glaucoma affected as shown in Figure-2. From each input retinal image a set essential features extracted like Optic disc and blood vessels, using different image processing techniques like image Filtration and segmentation. These set of extracted features are used to define the classifier by using a well-known machine learning technique Support vector machine (SVM).

Related Work

Many works of literature have been done in the past, for the detection of Glaucoma using diverse methodologies and techniques. The variation in model accuracy and average specificity depends upon the design of the algorithm and dataset. To classify the disorder related to the retina, different data mining, image processing, and Machine Learning algorithms have been suggested for feature extraction and classification. For automated Glaucoma detection, mostly used features are Intraocular Pressure (IOP) [5], Retinal Blood Vessel [6], papillary rim [6], and CDR and ISNT ratio [7]. Similarly different ML techniques such as, Neural Network is used for detection of glaucoma in article [5]. Decision tree algorithm was able to achieve 85% accuracy in glaucoma prediction, in article [8]. Naive Bayes classifier and k-nearest neighbor used and resulting an accuracy of 86%, in article [9]. In article [10], an automated Diagnosis of glaucoma using texture and higher-order spectra Features was developed, which produces an accuracy of 91%.In another article [11], the model is using the neuro retinal cup detection model and getting an average sensitivity and specificity of 97.2% and 98% respectively. But the dataset used for defining the model is very small (71 images).

METHODOLOGY

Assemblage and Selection of images

The dataset for this paper is collected from deep blue data library [12]. The dataset consists of 3 different files: 1) MESSIDOR dataset file contains 460 Glaucomatous Retinal Images 2) Bin Rushed files contain 195 images 3) Magrabi Eye center file and contains 95 images. The total number of collected data from the above source is 750 which is of Glaucoma. The images are in JPG and TIFF format.300 normal non-glaucomatous retina images are collected from different sources in JPG and PNG format.

Preprocessing of retina image using Open cv

Image processing is a method to perform different operations on an image, to get an enhanced image, or to extract some useful information from it. It takes the image as input however the output may be image or characteristics/features related to that input image. As we have Fundus retinal images as input, the accuracy of the model exclusively depends upon however we tend to preprocess the data. The supervised machine learning is employed for building the model that the RGB image dataset must undergo some basic image processing operations like compression to create it labelled for additional processes. The collected retinal images are of upper resolution that will have an effect on the ultimate model accuracy. Consequently, all images are resized to a resolution of 512*512.Then retinal images are filtered through layer separation techniques e.g. channel separation, image smoothing/blurring (Gaussian blurring, bilateral filtering) by convolving the image with a low-pass filter kernel that removes high-frequency content like extra noise and detecting required edges needed for further procedure. Contrast-Limited Adaptive Histogram Equalization (CLAHE) is employed to boost the contrast. Through this adjustment, the intensities are often higher distributed on the histogram [13]. This method allows a lower contrast region to achieve higher contrast.

Feature Extraction

There are many features involved for the detection of glaucoma as shown in Figure-3, in this paper, two main features are used for detection of the disease.

(a) Retinal Blood Vessels
(b) Optic Disk Detection
(c) CDR(Cup To Disk Ratio)

Retinal Blood Vessel Extraction

Traumatic Glaucoma is the emptying impairment at the fibrous tissue mesh because of external harm and hemorrhage. The surplus quantity of blood, plasma, and debris will accumulate and clog the drainage system and badly have an effect on the retinal blood vessels. This can lead to an increase in IOP, which can damage the optic nerve causing Glaucoma. Therefore the RBV (Retinal Blood Vessel) is one amongst the physiological characteristics that are utilized for the detection of glaucoma. At the start the dataset goes through preprocessing techniques as mentioned earlier. That method helps in removing the noises and enhances the contrast of the image. Then RBV is separated by playing morphological operations i.e. Opening and closing several times. Contours area unit detected from the image followed by thresholding that enhances the distinction of the output image for higher transparency. Then, the final output image is acquired by performing Bitwise operations on thethresholded image as shown in Figure 4.

Optic Disc Detection

The optic disc is the largest area in the retina where retinal ganglion cells exit the eye to form optic nerves. It is made of 1.2 million ganglion cells, crucial for transmitting visual information to the brain. It's divided into 3 different components (a) Neuroretinal rim (b) The cup central area (c) Parapapillary atrophy. In Glaucoma, there's a modification in form, color, and depth of OD (Optic Disc), and also the optic nerve degeneration results in the enlargement of the cup area that occupies most of the disc area. The segmented optic disc will be used as a parameter for the detection procedure of the Glaucoma. Accurate segmentation of OD requires the detection of the boundary between the retina and the rim. The segmented optic disc can be an effective parameter for the detection procedure of the glaucoma. The steps for extraction of OD are represented below in Figure 5.

1. Apply pre-processing techniques along with image smoothing and CLAHE on gray image.
2. Perform Morphological operations like erosion and dilation.
3. Create a mask using labels and apply the mask on the output image.
4. Segment the optic disc by using the Grabcut algorithm

Calculation of CDR (Cup to Disc Ratio)

Optic disc (OD) is filled with fibers and the leftover white-colored cup-like area in OD is called as Optic Cup (OC).CDR is the ratio of vertical diameter of OC to the vertical diameter of OD. The CDR is found to be less than 0.5 for normal OD but for glaucoma condition it exceeds 0.5 as shown in [14]. OC segmentation is a more complex process than the OD segmentation due to high intensity blood vessels. OC is extracted and supports the gradient method [15]. Gradient is that the variation within the intensity or color of an image**.** The gradient image is obtained by performing different filtering operations and the contrast of the image is adjusted by CLAHE. G and B channels are more effective for OC segmentation [16].Finally, the disc and cup boundary is decided using ellipse fitting as shown in Figure 6.

Building the Model

Now we have 2 features, first extracted blood vessels and second is CDR. Using the pillow module of python we get the pixel values matrix of both the features. Then the pixel matrix of both the features is flattened, and stacked horizontally. We keep track of the length of all the pictures taken to ensure a perfect feature matrix. The all above action is performed for the Normal and affected images. 1D Arrays for each sample are created and stacked vertically after grouping. This process yields a feature matrix of all the images. Now we create the target vector for the affected with the help of np.ones and for the unaffected np.zeros. The target vector is stacked horizontally with the feature matrix. Now we got the pixel values and label, which makes the dataset. Which is now ready to feed into the model. In this paper, the SVM classifier is used for the classification purpose. SVM is a type of classifier that finds a hyper plane which distinctly classifies the given data into two chunks. It has a powerful mathematical background. Unlike logistic regression, it classifies the data into a particular class. The Flow diagram of the model shown in Figure 7.

RESULTS AND DISCUSSION

The model is evaluated using 210 test images out of which 150 are Glaucoma affected and 60 are normal images. The performance of the classifier evaluated in terms of sensitivity, specificity, overall accuracy and F1 score as shown in table-1 is calculated using sklearn.metrics.The ROC curve shown in Figure-8, presenting the tradeoff between sensitivity and specificity. X-axis of the graph shows Specificity also known as False Positive rate and Y-axis shows the sensitivity known as True Positive Rate.

The precision-recall curve shown in Figure-9, presenting the tradeoff between precision and recall. X-axis of the graph shows recall also known as True Positive rate and Y-axis shows the Precision known as False Predictive Rate.

CONCLUSION

Glaucoma is an irredeemable disease, if it remains untreated may lead to permanent vision loss. This paper expresses effort concerning the automatic detection of Glaucoma disease using image processing and Machine Learning techniques. The features like OD, CDR are used for modeling the classifier using a well-known machine learning technique SVM. The proposed model achieved an overall accuracy of 95.83% over 210 test images and has the potential to be additional sensitive for prediction of Glaucoma at its early stage. In future this work can be extended for classification of the disease using a multi-class classifier.

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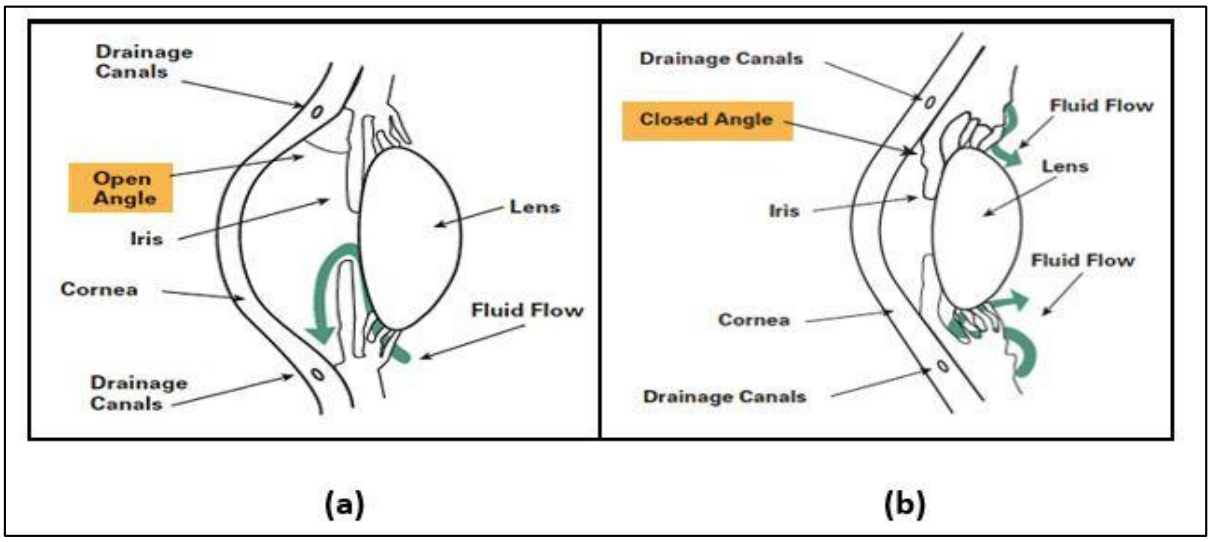

Figure 1.Types of Glaucoma (a. Open Angle Glaucoma and b. Angle Closure Glaucoma)

Figure 2.Retinal Fundus Image
(a) Normal Healthy Retina Image,

Figure 2. Retinal Fundus Image
(b) Glaucoma Affected Retina Image

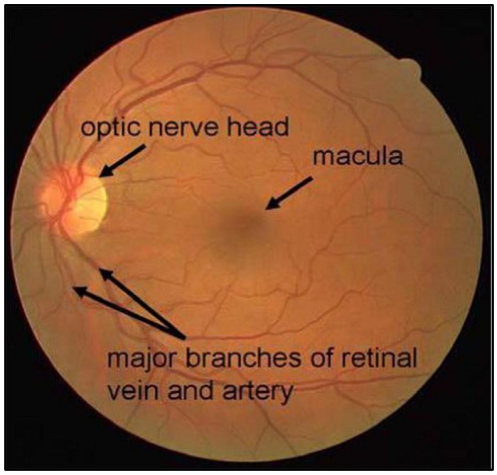

Figure3.Important features for detecting Glaucoma in retina image.

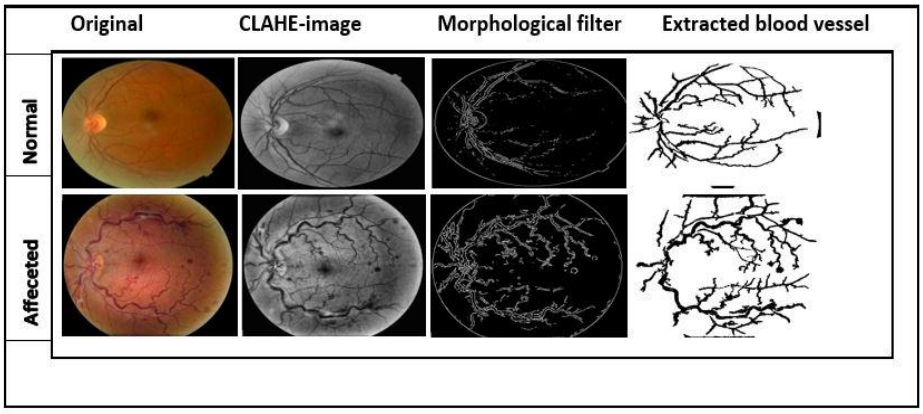

Figure4. Methods for Retinal Blood Vessel Extraction

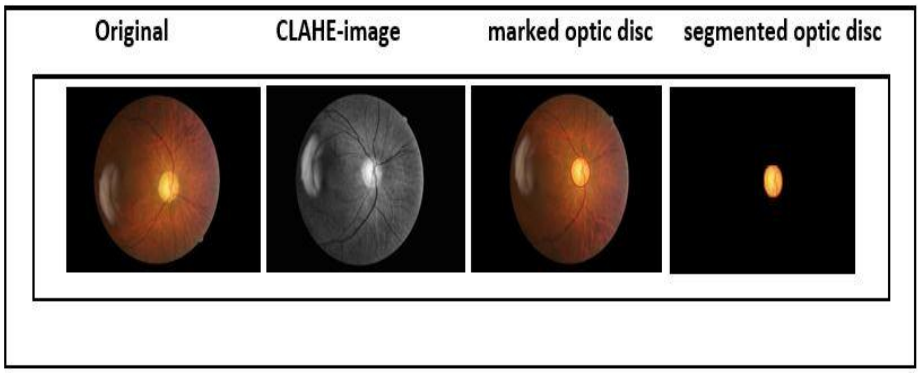

Figure 5.Methods for Segmentation of Optic Disc (OD)

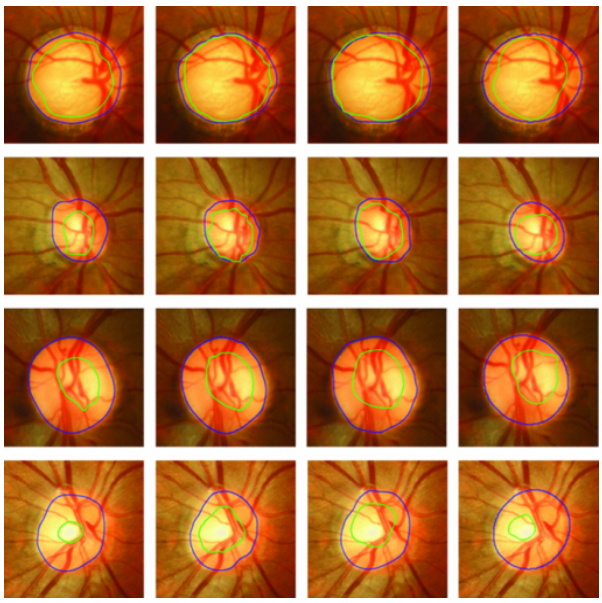

Figure 6.Segmented OC from OD

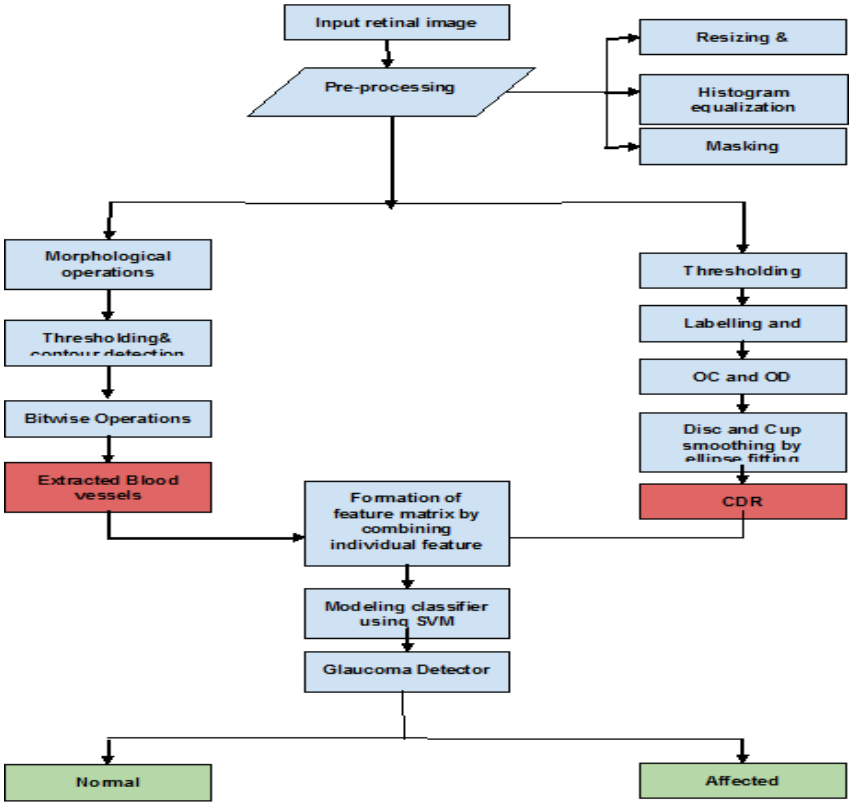

Figure 7. Flow Diagram of the Model

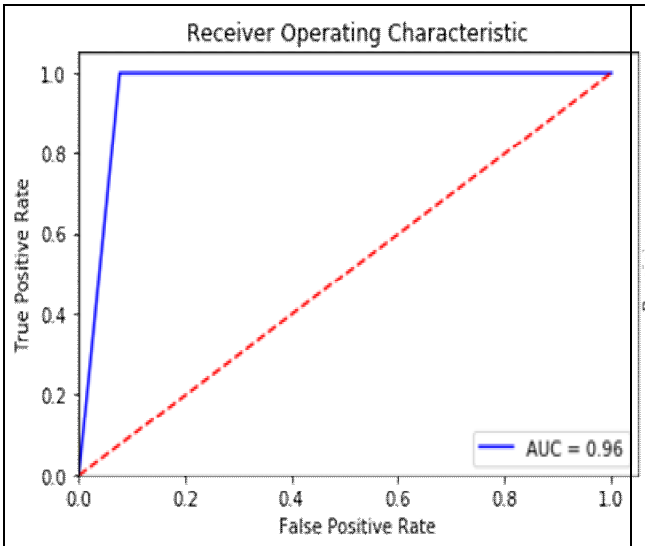

Figure 8 Graph representing Specificity and Sensitivity.

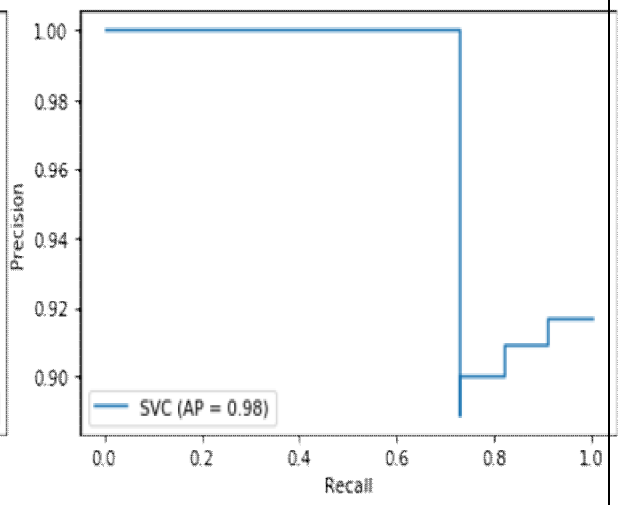

Figure 9. Curve for Precision Recall

Table 1. Performance measure of the model

Accuracy	95.83%
Sensitivity	100%
Specificity	91.66%
F1 score	96%

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Sustainability Oriented Parameter Selection in Arc Welding of Mild Steel using ANN

Sudeep Kumar Singh*, R. C. Mohanty and A. M. Mohanty

Department of Mechanical Engineering, Centurion University of Technology and Management, Odisha, India.

Received: 01 Mar 2020 Revised:03 Apr 2020 Accepted: 06 May 2020

***Address for Correspondence**
Sudeep Kumar Singh
Department of Mechanical Engineering,
Centurion University of Technology and Management,
Odisha, India.
Email: sudeep.singh@cutm.ac.in

ABSTRACT

The selection of optimum input parameters in joining processes has a crucial effect on the intended joint quality and source usage, e.g., power. The Manual Metal Arc Welding (MMAW) of mild steel is most well-known among all welding procedures, as it offers low-cost remedy, finds extensive use in structural work, restoration & maintenance. The present study focuses on selecting ideal joint parameters in MMAW of low carbon alloy metal, taking into consideration joint quality power and parameter consumption through the welding operation. All the experiments conducted during the investigation process were designed using Minitab 18 software. The transverse tensile strength of the joints and the effectivehardness of the joint region are taken as quality parameters of the welded joint. Measurement of power has been performed utilizing a charged power analyzer. Artificial Neural Network is utilized for training the info acquired from the experiments carried out using Bayesian regularization 'trainbr' learning function. The regression evaluation model was applied in Matlab R2019a to determine a relationship between your input and result variables to greatly help predict the perfect mix of joint input parameters.

Keywords: Arc Welding; Mild Steel; Artificial Neural Network; Taguchi; Energy consumption.

INTRODUCTION

Welding (SMAW) of Mild Steel (MS) has been a widely adopted process, finding extensive application in structural frames, pipelines, visually aesthetic designs, and repair works; due to its high ductility and weldability properties [1, 2, 3]. In spite of its high energy-intensive property, welding remains the most widely adopted joining process. Parameter selection is very important in a multi-input multi-output process like welding [4, 5]. Power consumption is

one among many factors responsible for the negative environmental effects generated from welding operations, raising the need for characterization of the SMAW process considering sustainability aspects [3, 6]. Thus, understanding the influence of input parameters on the joint quality is essential. The mechanical property of welded joints largely depends on the selected process parameters used in the manufacturing process [7]. Generally,more emphasis is put on the quality aspects of the produced joints rather than the process parameterselection. In practice, the process parameters selected, bears great impact on the resources consumed like energy consumption. Thus, the present study intends to draw a relationship between the threemost influential inputs and the four output parameters adopted for investigation.

Adnan et al. [4] carried out Pareto Analysis to find uncontrollable input parameters forthe GMAW welding process, developing three ANN models for input, output parameter prediction and classifying products. Laser welding of aluminium alloy AA5754 was also analyzed using ANN, for investigating the effects of process parameters [8]. The optimization process was carried out by varying welding speed and shielding gas, using a developed Excel add-in named "Neural Tools". Authors also developed ANN models for classification of defective products and prediction of the input parameters [5]. Optimization of key welding parameters is also important to mitigate the existing poor environmental image of welding processes. Authors also adopted hybrid neuro-fuzzy approach for optimizing SMAW process parameters focusing on sustainability approach [6]. The crucial welding parameters considered in the investigation are current, voltage and welding speed. Welding of dissimilar metals involving Al alloy and stainless steel has been studied using laser-arc welding technique [9]. Taguchi is used for studying the effect of different welding parameters to get optimum values of angular distortion in SMAW [10]. Central Composite Design applied on TIG welding of mild steel has been optimized using Response Surface Methodology (RSM), [11], ANN [12], and grey wolf optimizer [13] on different materials. In yet another study, RSM has been adopted for optimizing GMAW parameters for welding Mild Steel IS:2062 [14]. Authors [15] have developed model for predicting mechanical and microstructural properties of copper plate using Friction Stir Welding. RPLNN and GA have been used involving three inputs and two response parameters.

Weld quality considering tensile properties and microstructure were analyzed based on power distribution using an arc assisted fiber laser welding of Al-Mg alloy [16]. Tensile and impact properties in multi-pass SMAW have been investigated by Saxena et al. for determining the influence of welding consumables in Armox 500T alloy [17]. MS welded parts under varying current was analyzed for mechanical properties and microstructure [1]. The outcome claims the highest tensile strength obtained at 75A with minor welding defects. Sheets of different thicknesses welded using SMAW and GMAW were investigated for finding a new set of welding parameters for structural grade steel welding [7].

The current research work aims to study the influence of key input parameters on the qualitative output of the arc welded joint. The arrangement of the paper is as follows. Next section describes the experimental methodology. The third section discusses test procedure and results. The fourth and the final section presents conclusions obtained from the analysis and also presents directions for future scope.

EXPERIMENTAL METHODOLOGY

Arc welding of Mild Steel considering energy consumption has been considered in the present experimental investigation. The material finds tremendous application in structural work and industrial application. The adopted methodology has been pictorially presented in figure no 1. The presented research utilizes raw material inform of platesfor the welding process. The input parameterstaken as variables are; current, joint gap, face widthand the output parameters; power consumed, Ultimate Tensile Strength (UTS), hardness (HRB) and impact energy (Izod). The input parameters (factors) involved in the study are presented in table no 1

The raw materials were first tested for finding its composition using XRF spectrometer (result presented in table no-2), then wascut to size having length 200 mm and width 100 mm. One longitudinal edge of each plate was beveled to produce a double V-groove butt joint. The including angle between the two plates of the V-shaped joint to be welded is 60^0 for all the MS plates used. The flux coated stick electrode employed in the welding process was tested using XRF spectrometer, and the obtained results presented in table no 2. The data in table no-2 displays close conformance of iron percentage in both the workpiece and filler. The filler rod used in the welding process is 3.15 mm in diameter; Superweld E6013 manufactured by ESAB. The XRF samples for both the types of material were prepared by the help of a surface grinder. The plates were cleaned properly using a solvent to remove dirt, rust, etc. present on the surface of the material to be welded. It is followed by welding the plates using process parameters obtained from TAGUCHI orthogonal array design presented in table no 3. The experiments designed using 4^3matrix, where three-factor and four levels of parameters are used.

The Welding Process

The welding process uses four different values of inputcurrentfor the experiments as 90, 110, 130, and 150 amperes. The remaining two input variables are root gap and face width. The same number of levels were adopted for both the factors as0, 1, 2 and 3mm. All the varying parameters taken together make the total number of factors involved in the experimental design asthree. The number of levels for each factor is four. The total number of experiments calculated becomes 16. All the experiments were conducted using L16 Taguchi orthogonal array design for a three-factor and four-level experimental design. The experimental design adopted for the experiments is presented in table no 3. The welding process was carried out by using RS400, a thyristorised Manual Metal Arc welding machine manufactured by ESAB India Ltd. The machine is equipped with 50 Hz 3-phase power supply with an input voltage of 415 volts and 27 ampere current. All the welding runs were carried out using AC power supply.

A 3-phase power analyser, model no DPATT-3Bi, manufactured by Uma Electronics Enterprises, Jaipur India, was used for measuring the instantaneous power consumption values during the arc welding process. A three-phase four-wire connection was used in the process of power measurement. Table 3 presents the three factors and the values of the four levels of process parameters adopted in the experimental runs. It displays the values of different process parameters used in the welding process. The welding speed was considered constant throughout the experiment. All the mild steel plates involved in the investigation for MMAW are of 10mm thickness.Sixteen number of welding joints were produced and processed further to preparethe test samples for Tensile, Rockwell, and Izod teststo be conducted further down the process. The details of the test procedure and results have been explained in the next section.

Post-weld Testing

The mild steel plates after completion of welding were properly cleaned to remove slag deposited by using chipping hammer and wire brush. Tensile test, Rockwell hardness and Izodtest specimens were extracted from the welded plates of 10mm thicknesses in conformance to ASTM E8 standard, presented in figure-2. A Rockwell hardness tester, HR-300, made in Brazil by Mitutoyo was employed for the purpose.Welding beads were removed by grinding from the welded surface before producing the test samples for both the tests. The hardness test was conducted at six different points on the bead face of the welded joints, designated by alphabets, A to F, as shown in fig 3(c). The HRB values at points A and F denote base metal hardness, the values at points B and E for hardness values at HAZ area of both parent metals, and the hardness values at points C and D denote the hardness for the face or cap side of the welded joint. The average hardness value of points C and D only are considered in the current investigation as HAZ and base material analysis does not come under the purview of our research scope.

The tensile test was conducted on a Universal Testing Machine (UTM) manufactured by Blue Star Engineering & Electronics Ltd. India, having a maximum capacity of 1000kN. The test specimens were loaded onto the UTM machine and made to undergo the tensile testing procedure, and the Ultimate Tensile Strength (UTS) values for each test specimen were noted. The samples prepared for Izod test were fitted on an Impact test machine and values of energy absorbed before failure for individual specimens were recorded. The values of UTS and Energy absorbed is presented in table no. 3 under respective columns. Figure no. 3(a) and (b) displays the tensile test samples before and after failure, fig 3(c) displays the hardness test specimen, and fig 3(d) depictsa broken Izod test specimen.

Neural Net modeling

Neural networks find wide application and recognized as efficient solvers of non-linear problems. Successful applications have been reported in literature containing real-world problems. Following these traits, ANN isutilisedto find optimum input parameters for SMAW in the present study. The architecture for the employed neural net is presented in figure no 4.

An Artificial Neural Network was modeled for training using the data collected from the conducted experiments. The bayesian Regularization backpropagation method is used for the construction of the network. This method is generally used for difficult, small and noisy datasets. In the current construction, the data set is small and prone to noise in the measured value mainly due to various reasons including, uncertainties involved in the test procedure.Thus, the application of Bayesian Regularization fits our requirement and '*trainbr*' learning function is used in the Matlab R2019a platform. The network takes 70% of input data for training, 15% for validation and 15% for testing. The ANN model developed in this study involves an input layer, one hidden layer, and one output layer. The input layer consists of 3 neurons; each neuron corresponding to individual input parameters and the output layer containing 4 neurons, representing one output parameter each. The hidden layer employs 50 neurons. The most promising network architecture is based on trial and error methods for which many trials have been conducted to arrive at the best combination. The performance of the network has been discussed in detail in the conclusion section

Parameter selection using ANN

Neural networksfind a wide application and recognized as efficient solvers of non-linear problems. Successful applications have been reported in literature containing real-world problems. Thus ANN has been selected for finding optimum input parameters for SMAW in the present study. The architecture for the employed neural net is presented in figure no 5. An Artificial Neural Network was modeled for training using the data collected from the conducted experiments. The bayesian Regularization backpropagation method is used for the construction of the network. This method is generally used for difficult, small and noisy datasets. In the current construction, the data set is small and prone to noise in the measured value; thus, the application of Bayesian Regularization fits our requirement. '*trainbr*' learning function is used in the Matlab R2019a platform. The network takes 70% of data for training, 15% for validation and 15% for testing. The ANN model developed in this study involves an input layer, one hidden layer, and one output layer. The input layer consists of 3 neurons; each neuron corresponding to individual input parameters and the output layer containing 4 neurons, representing one output parameter each. The hidden layer employs 50 neurons. The most promising network architecture is based on trial and error method for which many trials have been conducted to arrive at the best combination. The performance of the network has been discussed in detail in the conclusion section.

CONCLUSION

The current work involves three input and four output variables for SMAW welding of structural grade mild steel. The quality of the welding has been tested; measuring UTS of the welded joint by applying load in transverse

direction, calculating average Rockwell hardness, and measuring the energy absorbed by the joint before fracture through Izod impact test. The input and output data collected from the test results were fed into an ANN network suitably designed for the purpose. The parameters of the network was chosen by trial and error method. The modeled network is capable of selecting all the three input parameters considered in the present work based on desired output parameters like energy consumed, UTS, hardness and impact energy. The network accuracy is impressive and the results obtained can help reduce the energy wastage in the welding process adopted without compromising the joint quality expressed in terms of tensile strength and impact energy in the present research. This work presented is applicable to other welding methods without much modification. Important process parameters not addressed in the present work can be considered as future research scope.

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Table 1. Input parameters.

Sl. No	Factors	Level1	Level2	Level3	Level4
1	Current	90A	110A	130A	150A
2	Root gap	0	1	2	3
3	Face width	0	1	2	3

Table 2. Material composition.

Sl. No.	Base material	Si	Mn	S	P	Fe
1	Mild steel plate	0.340	0.533	0.100	0.059	95.102
2	Electrode E6013	1.451	0.437	0.125	0.034	96.115

Table 3. Experimental runs with output values.

Sl. No.	Current (A)	Root gap (mm)	Face width (mm)	Power (kW)	UTS (MPa)	Hardness (HRB)	Impact Energy (Joule)
1	90	0	0	4.14	400	73.8	42
2	90	1	1	4.32	371	81.95	47
3	90	2	2	4.45	472	81.05	52
4	90	3	3	4.71	530	83.5	58
5	110	0	1	5.03	847	80.45	40
6	110	1	0	5.24	643	81.15	48
7	110	2	3	5.43	721	81.8	44
8	110	3	2	5.71	788	77.9	49
9	130	0	2	6.04	632	81.15	52
10	130	1	3	6.27	562	85.0	60
11	130	2	0	6.45	689	81.2	68
12	130	3	1	6.90	736	80.95	62
13	150	0	3	7.12	563	79.75	38
14	150	1	2	7.35	492	77	44
15	150	2	1	7.48	586	78.6	56
16	150	3	0	7.79	643	85.25	64

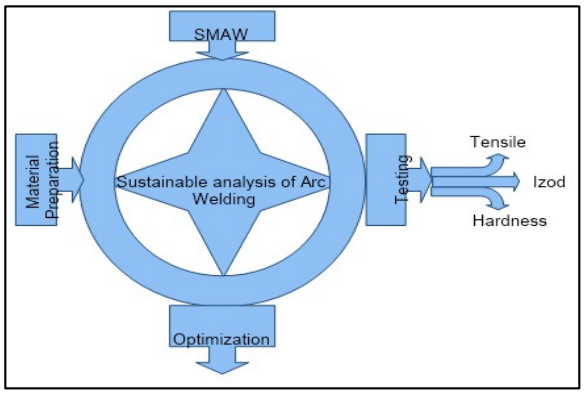


Fig. 1. Experimental methodology

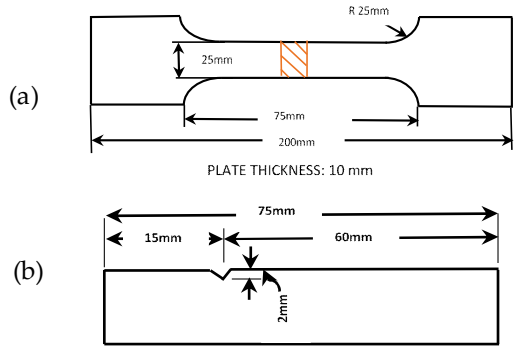


Fig. 2. Schematic diagrams of (a) Tensile Test specimen; (b) Izod specimen

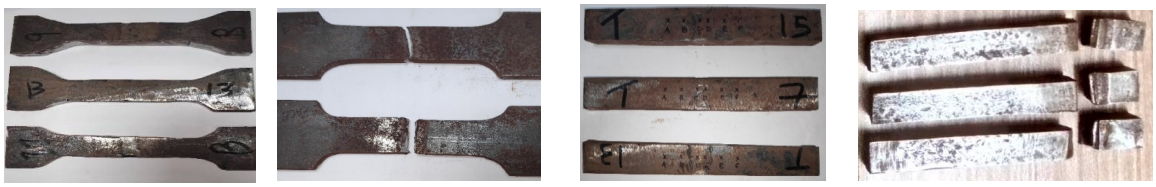


Fig. 3 (a) **Fig. 3 (b)** **Fig. 3 (c)** **Fig. 3 (d)**

Fig. 3. (a) Tensile specimen before fracture; (b) Tensile specimen after fracture; (c) Rockwell test sample; (d) Izod test sample

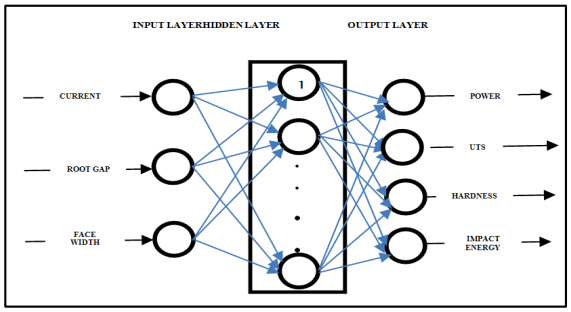


Fig. 4. ANN architecture

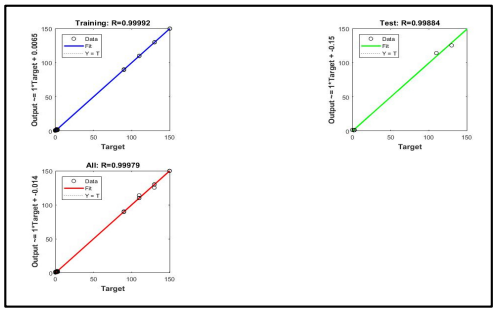
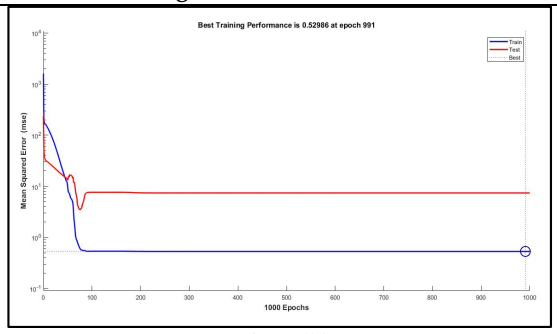


Fig. 5 (a)



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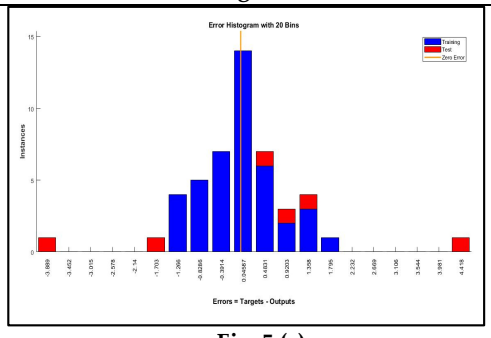

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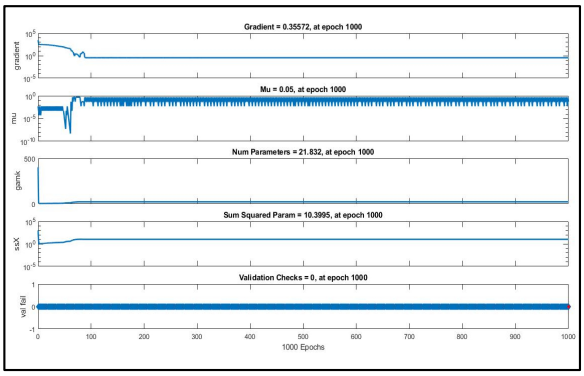
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Fig. 5 (d)

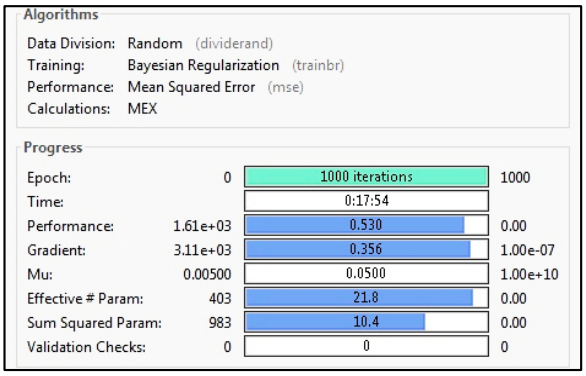
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Fig. 5 (e)

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Phytochemical and Pharmacological Properties of *Caesalpinia bonducella* with Cytotoxic Screening: HPLC Analysis Proves the Presence of Phloroglucinol, Catechol and Resorcinol

J.Joonu

Assistant Professor, Department of Zoology, Bishop Heber College, Trichy, TamilNadu, India.

Received: 09 Feb 2020 Revised:12 Mar 2020 Accepted: 15 Apr 2020

***Address for Correspondence**
J.Joonu
Assistant Professor,
Department of Zoology,
Bishop Heber College,
Trichy,Tamil Nadu,India.
Email: joonucharles@gmail.com

ABSTRACT

Today there is an interest in traditional medicine and an increasing demand for more drugs from plant sources. The present study deals with the antimicrobial activity and cytotoxicity screening and analysis of phytochemical compounds from the *Caesalpinia bonducella* seed kernel extract. This helps in designing a new drug using the medicinal plants. Initially the two methanol and ethyl acetate extracts were prepared and treated against the bacteria *Bacillus*, *Enterobacter* and *Streptococcus* spp that were isolated from the soil. Phytochemical tests were also done to know the compounds that are present in the seed extracts. HPLC analysis proves the presence of identification of bioactive phytochemical compounds including Phloroglucinol and Catechol in ethanol extracts and Resorcinol in methanol extracts Cytotoxicity screening was done to determine the liver functions of the earthworm and the effect of powder on them. Thus these bacteria show greater sensitivity to these extracts and hence confirm the antibacterial effect of the *Caesalpinia bonducella* seed kernel powder.

Keywords: *Caesalpinia bonducella*, traditional medicine, Resorcino, Phloroglucinol,Catechol, phytochemicals.

INTRODUCTION

Plants are considered to be the nature's gift as remedy for many human ailments. It has a vital role in maintaining human health and improving the quality of human life for thousands of years and have served humans well as valuable components of medicines, seasonings, beverages, cosmetics and dyes. (Komal Moon et.al 2010) Given their potential to produce significant effect, they can be useful in the treatment of various diseases.(Uday M.Muddapur

et.al 2014 The common name for *Caesalpinia bonducella* is fever nut or bonduc nut. *Caesalpinia bonducella* (L.) Fleming (Syn. Caesalpinia bonduc (L.) Roxb, It belongs to the family Fabaceae / caesalpiniaceae, is a wide spread prickly shrub distributed all over the world specially, in India, Sri Lanka and Andaman and Nicobar Islands, in India specially found in tropical regions (Asolkar LV, et.al 1992). All parts of the plant have medicinal properties so it is a very valuable medicinal plant which is utilized in traditional system of medicine (Kirtikar KR, Basu BD).

Caesalpinia bonducella of family Fabaceae is a prickly shrub or woody vine reaching a length of 10 m or more also known as Sagargoti (Marathi). Leaves are bi-pinnate, often nearly 1 m long, with the rachis armed with stout, sharp, recurved spines. Seeds of fever nut were considered as febrifugal, periodic, tonic, and vesicant. It has its curing properties in treating colic, convulsions, leprosy, and palsy. The oil from the seeds is said to soften the skin and remove pimples. The bark of the shrub is rubefacient and has a miraculous power to counteract toothache. The different parts such as leaves, seed, root, bark were also used in colic fever, intermittent fever, malaria, menstrual complaints, pneumonia, skin diseases, swelling, tonic, pulmonary tuberculosis and as a uterine stimulant, to cleanse the uterus. It also alleviates the fever, edema and abdominal pain during this period. In India, various parts of this plant has been used in various therapeutic uses including adaptogenic, antimicrobial, antiproliferatve, antidiabetic, anti-filarial, enhanced uterine contractility, hepatoprotective, antitumor and antioxidant. In Iraq, the seeds were used as antipyretic andfebrifuge and the leaves were used in disorders of the liver (Ali Esmail Al-Snafi 2015).

The seeds contain various chemical constituents such as furanoditerpene's: a-caesalpin, β-caesalpin, γ-caesalpin, δ-caesalpin, ε-caesalpin, and caesalpin –F; fatty acids: palmitic, stearic, octadeca-4-enoic, octadeca-2, 4-dienoic, lignoceric, oleic and linoleic acids, phytosterinin, b-sitosterol, homoisoflavone bonducellin; amino acids: aspartic acid, arginine, and citrulline; carbohydrates: starch and sucrose; β-carotene, glycoside-bonducin, gums, and resins.(Dayanand M. Kannur et.al 2012)

MATERIALS AND METHODS

Collection of Sample

The medicinal plants *Caesalpinia bonducella* (fever nut) was collected from the local market of Tiruchirappalli district, Tamil Nadu, India. It was then used for the extraction of its bioactive compounds.

Preparation of Plant Extract

The dried seeds of Fever nut was crushed into fine powder with the help of a mechanical grinder. 10g of the seeds powder was placed in a glass container and soaked in a 80% of methanol. The container with its content was sealed and kept for 7 days. The entire mixture then underwent a coarse filtration by a piece of clean, white cotton material. The extract then was filtered through Whatman filter paper. The extract was dried at room temperature and both the aqueous solution and solidified extract was stored under refrigeration for further studies.

Isolation of Bacteria from Soil

The soil sample was collected from the campus of Bishop Heber College, Tiruchirappalli,TamilNadu,India

Characterisation of Colonies

When microbes were grown in different media it shows differences in the macroscopic appearance of their growth. These difference called cultural characteristic and are used as the basis for separating microorganism into taxonomic groups. These are determined by culturing the organism on nutrient agar.

Gram Staining

The isolated bacterial strains were made into a thin smear in a clean glass slide, air dried then heat fixed. The primary stain crystal violet was flooded on the smear washed with running tap water.The mordant stain Gram's iodine was flooded on the smear and left for one minute and then washed with water. Decolorizing agent alcohol was added drop and then washed with water. The slide was dried and observed under microscope.

Biochemical Analysis (J. Joonu* and Horne Iona Averal, 2012)

Indole Test (Tryptone Broth)

Inoculate a loopful of bacteria into a Tryptone broth. Incubate 48 hours. After incubation: The broth must be turbid. A clear broth indicates that the organism did not grow and cannot be tested. Add a few drops of Indole reagent to the broth culture (tryptone broth). A positive result has a red layer at the top. A negative result has a yellow or brown layer.

Methyl Red Test (MRVP broth)

Inoculate a loopful of bacteria into MRVP broth. Incubate 3 to 5 days. After incubation: the broth must be turbid. A clear broth indicates that the organism did not grow and cannot be tested. Remove 1 ml of broth and place into a sterile tube. Add 3-4 drops of methyl red to the original broth. A positive result has a distinct red layer at the top of the broth. A negative result has a yellow layer. Many gram-negative intestinal bacteria like Escherichia, salmonella, and proteus can be differentiated.

Voges Proskauer Test

Inoculate a loopful of bacteria into MRVP broth. Incubate 3 to 55 days. After incubation: a clear broth indicates that the organism did not grow and cannot be tested. Barritt's reagent A (VP A) contains naphthol and barritt's B (VP B) contains KOH. Test 1 ml of the culture from the MRVP broth. Add the entire contents of the VP A reagent (15 drops) and 5 drops of the VP B reagent to the 1ml of the broth culture. With a positive reaction the medium will change to pink or red indicating that acetoin is present. With a negative reaction the broth will not change colour or will be copper coloured. Enterobacter, serratia and some species of bacillus shows positive result.

Citrate Test (Simmon's citrate slant)

A loopful of bacteria is streaked onto a citrate agar slant, do not stab the butt. Incubate 24 to 48 hours, longer for bacillus species. Incubate with a loop cap. After incubation: a positive reaction is indicated by a slant with a prussion blue colour. A negative slant will have no growth of bacteria and will remain green.

Urease Test

Inoculate a tube of urea broth with your test organism and incubate at room temperature for 24 to 48 hours. Urea broth is composed of yeast extract, urea and the pH indicator phenol red. If urease is present, ammonia will be released and the pH will rise. A positive urease test is a change from yellow to cerise (light cherry colour, pH 8.1 or greater). No chnge in the colour of the indicator is a negative test.

Mannitol Fermentation Test

Mannitol salt agar contains 7.5% NaCl, which is inhibitory to most bacteria. Bacteria that can grow on this agar can be differentiated based on mannitol fermentation. Fermentation of mannitol results in acidic products which turn phenol red Ph indicator from red to yellow. Streak MSA plate and incubate at 37 degree celsius for 2 days. Positive test indicates colour change from red to yellow. Negative test shows there is no colour change.

Starch Hydrolysis

Inoculate a starch plate with the organism to be tested. Incubate at optimum temperature for atleast 48 hours. Flood plate with iodine, observe results. Blue colour indicates no hydrolysis, while a clear zone indicates hydrolysis. B.subtilis is the organism which shows positive result.

Catalase Test

Remove a small amount of your environmental unknown from your agar slant, or a loopful of control test organisms from a broth culture and place it on a glass slide. Mix the organism with a drop of 3% H2O2 and check for the appearance of gas bubbles (a positive test). No bubbles are a negative test. Bacillus spp. Is used as the positive control and streptococcus lactis is used as a negative control.

Eosin Methylene Blue (EMB) Agar

A selective medium for gram-negative bacteria. Levine's EMB agar contains methylene blue, which inhibits gram-positive bacteria. Differential for enterics: will differentiate lactose fermenters from nonfermenters. After incubation: lactose nonfermenters will have cream coloured colonies. Lactose fermenters will have pinkish colonies, sometimes with dark centers. E. coli often has a greenish metallic sheen.

Macconkey Agar

This Macconkey Agar medium is both selective and differential. The selective ingredients are the blue salts and dye, crystal violet which inhibit the growth of gram-positive bacteria. The differential ingredient is lactose. Fermentation of sugar results in an acid Ph indicator, neutral red, to turn a bright pink-red colour. Thus the bacteria capable for lactose fermentation such as Escherichia coli, form bright pink red colonies. Maccokey agar is commonly used to differentiate between enterobacteriaceae.

Blood Agar

Blood agar is used for the differential of staphylococcus, streptococcus and others based on haemolysis. 5% defibrinated sheep blood is recommended for the preparation of blood agar. Three haemolytic are described in blood agar, alpha haemolysis. Coagulase positive staphylococcus aureus produce beta haemolysis. Streptococcus pyogenes produce beta haemolysis when it is incubated anaerobically. Based on the type of supplements added to the blood agar its name will vary, they are neomycin blood agar, ampicillin blood agar, tellurite ceffixime blood agar, kanamycin blood agar. Supplements are used to select particular species from the human body. Satellism pattern is described when H.influenza is cross inoculated with staphylococcus aureans.

Antibacterial Assay

Broth Culture in broad range

The three isolates were tested for the bacterial resistance using three different concentrations of two plant extracts. Methanol extract and ethyl acetate extract were used in different concentrations like 5ml, 10ml, 15ml. In different concentrations the three bacteria's were inoculated in broth containing plant extracts and incubated for 24 hours. Then OD were taken at different intervals of time in uv spectrophotometer. By using reading graphs were plotted.

In narrow range

The three isolates were tested for the bacterial resistance using three different concentrations of two plant extracts. Methanol extract and ethyl acetate extract were used in different concentrations like 1ml, 2ml, 4ml. in different concentrations the three bacteria's were inoculated in broth containing plant extracts and incubated for 24 hours. Then OD were taken at different intervals of time in uv spectrophotometer. By using reading graphs were plotted.

Analysis of Phytochemical Compounds (MANJULIKA YADAV et.al 2014)
Screening of the plant extracts for various phytochemical constituents were carried out using standard methods.

Test for tannins (Braymer's Test)
To the 2ml of plant extract 2ml of water H2O is added. And then 2 to 3 drops of 5% ferric chloride (Fecl3) solution is added. Appearance of green precipitate indicates the presence of tannins.

Test for flavonoids
To the 1ml of plant extract 1ml of 10% lead acetate [Pb(OAc)] solution is added. Appearance of yellow colour indicates the presence of flavonoids.

Test for terpenoids
To the 2ml of the plant extract 2ml acetic anhydride [(CH3CO)2O] is added. And then 2 to 3 drops of conc. Sulphuric acid is added. Appearance of deep red colour indicates the presence of terpenoids.

Test for saponins (foam test)

A) To the 5ml of plant extract add 5ml of water H2O and heat. Appearance of froth indicates the presence of saponins.
B) To the 5ml of plant extract few drops of olive oil is added. Appearance of emulsion form indicates the presence of saponins.

Test for steroids (salkowski test)
To the 2ml of the plant extract add 2ml of chloroform (CHCl3) is added. And then 2ml of conc. Sulphuric acid (H2SO4) is added. Appearance of reddish brown ring at the junction indicates the presence of steroids.

Test for phlobatannins (Precipitate Test)
To the 2ml of plant extract add 2ml of 1% hydrochloric acid (HCL) and heat. Appearance of red precipitate indicates the presence of phlibatannins.

Test for carbohydrates (Molisch's Test)
To the 2ml of plant extract 10ml of water (H20) is added. And then 2 drops of 20% Ethanolic α-naphthol and 2ml of conc. Sulphuric acid (H2SO4) is added. Appearance of reddish violet ring at the junction indicates the presence of carbohydrates.

Test for glycosides (Liebermann's Test)
To the 2ml of the plant extract 2ml of chloroform (CHCl3) and 2ml of acetic acid (CH3COOH) is added. Appearance of violet to blue to green colour indicates the presence of glycosides.

Test for Coumarins
To the 2ml of plant extract 3ml of 10% sodium hydroxide (NaOH) is added. Appearance of yellow colour indicates the presence of coumarins.

Test for Alkaloids (Hager's Test)
To the 2ml of plant extract few drops of Hager's reagent is added. Appearance of yellow precipitate indicates the presence of alkaloids.

Test for Proteins (Xanthoproteic Test)
To the 1ml of plant extract 1ml of conc. Sulphuric acid (H2SO4) is added. Appearance of white precipitate indicates the presence of proteins.

Test for Emodins
To the 2ml of plant extract 2ml of ammonium hydroxide (NH4OH). And then 3ml of benzene is added. Appearance of red colour indicates the presence of emodins.

Test for Anthraquinones (Borntrager's Test)
To the 3ml of extract add 3ml of benzene and 5ml of 10% ammonia is added. Appearance of pink, violet or red colour indicates the presence of anthraquinones.

Test for Anthocyanins
To the 2ml of plant extract add 2ml of 2N hydrochloric acid (HCL) and ammonia. Appearance of pinkish red to bluish violet colour indicates the presence of anthocyanins.

Test for Leucoanthocyanins turns
To the 5ml of plant extracts add 5ml of isoamyl alcohol. Appearance of organic layer in to red indicates the presence of leucoanthocyanins.

HPLC Analysis (S.Sasidharan *et.al* 2011)

High performance liquid chromatography (HPLC) is a versatile, robust, and widely used technique for the isolation of natural products. Currently, this technique is gaining popularity among various analytical techniques as the main choice for fingerprinting study for the quality control of herbal plants. Natural products are frequently isolated following the evaluation of a relatively crude extract in a biological assay in order to fully characterize the active entity. Chemical separations can be accomplished using HPLC by utilizing the fact that certain compounds have different migration rates given a particular column and mobile phase. The extent or degree of separation is mostly determined by the choice of stationary phase and mobile phase. Generally the identification and separation of phytochemicals can be accomplished using isocratic system (using single unchanging mobile phase system).Identification of compounds by HPLC is a crucial part of any HPLC assay. In order to identify any

compound by HPLC, a detector must first be selected. Once the detector is selected and is set to optimal detection settings, a separation assay must be developed. The parameters of this assay should be such that a clean peak of the known sample is observed from the chromatograph. The high sensitivity of UV detection is bonus if a compound of interest is only present in small amounts within the sample.

The processing of a crude source material to provide a sample suitable for HPLC analysis as well as the choice of solvent for sample reconstitution can have a significant bearing on the overall success of natural product isolation. Many natural product materials contain significant level of strongly binding components, such as chlorophyll and other endogenous materials that may in the long term compromise the performance of analytical columns. Therefore, the guard columns will significantly protect the lifespan of the analytical columns.

RESULTS AND DISCUSSION

This investigation highlights the antimicrobial effect of *Caesalpinia bonducella* seed kernel and its phytochemical properties and cytotoxicity testing.During prehistoric times, medicinal plants, medicinal herbs, simply herbs have been identified and used . Plants make many chemical compounds for biological functions, including defence against insects, fungi and herbivorous mammals. Science have identified nearly 12,000 active compounds are known. These chemicals work on the human body in exactly the same way as pharmaceutical drugs. Several works have been done on this seeds and they studied the resistance of this seeds against bacteria, microbes and fungi.There are many other procedures for extraction of seeds. But we followed a simple method of extraction. We bought the seeds of *Caesalpinia bonducella* from the local shop. The seeds were broken and the kernel was used for extraction. The kernel of the seed was made in to powder using grinder. The powder was weighed to 10g and mixed with 80% of methanol and 80% of ethyl acetate separately. The container was sealed and kept for 7 days. After 7 days they were filtered using whatman filter paper and the extracts were collected and used for further studies.

In this study, the bacteria were isolated from the soil which was collected from the Bishop Heber College campus, Trichy, Tamil Nadu, India. Using the Serial Dilution Method, the soil sample were used for isolating the bacteria. Biochemical analysis was done for all the dilution containing the bacteria. It was observed that the bacteria present in the soil sample were *Streptococcus, Enterobacter and Bacillus*. The most frequently isolated genus has been *Bacillus,* but we have also seen *Streptococcus, Staphylococcus, and Escherichia*. Gram staining was performed for the three strains of bacteria, *Streptococcus and Bacillus* has a Gram-positive (+) and Enterobacter was gram-negative.

The MIC sensitivity study of fever nut was carried out by both broth and agar method. In the agar method, the inhibition zone of *Caesalpinia bonducella* ethyl acetate extract against *Bacillus spp* was higher (31%) followed by *Entrobacter spp. (30%)* and *Streptococcus spp. (26%).* The inhibition zone of Caesalpinia bonducella methanol extract against *Bacillus spp* was higher (27%) followed by *Entrobacter spp. (26%)* and *Streptococcus spp. (24%)* respectively. In the broth method, each bacteria were treated with the three different concentrations (5ml, 10ml, 15ml) of the extracts. The broth culture with different bacteria and different concentrations were incubated for 24hours. O.D values were taken in spectrophotometer after each three hours respectively. There is a decrease in the O.D value after each three hours which indicates that when the time increases the growth of the bacteria decreases due to the different concentrations of the extracts. This clearly shows the antimicrobial activities of the methanol and ethyl acetate seed extract.

Many human infections include, skin and soft-tissue infections, bacteremia, lower respiratory tract infections, urinary tract infections (UTIs), endocarditis, intra-abdominal infections, septic arthritis, osteomyelitis, CNS infections, and ophthalmic infections are caused mainly by *Enterobacter*. *Enterobacter* infections results in prolonged hospitalization, multiple and varied imaging studies and laboratory tests, various surgical and nonsurgical procedures, and powerful and expensive antimicrobial agents. (Susan L Fraser,2016)._*Streptococcus*_species are responsible for many cases like_per tonsillar abscess, otitis media, sinusitis, and bacteremia. which can cause septicaemia, puerperal sepsis,

endocarditis, and pneumonia. Streptococcal pharyngitis, Scarlet fever, Skin infections include Impetigo, Erysipelas and Cellulitis. *Bacillus cereus*, causing serious human infections, including endocarditis, sepsis, meningitis, pneumonia, endophthalmitis, and surgical wound infections Bacillus has the capacity to produce several toxins that target intestinal mucosa. As these three bacteria which were isolated from the soil can cause many different infectious diseases. In this study, the antibacterial activity of *Caesalpinia bonducella* seed extract (both ethyl acetate and Methanol extract) showed a great inhibition against these three bacteria, which clearly shows that fever nut can be used for treating the infection caused by these bacteria by killing them or inhibiting their growth.

The results of this study also reveals that the seeds extract of *Caesalpinia bonducella* (fever nut) contains a phytochemical compounds such as steroids, saponins, terepenoids, flavonoids and tannins in the extract of both Methanol and Ethyl acetate (Fig.9, 10, Tables 11). Among the two extract, Ethyl acetate extract of *Caesalpinia bonducella* is more effective than Methanol extract against the bacteria *Streptococcus, Enterobacter and Bacillus*. (Graph 1.1, 1.2).Biological properties of steroids are antibiotic and antioxidant. Flavonoids saponins Phloroglucinol , Catechol and tannins show antifertility, antidiarrheal, antimicrobial and anti-inflammatory (P. AMUDHA et al 2016). The sensitivity of a specific test organism to the seed extracts may be due to the presence of specific active phytochemical in the individual extract. The seed extract also have antifungal properties.

Certain plant extracts possessing essential phytochemicals act in many ways on various types of disease complex, and may be applied in food, agriculture and medicine industries to control filamentous fungi and yeast. In the present study, among the tested seed extracts of *Caesalpinia bonducella*, ethyl acetate extract showed maximum antimicrobial effect as a radial growth inhibition percentage against *Bacillus spp.*(*31%), Streptococcus spp.*(26%) and *Entrobacter spp.*(30%) respectively.

Cytotoxic screening was done on earthworm using the extract of Fever nut. In this screening, liver function test; Bilirubin (Total), Bilirubin (Direct), T.Protein, Albumin, AST/SGOT, ALT/SGPT, ALP and GGT were done on the serum sample of earthworm. The test was performed before treated with *Caesalpinia bonducella*, seed extract, the test showed a result (<0.2, <0.1,<1.0,<0.5, 430,20,454,18) and after treated with the C.B seed extract, the result of this liver function test was decreased (<0.10,0.23,<0.5,<0.2,8,7,520 ,27) (Table .11) This shows that there is a decrease in the liver enzymes which indicates the prevention of liver cirrhosis by treating it with the *Caesalpinia bonducella* kernel powder. Increase in these liver enzymes causes liver damage and liver cirrhosis. By treating with *Caesalpinia bonducella* kernel powder there is decrease in the liver enzymes which shows normal liver function.

HPLC test were also done for both the methanol and ethyl acetate seed extract in which presence of compounds were confirmed. Thus these bacteria show greater sensitivity to these extracts and hence confirm the antibacterial effect of the *Caesalpinia bonducella* seed kernel powder (Graph 1 & graph 2).Identification of bioactive phytochemical compounds through HPLC analysis prove the presence of Phloroglucinol and Catechol in ethanol extracts and Resorcinol in methanol extracts. (Table 12 & 13) . These compounds are one of the largest and important families of natural secondary products. They possess many pharmacological properties such as antibiotics, anticancer drugs, antifungal agents, immunosuppressants, and insecticides (Hiroyuki et al.,2010). They have a chemical structure with pharmaceutical activity. Many studies reveal that they are biosynthesized by a group of chalcone synthase (CHS) superfamily of type III polyketide synthases (PKSs) (Hiroyuki et al.,2010).SPSS version 16 were done on the antibacterial assays of the nutrient broth of both the extracts. Correlation was done on the OD values obtained from the antibacterial assay. The result shows that the correlation is significant and hence rejects the null hypothesis (Table 9 & Table 10.

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Figure1.Preparation of extract (a)

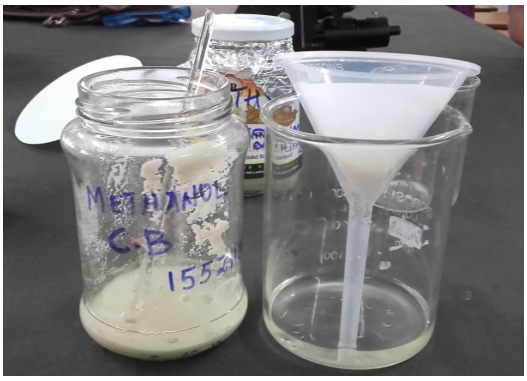


Figure1.Preparation of extract (b)

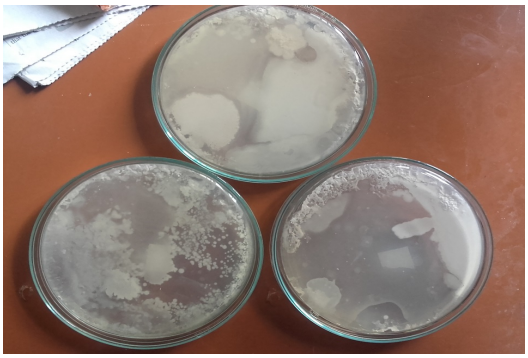


Figure2. Pour Plate Method with Dilution 10^{-2} 10^{-3} 10^{-4} Bascillus (gram positive)

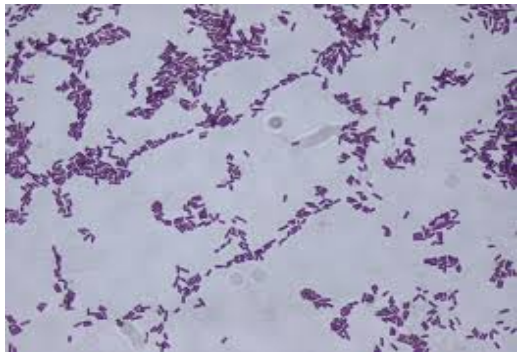


Figure 3. Streptococcus (gram positive)

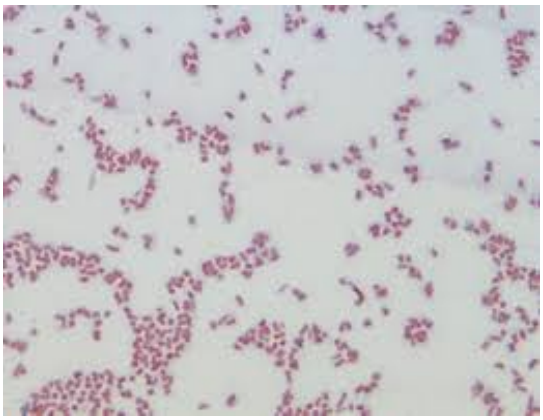


Figure 4.Enterobacter (gram negative)

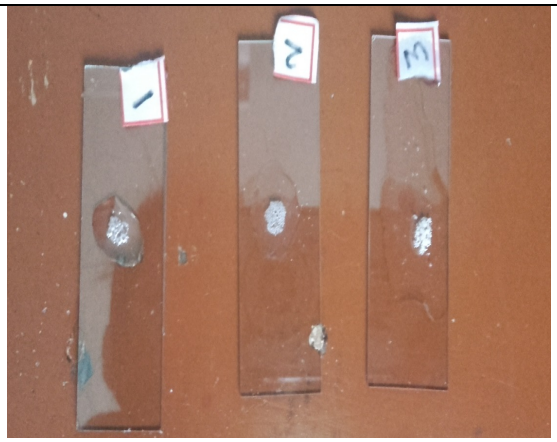


Figure 5.Catalase test shows the presence of Blood agar shows the growth of *Bacillus spp.*

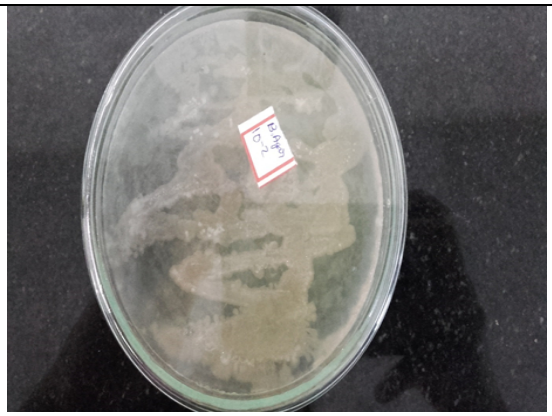


Figure 6.Growth of *Streptococcus spp*.

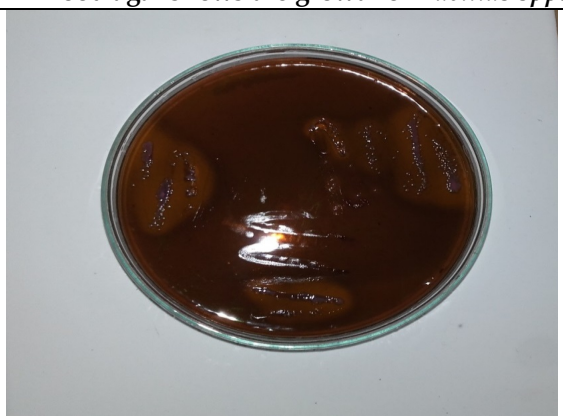


Figure 7.Growth of *Enterbacter* in EMB Agar

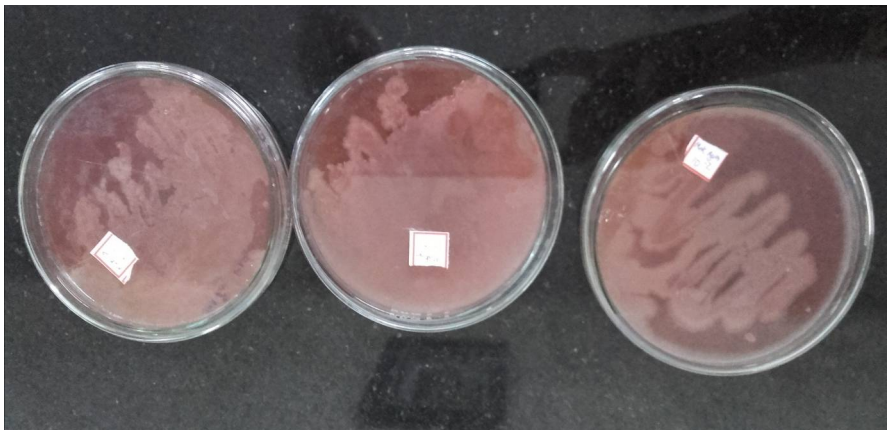
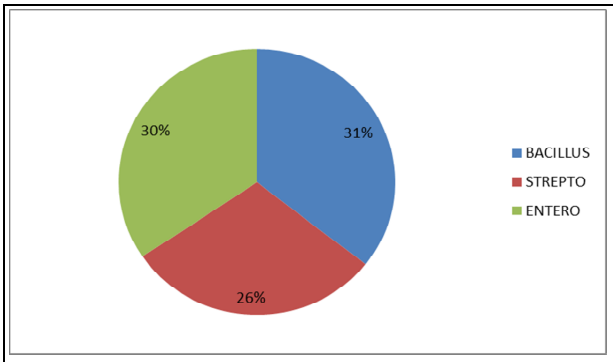
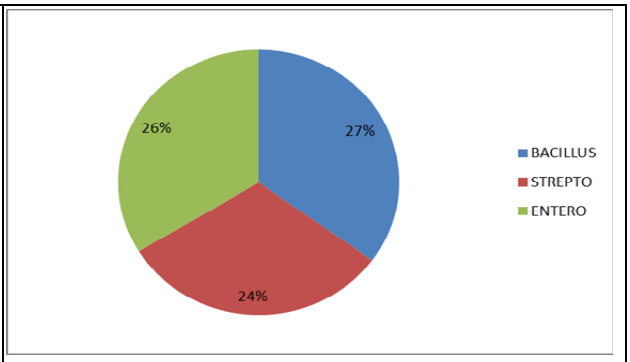


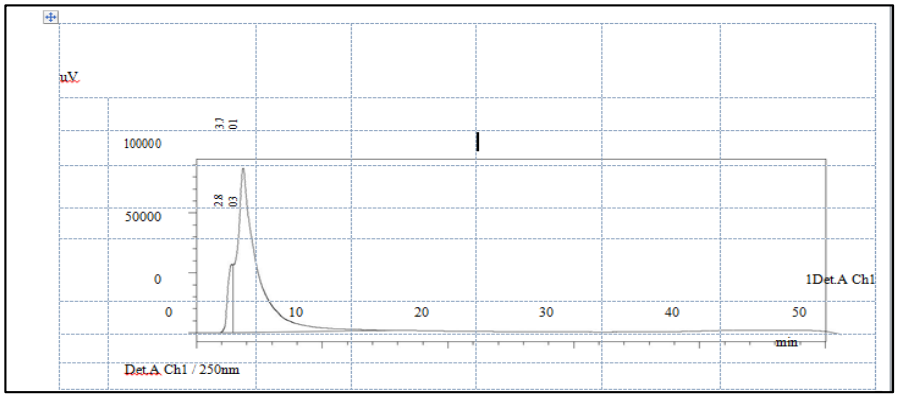
Figure 8.Macconkey agar shows the growth of *Enterobacter spp.*



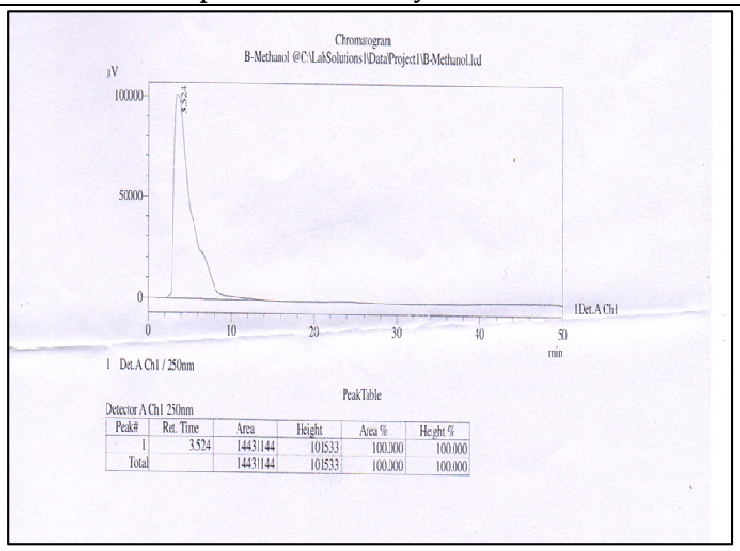
Graph 1.Sensitivity of bacteria against *Caesalpinia bonducella* (fever nut) ethyl acetate extract



Graph 2.Sensitivity of bacteria against *Caesalpinia bonducella* (fever nut) methanol extract



Graph 3. HPLC of Ethyl Acitate extract



Graph 4 . HPLC Analysis of Methanol extract

Phytochemical Analysis

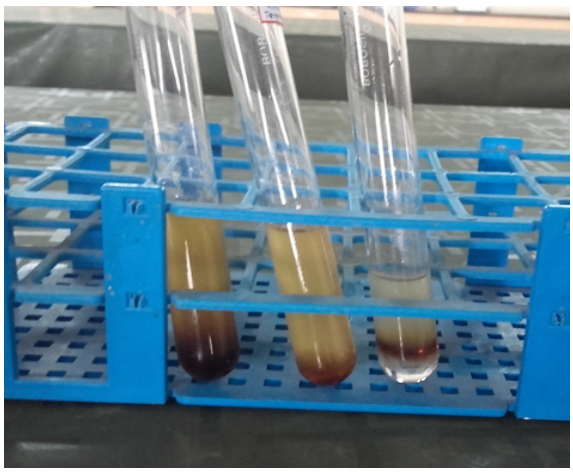


Figure9.Shows the presence of trepenoids

Figure 10.Shows the presence of saponins

Table 1.Biochemical Tests

S.No.	Biochemical tests	Observation	Results	Organisms
1	Indole Test (Tryptone broth)	Red layer at the top	Negative(-)	-
2	Methyl Red Test (MRVP broth)	Red layer at the top	Negative(-)	-
3	Vogues proskauer Test	Pink/Red	Negative(-)	-
4	Mannitol Fermentation	Red to yellow	Negative(-)	-
5	Starch hydrolysis	A clear zone	Negative(-)	-
6	Catalase test	Gas bubbles	Positive(+)	Bacillus
7	Emb agar test	Pink colonies	Positive(+)	Enterobacter
8	Macconkey agar test	Bright pink red colonies	Positive(+)	Enterobacter
9	Blood agar test		Positive(+)	streptococcus
10	Cimmon citrate agar test	Yellow to cerise	Negative(-)	-

PeakTable for Graph No.3
Detector A Ch1 250nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.803	1673771	56974	10.092	29.373
2	3.701	14911166	136992	89.908	70.627
Total		16584938	193965	100.000	100.000

Table 2. Gentamycin against *Streptoccocus, Enterobacter* and *Bacillus* (Control)

S.No.	Organisms	Radius of inhibition zone	Sensitivity
1	*Streptococcus spp.*	20mm	Sensitive
2	*Enterobacter spp.*	15mm	Sensitive
3	*Bacillus spp.*	15mm	Sensitive

Table 3.Antibacterial activity of *Caesalpinia bonducella* (fever nut) ethyl acetate extract against *streptococcus spp.*

S.No.	Concentration	Control	Radius of inhibition zone	Sensitivity
1	5	20	6mm	Sensitive
2	10	20	10mm	Sensitive
3	15	20	10mm	Sensitive

Table 4. Antibacterial activity of *Caesalpinia bonducella* (fever nut) ethyl acetate extract against *Enterobacter* spp.

S.No.	Concentration	Control	Radius of inhibition zone	Sensitivity
1	5	15	5mm	Sensitive
2	10	15	10mm	Sensitive
3	15	15	15mm	Sensitive

Table 5. Antibacterial activity of *Caesalpinia bonducella* (fever nut) ethyl acetate extract against *Bacillus spp.*

SNo.	Concentration	Control	Radius of inhibition zone	Sensitivity
1	5	15	6mm	Sensitive
2	10	15	10mm	Sensitive
3	15	15	15mm	Sensitive

Table 6. Antibacterial activity of *Caesalpinia bonducella* (fever nut) methanol extract against *Streptococcus spp.*

S.No	Concentration	Control	Radius of inhibition zone	Sensitivity
1	5	20mm	4mm	Sensitive
2	10	20mm	8mm	Sensitive
3	15	20mm	12mm	Sensitive

Table 7. Antibacterial activity of *Caesalpinia bonducella* (fever nut) methanol extract against *Enterobacter spp.*

S.No.	Concentration	Control	Radius of inhibition zone	Sensitivity
1	5	15mm	6mm	Sensitive
2	10	15mm	10mm	Sensitive
3	15	15mm	10mm	Sensitive

Table 8. Antibacterial activity of *Caesalpinia bonducella* (fever nut) methanol extract against *Bacillus spp.*

S.No	Concentration	Control	Radius of inhibition zone	Sensitivity
1	5	15	2mm	Sensitive
2	10	15	10mm	Sensitive
3	15	15	15mm	Sensitive

Table 9.SPSS statistics showing Correlation - Ethyl acetate Descriptive Statistics

	Mean	Std. Deviation	N
Organisms	2.0000	.83205	27
Concentration	2.0000	.83205	27
Hours	2.0000	.83205	27
Growth	.4515	.25416	27

Correlations					
		Organisms	**Concentration**	**Hours**	**Growth**
Organisms	Pearson Correlation	1	.000	.000	.027
	Sig. (2-tailed)		1.000	1.000	.893
	N	27	27	27	27
Concentration	Pearson Correlation	.000	1	.000	-.275
	Sig. (2-tailed)	1.000		1.000	.166
	N	27	27	27	27
Hours	Pearson Correlation	.000	.000	1	-.822**
	Sig. (2-tailed)	1.000	1.000		.000
	N	27	27	27	27
Growth	Pearson Correlation	.027	-.275	-.822**	1
	Sig. (2-tailed)	.893	.166	.000	
	N	27	27	27	27
**. Correlation is significant at the 0.01 level (2-tailed).					

Table 10.Methanol extracts shows correlation

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
Organisms	2.0000	.83205	27
Concentration	2.0000	.83205	27
Hours	2.0000	.83205	27
Growth	.4641	.24703	27

Correlations					
		Organisms	**Concentration**	**Hours**	**Growth**
Organisms	Pearson Correlation	1	.000	.000	.073
	Sig. (2-tailed)		1.000	1.000	.718
	N	27	27	27	27
Concentration	Pearson Correlation	.000	1	.000	-.213
	Sig. (2-tailed)	1.000		1.000	.285
	N	27	27	27	27
Hours	Pearson Correlation	.000	.000	1	-.876**
	Sig. (2-tailed)	1.000	1.000		.000
	N	27	27	27	27
Growth	Pearson Correlation	.073	-.213	-.876**	1
	Sig. (2-tailed)	.718	.285	.000	
	N	27	27	27	27
**. Correlation is significant at the 0.01 level (2-tailed).					

Table 11 . Phytochemical Analysis

S.No.	Phytochemical tests	Observation	Result	
			Methanol	Ethyl acetate
1	Tannins	Green precipitate	Presence	Presence
2	Flavonoids	Yellow coloration	Presence	Presence
3	Terpenoids	Deep red coloration	Presence	Presence
4	Saponins	Froth appears	Presence	Presence
5	Steroids	Reddish brown ring at the junction	Presence	Presence
6	Phlobatannins	Red precipitate	Absence	Absence
7	Carbohydrates	Reddish violet ring	Absence	Absence
8	Glycosides	Violet to blue to green coloration	Absence	Absence
9	Coumarins	Yellow coloration	Absence	Absence
10	Alkaloids	Yellow precipitate		
11	Proteins	White precipitate	Presence	Presence
12	Emodins	Red coloration	Absence	Absence
13	Anthraquinones	Pink violet or red coloration	Absence	Absence

Table 11. Cytotoxicity Screening

S.No.	Tests	Results		Normal Range	Units
		Before treating	After treating		
1	Bilirubin (total)	<0.2	<0.10	0.3-1.9	mg/dl
2	Bilirubin (direct)	<0.1	0.23	0-0.3	mg/dl
3	Total protein	<1.0	<0.5	6-8.3	gm/dl
4	Albumin	<0.5	<0.2	3.5-5.5	gm/dl
5	AST/SGOT	430	8	8-48	U/l
6	ALT/SGPT	20	7	7-55	U/l
7	ALP	454	520	45-115	U/l
8	GGT	18	27	9-48	U/l

Table 12. Identification of bioactive compounds in *Caesalpinia bonducella of ethanolic extracts*

S.No	Ethanol extract Retention Time	Area %	Bioactive compound
1.	2.803	10.092	Phloroglucinol
2.	3.701	89.908	Catechol

Table 13. Identification of bioactive compounds in *Caesalpinia bonducella* of methanolic extracts

S.No.	Methanol extract Retention Time	Area %	Bioactive compound
1	**3.524**	**100**	**Resorcinol**

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Simulation Study of Material for Faraday Cup Design for Low Energy Ion Accelerator

P. K. Rath[1]*, S. Dhal[1], N. Venketesh[1] and M. Mishra[2]

[1]Centurion University of Technology and management (CUTM), Odisha, India
[2]Saraswati Institute of IT & Management, Vikas group of Instituatation,Bhawanipatna, Kalahandi, Odisha, India

Received: 03 Mar 2020 Revised:06 Apr 2020 Accepted: 08 May 2020

***Address for Correspondence**
P. K. Rath
Centurion University of Technology and Management,
Odisha, India.
Email: prasanta.cutm.ac.in

ABSTRACT

A study & simulation has been performed to understand the properties of a Faraday Cup (FC), which is a main active detecting device in any ion beam facility. Different material has been investigated. A Monte Carlo simulation has been performed to understand the interaction of particle with material. A heat analysis has been performed using the Laplace equation and the results has been presented. It has been found that there are many material which can be potential candidate for FC but best suitable candidate can be Cu. The detail calculation has been presented.

Key words: Cu, accelerator, ion, beam, quantity, material

Introduction:

The beam intensity is a very much important quantity in any experiment involving ion beam /accelerator physics. The main accuracy of the experimental data (cross section) depends on the incident beam intensity/ incident flux. As this is one of the important parameter of the experimental investigation, therefore the measurement procedure itself is interesting and challenging. Some places people use a special device to measure the beam intensity.Most of the places people use a device called faraday cup (FC) for the beam current measurement. Some places it is called as the beam monitoring device. It is a destructive way of measurement of the incident beam intensity. In this paper we have attempted the simulation study for FC which will be helpful for it's design. The material choice another important work. In the present investigation we have performed simulations and comparison to choose a proper material.

The very simple design of FCconsists of an electrically conductive material in a cup shape. The cup shape has the cylindrical symmetry, which is placed in the path of the incident charge particle beam and the currentwill measure. Once the current measures it then deconvoluted to the number of ions i.e the incident number of ions. So a proper use of the electronic read out systemwill require for this purpose. Most of the places before deploying the FC a calibrationmust have to be done by using a knowncurrent source. Once the calibration done then it deployed in the

beam line to measure the incident beam current/flux. The range of the current is very less ~nA range where this simple looking device works much better way but the complexity involves in the physics and design. Since there are many other phenomena has to be taken care. . The information related to Faraday cups has given in [1-5]. Some general aspects of Faraday cup design and operation are discussed in multiple references and, as such, it is difficult to determine the originator for some topics. As mentioned above the Faraday cup looks simple but there are other important phenomena has to be taken care during designing it. Some of the important phenomena are Ionization, secondary electron emission, Coulomb scattering. These are the main process responsible for the large angular deflections that can lead to backscattered ions.

Transmission efficiency is important to measure the transmission of an accelerator using many devices one of them is FC. In a simplest way first one can place the FC in one position and note down the beam current (extract the incident ion flux) and then changed the position of the FC to another location of the transport section and take the beam current measurement again. Compared both the result and one can inform about the transmission efficiency, say for example if the measurement of both the places is same that indicates the transmission efficiency is 100% between those points. From the FC current measurement one can able to extract the ion information. For instance Let us consider a case where the FC shows a current of 100nA of proton beam. The proton has charge one and one mole contains the Avogadro number so if we do a small math we will see that 100nA ~62.5×10^{10}particles per second. In this way FC is very important for any ion beam facility/Accelerator.

SIMULATION AND RESULT

Since the FC is very important component it is necessary to understand the operations principle.The FC looks simple but there are many important problems related with it. Some of the important issuesare Faraday Cup Current Loss,Backscatter Losses, Current Leakage Sources etc. As we discussed above the faraday cup is based on the simple mechanism but the mechanical design is complex as many points has to be taken care.Bellow three important aspects has beenpointed out which serves as three important properties to choose the material for FC design. 1) Natural abundance of the material: The natural abundance of the material is very important for the cost-effective point of view. In Fig 1. We have presented the natural abundance of many materials. One can see from Fig.1 that many material has high abundance but only few material are the most promising candidate. 2) electrical conductivity: As the FC is a metallic body and the important job of the FC is to provide the ion information which lead to a very small current reading using sophisticated electronic device, so the electrical conductive of the material is very important and it should be very high.

When the ions will strike the metallic cup which will provide the number of ions information via beam current measurement in a destructive way it will produce substantial amount of the thermal heat at the point of Interaction which has to be dissipates quickly to avoid the secondary effect like Melting, degassing from the material and the secondary electron emission, which is 3rd important point to keep in mind when choosing material for FC. Therefore thermal conductivity of the material has to be very high also. Many material to choose the best one a numerical simulation has been performed. For a clear picture of the thermal analysis we have considered a practical example.Let us consider 400µA of "p" beam having energy 200KeV will strike a 20mm x 20mm metal (Al & Cu) sheet which will produce ~ 80W of power. Here we have considered the incident beam dia is 6mm i.e a large beam. Once the beam will strike the metal surface it will produce the thermal heat as calculated above. The thermal heat need to be dissipate very fast. For the heat distribution (a static picture) has been generated using the Laplace 2D heat equation ($\partial^2U/\partial x^2 + \partial^2U/\partial y^2 = 0$) .This equation has been solved for 2D case using the Finite difference approximation . For the solution we have used the Finite difference approximation. We have considered one boundary is due to the temperature created by striking of the ions where as in the other boundary it is zero. To know which material is more efficient we have solved the time dependent solution which has been solved in the similar way & presented above. The result has been shown in Fig.2. One can see from Fig.2 that to cool the Al it takes ~3 min

where as for Cu to dissipate the same heat it needs < 1.5 min i.e. it will cool faster rate. In addition with thermal analysis a montecarlo simulation has been performed using the material Cu to choose the thickness of the material. The calculation has been performed using the code SRIM/TRIM which provide the stopping range of a material for a 5Mev of proton beam on Cu material and shown in Fig.3 one can observe from Fig.3 that the thickness of the material is < 2mm but for the safer side one can take >5mm of thickness as that will provide extra space for cooling channels to dissipate the heat.

CONCLUSION

A complete analysis has been done to choose the material. different aspects has been discussed. Monte Carlo simulation has been performed to fix the thickness of the material. A heat analysis has been performed using the Laplace equation and the results has been shown. It has been found that the Cu has a suitability for the machining of FC compared to other material.

ACKNOWLEDGMENT

I am very much thankful to CUTM & SRIM team to provide support to carry out this investigation.

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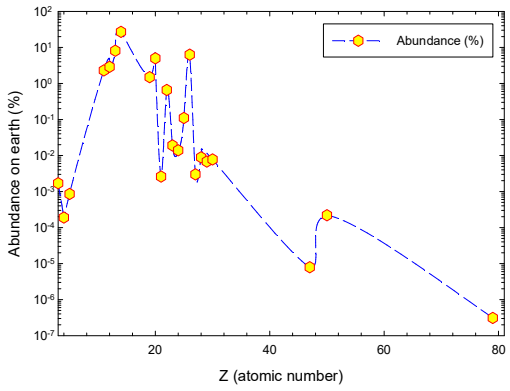

Fig.1 The natural abundance of many different material over the earth crust. Many material shows the promising candidates including Al and Cu.

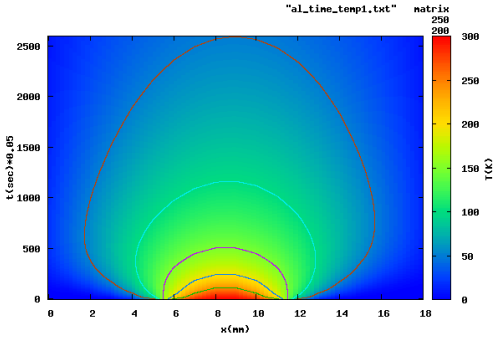

Fig.2 (a)

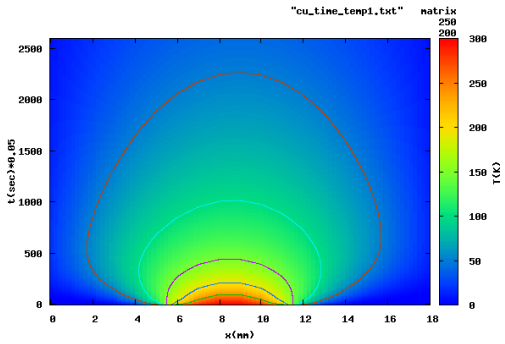

Fig.2 (b)

Fig.2 (a) The time dependent solution for the heat transfer inside the material .one can see that it will take ~3min to reach to the last contour for Al. (b) same as above only the material is Cu.one can see that it will take <1.5 min to reach to the last contour.

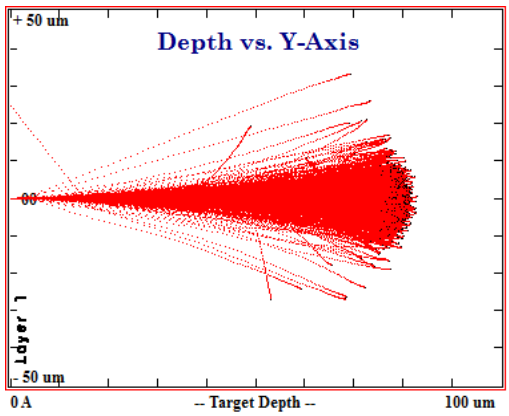

Fig.3AMonte Carlo simulation using SRIM / TRIM for the thickness of the Cu when 5Mev proton (p) strikes the material.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Synthesis and Characterisation of Electrospun PAN / FeO(OH) Composite Nanofibers for Adsorptive Removal of Cong Red Dye

Shraban Kumar Sahoo* Gagan Kumar Panigrahi and Susanta Kumar Biswal

School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

Received: 02 Mar 2020 Revised:05 Apr 2020 Accepted: 08 May 2020

***Address for Correspondence**
Shraban Kumar Sahoo
School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: shraban.sahoo@cutm.ac.in

ABSTRACT

Polyacrylonitrile (PAN) / FeO(OH) composite nanofibers membrane was successfully prepared by electrospinning method. FeO (OH) nanoparticles were prepared by hydrothermal method. FeO(OH) nanoparticles were impregnated with PAN-DMF 12 wt % solution and then electrospun this homogenous solution to obtain nanocomposite PAN fibers. This nanocomposite electrospun PAN/FeO(OH) fibers membrane has been used as adsorbent material for the removal of Congo red dye from the aqueous solution. The formation, surface morphology and crystalline phase of PAN / FeO(OH) nanocomposite electrospun fibers were characterized by FTIR (Fourier Transform Infrared) spectroscopy, SEM (Scanning Electron Microscope) and XRD (X-Ray Diffraction) analytical techniques. The batch experiments were carried out for the adsorption studies of Congo Red dye. The effect of contact time for the adsorption of Congo red dye on the composite nanofibers has been studied. It is observed that maximum 99% of CR dye removal was achieved with in 60 min of contact time. This result indicates PAN/FeO(OH) nanocomposite fibers have high affinity for the Congo Red dye removal.

Key words: Nanofibers, Electrospinning, Nanocomposite Congo-red, Adsorption

INTRODUCTION

Nanomaterials are foundations of nanoscience and technology. These are the materials, where the sizes of the individual's building pieces are under 100nm, at any rate in one dimension. These are given higher need in exploration proposition [1-11]. These materials are progressively essential result of nanotechnologies [12]. Nanomaterials can be 0 dimensional (e.g., nanoparticles), 1 dimensional (e.g. nanofibers, nanotubes, nanorods, nanowires), 2 dimensional (e.g., scattering of nanoparticles, packs of nanowires, multinanolayers) and 3 dimensional (e.g., nanospheres, nanocubes) [13]. The size of nanomaterials lies in between those of atoms and the bulk materials.

Most of the microstructured materials have similar properties to the corresponding bulk materials but the properties of nanomaterials are significantly different from those of atoms and bulks materials. This is mainly due to the nanometer size of the materials which provides them: (i) large fraction of surface atoms; (ii) high surface energy; (iii) spatial confinement; (iv) reduced imperfections, which do not exist in the corresponding bulk materials.Unique properties at the nanoscale have led to the use of nanomaterials in the fields (e.g. Heat transport, super-paramagnetism, Adsorption, Emission and Reflection) where conventional materials have limitations [14].

Synthetic process of nanomaterials is mainly of twotypes. They are Top-down method (destruction) and bottom-up method (construction).Topdown method involves mechanical milling, etching (chemical), electro-explosion (thermal/chemical), sputtering (kinetic) and laser ablation (thermal). And Bottom up method involves super critical fluid synthesis, spinning, use of templates, plasma or flame spraying synthesis, green synthesis, sol-gel process, hydrothermal process, laser pyrolysis, aerosol based process and co precipitation etc [15]. Fiber having measurement in nanometer to submicron range is called nanofiber. These nanoscale distances across of nanofibers give a few stunning qualities, for example, expansive surface range to volume proportion, high porosity, high gas porousness, little interfibrous pore size, adaptability in surface functionalities[16]. Because of these extraordinary properties nanofibers are utilized as a part of numerous essential applications, for example, biomedical [17], electrical and optical, defensive dress [18], filtration [19], antibacterial action [20], battery immobilization, electro chemical sensing, composite materials, reinforcements, blood vessel engineering and tissue engineering[21].Various techniques have been utilised to create nanofibers. Those are electrospinning, flash spinning, drawing, application of pressurised gas, forcespinning, jet-blowing and melt spinning etc. Among these methods, electrospinning seems to be the simplest, low cost and highly versatile technique that allows for the fabrication continuous fibers with diameters ranging from a few micrometers to a few nanometers. This technique is applicable to virtually every soluble or fusible polymer [22].

Electrospinning is by all accounts the least difficult, minimal effort and profoundly adaptable system that takes into consideration of creation of fibers with width from micrometers to nanometers. Many other potential approaches in electrospinning are bubble electrospinning, electroblowing, electrospinning by porous hollow tube, electrospinning by microfluidic manifold, roller electrospinning, melt electrospinning [23] etc. Mainly it is a method of fabricating thin fibers from polymers, ceramics and composites. Here the nanofibers form has both solid and hallow interiors having long length and uniform diameter [24-25]. It is a uniaxial elongation of a viscoelastic jet derivedfrom polymer melt. This is a technique, which involve high voltage power to induce the formation of a liquid jet. A solid fiber is generated as the electrified jet, which is stretched continuously due the electrostatic repulsion between the surface charge and the evaporation of solvent [26]. The main objective of this work are (i)To synthesize FeO(OH) nanoparticles by hydrothermal method, (ii) Synthesis of PAN/FeO(OH) composite nanofibers by electrospinning method. (iii) Characterisation of the prepared composite nanofibers by FE-SEM, XRD, FT-IR and UV-Vis analytical techniques. (iv) To study the adsorptive removal of Congo red dye from aqueous solution by using PAN/FeO(OH) composite nanofibers membrane.

MATERIALS AND METHODS

Materials required

Polyacrylo nitrile (PAN) was purchased from sigma Aldrich. N, N-Dimethylformamide (DMF), sodium hydroxide, ferric nitrate nonahydrate was purchased from SD fine chemical limited, Congo Red dye was purchased from Merck India. All these chemicals were used without any further purification.

Synthesis of FeO(OH) nanoparticles by hydrothermal process

For the process to produce iron oxide nanoparticles, first 4.5 mmol of ferric nitrate was dissolved in 20 ml of deionised water. It is named as solution A. Then again 20 mmol of sodium hydroxide was dissolved in 20 ml of

deionised water. It is named as solution B. After this solution B is added drop wise to solution A with maintaining a PH of 10 in stirring condition. After stirring for 30-45 minutes, the resulting suspension was transferred to a 150 ml Teflon-lined autoclave. It is heated to 100 degrees centigrade for 3 hours. After heating, the autoclave was cooled in room temperature. The obtained precipitate was centrifuged, washed repeatedly with water and then with alchohol. The precipitate was then dried in oven for the formation of FeO(OH) nanoparticles. Hence red-brown FeO(OH nanoparticles was formed (Fig.1).

Synthesis of PAN/FeO(OH) nanofiber by electrospinning process

12 wt % of solution was prepared by using 0.6 gm of PAN and 4.2 gm of DMF in stirring condition for 24 hours to obtained a homogeneous clear solution mixture. The PAN and FeO(OH) nanoparticle was maintained at 2:1ratio. So, according to that, 0.3 gm of FeO(OH) nanoparticles were added to the prepared mixture in stirring condition and again keep stirring for more 24 hrs to prepare the electrospinning solution. Then the solution was taken for electrospinning by application of high voltage of 13 KV with a feeding rate of 1mL/h. Hence the nanofibers were formed, which was collected at metal collector (Fig.2).

Adsorption of congo red

PAN/ FeO(OH) nanocomposite fibers was taken as adsorbent for the removal of Congo red dye from aqueous solution. 1000 ppm stock solution of the dyes was prepared. Then different test solution was preparing by proper dilution of stock solution. Then the adsorption was studies carried out by taking 0.05g of adsorbents in 50 mL of 20 ppm dye solution taken in a 100 mL reaction bottle. During the adsorption process the bottle was kept in a magnetic stirrer and stirred for 1h. After equilibrium time the solution was filtered and the remaining concentration of the dye was measured by using UV-visible spectrophotometer with corresponding λ_{max} value 498 nm. Finally, the effect of contact time for the adsorption of dye on the surface of the adsorbent was investigated.

Characterization technique

Different Instrumental techniques are used for the characterization of the prepared adsorbent such as XRD (Philips X'Pert X-ray difractometer), FTIR (Bomem MB 100 spectroscope), FE-SEM (Nova Nano SEM 450) and UV-Visible (Shimadzu UV-2450 spectrometer)

RESULTS AND DISCUSSION

XRD analysis

X-ray diffraction (XRD) patterns were performed on a Philips X'Pert X-ray diffractometer with Cu Kα radiation (λ = 1.5418 Å). The Fig. 3 shows the XRD patterns of FeO(OH) nanoparticles. These patterns represent the peaks of two phases of iron oxide nanoparticles. One of the phase of the hydrothermal product matches with that of Goethite phase of FeO(OH) nanoparticles (JCPDS file no17-0536). The other phase is of iron hydroxide oxide nanoparticles (JCPDS file no76-0182). These peaks represent that the sample highly crystalline in structure. Geothite phase of ironoxide has an orthorhombic structure and iron hydroxide oxide has a rhombohedral structure.

FTIR analysis

Fourier transform infrared (FT-IR) spectra were recorded on a Bomem MB 100 spectroscope in absorbance/transmission mode at a resolution. The IR spectra of composite nanofibers (Fig. 4) of PAN/FeO(OH) which has a broad peak at 3407 cm^{-1}due to–OHand the peaks at 2248 and 2930 cm^{-1} is due to stretching vibration of nitrile groups (-CN-) and bending vibration of methylene (-CH_2-) group respectively. The peak at 1740 cm^{-1}refers to the deformation of the carbonyl group. The peak at 573 cm^{-1} is due to FeO nanoparticles [30].

FESEM analysis

The surface morphologies of the nanocomposite fibers and FeO(OH) nanoparticles were investigated using Field Emission Scanning Electron Microscope and shown in Fig-5(a) and Fig-5(b) respectively. The FESEM images of PAN/FeO(OH) nanocomposite fibers (Fig. 5a)shows that nanofibers have a basic smooth and uniform structure, with the diameter in range of 300–410 nm there is uniform distribution of the FeO(OH) nanoparticles on the surface of the PAN nanofibers. The surface morphology of the synthesized FeO(OH) nanoparticle was studied by FESEM (Fig. 5b). Rod-like morphology with nanometer 60–90 nm size could be observed clearly in Fig. 8b. The obtained FeO(OH) rod-like nanoparticles possess a uniform shape and fairly regular structure..

Adsorption of dye on PAN/FeO(OH) nanocomposite fibers

Adsorption experiments were conducted to determine the equilibrium adsorption capacities of PAN/FeO(OH) nanocomposite fibers for the adsorption of Congo red dye from aqueous solution. 50 mL of 20 ppm dyes solutions were taken in a 100 mL reaction bottle and 0.05 g of nanocomposite fibers was added.The effect of contact time of the adsorption of the dye was investigated. The effect of time for the removal of Congo Red dye by PAN//FeO(OH) nanocomposite fibers is shown in fig.6.From the figure, it has been observed that the maximum removal (99%) was achieved at 60 min of contact time. The reason might be that the PAN/FeO(OH) nanocomposite fibers have high porosity and high surface area at the initial 60 minute for the adsorption of dye. After 60 min the adsorbent surface is filled with the dye molecules and there is no vacant side. Thus at 90 mints the adsorption becomes constant.

CONCLUSION

PAN/FeO(OH) composite nanofibersmembrane was synthesized successfully by electro spinning method.Different analytical techniques such as XRD, FTIR, FESEM were used to characterized the prepare adsorbent. Adsorption behaviours of the prepared adsorbent materials were studied for Congo red dyeremoval from aqueous solution. The effect of contact time for the adsorption of Congo red dye on the composite nanofibers has been studied. It was observed that maximum 99% removal was achieved with in 60 min of contact time. From the experimental results it can be concluded that PAN/FeO(OH) nanocomposite fibers have high affinity for the Congo Red anionic dye.

ACKNOWLEDGEMENTS

Authors thank the administration and management of Centurion University of Technology and Management, Odisha, India.

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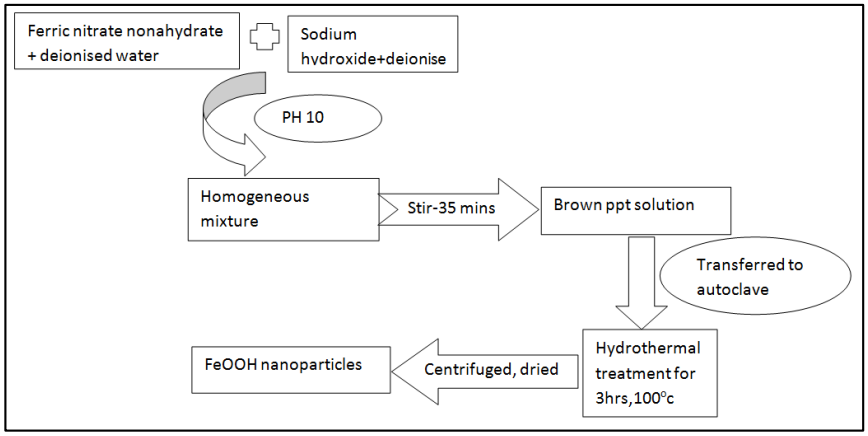

Fig. 1 schematic representation for the synthesis of FeO(OH) nanoparticles

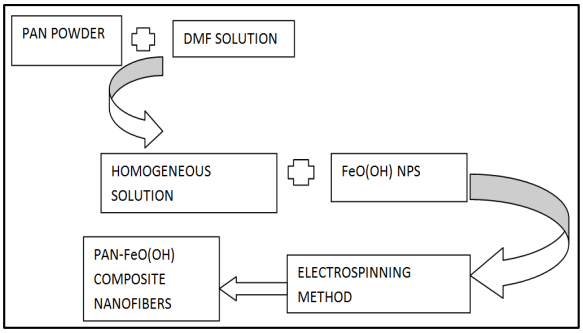

Fig-2: Schematic representation for the synthesis of PAN/FeO(OH) nanocomposite fibers

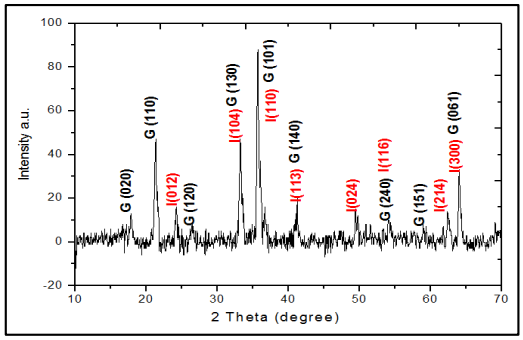

Fig-3 XRD patterns of FeO(OH) nanoparticles

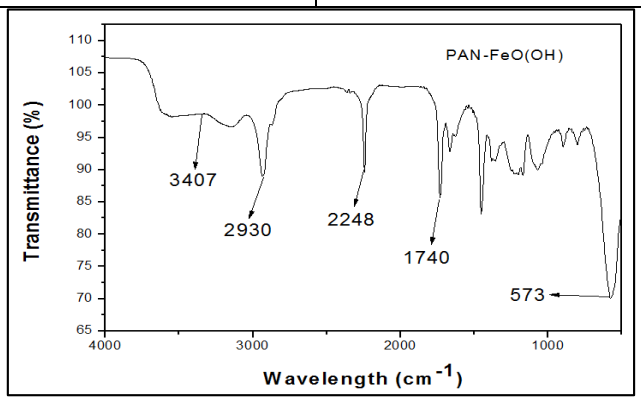

Fig-4 FTIR spectra of PAN/ FeO(OH) nanocomposite fibers

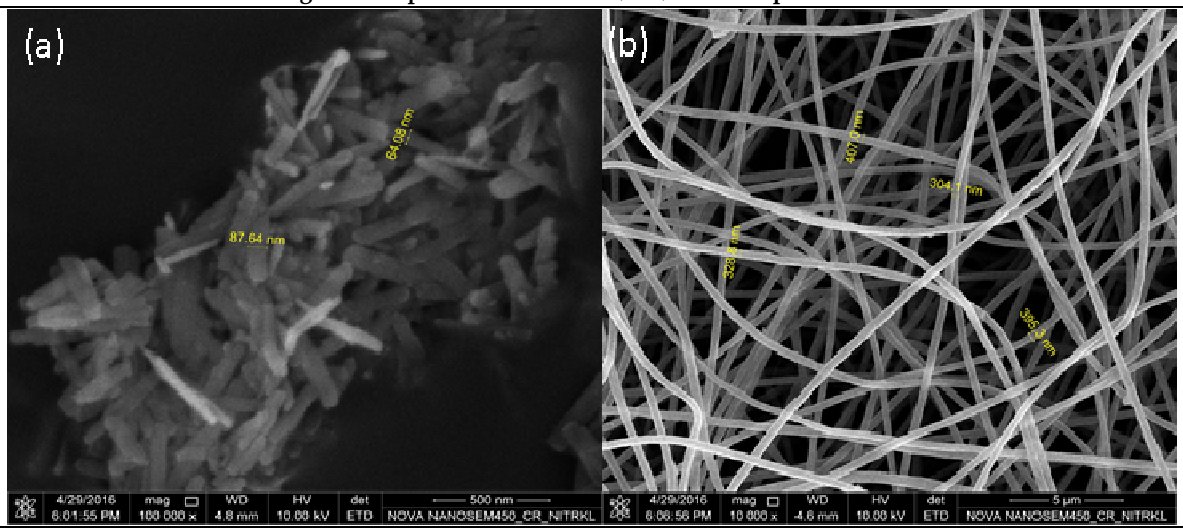

Fig -5 FESEM image of (a)FeO(OH) nanoparticles and(b)PAN/ FeO(OH) nanocomposite fibers.

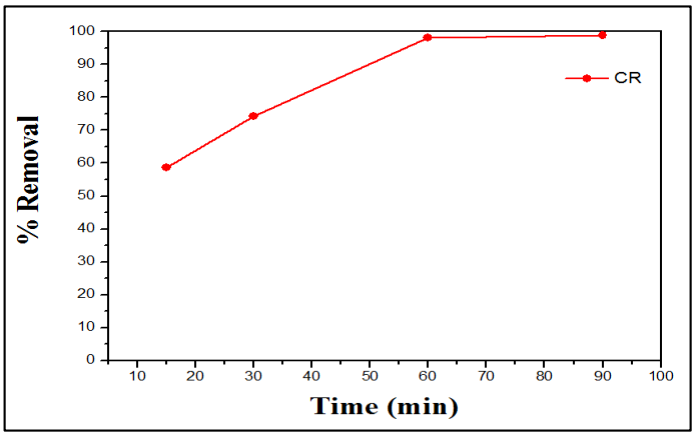

Fig-6 Adsorption of CR dye by PAN/FeO(OH) nanocomposite fibers

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Rainfall Prediction using Machine Learning Approach: A Case Study for the State of Odisha

Rajesh Kumar Misra*[1], Prafulla Kumar Panda[2], Anjan Kumar Sahu3, Smrutirekha Sahoo[4] and Debi Prasan Behera[5]

[1]Department of ECE, Centurion University of Technology and Management, Odisha,India
[2]Department of Civil Engineering, Centurion University of Technology and Management, Odisha,India
[3]Department of EEE, Centurion University of Technology and Management, Odisha, India
[4]Department of Geology, Fakir Mohan University, Baleshwar, Odisha, India
[5]Department of Petroleum Engineering, VELS Institute of Science, Technology & Advanced Studies (Vels University-Deemed to be a University), Pallavaram, Chennai, Tamil Nadu, India

Received: 05 Mar 2020 Revised:07 Apr 2020 Accepted: 09 May 2020

***Address for Correspondence**
Rajesh Kumar Misra
Department of ECE,
Centurion University of Technology and Management,
Odisha, India.
Email: rkmishra@cutm.ac.in

ABSTRACT

In the present article, an attempt has been made to derive optimal data-driven machine learning methods for forecasting an average rainy season (June to September, 1901-2018) rainfall of the state of Odisha in India. This comparative analysis is based on three aspects: pre-processing techniques input modeling and modeling methods. Comparisons among the three linear regression analysis, random forest method and Artificial Neural network method have been considered to find out a best prediction technique. In this study it has been observed that the maximum rain fall 385.3mm occurred in year 1961and minimum197.2mm rain fall occurred in year 1974.It has been found that maximum accuracy for Random forest regression 91% and mean absolute error was 2.3%, for ANN accuracy was 89.64% and mean absolute error was 3.2%,for Linear regression accuracy was 87.28% and mean absolute error was 3.8%.from the present study it has been observed that Random forests is a viable model to be used in the field of rainfall prediction.

Key words: Linear regression, Random forest, artificial neural network, rain fall prediction etc.

INTRODUCTION

Prediction of the rainfall is helpful in preventing floods that save human lives and property. In fact, it helps manage the water supply. Rainfall information in the past helps farmers better manage their crops which leads to economic growth in the country. Fluctuation in the timing of rainfall and its volume makes prediction of rainfall a difficult activity for meteorological scientists.Precise rainfall forecasting has become one of the most important concerns in hydrological science, as early notice of extreme weather will help avoid natural disasters and damage if prompt and accurate forecasts are made. To construct a predictive system for accuraterainfall, forecasting is one of the greatest challenges to researchers of diverse fields such as weather data mining (Yang et al., 2007), environmental machine learning (Hong, 2008), operational hydrology (Li and Lai, 2004),and statistical forecasting (Pucheta et al., 2009). In such issues, a common question is how to evaluate the past and use future predictions. The parameters needed for predicting rainfall are incredibly complex and subtle even over a short period of time.

In the country like India where, based on the monsoon season, crops are harvested. So, it's critical to have advanced predictive knowledge. Some states suffer from droughts, while others from floods. This prediction model will help us take the requisite precautions by providing transportation and food to save lives. To solve this problem, various methods of predicting the rainfall were proposed. These methods however have performance limitations due to wide range of data variations and the amount of data is restricted. Other techniques have been employed such as stochastic process, statistical methods and neural networks. Many of these strategies showed good performance promising results while others did not offer clear reasons. Researchers have suggested many methods to help in these tasks. This, however, led to the issue being broken down into two predictive types: rainfall events (Binary prediction), and rainfall classification when it actually happens (light, moderate, and heavy rainfall). To date, ANN has been used in this area and has opened several new approaches in the prediction of phenomena related to the climate (Gardener and Dorling, 1998; Hsiesh and Tang, 1998).Distinct structures of the models of auto-regressive moving average (ARMA), ANN, and Nearest-Neighbor techniques were used to forecast storm rainfall in areas such as the Sieve River Basin, Italy, between 1992 and 1996.Proposed the practice of using ANNS for the monthly average rainfall forecast for an Indian area based on the climate of the monsoon type. This case study found the prediction four months a year. There has been some certainty of a rainfall event to occur during these months. The research was performed using three different network types: Feed Forward Back Propagation, Layer Recurrent, and Cascaded Feed Forward Back Propagation.

The Feed Forward Back Propagation was the network which got the best results. Liu et al proposed a system of substitution over the preceding pattern. We discuss the idea of using the genetic algorithm as a search algorithm for features and the algorithm Naïve Bayes as a predictive algorithm. The use of genetic algorithms for the selection of inputs makes it possible to simplify the intricacy of the data sets and also improving upon the performance. Shoba G.and ShobhaG analyzed various algorithms such as Adaptive Neuro-Fuzzy Inference System (ANFIS), ARIMA and SLIQ Decision for the forecast of rainfall. R.Sangari and M.Balamurugan related data mining methods such as the K-Nearest Neighbor(KNN), Naïve Bayes, Decision Tree, Neural Networks, and Fuzzy Logic for the use of rainfall prediction. Beltrn-Castro used decomposition and ensemble techniques to rainfall on daily basis. Ensemble Empirical Mode Decomposition (EEMD) is the decomposition technique adopted by Beltrncastro for dividing data into multiple segments. Few scholars like D. Nayak and A. Mahapatra used different machine learning algorithms like Multi Layer Perception Neural Network (MLPNN), Back Propagation Algorithm (BPA), Radial Basis Function Network (RBFN), SOM (Self Organization Map) andSVM(SupportVector Machine)topredictrainfall.Their results have shown positive results on favor of back propagation algorithm. Authors used different neural network models to predict rainfall. They have adopted feed forward neural network using back propagation, cascade-forward back propagation NN (CBPN), distributed time delay neural network (DTDNN) and nonlinear autoregressive exogenous network (NARX) and compared which gives bestresults.

The rest of the paper is as follows: in Section 2, discussed briefly about the study area and the rainfall series used in this present study. In Section 3, have been describedthe modelling approach which includes the input selectiontechnique and the variable selection method, and how theweights are extracted. This is followed by discussionsabout the experimental setup and result (Section 4) and conclusion of the paper appear inSection 5.

Study Area

The rainfall data have taken from 2ndary source IMD (Indian Metrological department rainfall updates from 1901 to 2018).In this paper; it has taken annual rainfall series of rainyseason (June to September)data of Odisha State.Objectives are as follows

1. Prediction of Rain fall for the study area
2. Comparative analysis and to provide best suitable model for prediction of rain fall

METHODOLOGY

The brief methodology is shown in fig no -1 gives step by step procedure for prediction of rain fall.High Dimensional data is tricky for classifications algorithms because of its higher computational costs and the required memory usage. To rectify this, it has been used dimensionality reduction techniques which are known as feature reduction and feature selection. Feature extraction andselectionmethodsareusedeitherseparatelyor integrated together in order to improve the performance, estimated accuracy, visualization, and comprehension of knowledge. The advantage in using feature selection is that the importance of any small information is not considered as insignificant but when considering a large pool of information which diverse features, some features may be omitted. While in Feature extraction, the size of the feature space is decreased along with minimal loss of info of the original feature space. Choosing between these two techniques is based solely upon the type and domain ofthe specific task.Data pre-processing: Consisting of the following steps below mentioned

1.importing datasets
2.Extracting Independent and dependent Variable
3. Splitting the dataset Into training and test set.
4. Feature Scaling

Linear Regression Method

When it comes to Linear Regression model, the rainfall dataset is used as the input where the pre-processing stage happens. The feature is extracted by making use of the Linear RegressionModel.

$$minimize \frac{1}{n}\sum_{i=1}^{n}(pred_i - y_i)^2 \qquad \text{Equation No -1}$$

$$J = \frac{1}{n}\sum_{i=1}^{n}(pred_i - y_i)^2 \qquad \text{Equation No -2}$$

This expression for calculating the predicted values, firstly, get the difference value, then doing square for the difference. There are some values are not satisfied the system on getting the difference value. This type of operation was named as mean squared error.

Mulilevel linear regression expression is

$$y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_p X_{ip} + \varepsilon_i, \quad i = 1, \cdots, n, \qquad \text{Equation No -3}$$

Here,

y_i - ith response.

β_k - kth coefficient, where β_0 is the constant term in the model.

X_{ij} - ith observation

Random Forest

Random Forest is a prominent machine learning algorithm within the supervised learning technique. It can be used in ML for Classification and Regression issues. This is based on the principle of learning the ensemble, which is a process of combining multiple classifiers in order to solve a complex problem and to enhance model efficiency. As the name suggests, "Random Forest is a classifier that comprises a number of decision trees on different subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset." Instead of relying on one decision tree, the random forest takes prediction from each tree and predicts the final outcome based on the majority vote of predictions.The functioning of the Random Forest algorithm can be understand using the following steps − Step 1 − First, begin with the collection of random samples from a given dataset. Phase 2 − Next, this algorithm will create a decision tree for each sample. Then any decision tree will get the prediction result. Phase 3 − Voting for any predicted result will be done in this stage. Step 4 − eventually, pick the outcome of the most voted prediction as the final result of the forecast.Forthe training model Random forest regression is used from sktlearn. Here 1000 trees are taken for decision making.

ANN

An Artificial Neural Network is specified by:**neuron model**: the information processing unit of the NN,**an architecture**: a set of neurons and links connecting neurons. Each link has a weight,**a learning algorithm**: used for training the NN by modifying the weights in order to model a particular learning task correctly on the training examples.(Fig.no-2)

The neuron is the basic information processing unit of a NN. It consists of:
A set of links, describing the neuron inputs, with weights W1, W_2, …,W_m
An adder function (linear combiner) for computing the weighted sum of the inputs:

(real numbers) $$u = \sum_{j=1}^{m} w_j x_j \qquad \text{(Equation no-4)}$$

Activation functions for limiting the amplitude of the neuron output. Here 'b' denotes bias.

$$y = \varphi(u + b) \qquad \text{(Equation no-5)}$$

The role Activation is necessary for an ANN to learn something really complicated and make sense of it. Its main function is to transform a node's input signal into an output signal in an ANN. This output signal is used as entry to the next stack layer. Our artificial neural network will consist of artificial neurons and synapses that will transfer information between them. The synapses, or connections, are weighted according to the intensity of control of the neuron in deciding the output.Such synaptic weights will go through a cycle of optimisation called back propagation. Backpropagation will be used for each iteration during the training phase to go back over the network layers and change the weights according to their contribution to the error of the neural net.(Fig No-3)

EXPERIMENT

In the experiments, the data have been split into two parts: training set and testing part. Training data have been considered as 75% and testing data 25% of all data set.For conduction all the relevant experiment and model design prediction have been conducted in python IDE 3.8.2and following libraries such as Matplot for plotting, Pandas-for data analysis and manipulation. From skit learn machine learning algorithm such as liner regression, Random forest regression have been used. In the training phase, each of the individual models are trained with extensive parameter optimization. This means that every model isconstructed with optimal values of the respective parameters. Fig 4,5,6 and 7 showing rain fall of June ,July August and September . Table 2 to 4 showing the maximum and minimum rain fall of June, July,August and September .From the fig-8 it has been observed that the maximum average rain fall 385.3mm occurred 1961and minimum average rain fall 197.2mm occurred 1974.

CONCLUSION

Rainfall forecast is a daunting task for any algorithm to handle. This paper investigates the use of several machine learning methods and particularly suggests using of Random forest method coupled with model design and rainfall forecasting in Odisha state. The rainfall series include mainly rainy period (June to September)in state of Odisha and comparatively analyses have been done. In this study it has been observed that the maximum rain fall 385.3mm occurred in year 1961 and minimum197.2mm rain fall occurred in year 1974.It has been found that maximum accuracy for Random forest regression 91% and mean absolute error was 2.3%, for ANN accuracy was 89.64% and mean absolute error was 3.2%,for Linear regression accuracy was 87.28% and mean absolute error was 3.8%.from the present study it has been observed that Random forests is a viable model to be used in the field of rain fall prediction. They can handle large data, handle inconsistences, and yield higher accuracies. Random forest is oneofthetruespearheadsinthedomainof weather forecasting.

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Table-1 Showing Avg.Rain fall data of June to September

STATE	YEAR	Avg rain fall (June to spt)	STATE	YEAR	Avg rain fall (Jun to spt)	STATE	YEAR	Avg rain fall (Jun to spt)
ORISSA	1901	214.9	ORISSA	1940	337	ORISSA	1980	305.83
ORISSA	1902	274.4	ORISSA	1941	275.75	ORISSA	1981	258.18
ORISSA	1903	281.38	ORISSA	1942	304.23	ORISSA	1982	252.68
ORISSA	1904	314.45	ORISSA	1943	322.8	ORISSA	1983	282.53
ORISSA	1905	261.9	ORISSA	1944	295.15	ORISSA	1984	305.45
ORISSA	1906	270.33	ORISSA	1945	303.98	ORISSA	1985	324.3
ORISSA	1907	291.7	ORISSA	1946	310.58	ORISSA	1986	281.3
ORISSA	1908	316.78	ORISSA	1947	275.18	ORISSA	1987	197.9
ORISSA	1909	302.3	ORISSA	1948	256.03	ORISSA	1988	263.78
ORISSA	1910	311.78	ORISSA	1949	249.95	ORISSA	1989	292.55
ORISSA	1911	300	ORISSA	1950	262.9	ORISSA	1990	288.08
ORISSA	1912	280.85	ORISSA	1951	256.65	ORISSA	1991	307.15
ORISSA	1913	300.18	ORISSA	1952	300.85	ORISSA	1992	287.28
ORISSA	1914	326.33	ORISSA	1953	311.33	ORISSA	1993	300.23
ORISSA	1915	247.08	ORISSA	1954	247.7	ORISSA	1994	382.48
ORISSA	1916	280.63	ORISSA	1955	291.75	ORISSA	1995	238.58
ORISSA	1917	313.85	ORISSA	1956	374.88	ORISSA	1996	227.33
ORISSA	1918	273.68	ORISSA	1957	278.18	ORISSA	1997	303.88
ORISSA	1919	329.4	ORISSA	1958	303.15	ORISSA	1998	233.7
ORISSA	1920	301.45	ORISSA	1959	304.55	ORISSA	1999	271.33
ORISSA	1921	289.85	ORISSA	1960	332.95	ORISSA	2000	234.4
ORISSA	1922	325.73	ORISSA	1961	385.53	ORISSA	2001	358.3
ORISSA	1923	234.75	ORISSA	1962	268.05	ORISSA	2002	232.55
ORISSA	1924	217.03	ORISSA	1963	299.53	ORISSA	2003	308.93
ORISSA	1925	354.65	ORISSA	1964	284.58	ORISSA	2004	259.73
ORISSA	1926	305.6	ORISSA	1965	231.55	ORISSA	2005	288.38
ORISSA	1927	327.2	ORISSA	1966	253.35	ORISSA	2006	377.2
ORISSA	1928	307.05	ORISSA	1967	292.75	ORISSA	2007	357.1
ORISSA	1929	333.18	ORISSA	1968	267.58	ORISSA	2008	348.3
ORISSA	1930	289.08	ORISSA	1969	270.58	ORISSA	2009	280.68
ORISSA	1931	263.98	ORISSA	1970	292.63	ORISSA	2010	242.48
ORISSA	1932	277.15	ORISSA	1971	291.05	ORISSA	2011	291.75
ORISSA	1933	359.18	ORISSA	1972	283.45	ORISSA	2012	288.33
ORISSA	1934	331.98	ORISSA	1973	296.35	ORISSA	2013	278.9
ORISSA	1935	279.38	ORISSA	1974	197.6	ORISSA	2014	313.93
ORISSA	1936	367.48	ORISSA	1975	290.35	ORISSA	2015	258.63
ORISSA	1937	310.4	ORISSA	1976	250.63	ORISSA	2016	260.7
ORISSA	1938	265.75	ORISSA	1977	282.28	ORISSA	2017	257.27
ORISSA	1939	315.23	ORISSA	1978	295.2	ORISSA	2018	322.9
ORISSA	1940	337	ORISSA	1979	215.55			

Table-2 Maximum and minimum rain fall of June month

	YEAR	june
count	118.000000	118.000000
mean	1959.500000	210.991525
std	34.207699	76.590991
min	1901.000000	71.700000
25%	1930.250000	157.250000
50%	1959.500000	199.700000
75%	1988.750000	254.275000
max	2018.000000	477.600000

Table-3 Maximum and minimum rain fall of July month

	YEAR	july
count	118.000000	118.000000
mean	1959.500000	348.727966
std	34.207699	87.950332
min	1901.000000	170.200000
25%	1930.250000	286.675000
50%	1959.500000	339.650000
75%	1988.750000	405.850000
max	2018.000000	586.000000

Table-4 Maximum and minimum rain fall of August month

	YEAR	Aug
count	118.000000	118.000000
mean	1959.500000	353.423729
std	34.207699	81.249173
min	1901.000000	187.300000
25%	1930.250000	295.250000
50%	1959.500000	348.450000
75%	1988.750000	409.125000
max	2018.000000	624.900000

Table-5 Maximum and minimum rain fall of August month

	YEAR	sep
count	118.000000	118.000000
mean	1959.500000	241.494915
std	34.207699	67.926850
min	1901.000000	113.200000
25%	1930.250000	194.750000
50%	1959.500000	237.150000
75%	1988.750000	281.625000
max	2018.000000	483.200000

Table-6 Maximum and minimum Avg. rain fall June to September

	YEAR	Avg rain fall (Jun to sep)
count	118.000000	118.000000
mean	1959.500000	289.467373
std	34.207699	37.853978
min	1901.000000	197.600000
25%	1930.250000	264.422500
50%	1959.500000	290.100000
75%	1988.750000	310.032500
max	2018.000000	385.530000

Table no-7. Comparative analysis accuracy of models for prediction

S.NO	Methods	Accuracy in %	Mean absolute error%
1	Random forest	91	2.3
2	ANN	89.64	3.2
3	Linear Regression	87.28	3.8

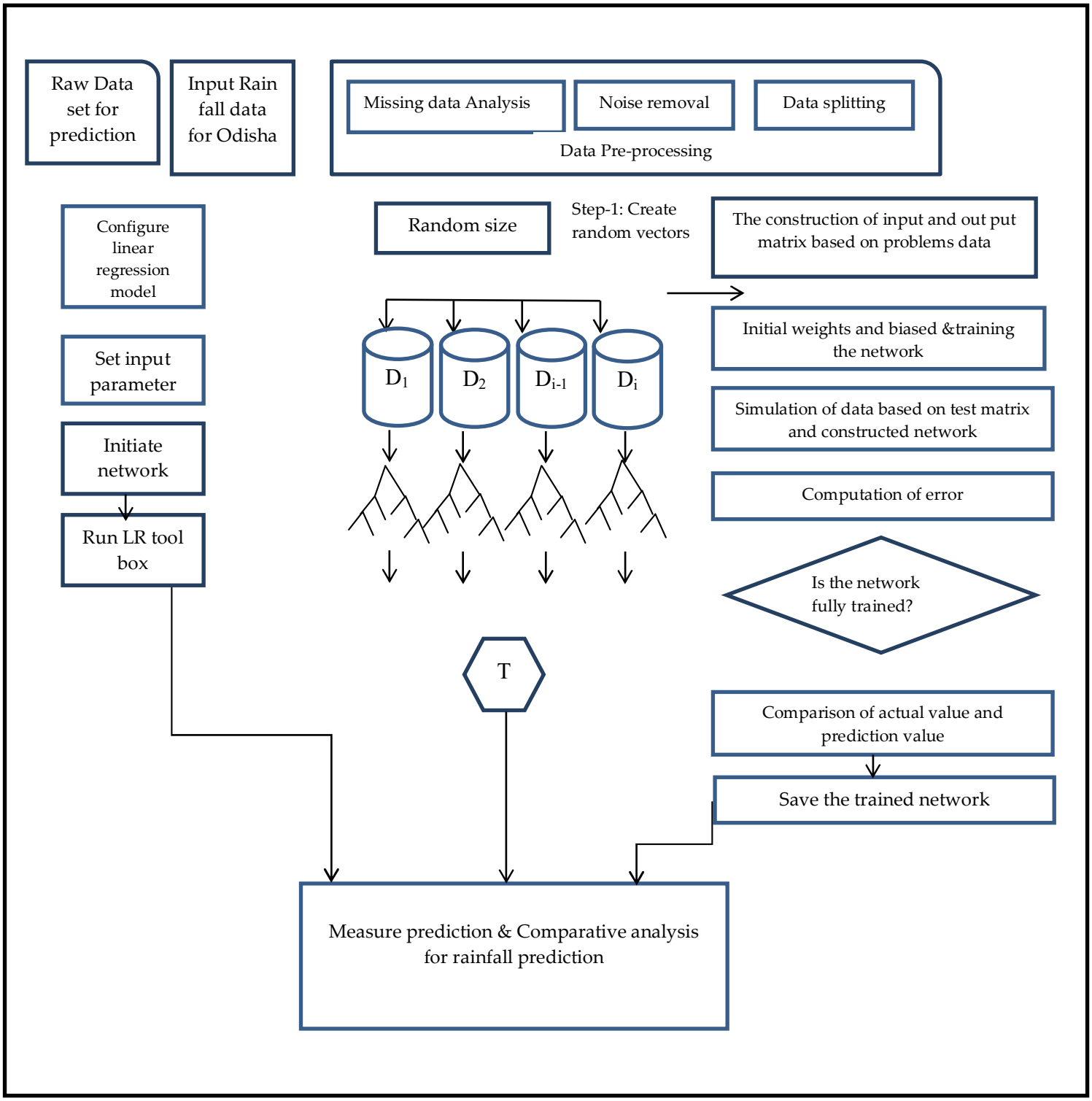

Fig. 1: Flow chart of methodology

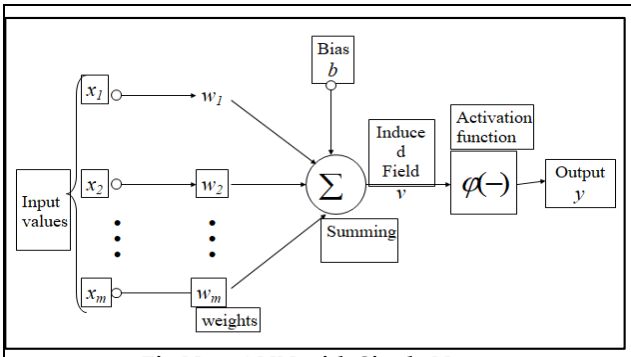

Fig No-2 ANN with Single Neuron

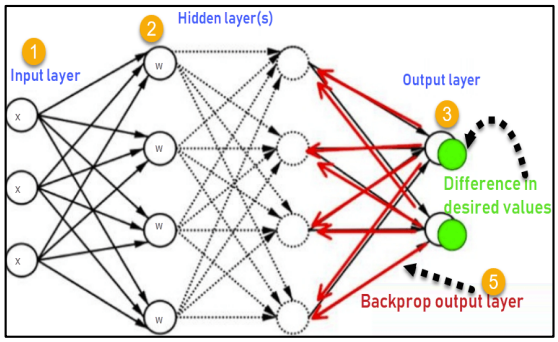

Fig No-3ANN with back propagation Algorithm

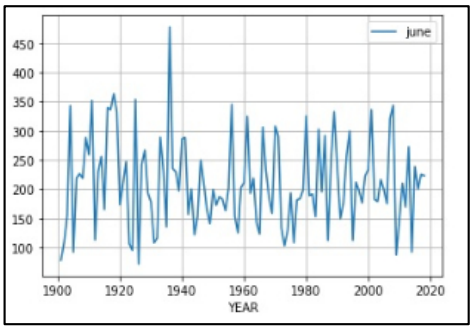

Fig: 4monthly rain fall of June

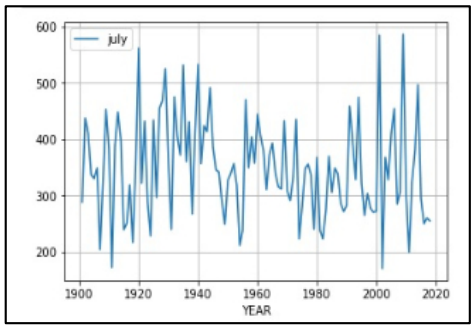

Fig: 5 monthly rain fall of July

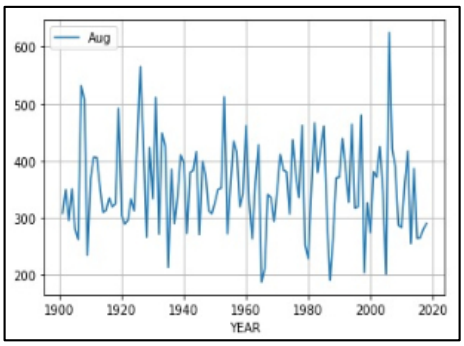

Fig: 6 monthly rain fall of August

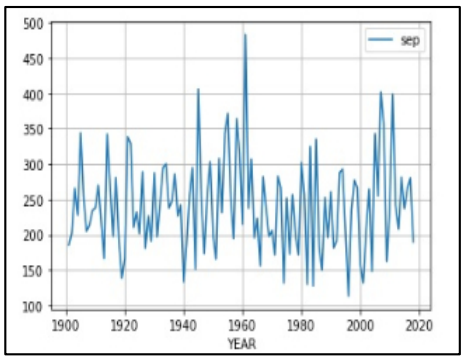

Fig: 7 monthly rain fall of August

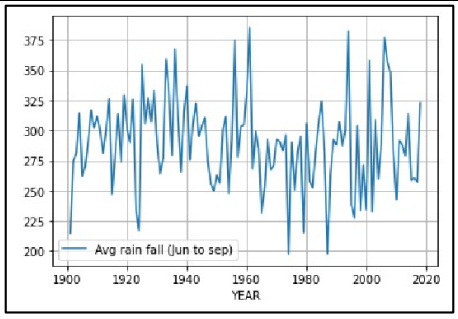

Fig no-8. showing average rain fall during June to September

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

A Study on Haematological Parameters of Some Farm Animals in Nayagarh Districts, Odisha

Priyadarsini Rajsunita* and Sitaram Swain

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 02 Mar 2020 Revised:05 Apr 2020 Accepted: 09 May 2020

***Address for Correspondence**
Priyadarsini Rajsunita
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: sweetgita13@gmail.com

ABSTRACT

The main objective of this study was to assess the haematological indices of some farm animals domesticated in rural areas of Odisha. This study was included with three different farm animals like goat, sheep and cow in Nayagarh district. Animals were housed individually and all were adults. Blood samples were collected from the site and analyzed in the laboratory within 48 hours from collection. Haematologic parameter shows variation in these three animals. The concentration of haemoglobin was significantly reduced from the lower limit of normal value in goat and other values are under normal range. The haematological parameters of cow and sheep were within the normal limit. The TRBC, TWBC, MCV and MCH values were statistically non-significant. The PCV was statistically significant at $P<0.001$.MCHC value was statistically significant at $P<0.01$ and Hb was statistically significant at $P=0.001$.This study will provide the base line health status of these animals in a particular habitat and their adaptation to that local environment.

Keywords: Farm animals, haematological indices, Nayagarh, Odisha.

INTRODUCTION

The study of haematology is important to assess the physiological status in different farm animals [1,2].The results of haematological analysis have a broad significance and incontestable role in evaluating the health condition of the animals [3,4].The animals who were apparently healthy, monitored for haematological parameters. Assessment of haematological parameter reveals information to reach at the diagnosis of numerous diseases in veterinary animals. Ultimately the nutritional biochemical, physiological and pathological status of an animal can also be reflected in haematological examination [5,6]. Haematological parameters are effective in examination of the extent of damage to

blood as well as identification of many diseases. Changes in haematological parameters were helped to identify different status of the body and also determine stresses due to nutritional and pathological factors [7].Haematological parameters have ecological and physiological importance, which helps to understand the characteristics of blood to the environment [8]. Goats are more adaptable to survive under unfavourable conditions and due to the ability of production of high quality milk and meat, considered as ideal animals. Goats have the ability to resist some diseases and the haematological profiles can also be helpful to evaluate the immunity status in goats. Haematological parameters provide valuable information about the breed, sex and health status of the animal; hence these are very useful to be determined [9].

Sheep are small ruminants with some special attributes among livestock resources. They have high ability to survive in broad range of environment. Due to short generation cycle, they are efficient to high production and their economic value is less. Haematological study is essential for determining the immunity and survival of sheep. Age, sex, nutrition, housing, management, stress, reproductive status had also an effect on haematological profiles of small ruminants [10].Haematological parameters measure the constraints on productivity in beef cattle. Haematological parameters indicate animal response which can also serve as the basis for diagnosis, treatment and prognosis of diseases[11]. The blood sample of different farm animals were analyzed in terms of haemoglobin concentration, RBC count, WBC count, PCV, and MCV values haematological analysis is not only applicable for diagnosis of disorder of the haematological system, but also useful in the identification of many organ and systemic disease [12].

MATERIALS AND METHODS

DESCRIPTION OF STUDY SITE

Nayagarh is one of the districts of Odisha situated in the eastern part. This district has wide range of biodiversity as it has various flora and fauna. Here most of the people depends upon agriculture and livestock.The blood collection was conducted from some villages of Nayagarh district and analysis was conducted at Centurion University of Technology and Management, Bhubaneswar, Odisha from November, 2019 to March 2020. The latitude of Nayagarh is 20° 7' 37.3008" N and the longitude is 85° 6' 18.2052" E is located in Odisha, India.

STUDY DESIGN AND ANIMAL MANAGEMENT

Animal management

Three varieties of farm animals like goat, cow, and sheep were selected for these experiment .All animals were adult and apparently healthy.

Blood sampling and collection

Blood samples were collected from the Jugular vein of each animal of these three varieties using bleeding needles into vacuum tubes containing EDTA Blood samples were collected from adult animals .The blood samples tested on the same day of collection. Blood samples were refrigerated and analyzed within 48 hours from the collections .All samples were collected to determine haemoglobin concentration, RBC count, WBC count, MCV, PCV, MCH, MCHC values [13]

Materials used

Packed cell volume percentage was determined using a micro haematocrit centrifuge . The samples were placed in microcapillary tubes and sealing the bottom of the tube by using cotton .The samples were centrifuged at 3000 rpm for 30 minutes. Hb (%) were determined using haemoglobino meter. RBCs, WBCs, count were performed using haemocytometer, slide stainer.The PCV(%),RBC values ,haemoglobin(g/dl) were used to calculate the mean corpuscle volume (MCV) the mean corpuscle haemoglobin concentration (MCHC) and the mean corpuscle haemoglobin(MCH)[14].

Statistical analysis

Haematological values are existing as mean ± standard deviation for each species. One way ANOVA was used to assess the statistical difference among the animals.

RESULTS

The results were found from this analytical studies mentioned in table-1and informed the (mean ± standard deviation) value of the haematological parameters of three different farm animals. RBC- Red blood cells, WBC- White blood cells, HB- Haemoglobin,MCV-Mean corpuscular volume, PCV- Packed cell volume, MCH –Mean cell haemoglobin, MCHC–Mean cell haemoglobin concentration.

DISCUSSION

Haematological analysis

Haematological analysis involves Total RBC count, Total WBC count, Percentage of Hb, PCV, MCV, MCH and MCHC (Table-1).

Total RBC Count

The total RBC Count of these three farm animals ranges from 5.73±0.18, 11.82±0.48 and 9.57±0.27 respectively in Cow, Goat and Sheep (Table-1).Total RBC Count was significantly higher in Goat and lower in Cow.The present result shows a Statistical difference among these three animals. The value of RBC of these three animals was statistically non-significant. Red blood cells play the vital role in oxygen and CO_2 transportation in body of the animal [15]. Increased and reduced level of red blood cell indicates a sign of blood disorder such as anaemia.

Total WBC Count

The TWBC was higher in Sheep and lower in Cow. The TWBC value was statistically non-significant. The total WBC value ranges from 4.45±0.36, 4.63±0.37, and 6.11±0.33 in respectively Cow, Goat, and Sheep. Low WBC causes malnutrition and autoimmune disorders. White blood cell provides protection to the body of the animals against foreign organisms [16].

Estimation of haemoglobin

Haemoglobin is the iron containing metalloproteinase in the red blood cell and helps in oxygen transport and transport of other gases [17]. The haemoglobin percentage was higher in Sheep and lower in Goat . The haemoglobin percentage was significantly reduced from the lower limit in Goat. Reduced level of haemoglobin usually indicates a form of anaemia which may be iron deficiency anemia due to malnutrition. The Hb ranges from 8.49±0.42, 8.18±0.49 and 8.96±0.32 respectively in Cow, Goat, and Sheep (Table-1). The value of haemoglobin was statistically significant at P=0.001.

Estimation of Packed Cell Volume

Increasing level of red blood cell and reduction of total blood volume increases PCV. Reduced level of PCV from the normal limit indicates anaemia. The packed cell volume ranges from 25±2.40, 25±0.94 and 28.1±1.19 (Table-1) respectively in Cow, Goat, and Sheep. Higher PCV has observed in Sheep whereas Goat and Cow have significantly similar. The PCV of these three animals was statistically significant at P<0.001. PCV is considered as haematocrit and also the percentage of red blood cells in blood. Thus increased PCV indicates increasing level of red blood cell. PCV serve as a carrier of oxygen and nutrition absorption [18].

Estimation of MCH

It ranges from 14.78±0.39, 7.03±0.36 and 9.34±0.09 respectively in case of Cow, Goat, and Sheep (Table-1). The MCH was higher in Cow and lower in Goat. The MCH Value was statistically non-significant. The MCH Value depends upon the increased and decreased value of haemoglobin and TRBC.

Estimation of Mean Corpuscular Value

Reduced level of red blood cells is the common cause of lower MCV which causes microcytic anaemia[19,20]. MCV will be reflected by MCH. Higher MCV was found in Cow and lower in Goat. It ranges from 43.50±3.17, 21.06±0.24 and 29.32±0.81 (Table-1). The MCV was statistically non- significant.

Estimation of MCHC

Higher value of MCHC was found in Cow and lower in Sheep. It ranges from 34.10±1.92, 32.69±0.91 and 31.9±0.85 respectively in Cow, Goat and Sheep. The MCHC value of these three animals was statistically significant at $P<0.01$. The MCHC value changes due to the increased and decreased value of haemoglobin and PCV.

CONCLUSION

The results of this study clearly show that the haematological parameters varied among Sheep, Goat and Cow. Reduced level of haemoglobin in Goat usually indicates a form of anaemia, which may be iron deficiency anaemia due to malnutrition. The present results show other haematological parameters of Sheep, Goat and Cow were within normal range.

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Table-1 – comparative haematological parameters of three farm animals

Parameters	COW	GOAT	SHEEP
RBC $\times 10^{-6}$	5.73±0.18	11.82±0.48	9.57±0.27
WBC $\times 10^{-3}$	4.45±0.36	4.63±0.37	6.11±0.33
HB (g/dl)	8.49±0.42	8.18±0.49	8.96±0.32
MCV (fl)	43.5±3.17	21.06±0.24	29.32±0.81
PCV (%)	25±2.40	25±0.94	28.1±1.19
MCH (pg)	14.78±0.39	7.03±0.36	9.34±0.09
MCHC (g/dl)	34.1±1.92	32.69±0.91	31.9±0.85

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Pharmacological Importance and Plasticizers of BIS (2-ethylhexyl) phthalate Phenylsilane and 17-Pentatriacontene, Artemiseole and 24 (S)-Ethyl-3-alpha, 5.alpha-cyclocholest-22 (E)-en-6-one: Unique Intermediary Biodegraded Products of LDPE obtained through LDPE Degrading Bacteria using FT-IR, GC-MS and SEM Analysis.

Joonu.J[1]*, Akshaya P[2], Sudharshini.J[2] and Priyadharshini M[2]

[1]Assistant Professor, Department of Zoology, Bishop Heber College,Trichy, TamilNadu,India.
[2]Department of Zoology, Bishop Heber College,Trichy, TamilNadu,India.

Received: 18 Feb 2020 Revised:20 Mar 2020 Accepted: 22 Apr 2020

***Address for Correspondence**
J.Joonu
Assistant Professor,
Department of Zoology,
Bishop Heber College,
Trichy,TamilNadu,India.
Email: joonucharles@gmail.com

ABSTRACT

Plastics create a great negative impact and menace on our Ecosystem. The substance that has been disintegrated by the microbial activity is termed as Biodegradation. The present study aims at identifying the bacteria involved in biodegradation of LDPE. The bacteria for the present study were isolated from plastic dumped area of Tiruchirappalli district. The five different isolates of bacteria were identified and characterised by morphological tests and biochemical tests such as IMViC and grown on different media such as EMB agar, Pseudomonas agar, MacConkey agar etc. The plastic bags were subjected to degradation for 75 days and incubated at 37^{0}C in incubator shaker. Fourier Transform Infrared spectroscopy (FT-IR) is used to discern the compounds from biodegraded LDPE. Analysis of the LDPE spectral figures shows the formation of new peaks such as Aromatic ethers, aryl – O stretch, aliphatic bromo and iodo compounds, Alkyl substituted ether, C-O, -N=N-, N=C=S stretch, primary and secondary alcohol, organic sulphates, carboxylic acid salt and Aromatic primary and secondary amines CN stretch. The Scanning electron microscopy (SEM) shows the surface erosion on LDPE due to microbial degradation (bacteria) was examined. The dry weight method is used to determine the degradation percentage of LDPE by microorganisms. Among the genus (Bacteria) *E.Coli, Enterobacter, Citrobacter, Serratia and Pseudomonas, Pseudomonas sp* had the highest capacity of degradation compared to the other genera in this study. GC-MS analysis revealed the presence of few unique degraded intermediary

products including Bis (2-ethylhexyl) phthalate , Phenylsilane , 17-Pentatriacontene, Artemiseole , and 24 (S)-Ethyl-3-alpha, 5.alpha-cyclocholest-22 (E)-en-6-one which are effective plasticizers used to increase the plasticity. They are also effective bioactive compounds which possess pharmacological importance.

Key words: FT-IR, Bacteria, LDPE, SEM, Biodegradation, GC-MS, bioactive compounds, plasticizers.

INTRODUCTION

Plastics create the greatest negative impact and menace on our Ecosystem. The global plastic production has reached almost 360 million tons in the year 2018 and high amounts are found in the marine ecosystem as industrial waste products. Packaging industries are the dominant sector of primary plastics which utilizes about 42 percent of plastics of the total. Due to some advantageous properties like good tensile strength, light in weight and its resistance to water, temperature (up to 80°C continuously and 95°C for shorter times) as well as microbial attack, hence paper and other cellulose-based products has been replaced by plastic in packaging industries. Plastic awareness has not spread among people which may result in hurling them everywhere. It resulted in poor consciousness to recycling plastic which leads to inevitable consequences. These junked plastics will ultimately lead to agro-farm fields mixed with other decomposed materials. The Microplastics used in cosmetics, chemicals, pharmaceuticals, detergents are nearly 30% which still expands at a high rate of 12%. Plastic persists in agricultural lands and inhibits the plant growth, it may also lead to bioaccumulation and they found to be non-degradable. The definition of biodegradation is the decomposition of substances through microbial activity. This is a complicated process which has several steps [1]. Bio-deterioration is defined as the symbiosis of abiotic factors and microbial communities to fragment the materials into tiny fractions), depolymerisation (The conversion of polymer into monomers), assimilation through the microbial action which secrete enzymes and free radicals. Recognition of receptors of some molecules which is intake via microbial cells and transverse across the plasma membrane leads to mineralization (complete oxidation of simple molecules as CO2, N2, CH4, H2O and different salts from intracellular metabolites) [2].

MATERIALS AND METHODS

Sample Collection and Preparation of Medium for LDPE Degrading Bacteria

An arbitrary block design was used to identify points for sample collection. There was an erratic collection of soil samples from three selected sampling blocks of the dumpsites in and around Trichy. The samples from each sampling block were assorted at 3 different points of 1m diameter. A minimum of 15 soil samples was stacked and analysed. The other physicochemical parameters like temperature, oxygen were noted to analyse the in-situ biodegradation conditions. Samples were kept in nylon bags and transported to the Zoology lab (a cool box); PG Department of Zoology, Bishop Heber College,Trichy,TamilNadu,India

Characterization of Colonies

The growth of microbes in different media leads to changes in the macroscopic appearance of their growth. These differences in their growth pattern are known as cultural or colony characterization which helps in describing the morphology of a microorganism and thereby to identify them.

Biochemical Analysis

The selected bacterial isolates were identified by morphological and biochemical characterization. Morphological characterization like shape, size, structure, texture, appearance, elevation and colors were studied [3]. Phenotypic

characteristics (microscopic characterization) such as gram reaction, motility test and biochemical tests including catalase, urease, oxidase disk, IMViC, triple sugar iron, nitrate reduction, salt tolerance, and carbohydrate fermentation tests were studied. They were subjected to grow on different agar medium including McConkey agar, Pseudomonas agar, EMB agar, Mannitol salt agar and starch agar.

Plastic- LDPE Biodegradation

Preparation of Artificial Media and Incubation [4].

The inoculum is prepared by adding 2 g of a soil sample to 50ml of 0.85% autoclaved normal saline solution. The inoculum is incubated at 37^0C and 30 rpm agitation for 2±3 hrs in a shaker incubator prior to inoculation. Artificial media is prepared using several nutrients in various proportions such as, 0.1% of ammonium sulphate, 0.1% of sodium nitrate, 0.1% of di-pottasium phosphate, 0.1% of potassium chloride, 0.02% of magnesium sulphate and 0.001% of yeast extract in 1000ml distilled water. The growth culture media for the microbes that degrade LDPE is prepared by adding 1% of the incubated inoculums to 200 ml of artificial synthetic media in 250ml conical flasks. LDPE Strips (approximately, 5cm x 3cm each) of Polyethylene are weighed, kept in 70% ethanol for disinfection and air-dried for 10 min in oven were introduced into the synthetic media. They were all repeated in triplicates. Synthetic media with LDPE and without inoculum is used as control. All the conical flasks containing the media, inoculum and LDPE strips are incubated in a shaker incubator at 50 rpm for up to 75 days.

Determination of Dry Weight of Residual Polyethylene

The measurement of the dry weight of LDPE is done by washing off the polyethene surface with 2% (v/v) Sodium Dodecyl Sulphate (SDS) overnight, followed by rinsing with distilled water [5].

$$\text{Weight loss \%} = \frac{\text{Initial weight- Final weight}}{\text{Initial weight}} \times 100$$

Determination of LDPE Degrading Potential of the Bacterial Isolates

After 75 days, the LDPE strips were recovered and final weight were measured. 2% SDS is used for washing the strips to remove the bacterial biomass. Before being weighed it is dried overnight. At the end of the incubation period, the formation of new functional groups or changes in the amount of existing functional groups was detected by Fourier Transform Infrared Spectroscopy (PERKIN ELMER, Spectrum Two, 4000cm-1 to 400cm-1) analysis at St. Joseph College, Trichy [6]. The results were recorded and analysed. The presence of unique intermediary products in each sample, formed due to the biodegradation of LDPE by different bacterial isolates was identified by Gas Chromatography Mass Spectrometer (SHIMADZU/ QP2020) at Bishop Heber College, Trichy.

===== Analytical Line 1 =====

[AOC-20i]

# of Rinses with Presolvent:3 # of Rinses with Solvent(post):3 # of Rinses with Sample:3 Plunger Speed(Suction):High ,Viscosity Comp. Time:0.2 sec ,Plunger Speed(Injection):High, Syringe Insertion Speed: High, Injection Mode: Normal, Pumping Times:5, Inj. Port Dwell Time:0.3 sec, Terminal Air Gap: No, Plunger Washing Speed: High, Washing Volume:6uL, Syringe Suction Position:0.0 mm, Syringe Injection Position:0.0 mm,Use 3 Solvent Vial: 1 vial
[GC-2010]

Column Oven Temperature: 50.0 °C, Injection Temperature: 250.00 °C, Injection Mode: Split, Flow Control Mode: Linear, Velocity Pressure: 68.1 kPa, Total Flow: 16.2 mL/min, Column Flow: 1.20 mL/min, Linear Velocity: 39.7 cm/sec, Purge Flow: 3.0 mL/min,
Split Ratio: 10.0, High Pressure Injection: OFF, Carrier Gas Saver: OFF, Splitter Hold: OFF

Oven Temperature. Program

RateTemperature(°C)	Hold Time(min)
- 50.0	0.00
6.00, 280.0	2.00

[GC Program] [GCMS-QP2020]
Ion Source Temp: 200.00 °C, Interface Temp.:250.00 °C, Solvent Cut Time: 3.50 min, Detector Gain Mode: Relative to the Tuning Result, Detector Gain: +0.00 kV,
Threshold: 1000
[MS Table] --Group 1 - Event 1-
Start Time: 4.00min, End Time: 40.33min, ACQ Mode: Scan Event Time: 0.30sec Scan Speed: 1666 Start m/z: 50.00, End m/z: 500.00

SEM Analysis

The SEM micrograph of 75 days incubated LDPE strip along with the bacterial isolate 5 present in the sample was shown in figure 12 A SEM analysis is the most effective method which illustrates the presence of physical instability. It also shows the surface topography (surface erosion, folds and cracks) Fig. 12 B. It can result in the production of extracellular metabolites and release of enzymes when the bacteria are under stress. There can be other reasons for LDPE degradation by bacteria such as bio-erosion.

RESULTS AND DISCUSSION

The bacteria were isolated from the various dumpsites in and around Trichy. The four strains were isolated by the various biochemical tests which include IMViC, EMB Agar, Mannitol Salt Agar, MacConkey agar etc. The LDPE degradation by bacteria is an effective method. The strains of bacteria such as *Escherichia coli sp, Enterobacter sp, Citrobacter sp, Serratia sp* and *Pseudomonas sp* were isolated from dumpsites of Trichy. The biodegradation studies of LDPE shows nearly 60% degradation. Among the bacteria isolated from the dumpsites *Pseudomonas sp* shows the highest capacity of degradation of LDPE for about 75 days. Analysis of the polyethene spectral figures indicate the formation of new peaks at the region between 1327cm^{-1} and 1254cm^{-1} indicates Aromatic ethers, aryl – O stretch, 1111.37cm^{-1} and 1053.88cm^{-1} indicates the formation of Alkyl substituted ether, C-O stretch, 1633cm^{-1} and 1392.52cm^{-1} shows the formation of carboxylic acids aromatic primary amine stretch. The FT-IR studies are a sensitive assay for macromolecular studies. This approach helps in determining the degradation process of various forms of plastics such as LDPE etc. The FT-IR spectra of control which is without bacteria show less formation of peaks which indicates that there is no degradation of LDPE without bacteria. Fig.13 shows a comparative study of Isolate A and control. The FT-IR studies had proved the biodegrading ability of bacteria into smaller compounds 2825.48 cm^{-1} – Methoxy, CH stretch, 2402.0 cm^{-1} – Hybride vibrations – silanes, thiols, sulphides,2081.87 cm^{-1} – Isothiocyanate (-NCS) (Nitrogen bond),1635.80 cm^{-1} – Open chain azo(-N=N-),1393.43 cm^{-1} – Organic sulfates, Ammonium ions1270.47 cm^{-1} – Organic nitrates, Aromatic ethers aryl -o stretch 697.167 cm^{-1} – Aliphatic Bromo compounds (C-Br stretch). Fig. 14 shows comparative study between control and isolate B which degrades into smaller compounds such as 2984.54 cm^{-1} – Methylene C-H asym/sym stretch, 2052.63 cm^{-1} – Terminal alkyne - Cyanide ion, thiocyanate ion, 1821.24 cm^{-1} – Open chain acid anhydride. Carbonyl compound ,1633.81 cm^{-1} – Open chain azo (-N=N-),1392.52 cm^{-1} – Nitrate ion.,1327.36 cm^{-1} – Aromatic primary amine, CN stretch.,1264.24 cm^{-1} – Organic nitrates, Aromatic ethers, aryl –o stretch,1169.47 cm^{-1} – Secondary amine, C-N stretch, 1104.17 cm^{-1} – Alkyl substituted ether, C-O Stretch,686.06 cm^{-1} –

Aliphatic Bromo compounds CC-Br stretch, 599.75 cm^{-1} – Aliphatic Iodo compounds C-I stretch. Fig 15 shows comparative study between control and isolate C shows the formation of new peaks which indicates formation of addition compounds such as 2050.34 cm^{-1} – Transition metal carbonyls 1824.47 cm^{-1} – Open chain acid anhydride, 1635.80 cm^{-1} – Carbonyl compound group frequencies, Amide, 1325.11 – Dialkyl/aryl sulfones, 1264.84 cm^{-1} – Organic phosphates (P=O stretch),1165.90 cm^{-1} – Alkyl – substituted ether, C-O stretch, 976.83 cm^{-1} – trans-C-H out of plane bend, 738.70 cm^{-1} – Skeletal C-C vibration 689.01 cm^{-1} – Cis C-H out of plane bend,600.83 cm^{-1} – Alkyne CH bend. Fig. 16 shows the formation of peaks in isolate D such as 2834.15 cm^{-1} – Methyne CH stretch,2107.76 cm^{-1} – Terminal alkyne,1736.80 cm^{-1} – Aldehyde,1636.03 cm^{-1} – Carboxylic acid salt,1349.81 cm^{-1} – Aromatic primary amine CN stretch,1269.96 cm^{-1} – Aromatic ethers, aryl – O stretch,1216.96 cm^{-1} – Tertiary amine, CN stretch,1111.37 cm^{-1} – Alkyl substituted ether, C-O stretch. Figure.17 shows the formation of new peaks in isolate E. The formation of new peaks between 1700±1650 cm-1 shows the presence of aldehydes and ketone groups which are found to be intermediary products of polyethylene biodegradation. The region of increased peak absorbance and new peaks in the 1000±1200 cm-1 region of the FTIR spectrum correlates with primary and secondary alcohols. The regions of new peaks are formed between 1636.03 cm^{-1} and 1349.81 cm^{-1} indicates the production of Carboxylic acid salt and Aromatic primary amine CN stretch. The final degraded products such as polysulfides of 453 cm^{-1} indicate the degradation of LDPE products. The control shows the formation of peaks between 3436 cm^{-1} and 2047 cm^{-1} which indicates the presence of phenols and alcohols in its original form which are not further degraded. The presence of peaks between 1634 and 1358 cm^{-1} shows the formation of less degraded products such as aromatic primary amines etc.

About 75 degraded intermediary products were identified through GC-MS analysis. Isolate D (*Serratia sp*) and isolate E (*Pseudomonas sp*) shows higher degradation percentage of LDPE which results in more number of intermediary products such as Bis(2-ethylhexyl) phthalate, 3-2 Valeryl-5-methyl-1,2,4-cyclopentane-trione, phenylsilane and 17-Pentatriacontene,3-Oxabicyclo Hexane,6-Ethenyl-1,4,4-Trimethyl, 24 (s)-Ethyl-3-alpha, 5-alpha- cyclocholest-22(E)-en-6-one . Phthalate and bis- phenols are mainly used as plasticizers. Plasticizers or dispersants are additives that decrease the plasticity or decrease the viscosity of a material. Phthalates are esters of phthalic anhydride that are present as Bis(2-ethylhexyl) phthalate, an intermediary product identified in the sample E . The *Serratia sp* (isolate D) has the potential to mineralize bisphenol A in substitute pathway which is similar to the substitute pathway of *pseudomonas sp*. [7]. Phenylsilane belongs to the group of compounds known as organosilanes which has similar structure to toluene. The *pseudomonas sp* (isolate E) is capable of degrading LDPE that leads to the formation of unique intermediary products namely 3-2 Valeryl-5-methyl-1,2,4-cyclopentane-trione and 17-Pentatriacontene. Artemiseole natural monoterpenes and their synthetic derivatives are endowed with various pharmacological properties including antifungal, antibacterial, antioxidant, anticancer, antiarrhythmic, anti-aggregating, local anesthetic, antinociceptive, anti-inflammatory, antihistaminic and anti-spasmodic 24 (S)-Ethyl-3-alpha,5.alpha-cyclocholest-22 (E)-en-6-one is a steroidal sapogenin possessing wide range of biological activities. It also helps in the synthesis of sex and adrenocortical hormones Saponins are a diverse group of natural active compounds widely occur in the plant kingdom and they are active constituents of more than 100 families including endophytic fungi of terrestrial and marine origin [8]. Structurally saponins containing a triterpene or steroid aglycone called sapogenin and one or more sugar chains attached to it. Steroidal saponins are mainly found in monocotyledons while triterpenoid saponins are found in dicotyledons. This study has identified the 75 intermediary degraded products and some of the new products also possess the pharmacologically property. Artemiseole and 24 (S)-Ethyl-3-alpha, 5.alpha-cyclocholest-22 (E)-en-6-one are the terpenoids which are also effective plasticizers and possess pharmacological properties. Plastics are not always considered a waste; the degraded intermediary by products can be used in the field of pharmacology. Few of the by products such as Artemiseole and 24 (S)-Ethyl-3-alpha,5.alpha-cyclocholest-22 (E)-en-6-one are some of the bioactive compounds which possess pharmacological importance. This research has led to new insights of utilising these bioactive compounds in the medical field which are degraded from LDPE.

CONCLUSION

Biodegradation of plastics using bacteria is a much efficient method. The four different strains of bacteria such as *Escherichia coli sp, Enterobacter sp, Citrobacter sp, Serratia sp* and *Pseudomonas sp* isolated from dumpsites of Trichy were found to be efficient in degrading LDPE. Among the five isolates, *Pseudomonas* sp shows the maximum percentage of degradation of 68%. The FT-IR spectra of five strains in LDPE degradation shows the formation of new peaks which indicates the process of degraded products including the formation of esters, carboxylic acids etc, The SEM examining also shows LDPE degradation with surface corrosion after 75 days of incubation., Bis(2-ethylhexyl) phthalate, 3-2 Valeryl-5-methyl-1,2,4-cyclopentane-trione, phenylsilane and 17-Pentatriacontene, Artemiseole, 24 (S)-Ethyl-3-alpha,5.alpha-cyclocholest-22 (E)-en-6-one are the new intermediary degraded products identified through GC-MS. These intermediary compounds are also bioactive sharing pharmacological properties which could be applied in medical field. These bacterial strains are efficient in partial degradation of LDPE. It can be applied in large scale for biodegradation (in situ) of plastics.

ACKNOWLEDGEMENTS

I would like to thank Bishop Heber College for providing me with an opportunity to carry out the research.

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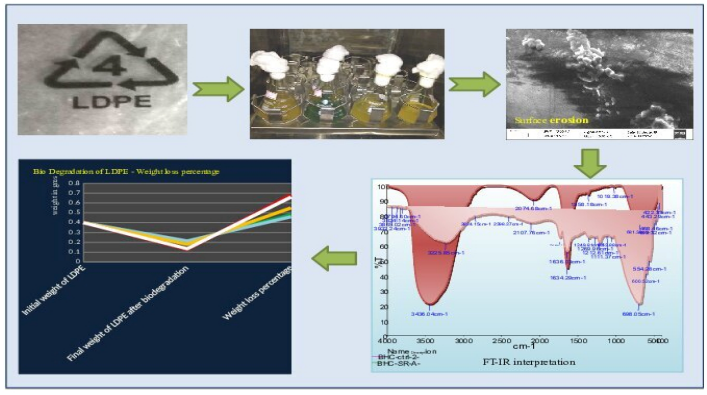


Graphical abstract

Table 1. Shows the biochemical tests for the isolated bacterial strains from 3 sites

S.No	Test	Isolate 1	Isolate 2	Isolate 3	Isolate 4	Isolate 5
1	Indole test	- ve	- ve	+ve	-ve	-ve
2	Methyl red test	- ve	-ve	+ve	-ve	-ve
3	Vogues proskauer	-ve	+ ve	+ve	+ve	-ve
4	Urease	+ve	-ve	-ve	-ve	+ve
5	Citrate	+ve	+ve	+ve	+ve	+ve
6	Oxidase disk	+ve	-ve	-ve	+ve	+ve
7	Motility test	motile	Motile	Motile	Motile	Motile
8	Pseudomonas agar	No growth	No growth	No growth	No growth	Growth
9	Starch hydrolysis	+ve	+ve	-ve	-ve	-ve
10	McConkey agar	-ve	-ve	-ve	-ve	-ve
11	EMB agar	-ve	+ve	-ve	-ve	-ve
12	Gram staining	+ve rod	- ve rod	- ve rod	- ve rod	-ve rod
13	Mannitol salt agar	-ve	+ve	-ve	-ve	-ve
14	Catalase test	- ve	+ve	+ ve	+ve	+ve
15	Salt Tolerance	-ve	-ve	-ve	-ve	-ve
16	Organisms	*Escherichia coli*	*Enterobacter*	*Citrobacter*	*Serratia*	*Pseudomonas*

Table .2: Weight loss percentage- Biodegradation of LDPE by bacterial isolates

S.No.	Organisms	The initial weight of LDPE (gms)	The final weight of LDPE after biodegradation (gms)	Weight loss percentage
1	*Escherichia coli sp*	0.4	0.208	48%
2.	*Enterobacter sp*	0.4	0.162	40 %
3.	*Citrobacter sp*	0.4	0.214	46%
4.	*Serratia sp*	0.4	0.180	55%
5.	*Pseudomonas sp*	0.4	0.128	68%

The artificial media prepared was inoculated with the four strains of bacteria (Fig 4.2). The biodegradation process was completed after 75 days.

Figure 1 . EMB Agar Test

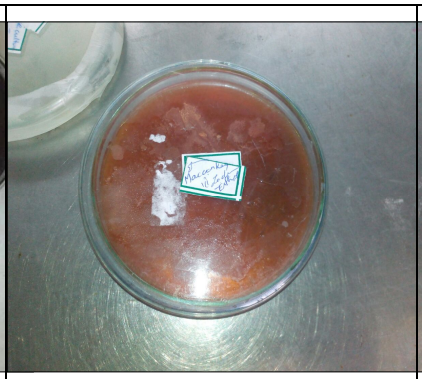


Figure2.Mc Conkey Agar

Figure 3.Pseudomonas Agar

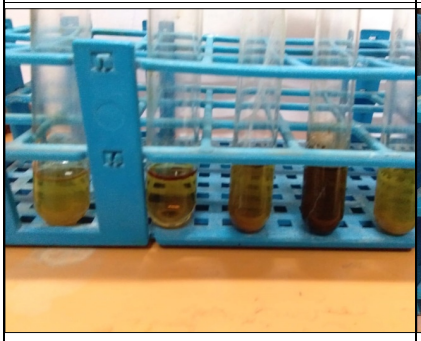


Figure 4: Indole Test- Methyl Red Test

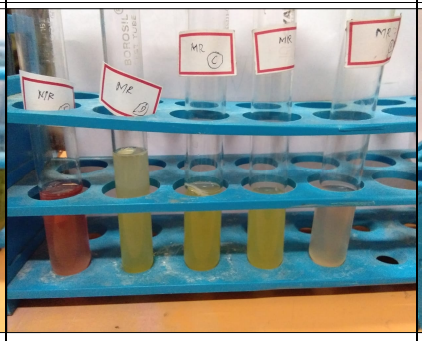


Figure 5. Vogues Proskauer Test

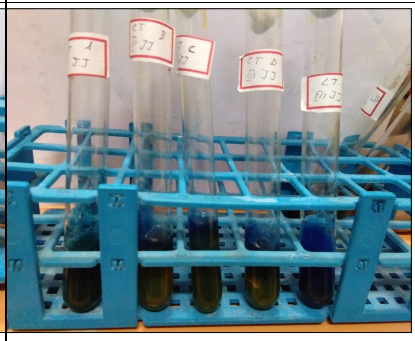


Figure 6. Citrate agar slant

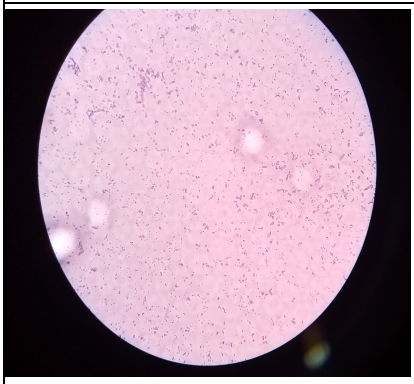


Figure 7. Gram staining

Figure 8. Starch hydrolysis test

Figure 9. Salt tolerance Test

Figure 10. Synthetic media

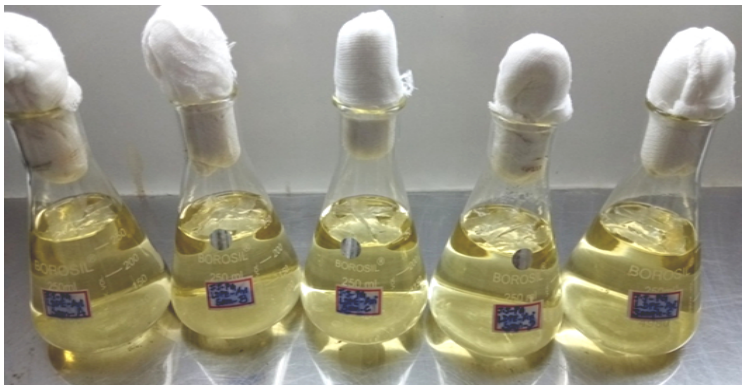


Figure 11. Insertion of LDPE into the media

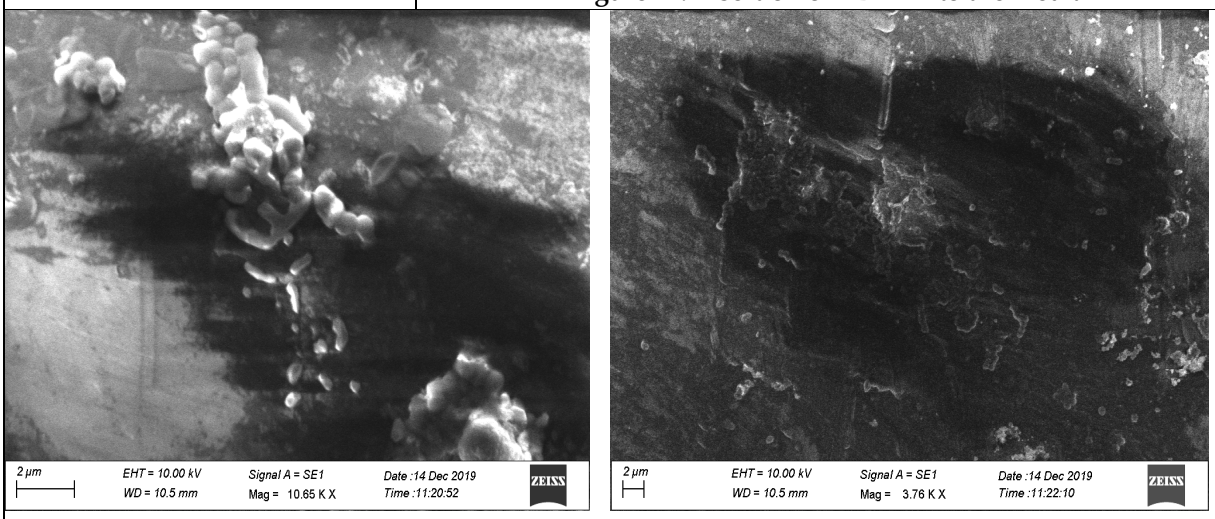


Figure: 12 .A &B. SEM Analysis of isolate E *Pseudomonas sp* and surface erosion of LDPE by the bacteria .

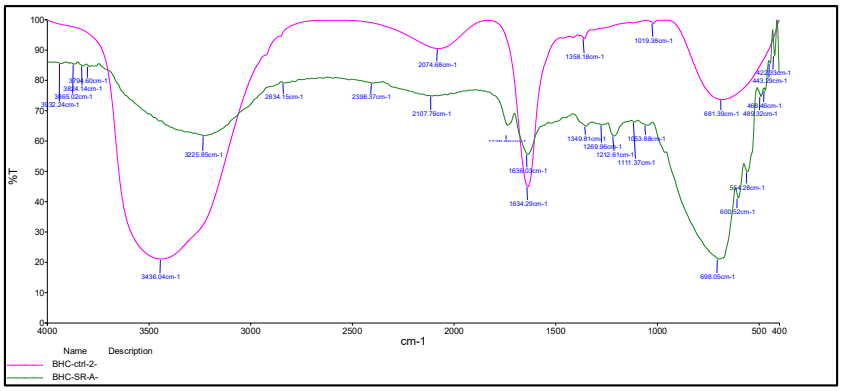


Figure 13. FT-IR results of Isolate A with control

Table 3 . FT-IR Analysis of isolate A showing various functinal groups and its band positions

S.No.	Isolate A	Band Position (cm^{-1})	Functional Groups
1	*Escherichia coli sp*	431.04 -601.01	S-S, C-I, & C-Br
2	*Escherichia coli sp*	697.16-1393.43	C-Br, Or. SO2-& NO3-
3	*Escherichia coli sp*	1635.80-2825.4	-N=N-, -NCS-, CH
4	*Escherichia coli sp*	3206.7-3926.5	OH, NH4+

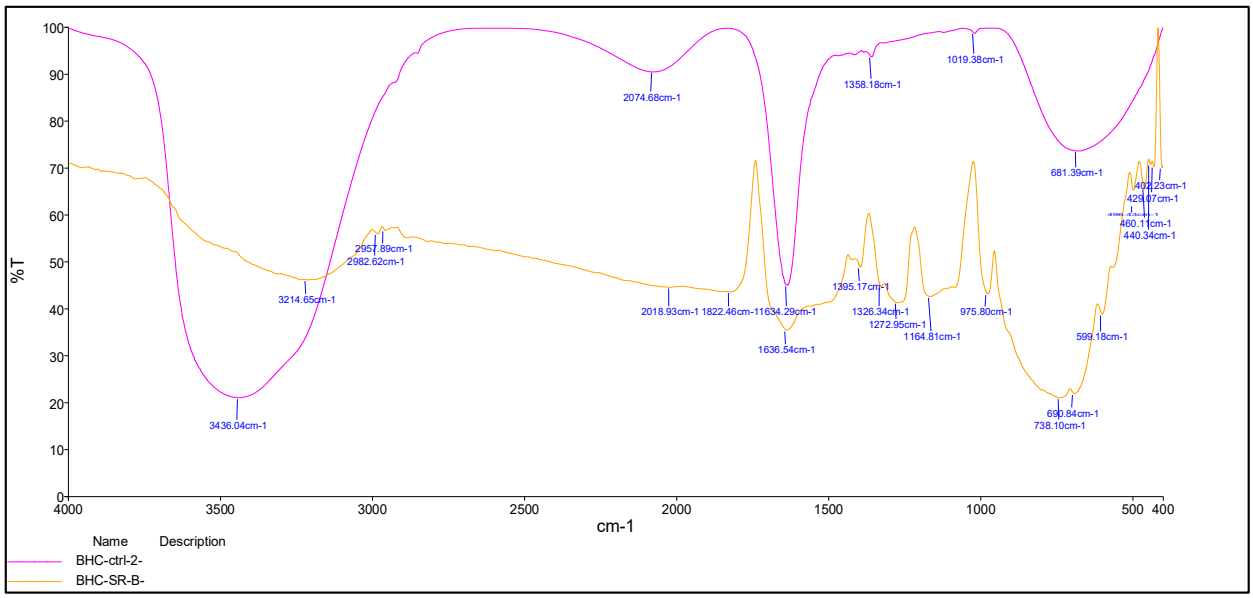


Figure 14. FT-IR Results by Isolate B with control

Table: 4 FT-IR Analysis of isolate B showing various functinal groups and its band positions

S.No.	Isolate B	Band Position (cm^{-1})	Functional Group
1	*Enterobacter sp.*	433.69-1104.17	S-S, C-I, C-Br, C-O
2	*Enterobacter sp.*	1169.24-2052.63	C-N, NO3-,-N=N-, CN, CN-
3	*Enterobacter sp.*	2984.54-3845.4	C-H,C=C,OH

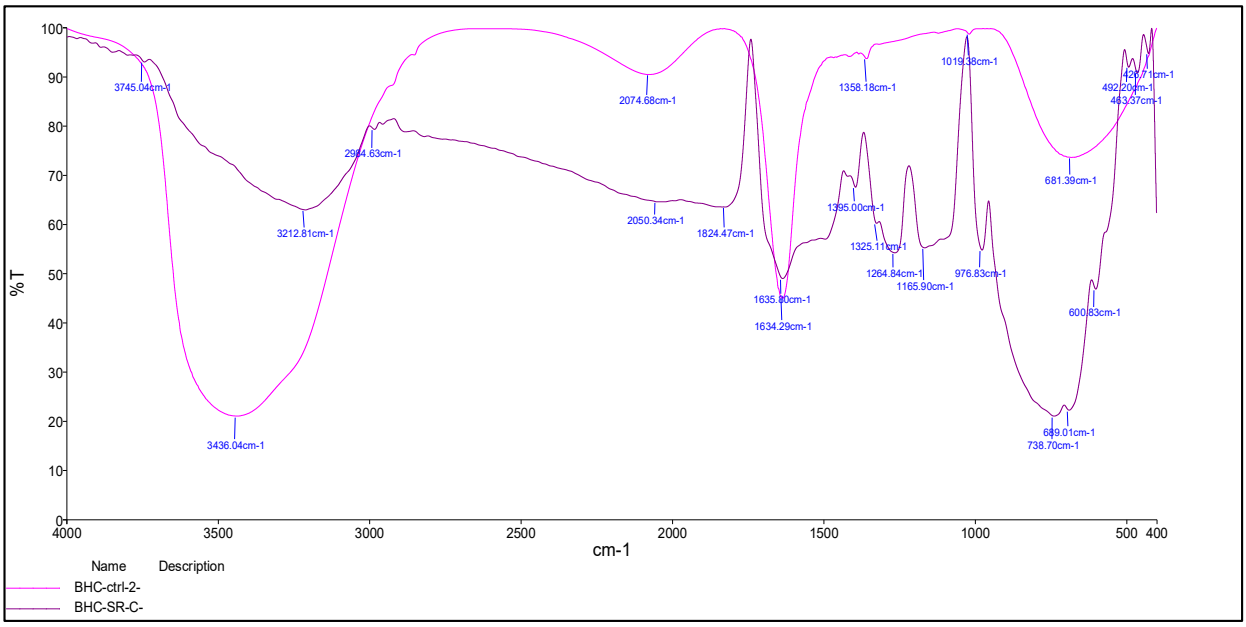


Figure.15 FT-IR Results by Isolate C with control

Table: 5 FT-IR Analysis of isolate C showing various functinal groups and its band positions

S.No.	Isolate C	Band Position (cm^{-1})	Functional Group
1	*Citrobacter sp.*	426.71-689.01	S-S, CH, C-H
2	*Citrobacter sp.*	738.70-1264.84	C-C, C-H, C-O, P=O
3	*Citrobacter sp.*	1325.1-2050.34	aryl/sulphone/amide/dialkyl
4	*Citrobacter sp.*	2984.6-3745.04	OH, C-H, NH4-

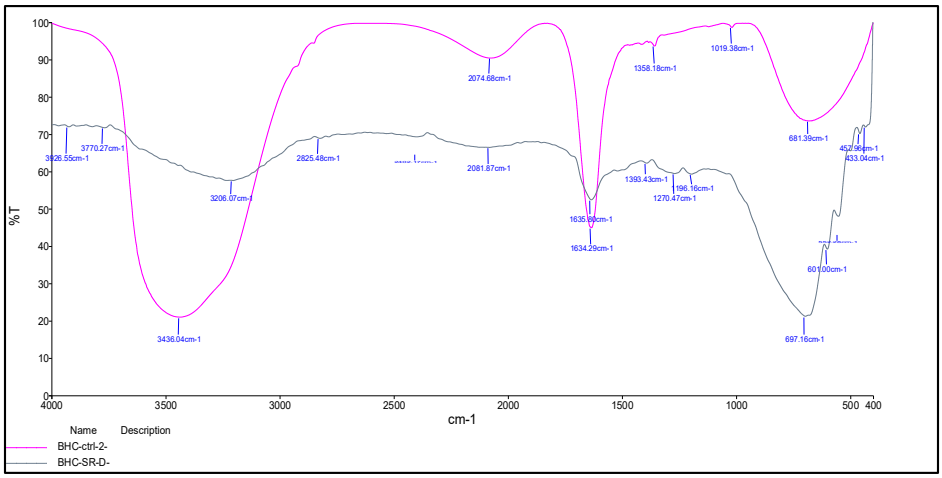


Figure 16. FT-IR resul ts of Isolate D with control

Table: 6 FT-IR Analysis of isolate D showing various functinal groups and its band positions

S.No.	Isolate D	Band Position (cm^{-1})	Functional Group
1	*Serratia sp*	422.33-1111.37	S-S, C-I, C-Br, C-O
2	*Serratia sp*	1216.9-2843.15	CN,-O,-CHO, CH
3	*Serratia sp*	3225.85-3794.6	NH, OH

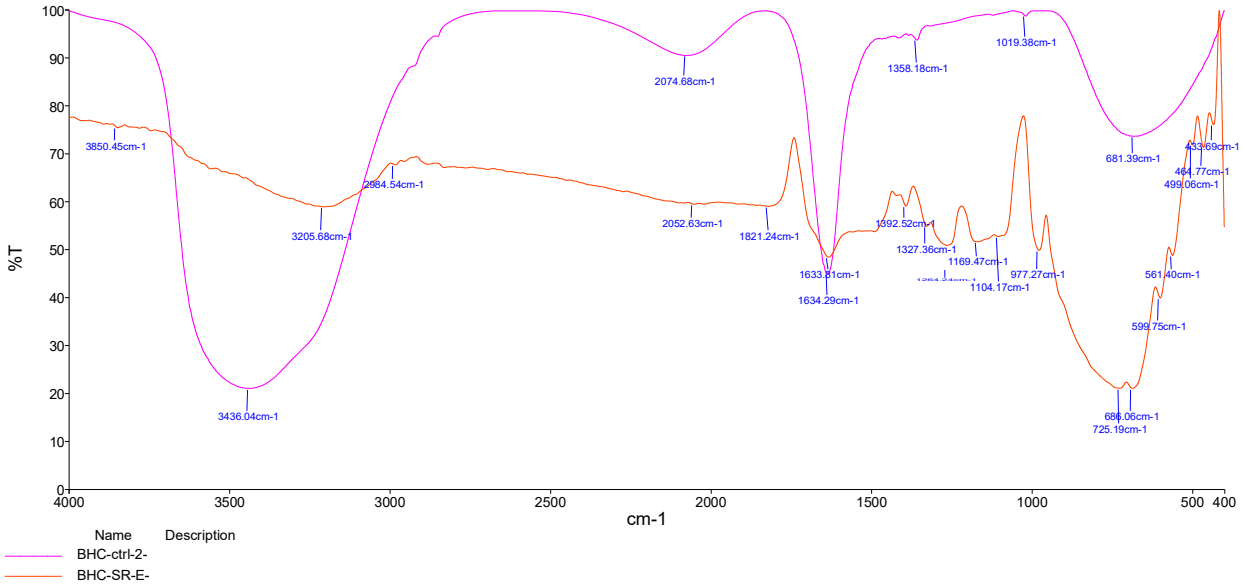
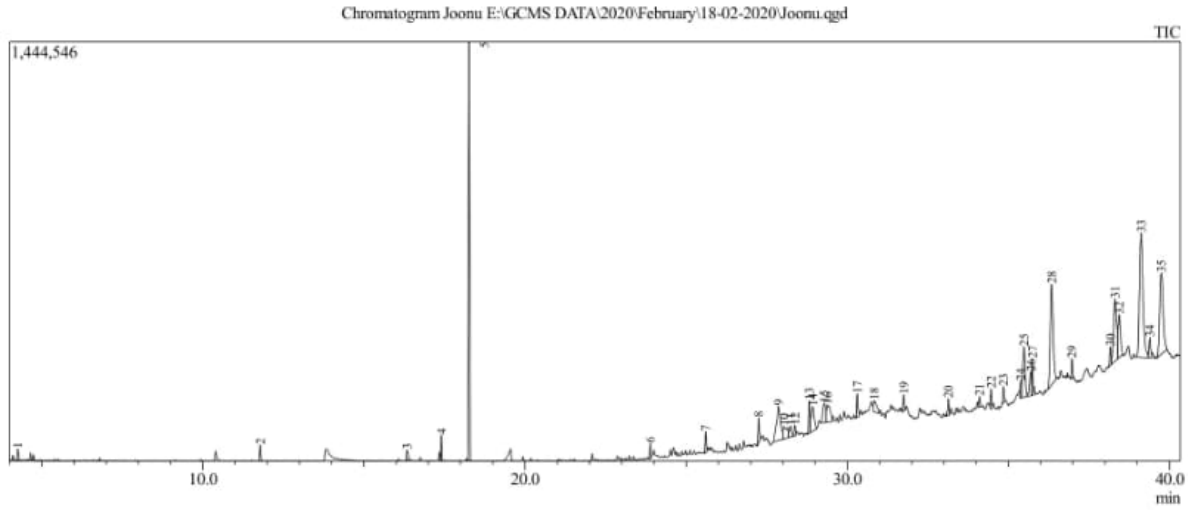


Figure 17. FT-IR results of Isolate E with control

Table 7 . FT-IR Analysis of isolate E showing various functinal groups and its band positions

S.No.	Isolate	Band Position (cm^{-1})	Functional Group
1	*Pseudomonas sp.*	499.08-725.19	C-I, C-H, C-Br, C=C
2	*Pseudomonas sp.*	977.27-1327.38	C=C, CO-O-CO,C-N, C-O, S=O
3	*Pseudomonas sp.*	1392.52-1821.24	S=O, O-H, C=C, N-H, C=O
4	*Pseudomonas sp.*	2052.63-2984.54	N=C=S, C≡C, N=C=N, C=C=O,O=C=O, CH
5	*Pseudomonas sp.*	3205.68-3850.45	C-H, O-H, N-H



GC-MS Results: The degraded byproducts of LDPE were determined by Gas chromatography-Mass spectrometer (SHIMADZU/ QP2020) at Bishop Heber College, Trichy

Figure 18.Gas chromatogram of Control

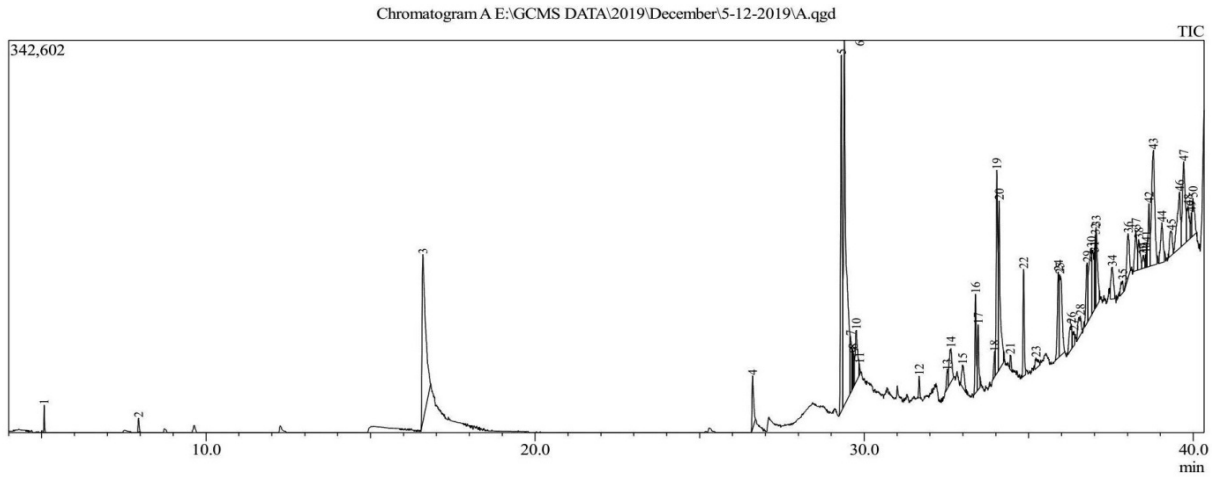


Figure 19. Gas Chromatogram of Isolate A

GC-MS results

The degraded byproducts of LDPE were determined by Gas chromatography-Mass spectrometer (SHIMADZU/ QP2020) at Bishop Heber College, Trichy.

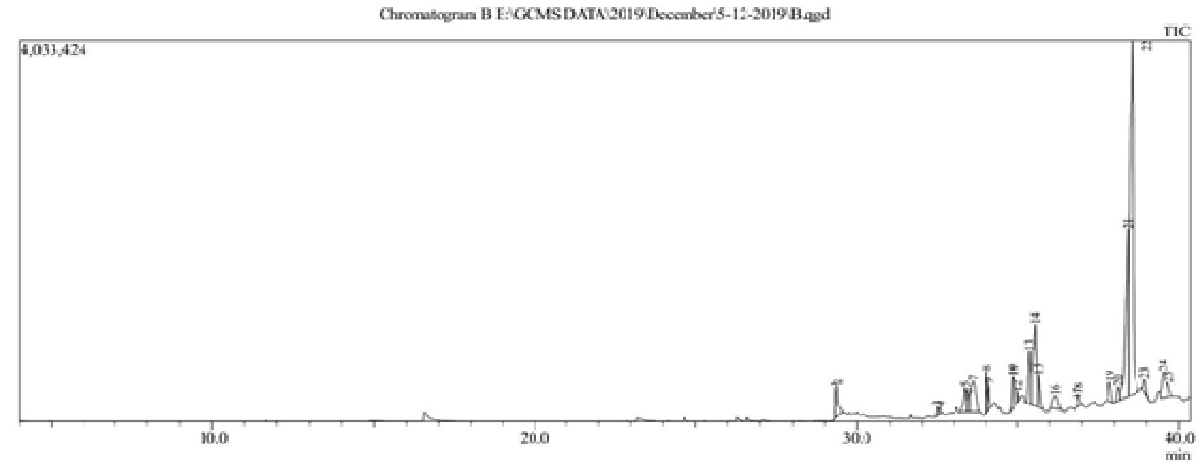


Figure 20.Gas Chromatogram of Isolate B

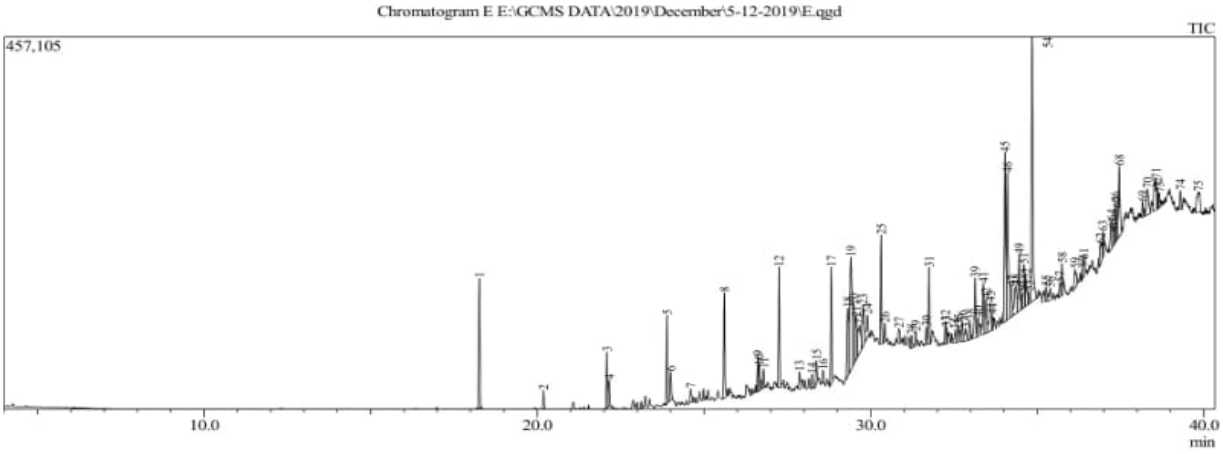


Figure 21.Gas chromatogram of Isolate D

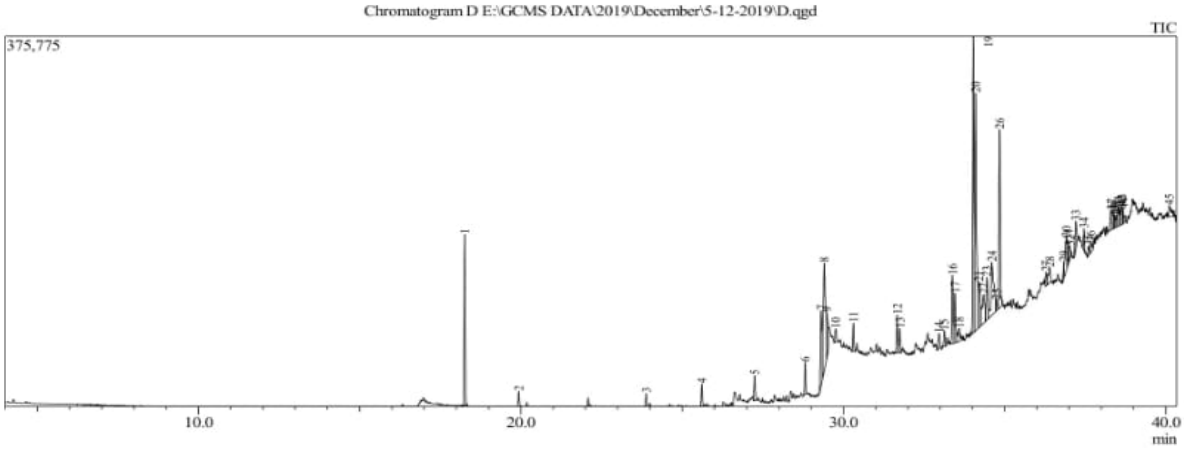


Figure 22.Gas chromatogram of Isolate E

Table 3.1.8 Compounds identified from the bacterial incubation of sample A, B, D and E for 75 days was subjected to GC-MS.

S.No.	Isolate	RET. Time	Compounds	Moleclar formula	Molecular weight
1	D	34.845	Bis(2-ethylhexyl) phthalate	C24H38O4	390
2	E	37.346	3-2 Valeryl-5-methyl-1,2,4-cyclopentane-trione	C11H14O4	210
3	E	34.67	PhenylSilane	C6H8Si	108
4	E	34.735	17-Pentatriacontene	C35H70	490
5	B	35.620	24 (s)-Ethyl-3-alpha, 5-alpha- cyclocholest-22(E)-en-6-one	C29H46O	410
6	A	29.655	3-Oxabicyclo Hexane,6-Ethenyl-1,4,4-Trimethyl (Artemiseole)	C10H16O	152

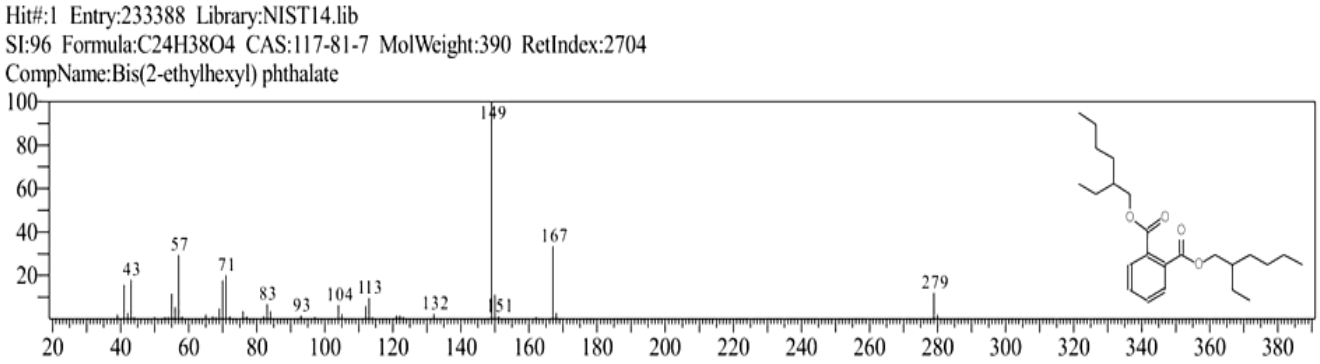


Figure 23. The chemical nature of Bis(2-ethylhexyl) phthalate

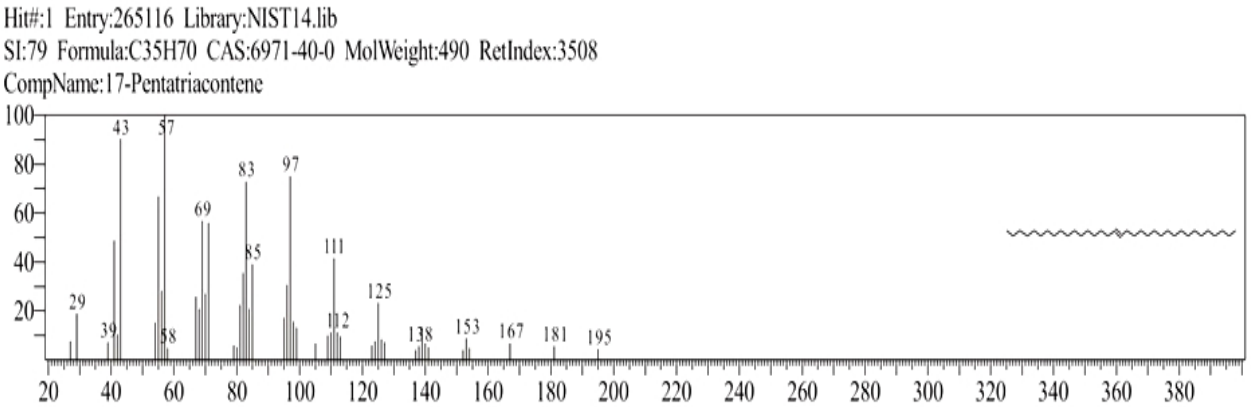


Figure 24. The chemical nature of 17-Pentatriacontene

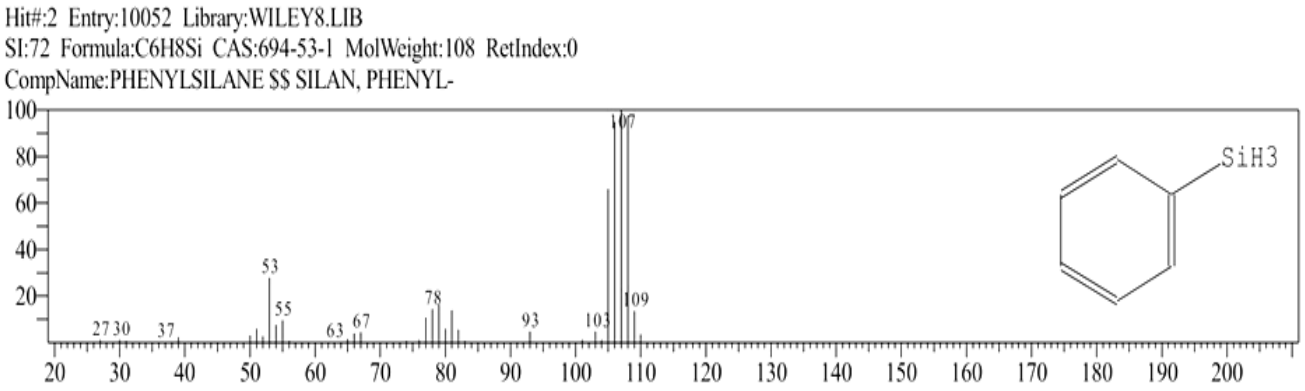


Figure 25.The chemical nature of PhenylSilane

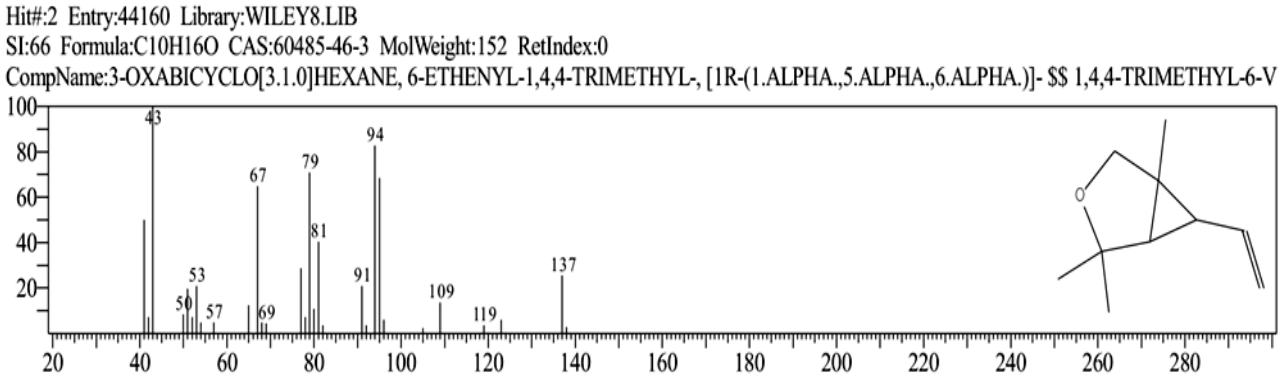


Figure 26. The chemical nature of 3-Oxabicyclo Hexane,6-Ethenyl-1,4,4-Trimethyl

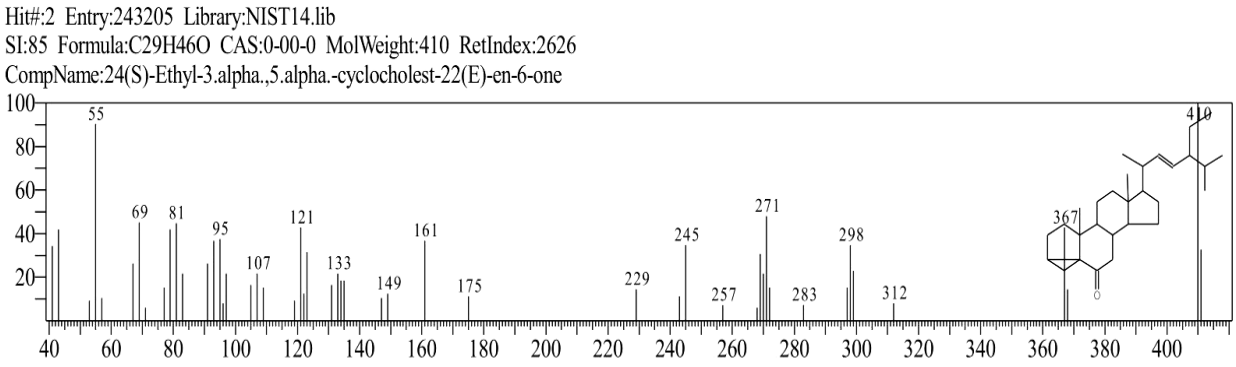
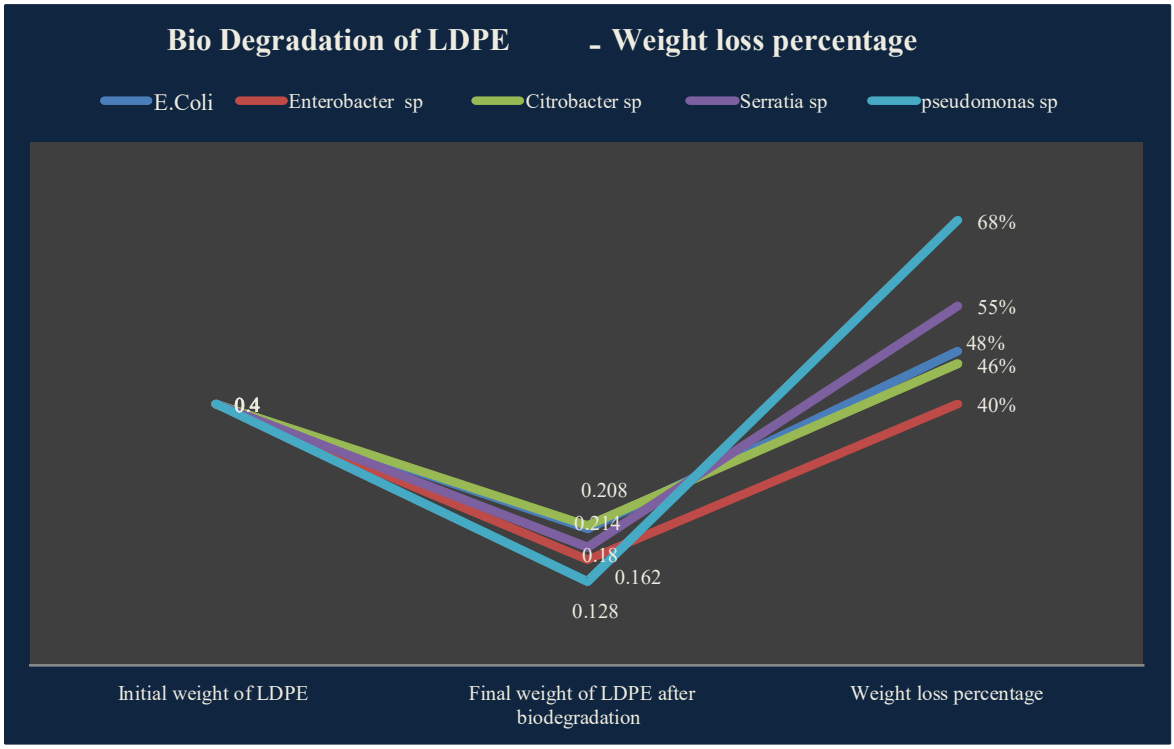


Figure 27. The chemical nature of 24 (s)-Ethyl-3-alpha, 5-alpha- cyclocholest-22(E)-en-6-one



Graph 1.Biodegradation of LDPE

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Investigation of Correlation of Morphometric and Meristic Characteristics of *Sorsogona tuberculate* (Cuvier, 1829)

Himadri Tanaya Satapathy and Siba Prasad Parida*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Bhubaneswar, Odisha, India.

Received: 06 Mar 2020 Revised:10 Apr 2020 Accepted: 13 May 2020

***Address for Correspondence**
Siba Prasad Parida
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Bhubaneswar, Odisha, India.
Email: himadritanayasatapathy@gmail.com

ABSTRACT

The samples (*S. tuberculata*) occurring mainly along the East Coast of India were preserved in EBRC, Gopalpur; out of which 15 specimens having different body lengths were selected for analysis. This work was conducted from 4th February to 17 th February, 2019. During this study 13 morphometric and 2 meristic characters were considered. The mean and standard deviation of the morphometric and meristic traits were performed by software statistica. Correlation coefficient in between head length (HL) and all other morphometric traits were evaluated. In which some of the morphometric traits showed similar correlation with head length (HL) and only one that is Eye distance (ED) negative correlation with HL. Past3 software used to analyse the variance among the morphometric traits which shows no significant differences. Meristic characters measurement shows few variations among the sample which is due to certain environmental changes during growth. This investigation revealed certain correlation between morphometric characters which easily help in identifying the flat head species.

Keywords: *S. tuberculata,* Preserve, Morphometric, Meristic, Statistics, Fishes,

INTRODUCTION

Majority of the marine fishes tend to be distributed over extensive geographic areas where no clear demarcation of geographic and oceanographic barriers is present. Sorsogona is a genus of flatheads native to the Indian Ocean and the western Pacific Ocean. Sorsogona has six recognised species having family Platycephalidae of class Actinopterygii (Froese et al., 2012). Family of Platycephalidae is a group of marine fishes and Estuarine fishes containing around 17 genera and 80 species (Nakabo, 2002). *Sorsogona tuberculata* (Cuvier,1829) otherwise called as *Platycephalus tuberculatus* is a marine, neritic and amphidromous fish distributed Indo-west pacific Persian Gulf to

Indonesia, Philippines, Northern Australia and east coast of India. In India the common name of *Sorsogona tuberculata* is Knobby flathead or Tuberculated flathead fish. In Odisha it was first identified in ZSI, Digha. Six species of *Sorsogona* are restricted to the west coast of India, while three species are occurring throughout Indian waters. However, flatheads are not popular as aquarium fishes, flatheads are valued food fish in many countries. Though the flatheads do not form commercial catch on both Indian coasts, they are landed in significant quantity, mainly on East coast. Apart from edible value, some of them have important traditional medicinal value (IUCN, 2015).

Morpho-meristic traits

Identification of a species plays a key role for the behavior study. Different methods are used for identification but meristic counts and morphometry are considered as earliest and authentic methods for the identification of species (Nayman, 1965). A meristic is a countable trait, such as number of dorsal, caudal, ventral fins and spines. Morphometrics examines the size and shape using measureable trait such as standard length or wet length. Meristic and morphometric counts measurements can help to identify a particular species of fish.

MATERIALS AND METHODS

The present study was conducted in Estuarine Biology Research Center (EBRC), ZSI, Gopalpur-on-Sea from 4th February, 2019 to 17th February, 2019. Thirty specimens of *Sorsogona tuberculata* were collected and preserved before from Gopalpur fish landing center by Dr. Anil Mohapatra and Sanmitra Roy. 15 specimens were onsiderd out of these 30 specimens for evaluations of morphometric and meristic character at ZSI having body length (10-14.5cm).
Specimen (n=1)5 morphometric and meristic characters were measured (table no. 1) where, morphometric character were measured by the help of scale ,tailor tape and divider (Fig.2) and meristic characters were measured by using Stereozoom microscope (Fig.3).The terminology of cephalic spines, and the morphometric traits as described was fallowed (Murty, 1975 and Knapp, 1983). The statistical analysis and description of morphometric ratios are tabulated in (Table 2) for comparison. Mean and standard deviation of the morphometric and merstic traits were performed by using software statastica. An analysis of variance (ANOVA) was performed on morphometric ratios to examine significant difference if any by using PAST 3 statistic software.

RESULTS AND DISCUSSION

Species description

Sorsogona tuberculata (Cuvier,1829)

Synonyms

Onigocia tuberculatus (Cuvier, 1829), *Platycephalus tuberculatus* (Cuvier, 1829), *Thysanophrys tuberculatus* (Cuvier, 1829) and *Rogadius tuberculatus* (Cuvier, 1829).

Table No. 1

Acronyms	Morphometric Traits	Description
TL	Total length	Distance from tip of the snout to the tip of the caudal fin
DF	Dorsal fin length	Distance from base of the first dorsal fin to end of the second dorsal fin
PDL	Pre dorsal fin length	Distance from the tip of the snout to the base of the first dorsal fin
HL	Head length	Distance from the tip of the snout to the posterior margin of the operculum
SL	Snout length	Distance for tip of the upper jaw to the tip of the eye
ED	Eye diameter	Diameter of the eye along the body axis

OS	Opercular spine number	Number of opercular spine along the body axis
LL	Lateral line scale	Total number of lateral line scale along the body axis
PFBL	Pectoral fin base length	The vertical distance between the origin and insertion of the pectoral fin
PFL	Pectoral fin length	Distance between the origin and posterior tip of the left pectoral fin
PPFL	Pre pectoral fin length	Distance from tip of the snout to the base of the pectoral fin
PVFL	Pre ventral fin length	Distance from tip of the snout to the tip of the pelvic fin
PAFL	Pre anal fin length	Distance from tip of the snout to the starting of the anal fin
SL	Standard length	Distance from tip of the snout and the base of the caudal fin rays

Table No.2(Morpho-meristic counts of specimens *Sorsogona tuberculata*)

SAMPLE	TL	DF	PDL	HL	SL	ED	PFBL	PFL	PPFL	PVFL	PAFL	SL	OS	LL
1	13.6	6.8	3.7	4	1	0.8	0.7	1.6	3.3	4.4	6.9	11.6	1	50
2	14	7.6	4.2	4.4	1.2	1	0.9	1.9	3.7	4.8	7.5	12.8	1	54
3	12	6.3	3.2	4	1	0.9	0.9	1.9	3.8	4.5	6.3	10.6	1	53
4	13.2	6.8	3.3	3.8	0.8	1	0.9	1.8	3.3	4.2	6.6	11.2	1	56
5	12.5	6.3	3.4	4.1	0.8	1	0.9	1.4	3.4	4.7	6.2	10.8	1	52
6	11.3	5.9	3.2	3.4	0.9	0.9	0.9	1.4	3.8	4.2	6	9.6	1	52
7	13.5	6.8	3.7	3.4	0.9	1.3	0.9	1.2	3.5	4.1	6.4	11.9	1	52
8	11.8	6.2	3.2	3.5	0.9	1.3	0.9	1.6	3.4	4	6.2	9.4	1	50
9	14.5	7.4	4	4.1	0.9	1.2	1.2	1.6	4.3	4.9	7.8	13.8	1	54
10	11.8	6.1	3.6	3.9	0.9	1.3	0.9	1.6	3.3	3.8	6.5	9.9	1	52
11	12.8	6.6	3.9	4.1	1.1	0.9	1.2	1.6	3.5	4.6	6.4	10.8	1	52
12	11.7	5.9	3.6	3.8	1.1	1.2	0.8	1.5	3.3	4.3	6.1	10	1	51
13	11.2	5.4	3.3	3.9	0.9	1	0.9	1.6	2.9	3.7	5.5	9.4	1	52
14	12.5	6	3.8	3.9	1	1.2	1	1.6	3.2	4.2	6.3	10.6	1	56
15	11.4	5.7	3.7	3.9	1.1	0.9	1	1.5	3.2	4.1	6	9.8	1	52

Table no.3 (Correlation coefficient of morphometric traits in respect to head length) CORRELATION DATA OF MORPHOMETRIC TRAITS

HL/TL	0.413671
HL/DF	0.416892
HL/PDL	0.583196
HL/SL	0.440967
HL/ED	-0.34871
HL/PFBL	0.240836
HL/PFL	0.597761
HL/PPFL	0.130567
HL/PVFL	0.606148
HL/PAFL	0.504035
HL/SL	0.468813

Table no-4 (Dunn's post hock method of correlation between morphometric traits)

	TL	DF	PDL	SL	ED	PFBL	PFL	PPFL	PVFL	PAFL	SL
TL		0.8312	0.2864	0.6698	0.5224	0.8312	0.2008	0.6698	0.1356	0.3938	0.5224
DF	0.8312		0.3938	0.8312	0.3938	0.6698	0.2864	0.5224	0.2008	0.5224	0.6698
PDL	0.2864	0.3938		0.5224	0.08808	0.2008	0.8312	0.1356	0.6698	0.8312	0.6698
SL	0.6698	0.8312	0.5224		0.2864	0.5224	0.3938	0.3938	0.2864	0.6698	0.8312
ED	0.5224	0.3938	0.08808	0.2864		0.6698	0.05501	0.8312	0.03301	0.1356	0.2008
PFBL	0.8312	0.6698	0.2008	0.5224	0.6698		0.1356	0.8312	0.08808	0.2864	0.3938
PFL	0.2008	0.2864	0.8312	0.3938	0.05501	0.1356		0.08808	0.8312	0.6698	0.5224
PPFL	0.6698	0.5224	0.1356	0.3938	0.8312	0.8312	0.08808		0.05501	0.2008	0.2864
PVFL	0.1356	0.2008	0.6698	0.2864	0.03301	0.08808	0.8312	0.05501		0.5224	0.3938
PAFL	0.3938	0.5224	0.8312	0.6698	0.1356	0.2864	0.6698	0.2008	0.5224		0.8312
SL	0.5224	0.6698	0.6698	0.8312	0.2008	0.3938	0.5224	0.2864	0.3938	0.8312	

Fig. 1. ***Sorsogona tuberculata***

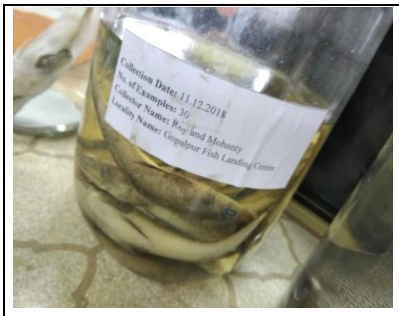
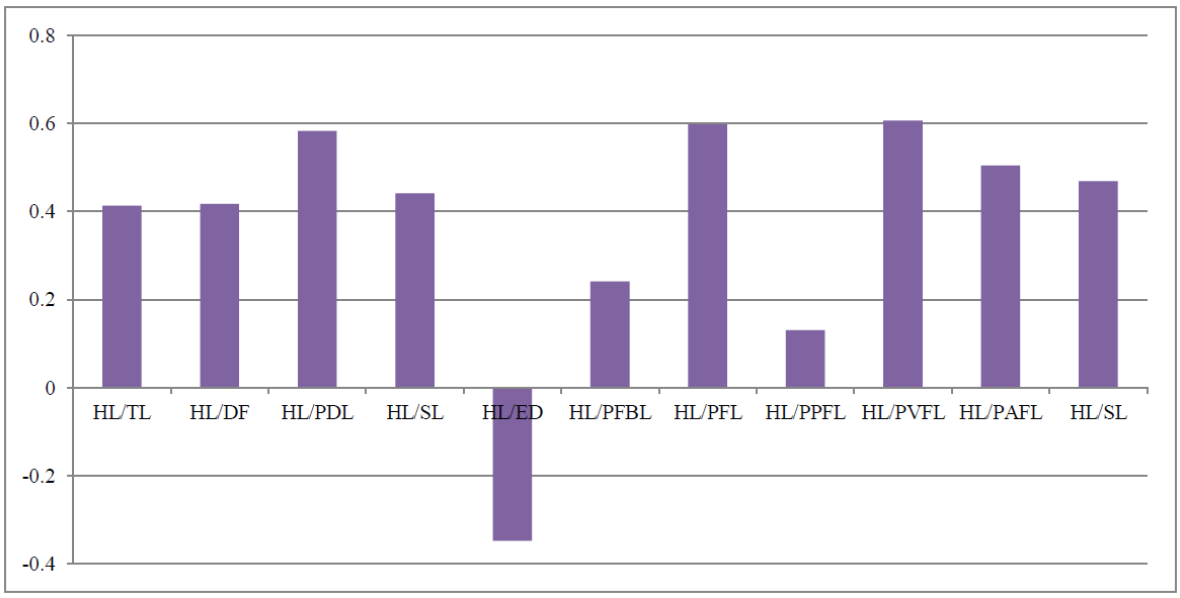


Fig.2 Sample collected form ZSI

Fig.3 Morphometric measurement of *S.tuberculata*

Fig.4 Meristic study under stereozoom microscope



Graph no 1 (Graphical representation of Correlation Coefficient of HL with respect to all morphometric traits)

DISCUSSION

Average head length of the specimens examined was 6-7cm, of caudal fin 7, total length 12-14cm. Eye directed upwards and somewhat outwards; diameter 3 to 4cm in length of head. Interorbital space was concave. A few spines in median line midway between eye and snout; a spiny ridge passes forwards from the spine on either side above the limbs of premaxillaries. The morphometric traits have not been intensively used for species distinction bye earlier researchers. Some researchers have integrated morphometric traits scaled either to head length (HL) or standard length (SL).In the present study compared 11 morphometric traits scale to head length for determining the highlighting differences in between all the 15 considered specimen of *Sorsogona tuberculata.* Lateral line scales of the 15 specimens were compared; there found no certain notable difference except their numbers. This change in the number of scale may be due to their adaptation to various environmental conditions.

The study was correlated the head length of *Sorsogona tuberculata* with all other morphometric traits (N=11) and found a similar correlation between HL/TL; HL/DF; HL/SL and in between HL/PDL; HL/PFL;HL/PVFL. There is also a negative correlation between HL/ED (Shown in table no - 3). An analysis of variance (ANOVA) carried forword for morphometric ratio indicates no significant difference between sample medians (Kruskal-Wallis test for equal medians) (Table no. 4). Correlation between morphometric traits also explain in Dunn's post hock method (Table no. 5). Yennawar et al. (2017) updated inventories the ichthyological faunal diversity of Digha coast, West Bengal and also examined *Sorsogona tuberculata.* In *S. tuberculata*, the proportion of HL/SL was found by Imamura (2006) and Murty and Manikyam (2007) reflecting similarity in the present study, which is similar to earlier finding of investigations.

CONCLUSION

The present study highlighted that little variation in morphological characterisation is a primary steps for the stock structure analysis of the species *Sorsogona tuberculata* The differentiation can be attributed to the ecophenotypic plasticity of the species, in response to the various hydrological conditions of the habitat. As evident from the above

notable discussion on morphological meristic and shape may result in separation and differentiation of stocks. Morphometrics, meristics and life history characteristics have been used successfully for stock identification at a range of different scales but are often limited by their possible alteration by environmental variation. These characteristics may be more applicable for studying short-term, environmentally induced disparities, and the findings can be effectively used for improved fisheries management. The correlation between various morphometric traits was found to be positive, high and significant except eye diameter. From the above study I concluded that, by conducting this work one can able to identify the fish stock very easily and can also determine various morphometric and meristic traits of a particular fish and this will result in increased production and employment, improved economy, upliftment of coastal fisher folk and other developments, Further confirmation of the present finding may be confirmed employing molecular and biochemical methods.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Path Planning of a Mobile Robot through Image Processing on a FPGA Board

Sandipan Pine[1]* and B B Choudhury[2]

[1]Research Scholar, Department of ECE, Utkal University, Odisha, India.
[2]Department of Mechanical Engineering, IGIT Sarang, Sarang, Odisha, India.

Received: 08 Mar 2020 Revised:11 Apr 2020 Accepted: 14 May 2020

***Address for Correspondence**
Sandipan Pine
Research Scholar,Department of ECE,
Utkal University, Odisha, India.
Email: sandipan@cutm.ac.in

ABSTRACT

This paper focuses on automatic path control of a mobile robot through image processing technique on a FPGA board. Particle Swarm Optimization technique is modified and implemented as a control strategy. First features are extracted from the original image and then it is preprocessed. Preprocessing consists of two main task resizing and RGB to Gray conversion. After colour image is converted to gray modified sobel edge detection technique is implemented to get the proper lines and curves. Once the edge is detected, filters are applied to avoid the unwanted noise portion. Simulation is performed with the help of MATLAB and Xilinx. Power, delays, logic utilization and frequency is measured and compared with existing techniques.

Key words: Preprocessing, filtering, feature extraction, modified sobel detection algorithm, improved particle swarm optimization algorithm.

INTRODUCTION

A field-programmable gate array (FPGA) is a device which have an advantage of programmingin the field depending on application [1]. It contains thousands to millions of logic gates with programmable interconnection. Programmable interconnections are available for users to perform any task in the field easily. Fig-1 shows a typical architecture with available input/output. I/O blocks are designed and numbered according to the required function. FPGA consists of logic blocks such as look up tables, flip-flops and some amount of memory [2-4].

Related Work

In real time requirements reconfigurable things like FPGA has been proposed to get high performance for very complex DSP applications such as image processing [5-7]. It's having advantage of application wise solution due to its flexibility.Low level model is a drawback of FPGA. To compensate the gap of the dual levels, the authors

presented a software environment of very high level for FPGA-based image processing. It is done to hide details of hardware from the user. Their perspective is to give a very high level image processing coprocessor (IPC) with a core instruction set based on the functions of image algebra. This includes a generator which produces optimized architectures for specific user-defined operations [9-11]. A generalpurpose of these languages is to conceal many of the low-level details from the developer by permitting the compiler for parallel extraction.It followsoptimization techniques such as loop unrolling to deal with spatial parallelism and automatic pipelining to deal with temporal parallelism [12-15]. This has becomean exact solution for image processing, which have a big stable code base of well-defined software algorithms for implementing many common image processing operations [16].

In the case of real-time image processing system, huge speed is required because data size is more.DSP can be used here to deal with this. On the contrary, FPGA has the capability of flexible logic control, big memory and high speed of execution. So, the real-time image processing system can be performed by the combination of DSP and FPGA that is DSP is used as executing image processing algorithms and FPGA as logic control unit for image sampling and display [17]. Awork is based onimplementation of a real-time moving car tracking on FPGA hardware based on modified mean-shift algorithm is proposed[18-20]. The design emphasizes on real-time processingwithout usingany extra off-chip memoryand optimizes FPGA logic elements (LE) at most possible. Precisely, the FPGA hardware structure consists of 3 things: (1) Pipelined architecture of modified color space transformation model perceivesvaluable pre-processing and appliesless on-chip RAM memory. (2) Kernel-based mass center calculation can balance the computing complication and precision, and its achieving flow is fit for FPGA computing architecture. (3) The time division multiplex (TDM) technology in algorithm organization optimization saves resources FPGA LE resources [18-20].

Robot controlling system using image analysis is generally used to observe and to debug in single-robot as well as multi-robot environments. At current time, majority of the availableobservation-based multi-robot controlling systems are established on use ofversatile computers. These types of arrangements are not empirical for embedded applications whererequirement is high resource efficiency or robustness. Field Programmable Gate Array (FPGAs)-based hardware accelerators can be used preciselyto grasp exactly compute-intensive applications like vision processing due to their huge intrinsic parallelism [21].Here an FPGA-based architecture is proposed for multi-robot controlling system using multiple GigE Vision cameras. A whole system is used, comprising a multi-camera frame grabber and IP cores for image preprocessing, edge filtering, and circle detection.

Motivation

All the above discussed approaches are mathematically rigorous and are used on robotic systems bundled with very expensive high end processors. There lies the need of a cost effective solution. The vogue of FPGA as a cheap solution brought in the idea of using FPGA to implement one of the dynamic image processing algorithms. The algorithm came out to be the best fit for implementing on FPGA due to its modularity. The architecture design has to be made such that power dissipation and processing time reduces. This led to a novel architecture. Parallelizing the algorithm gives essential advantage in terms of response time and power dissipation. Architectural design style facilitates bottom up approach of designing hardware implementation of algorithm and hence brings out the modules which can be parallelized in the algorithm.

PROPOSED METHODOLOGY

The proposed work has enabled more images in order to control the robot, all the data's are stored in the robot to move automatically. Here, the control strategy is developed in the image processing. The controlled output is given to the input of the robot, which have the four directions like start, right, left, and stop. The image processing technique utilized in the proposed work having pre-processing and feature extraction phases. Initially the original

image is opened in MATLAB and it is preprocessed. Under the preprocessing the steps like resizing and RGB to gray conversion is appeared.

Pre-processing

The image is sampled; noise is removed and then converted into binary by utilizing the binary conversion methodology. In an image processing the brightness and the geometry of the pixels are recorded through the sensors, these defined errors can be cleared by the appropriate models in image processing. The visual impact of the image can be accurately cleared by the pixel changes and the modification of image. The image enhancement is presented along with the preprocessing. When the images are captured by the digital cameras, which lacks the brightness and contrast. The images contains a kind of noise sources, and it can be rectified it and improve the visual appearance of the image [22-23].

Resize of the image

The resizing is the process of increasing or decreasing the total number of pixels from the available total number of pixels. The zooming character is involved in the resizing process defined like the zooming, in which the number of pixels can be increased, through which the long distance object can appeared as near, and shrinking is the characters of decreasing the pixels from the original pixels. Many digital cameras can perform both the optical and zooming behavior.

Conversion from RGB to Gray

Enormous knowledge on colour image is required to convert colour image to gray scale. A pixel color in an image is a combination of three colors Red, Green, and Blue (RGB). The RGB color values are represented in three dimensions XYZ, illustrated by the attributes of lightness, chroma, and hue. Image Quality depends on the color represented by the number of bits the digital device could support.

The colour image can be represented with colour intensity and it is given by,

$$I_{RGB} = \left(F_R, F_G, F_B\right)$$

In above equation, the term of F_R represents the intensity of red, F_G denotes the intensity of green and F_B represents the intensity of blue.

SOBEL edge detection,

The magnitude of the vector is calculated and it is represented by eq. 1.

$$\Delta v = mag(\Delta v) = \left[G_x^2 + G_y^2\right]^{1/2} \quad (1)$$

The x and y denotes the direction.

After getting the SOBEL edge detection value the image has the unwanted distortion, this can be avoided by the filtering process. Then the clear image is return from the filtering process these all the process are done under the coding and the image is given to the input of Xilinx tool for feature extraction.

Feature extraction

In the feature extraction, phase the modified swarm optimization algorithm is proposed to extract the features of the image. By the extracted features of the image the outputs are evaluated to control the mobile robot. The swarming behavior of particle moves around the search space to find the best location. The convergence and speed cannot be reached at maximum level in PSO, and it can be achieved by MPSO. The fitness value is constructed to evaluate the performance of the particle. It is explained below,

Step 1: Randomly initialize the value of the position $P = p_i^1, p_i^2, \ldots p_i^n$ and the velocity can be stated by $V = v_i^1, v_i^2, \ldots v_i^n$.

Step 2: Evaluate the fitness function of the particle. Each particle has a different value.

Step 3: Then compare the fitness value of both local and global best value. In which the global value is considered as best solution.

Step 4: Then update the new velocity and location by eq. 2.

$$V_{new} = w * v_i^n + c_i * rand(0) * \left(p_i^n - x_i^n\right) + c_j * rand(1) * \left(p_{gb} - x_i^n\right) \quad (2)$$

Where w represents the inertia weight, c_i and c_j are the constants, p_{gb} represents the global best value. Then the location can be updated in terms of the equation (eq. 3).

$$X_I^N = x_i^n + v_i^n \quad (3)$$

The exact location to be the addition of current location and the velocity of the particle.

Step 5: The selection of cluster head is the objective function. The selection process is done under the best fitness value. Suppose if two particles are considered, then the fitness function can be evaluated by the algorithm [24], and it is shown in below Fig. 2.

RESULT AND DISCUSSION

The image processing and the VLSI is done to exhibit the characters of automatic moving, on the account of that the objects move automatically. Before that we have to fix the signal conditions like right, left, straight and stop. The image processing involves the original image, first we retrieve the original image and after that resizing is takes place, then the RGB image is converted into the GRAY level image, after that the filtering process is done to remove the unwanted segments presented in the image. These all done under the MATLAB environment. Then the finalized image is given to the input of Xilinx to perform the conditions. The above Fig. 3(a), shows that the captured image which contains large number curves and noises. Then the preprocessing steps are carried out. The image is resized first and it contains large number of pixels and after shrinking it decrease the pixels from the original pixels and it is shown in Fig. 3(b). The zooming behavior is useful to show the image as clear view point. In above figure the curves and lands are not getting clearly, but after resizing the images it is cleared like better vision the RGB to GRAY conversion is applied to the resized images in order to get the gray images as shown in Fig 4. Because, most of the applications needs the gray scale images, e.g. Steganography.

The intensity of the images can be changes due to the edges and it is located between the boundaries of two images. It is very useful to make the clear vision of lines. The sobel detection algorithms can extract the curves, lines, and corners presented in the images. The strong contrast images are presented at the edges, from one pixel to another pixel the intensity levels are varied. In previous Laplace and gradients are used. In Laplace transform zero crossings are detected and in the gradient, minimum and maximum values are find out. Fig. 6 shows the filtered image, after getting the sobel detection it is directly applied for filtering process to remove the unwanted things presented in the image. The filtering can show the better image when compared with fig 5. It shows the road with some lines intended to it and curves along the road. The original image have the size with 2395*3600, after getting resizing the image is like 512*512 size. Fig.7 shows the schematic diagram of RTL (Register transfer level), and it is used to check out the errors. These can be described the sequence of registers and electronic circuits, but never express the hardware operations. In which the first line denotes the data path contains the inputs. It starts with the zero clock cycle. It consists of adder, registerand multiplexer in order to select the input and added with the current value of the register and the internal structure of the RTL is given in below Fig. 8.

Fig.9shows the Xilinx output of the road image, in which the automatic signals are represented like auto start, right, left and stop. In which the improved particle swarm optimization algorithms are used for the direction estimation. The position updation is done in the algorithm, initially the image is said to be binary image which is like zero's and ones. The image is checked with the positionzero and then it starts. If the image value is less than that the position the object turn right, if it is greater than the position then it moves left, and the position is going to be one then it is stop. In each iteration the position become change. The above Table 1, shows that performance of clock frequecy and time.Maximum frequency is about 259.282MHz, the minimum arival time of the input is to be 3.990 nano seconds and the maximum interval time of the output appearance is about 4.694 nanoseconds in existing particle swarm optimization algorithm, which is similar to the MPSO algorithm.

The overall architecture have some specification like flip flops, input LUTS, slices and total number of LUTS. Table 2 shows comparision of proposed logic utilization with existing system. These all have the utiliation is about 1%, and the available flip flops and input LUTs are like 1,78,176, among them in our work 132 flip flops and 412 inputs are used. The slices are availbale as 89,088, in which 222 is used, similarly the total number of LUTs are 1,78,176, and 413 is used in our work.But in existing algorithm available and utilization factors are same in all parameters but it differ only in available like the flipflops ranges like 140, inpu of LUTs like 436, occupied slices like 232, and the total number of LUTs is about 436 which is very high when compared with the proposed system. Thus the numbers are reduced than the existing methods.

CONCLUSION

This application of controlling small mobile robot has more and more importance these days, so using them in the higher education is increasing rapidly. Auto controlled mobile robots have huge application in delivering parts in industries; they are becoming supplementary platforms in a security system. This application can be used in dangerous area where human being cannot work.This approach can be extended to moredemanding applications by adding more modules, or otherperipheral hardware interfaces.

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Table 1: Comparison of proposed Performance with existing system

Performance	MPSO	PSO
Maximum frequency	259.282MHz	259.282MHz
Minimum input arrival time	3.990ns	3.498ns
Maximum output time	4.694ns	4.700ns

Table 2:Comparision of proposed logic utilization with existing system.

Area	MPSO	PSO
Logic employment	**Taken**	**Taken**
Flip Flop Slice	132	140
LUTs(4 input)	412	436
Slides used	222	232
LUTs(total)	413	436

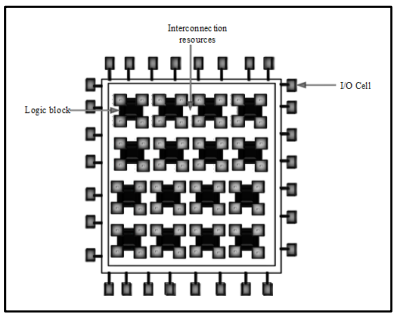

Fig 1: FPGA architecture[1]

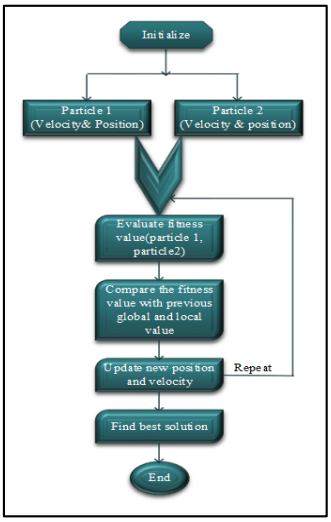

Fig 2: ModifiedParticle swarm optimization algorithm

Fig. 3(a): Captured image

Fig. 3(b): Resized image

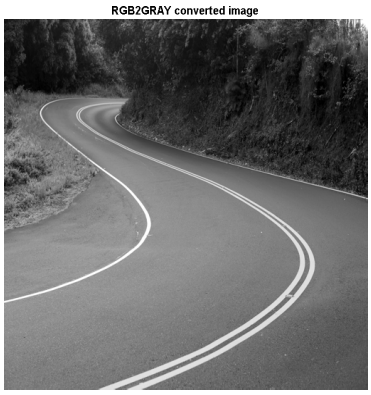

Fig 4: RGB to GRAY conversion

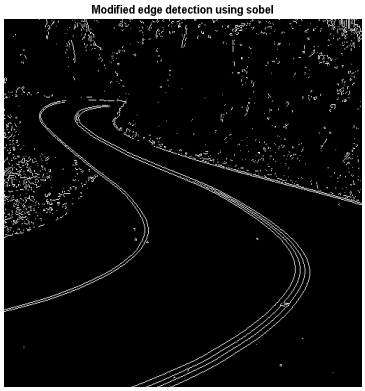

Fig 5: SOBEL edge detection

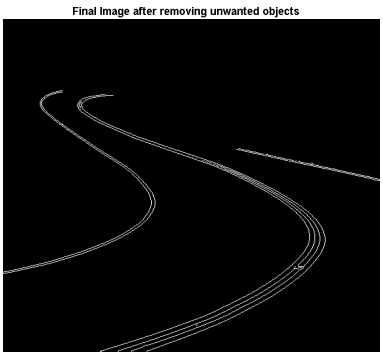

Fig 6: Filtered image

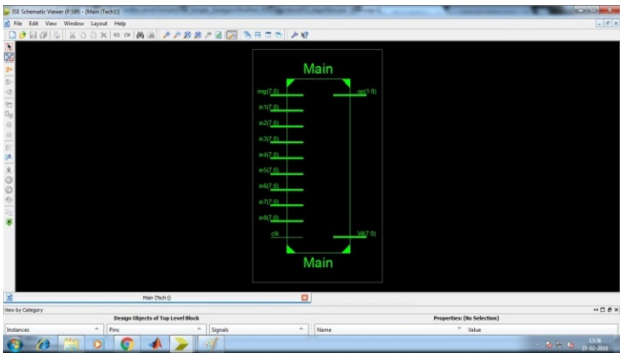

Fig 7: RTL schematic diagram

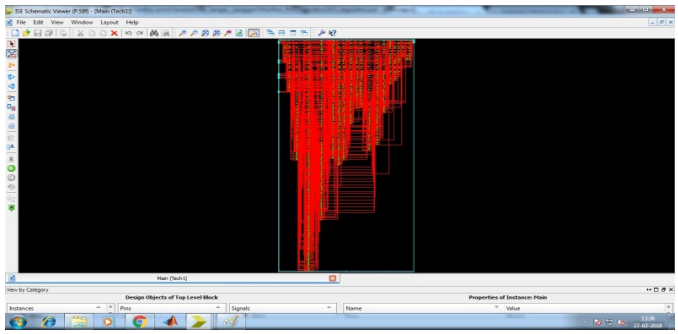

Fig 8: Internal structure of RTL

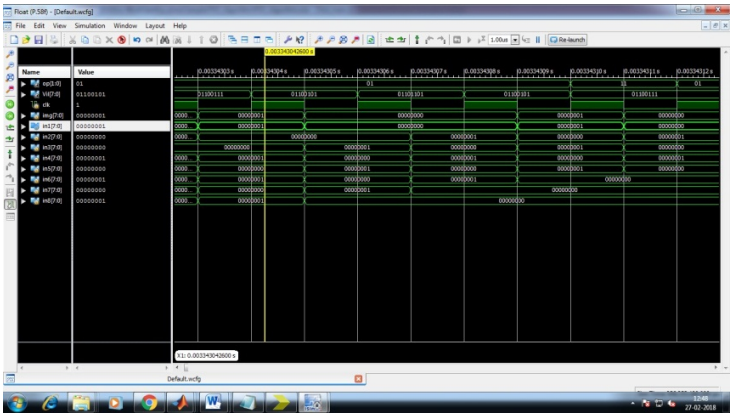

Fig 9: Xilinx output

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Synthesis, Characterization and Assess of Metal Compound and Cytotoxic Studies

N.Srividhya[1]*, Ignatius Navis Karthika[1] and K.Kavipriya[2]

[1]Assistant Professor, Department of Chemistry, PSNA College of Engineering and Technology, Dindigul, Tamilnadu, India.
[2]Associate Professor, Department of chemistry, PSNA College of Engineering and Technology, Dindigul, Tamilnadu, India.

Received: 23 Feb 2020 Revised:25 Mar 2020 Accepted: 27 Apr 2020

***Address for Correspondence**
N.Srividhya
Assistant Professor,
Department of Chemistry,
PSNA College of Engineering andTechnology,
Tamilnadu, Dindigul India.
Email: vidhyahari11@gmail.com

ABSTRACT

Metal (II) chelates of Schiff bases derived from the condensation of 4- amino-1,5-dimethyl-2-phenylpyrazol-3-one with 2- amino 3- pyridine, carboxaldehyde and characterized by 1H NMR, IR, UV-Vis and EPR spectral studies. The complexes are of the type $M(-4AAP)_2$ [where M = Cu(II), Co(II)), Ru(III), & V(II)]. The metal atom is coordinated to nitrogen and nitrogen atoms of the Schiff base ligand. The free ligand and its metal complexes were screened for Cytotoxicity. Anticancer activity of ligands and their metal complexes and evaluated in human breast cancer cells. The preliminary bioassay indicates that the Schiff base and its complexes exhibit good inhibitory activity against the human breast adenocarcinoma cancer cell lines. Cytotoxicity is one of the most important indicators for biological evaluation in vitro studies.

Key words: 4 –Aminoantipyrine, 2- amino 3- pyridine , Cytotoxic Studies, human breast cancer

INTRODUCTION

The interest in the synthesis and characterization of transition metal complexes containing Schiff bases lie in their biological and catalytic activity in many reaction [1,2].Transition metal complexes with ligands containing both hard and soft donor groups have been used extensively in co-ordination and organometallic chemistry.Over past few years N_2S_2 and N_2O_2 .Schiff base ligand have been extensively investigated with regard to their numerous applications in organic synthesis as well as medicine[3].The derivatives of 4-

aminoantipyrine is a remarkable reagent due to its important in biological, pharmacological, clinical and analytical applications [4]. Schiff bases are now attracting the attention of biochemists. They have been of great and due to their synthetic, flexibility, selectivity and sensitivity towards the metal ions. In view of biological importance of Schiff base derived from the condensation of 4-aminoantipyrine derived with various subsitution its applications in various fields, in the present investigation it is thought to synthesize the metal complexes with transition metal ions such as Co(II), V(II), Cu(II) and Ru(III). It is therefore of interest to carryout investigations to understand how a ligand environment and its metal complexes show the activity in cytotoxic studies of the inorganiccomplex. The development of metal complexes as antitumor drugs began after the discovery of the tumor-inhibiting properties of cisplatin by Rosenberg, and the first clinical trials of cisplatin were reported in 1971. One of the world's best anticancer drugs is cisplatin, a commercial name for the platinum complex cis-dichloro diammineplatinum(II). Cisplatin is especially effective against small cell lung cancer, testicular and ovarian cancer. Cytotoxicity effectively explains us the degree to which an agent possesses a specific destructive action on certain cells. Most often it wasused to describe the character of immune activity or toxicity of certain drugs that limit the development of cancer cells and can be monitored using the 3-(4, 5-dimethyl-2- thiazolyl)-2,5-diphenyl-2H-tetrazolium bromide (MTT) or MTS assay. This assay measures the reducing potential of the cell using a colorimetric reaction.[5] studied the mechanism of cytotoxicity of Cu(I) complexes of 1,2- bis(diphenylphosphino)ethane,[6] studied the cytotoxicity of ferrocenyl-ethynyl phosphine metal complexes of gold and platinum and found that they have good anticancer activity.

MATERIALS AND METHODS

The instruments used for various physical measurements (FT-IR, ^{1}H-NMR, UV-Vis, EPR, Anticancer activities) are explained.

Synthesis of ligand

A solution of 1-phenyl-2,3-dimethyl-4-amino-3-pyrazolin-5-one (0.4065g, 1 mmol) in ethanol (5 ml) was added to a solution of 2- Amino3- pyridine carboxaldehyde (0.2442g, 1 mmol) in ethanol (5 ml). The reaction mixture was stirred for 2 hrs at room temperature then heated to reflux for 3 hrs and kept at 273 K for 4hrs. The characteristic pale-green precipitate obtained was filtered and recrystallised by dissolving in methanol (m.p. 160oC K). Yield: 83 %.

Synthesis of metalcomplexes

An ethanol solution of Metal (II) acetate & III chloride (1 mmol, 15 mL aqueous ethanol) was added dropwise to a stirred ethanol solution of the Schiff base ligand. The resulting solution was gently heated for 5 hrs with constant stirring. The precipitate solid was filtered, washed with hot water, and then ethanol followed by ether and dried in vacuo. Yield: 70%; M.p. 300ºC. The complex is soluble in DMF and DMSO, and is partially soluble in chloroform andmethanol.

RESULTS AND DISCUSSION

Analytical, colour and magnetic susceptibility data of all metal complexes are given in below Table and are in good agreement with proposed composition. The Synthesized ligands and its metal complexes were characterized by various physiochemical techniques. these complexes are readly soluble in DMF & DMSO. All the analytical data with respect to these complex agreed to the proposed general formula [ML]OAC$_2$.

^{1}H-NMR Spectra of Ligand (L)

The ^{1}H NMR spectrum of the ligand were recorded at room temperature in $CDCl_3$. Using tetra methylsilane (TMS) as internal standard. The ^{1}H-NMR spectrum shows the peaks at 6.2-7.2 δ (m) shows the phenyl multiplet of Schiff base ligand. The ligand also shows the following signals: =C-CH_3 2.1–2.8(s);-CH=N 8.3 δ (s) and 7.72, 7.94 and7.983.

Infrared spectra of the ligands and their metalcomplexes

The coordination sites of the ligand to the metal ions were investigated by comparing the infrared spectra of the free ligand with their metal complexes. The Spectra of the ligand (L) and its complex were regarded in the region 400-4000 cm^{-1} . The FT-IR spectra of the Schiff base ligand (L) show a band at 1630 cm^{-1} which is assigned to azomethine ν (CH=N) linkage. These bands are shifted towards lower frequencies in the spectra of their metal complexes (1608–1606 cm^{-1}). The comparison of the FT-IR spectra of the complexes with the above Schiff bases indicates the involvement of the azomethine nitrogen in chelation with the metal ion. The coordination of nitrogen to the metal ion could be expected to reduce the electron density of the azomethine link and thus causes a shift in the ν(CH=N) group.

Electronic spectra of ligand and its metalcomplexes

The UV-Visible spectra are recorded in $CHCl_3$ in the range of 726 nm of the Schiff base.The UV–Vis. spectrum of the ligand exhibits an absorption band at 355 nm, which can be attributed to the n-π* transition of azomethine Chromophore. The molar absorbtivities ligand at 355nm may be assigned to an transition between the lone-pair electrons of the p orbitals of the N atoms in the azomethine (HC=N) groups and the π bonds of the aromatic rings [7], [8]. The peaks at 276 nm are assigned to theπ-π*transitions of the Schiff base. In the present case, the absorption band in the 420 nm range, which is assigned to a metal ligand charge transfer band. The electronic spectrum of the Cu (II) complex shows a broad band at 515 nm assignable to transition [9] which is characteristic of square planar environment.

EPR Spectra

The X-band EPR spectrum of the copper (II) complex was recorded in DMSO at liquid nitrogen temperature (LNT) as exposed in Figure. It shown four lines [10] with nuclear hyperfine spin 3/2 due to hyperfine splitting. . The observed g|| values were less than 2.3 indicating considerable covalent character in the M–L bonds . The trend $A_{\parallel}$(158) > $A_{\perp}$(88);$g_{\parallel}$(2.28 > $g_{\perp}$(2.08) > 2.0027 indicate that the unpaired electron was located in the d_{x} –y orbital (B1g state) to envisage a square planar geometry around Cu(II) ions [11].According to Hathaway [12], if the G value > 4, the exchange interaction is negligible, while a value is < 4 gives an indication for considerable exchange interaction in the complex. The axial symmetry parameter (G) of the reported Cu(II) complex was > 4 suggesting that the local tetragonal axes were aligned parallel or slightly misaligned and the unpaired electron is present in the d_{x} –y orbital. This result also indicates that the exchange coupling effects are not operative in the presentcomplex.

Cytotoxicactivity

The *invitro* cytotoxic activities of the synthesized metal complexes are studied on breast cancer cell lines (MCF-7) by applying the MTT colorimetric assay. The calculated IC_{50} values, that is, the concentration (12.5μg/mL) of a compound able to cause 50% of cell death with respect to the control culture, are presented in below figure. A Gonad is used as a reference compound. The MCF-7 cells are sensitive to the O-N Schiff base with the IC_{50} value of 7.3,6.3,

15.7,3.1μg·cm^{-3}. The complexes cytotoxic to the breast cancer cell lines with IC_{50} value of 7.3,6.3, 15.7,3. μg·cm$^{-.1}$The complexation of metal ions enhances the anti-cancer behavior as is evidenced by the lower IC_{50} values of the complex compared to the control drug.. This may be attributed to the increase in conjugation R=N-R', in the ligand moiety on complexation. The preliminary bioassay indicates that the Schiff complex exhibits inhibitory activity against the human breast cancer cell lines. The different activities are currently being investigated in terms of the mechanism of action of these compounds at the cellular level[13]. In the table 4.6a shows that the copper complex having better activity than ligand and control drug.

Fluorescent staining studies

Apoptosis (programmed cell death) is a normal component of the development and maintenance of health of multicellular organisms. Cells die in response to a variety of external and physiological stimuli, and during apoptosis, they do so in a controlled and regulated fashion. This makes apoptosis distinct from the other form of cell death, namely, necrosis in which uncontrolled (accidental) cell death leads to lysis of cells, to inflammatory responses and potentially, toserioushealthproblems.Also, apoptosis, by contrast, is a process in which cells play an active role in their own death (cell suicide). Most tumour cells retain their sensitivity to some apoptotic stimuli from chemotherapeutic agents, and in this context, the apoptosis-inducing ability of drugs seems to be a primary factor in determining their efficacy.

In the present study the characteristic morphological changes induced by the complex have been evaluated by adopting fluorescent microscopic analysis of Acridine orange/EtBr (AO/EB)-stained cells. The present results reveal that the metal complexes induce cell death through both apoptosis and necrosis. Upon treatment of the cells with IC_{50} concentration of their metal complexes at different incubation time 24 hrs, morphological changes such as chromatin fragmentation, bi- and/or multinucleation, cytoplasmic vacuolation, nuclear swelling, cytoplasmic blebbing, and late apoptosis indication of dot like chromatin condensation [14] have been observed by adopting AO/EB staining. The cytological changes observed are classified into four types according to the fluorescence emission and morphological features of chromatin condensation in the AO/EB-stained nuclei: (i) viable cells having uniformly green fluorescing nuclei with highly organized structure; (ii) early apoptotic cells (which still have intact membranes but have started undergoing DNA fragmentation) having green fluorescing nuclei but with perinuclear chromatin condensation visible as bright-green patches or fragments; (iii) late apoptotic cells havinggreen-to-yellowfluorescingnucleiwithcondensedorfragmentedchromatin;(iv) necrotic cells, swollen to large sizes, having uniformly green-to-yellow fluorescing nuclei with no indication of chromatin fragmentation. All the morphological changes observed for the metal complex suggest that the cells are committed to death in such a way that both apoptotic and necrotic cells increase in number in a time-dependent manner and the ability of the complex.

CONCLUSION

The present study describes the synthesis of new Schiff bases derived from 4- aminoantipyrine and 2- amino 3-pyridine carboxaldehyde. The EPR study confirms the structure of newly synthesized Schiff bases. The spectral data show that the Schiff bases act as monobasic bi dentate M-N chelating agents coordinating the metal ion *via* the azomethine nitrogen and nitrogen atom.. The free ligand and their metal complexes show anti-cancer activity against MCF7cells. In view of the biological activity, copper complexes have shown a higher activity.

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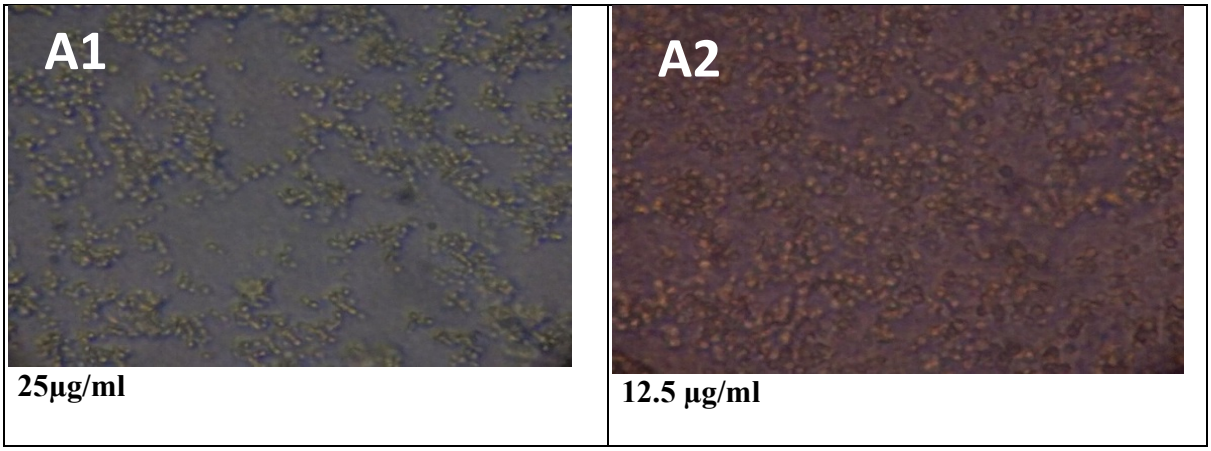
Table 1. Physico chemical Properties of Ligand and Metal Complexes

Compound	Empirical formula	Molecular Weight	Colour	Elemental analysis % calc.(found)		
				C	H	N
Ligand	$C_{17}H_{17}N_5O$	307.35	Light brown	66.43 (66.32)	5.58 (5.56)	22.79 (22.75)
Cu (L1)	$C_{34}H_{32}CuN_{10}O_2$	676.23	green	(60.29)	(4.70)	(20.61)
Co(L1)	$C_{34}H_{32}CoN_{10}O_2$	671.62	Moss green	60.80 (60.78)	4.80 (4.75)	20.86 (20.65)
V (L1)	$C_{34}H_{32}N_{10}O_2V$	663.63	Corn yellow	61.54 (61.50)	4.86 (4.68)	21.11 (21.10)
Ru (L1)	$C_{34}H_{32}N_{10}O_2Ru$	713.75	Dark green	57.21 (57.20)	4.52 (4.44)	19.62 (19.52)



25µg/ml **12.5 µg/ml**

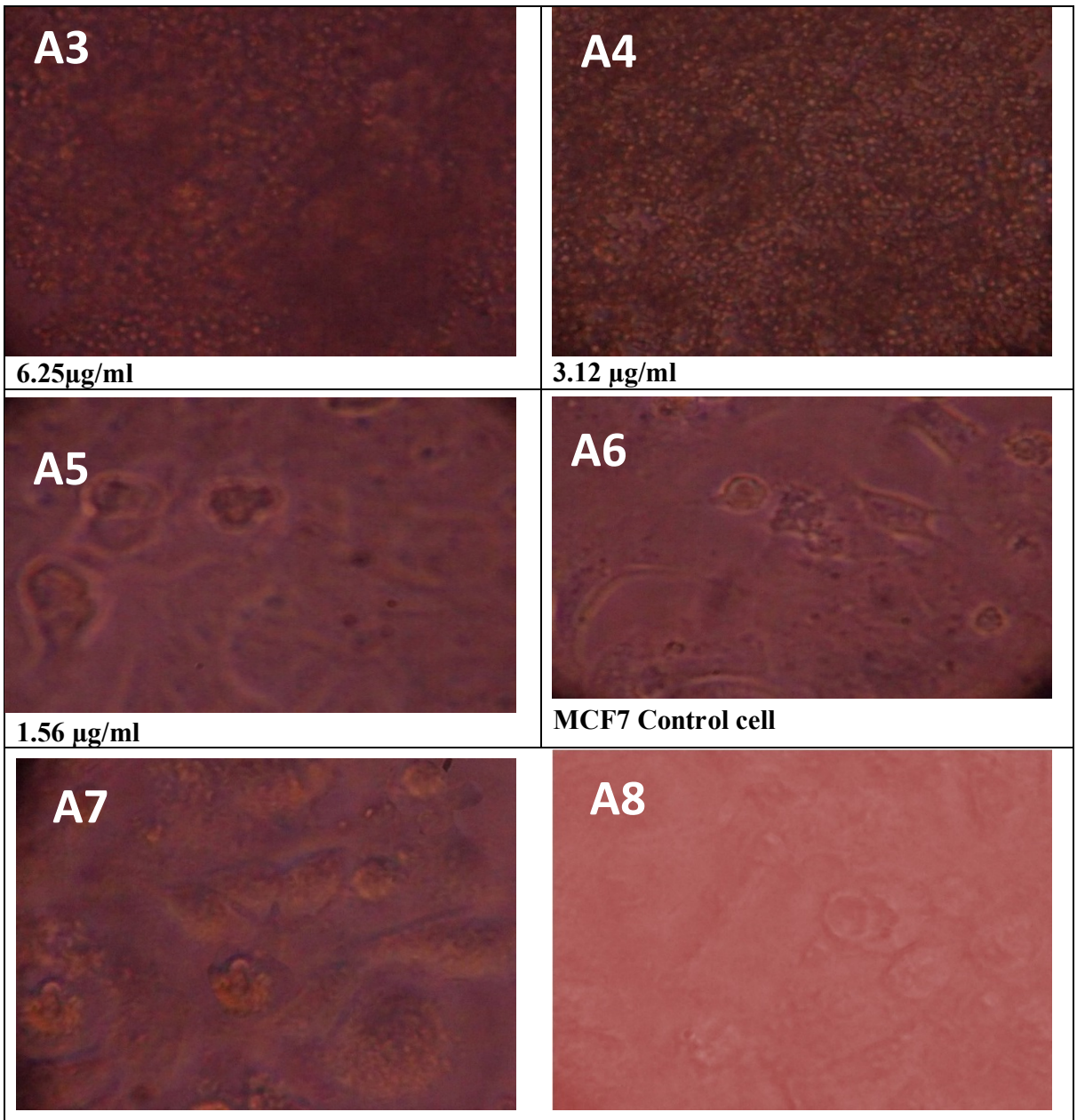


Figure 1.Images of (A1-A8) Percentage of cell viability and death analysis in duplicate study model for Ligand.

Table: 2 Percentage of cell viability and death analysis in duplicate study model for Ligand

S.No.	Concentration µg/ml	Dilution	Absorbance 540nm	% cell Viability
1	25	1:2	0.04	4.2
2	12.5	1:4	0.06	7..3
3	6.25	1:8	0.19	20.0
4	3.12	1:16	0.31	32.6
5	1.56	1:32	0.47	49.4
6	Control	-	0.95	100

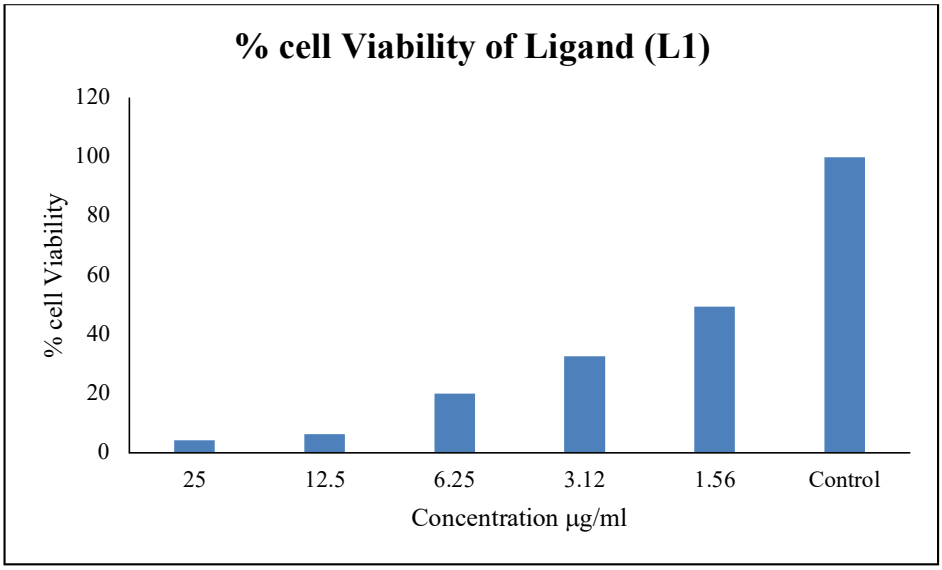


Figure 2 . Percentage of cell viability and death analytsis in duplicate study model for Ligand

Table 3.Shows the percentage of cell death viability of the ligand and the metal complexes

Sl.No	compound	% of cell viability
1	Ligand	32.6
2	Copper	27.3
3	vanadium	41
4	control	27.3

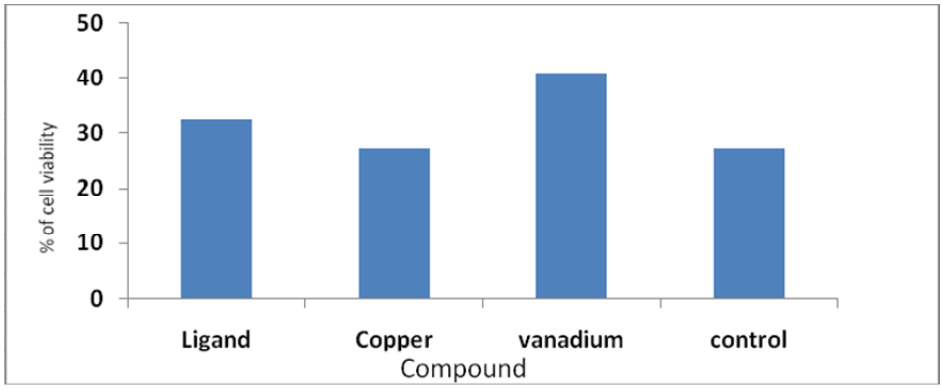


Figure 3.shows the variation of cell death viability of ligand and the metal complexes

Table 4.Shows the values of IC 50 of the ligand and the metal complexes

Sl.No	Compound	IC50
1	Ligand	7.3
2	Copper	6.3
3	vanadium	15.7
4	control	3.1

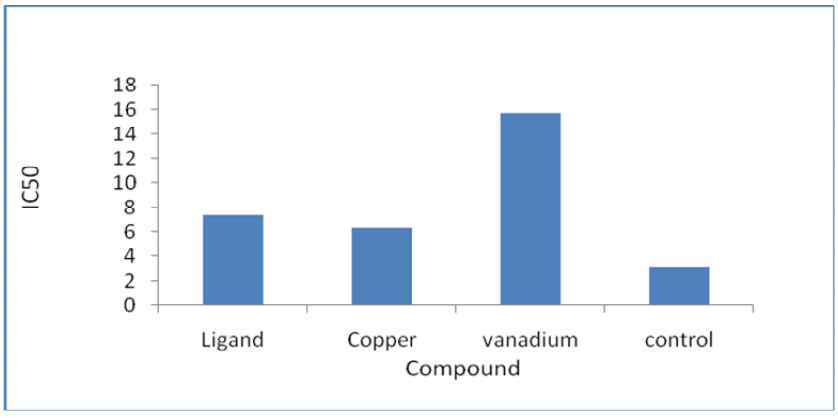


Figure 4. Shows the variation of IC50 values of ligand and the metal complexes

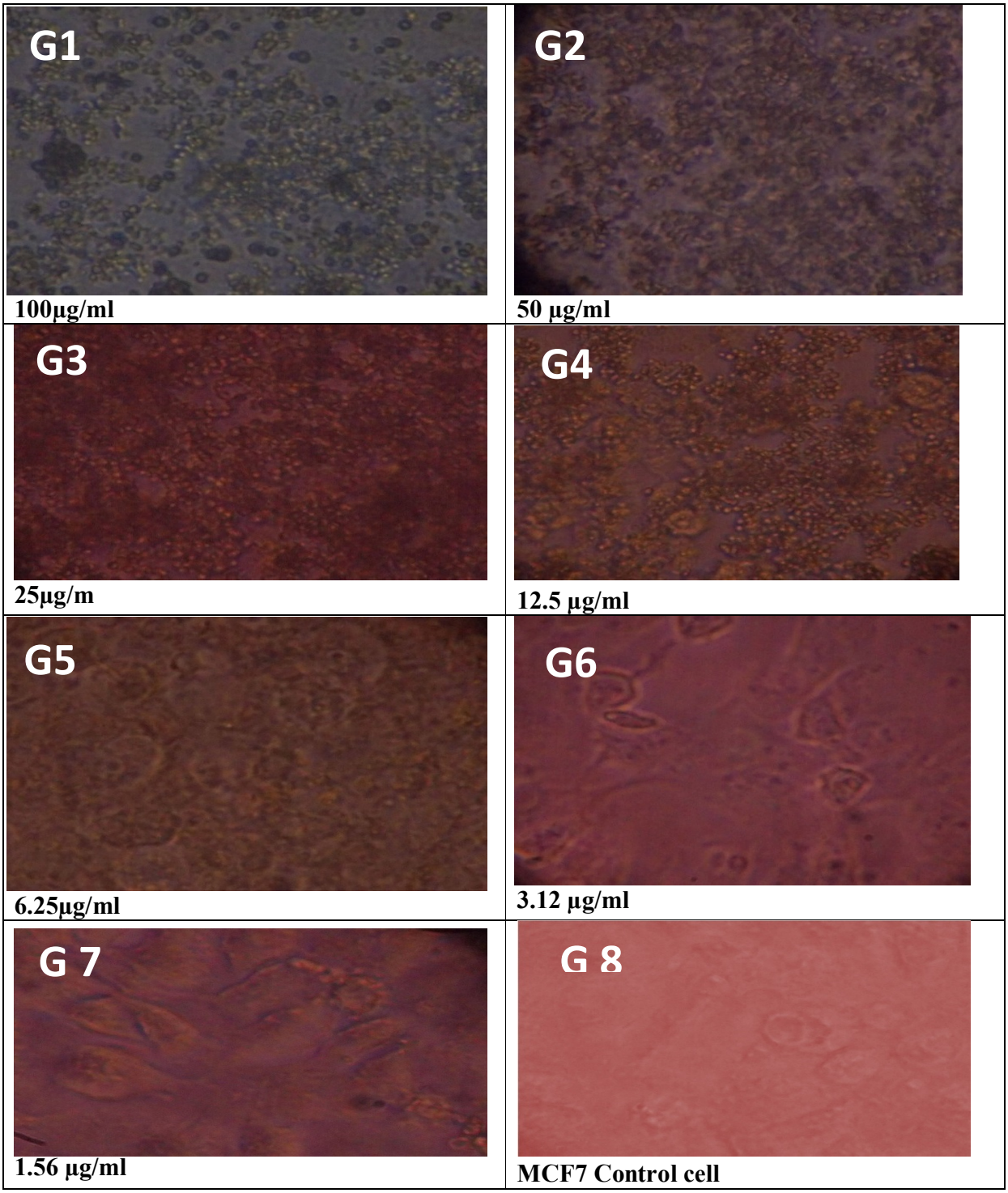


Figure 5. Images of (G1-G8) Percentage of cell viability and death analysis in duplicate study model for Copper Complex.

Table 5. Percentage of cell viability and death analysis in duplicate study model for copper complex

S.No.	Concentration µg/ml	Dilution	Absorbance 540nm	% cell Viability
1	25	1:2	0.4	4.2
2	12.5	1:4	0.7	6.3
3	6.25	1:8	0.17	17.8
4	3.12	1:16	0.26	27.3
5	1.56	1:32	0.48	50.5
6	Control	-	0.95	100

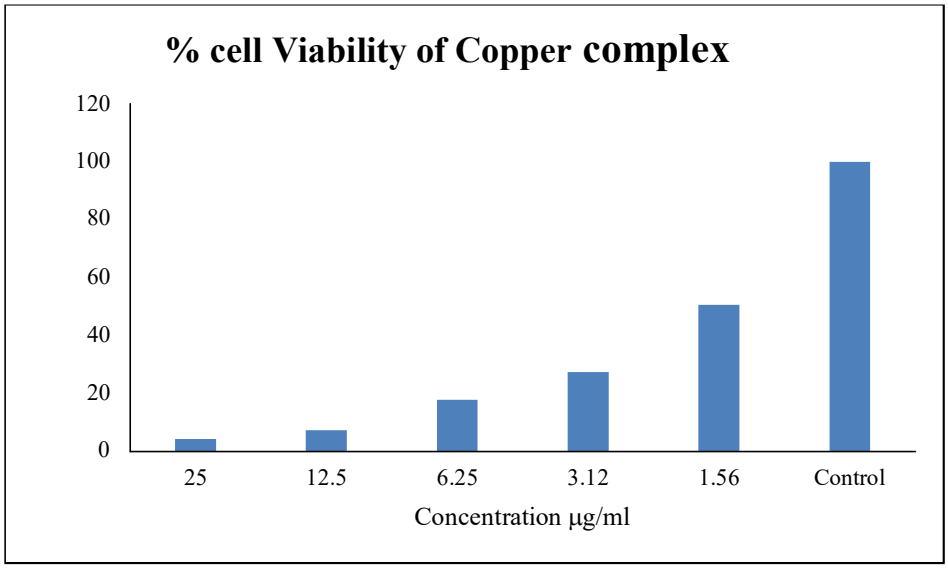


Figure: 6 Percentage of cell viability and death analysis in duplicate study model for their copper complex.

Table 6. Percentage of cell viability and death analysis in duplicate study model for vanadium complex

S.No.	Concentration µg/ml	Dilution	Absorbance 540nm	% cell Viability
1	25	1:2	0.05	5.2
2	12.5	1:4	0.15	15.7
3	6.25	1:8	0.22	23.1
4	3.12	1:16	0.39	41.0
5	1.56	1:32	0.49	51.5
6	Control	-	0.95	100

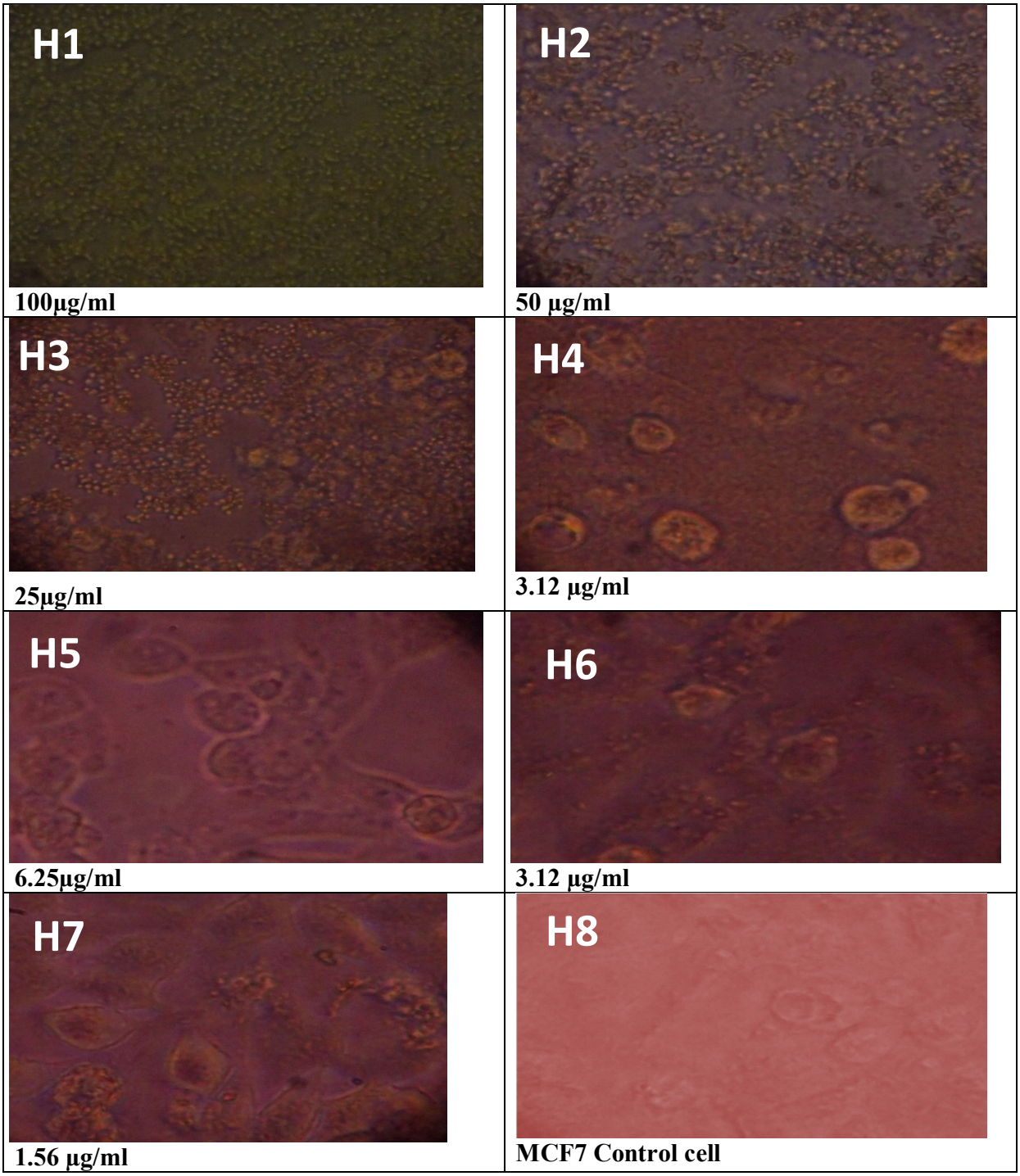


Figure 7. Images of (H1-H8) Percentage of cell viability and death analysis in duplicate study model for vanadium complex

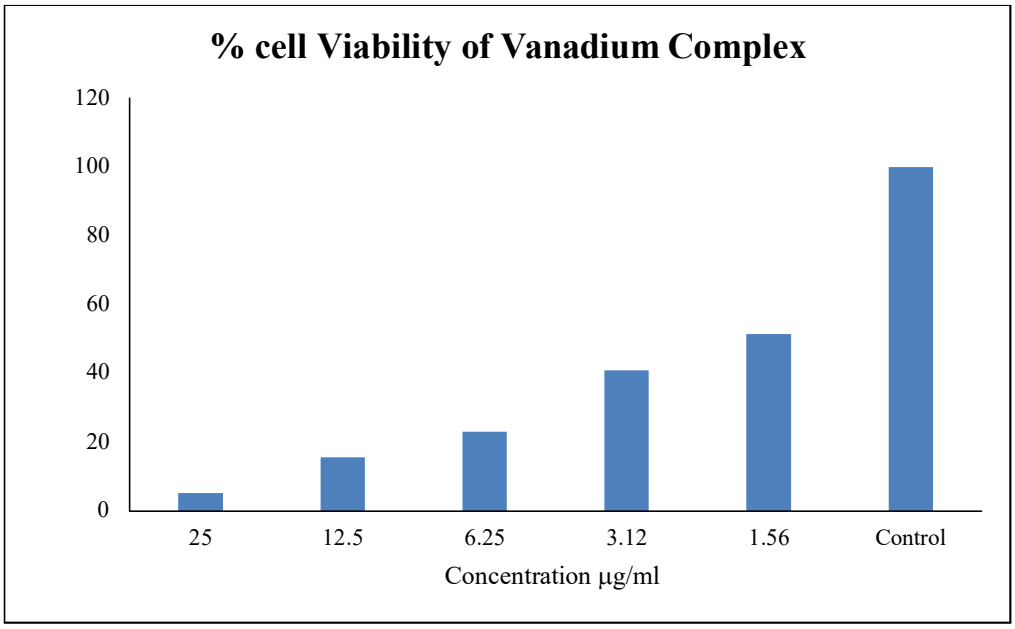
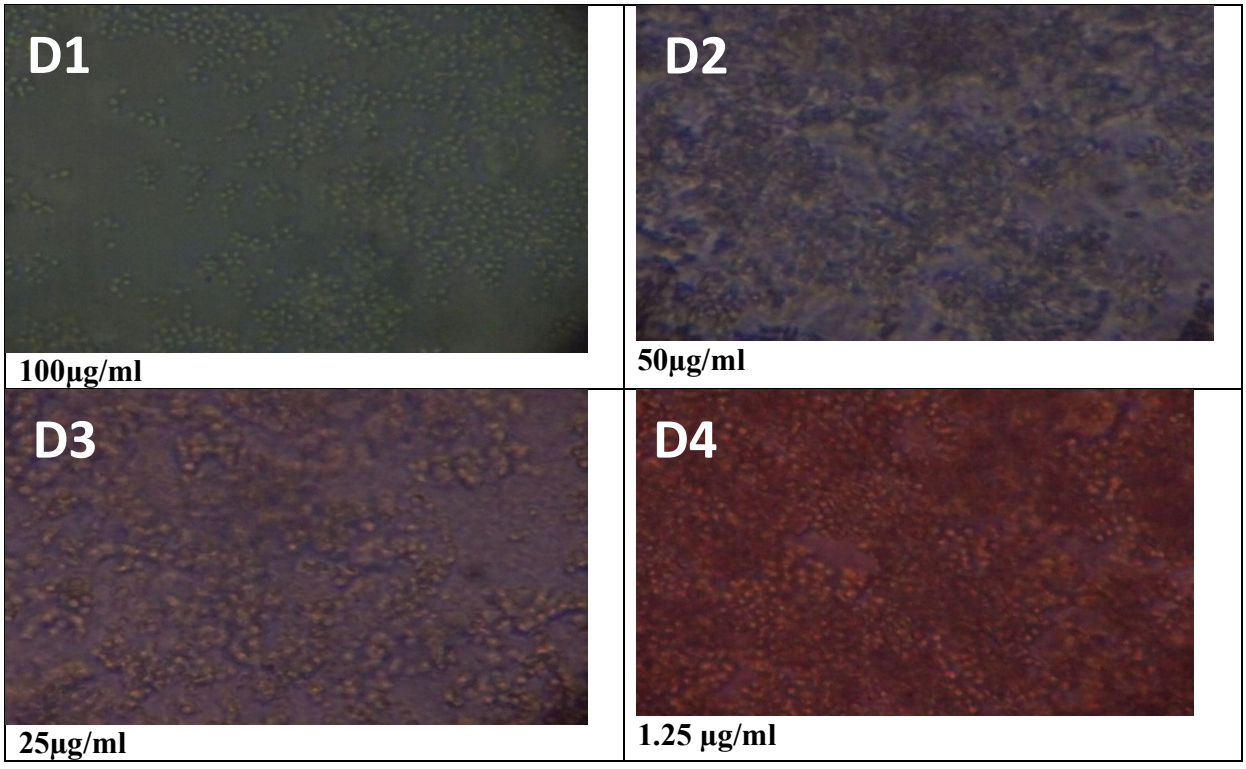


Figure 8.Percentage of cell viability and death analysis in duplicate study model for their Vanadium complex.



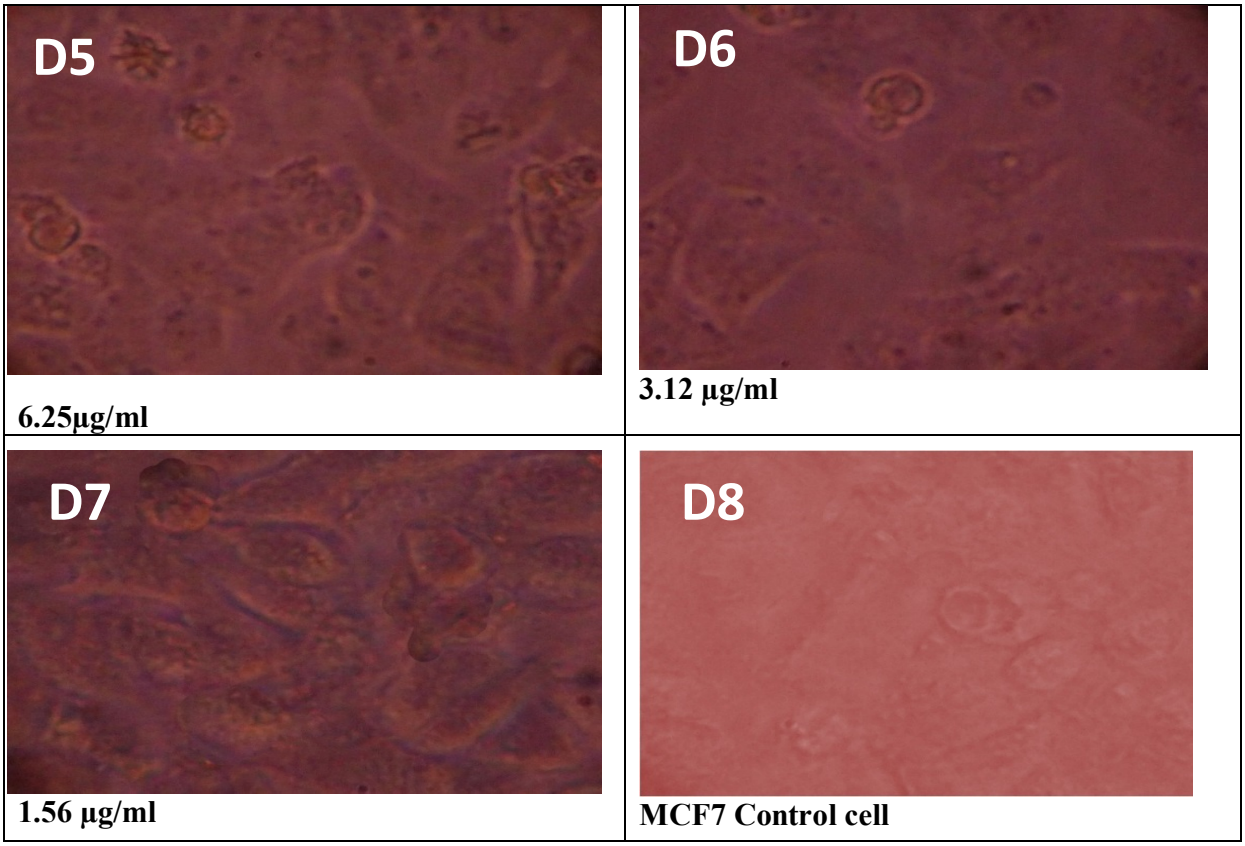


Figure 9. Images of (D1-D8) Percentage of cell viability and death analysis in duplicate study model for Gonad complex

Table 6. Percentage of cell viability and death analysis in duplicate study model for vanadium complex

S.No.	Concentration µg/ml	Dilution	Absorbance 540nm	% cell Viability
1	25	1:2	0.03	3.1
2	12.5	1:4	0.17	17.8
3	6.25	1:8	0.26	27.3
4	3.12	1:16	0.50	52.6
5	Control	1:32	0.95	100

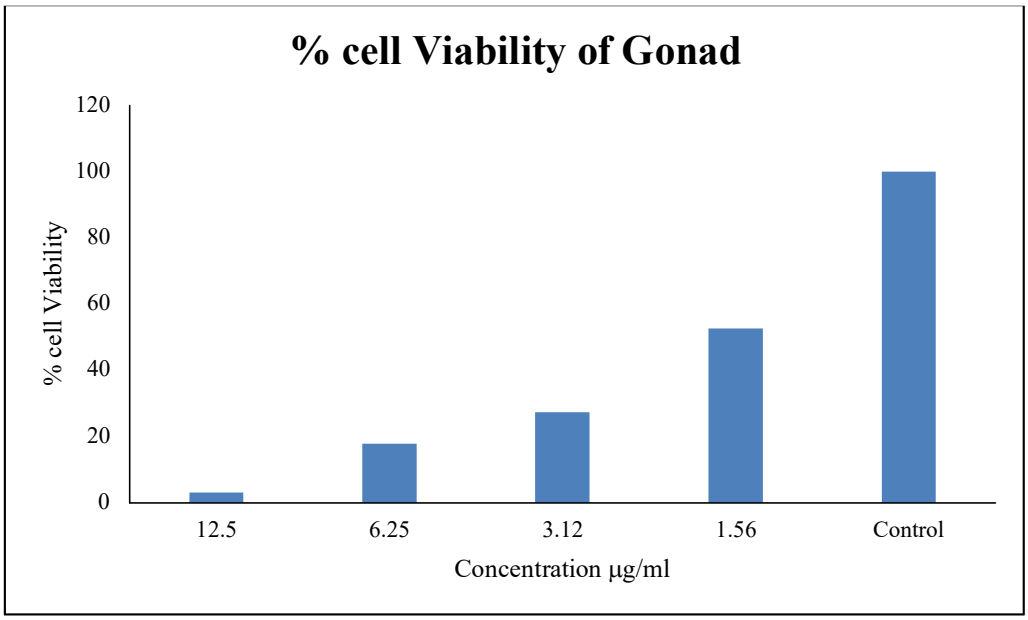


Figure 10. Percentage of cell viability and death analysis in duplicate study model for their Gonad.

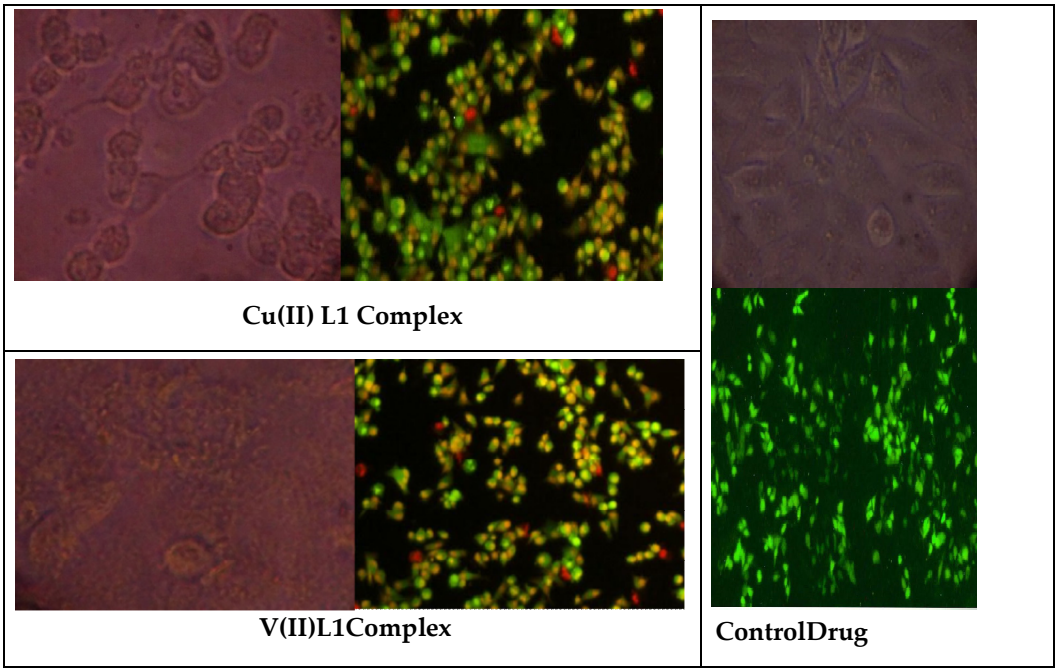


Figure 11 . Images of Fluorescent Staining Studies of Ligand , copper complex and control cells.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

A Study on Diversity of Lichen in Jashipur and It's Adjoining Area of Mayurbhanj, Odisha, India.

Akshaya Kumar Sahoo and Srimay Pradhan*

Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 07 Feb 2020 Revised:11 Apr 2020 Accepted: 14 May 2020

***Address for Correspondence**
Srimay Pradhan
Department of Botany,
Centurion University of Technology and Management,
Odisha, India.
Email: srimaypradhan@gmail.com

ABSTRACT

The present field study in Jashipur and their adjoining areas which reveal a total of 19 species belongs to 15 genera and 7 family collected from 4 locations (Badadaposi, Badsole, Digposi, Aktapal) of Jashipur area during survey. Trypetheliaceae was the dominant family represented by 6 species belongs to 4 genera, followed by graphidaceae which constitute 3 species belongs to 2 genera. The study area showed dominance of crustose lichens, exclusively represented by corticolous taxa only. In the study area, the dominant trees like *Shorea robusta* Gaertn. followed by *Mangifera indica* L. and *Simarouba glauca* DC. provided suitable conditions for luxuriant growth of lichens. Out of 19 species, 16 lichen species tightly adhere to the tree trunk forming crust (crustose lichen) and producing secondary metabolites were dominated on almost all the sites while only three leafy (foliose lichen) species were recorded. The luxuriant growth of pyrenocarpous lichens within a small area clearly indicates that the region is abode of rich lichen diversity and further intensive and extensive exploration may add more species to the lichen flora of the state of Odisha.

Keywords: Jashipur, Diversity, Odisha, India

INTRODUCTION

Lichen are symbiotic association of algae and fungi. The diversity of lichen is widely spread. During last few decades urbanization, industrialization and heavy vehicle activity of our state increase day by day, as a result in deterioration of our environment quality. Lichen has been seen that it maintains the ecosystem as pollution indicator. When the fungi, algae, or cyanobacteria have the potential to engage with other micro-organism in a functioning system that may involve as an even more complex composite organism (Casano et al. 2010). The lichens are mostly found in

temperate, tropical, and also sandy places of India. Due to the peculiar and physiological structure of lichen, it tolerates extreme abiotic stress like cold, and drought condition (Satya et al. 2013). Lichens are mostly found in colonial form. It may occur on the stem, bark, and some branches. Lichens are the vital components of the ecosystem, in terms of substrata, shelter, food, nutrient cycles and succession (Gradstein, 1992).

India is one of the mega-diversity countries. About 2303 species are reported in the temperate, alpine, subtropical and Tropical regions of India. This 2303 species belongs to 305 genera and 74 families (Singh and Sinha, 2010). In Odisha lichen diversity was studied in different districts, which includes Jharsuguda district (Upreti 1996), Bhitarkanika National park (Panda et al. 2017), Kapilash Reserve forest (Nayak et al. 2015) and Sun Temple of Konark (Nayak et al. 2017). The lichen taxa enumerated in earlier studies were compiled by (Nayak et al. 2016), reporting occurrence of 252 species belonging to 81 genera and 35 families. (Nayak et al. 2018), further reported the occurrence of bio-deteriorating lichen species belonging to genera of *Lecidella*, *Buellia*, *Lecanora*and *Lepraria*, growing luxuriantly on historical monuments of Ratnagiri and Udayagiri in Jajpur district.

MATERIALS AND METHODS

Study site

Identification of collected lichen species has done based on morphology as well as anatomical characters taking into account. Identification of lichens from morphology was done by their structure, presence or absence of vegetative and reproductive parts, and colour and texture of thallus. Cross section of each lichen sample was prepared on slide and observed under Nikon Eclipse- E400 Stereo Microscope to study their structures. Inner section of lichen species was covered with hyphae and at the middle of them algal cells was sandwiched.

Method

More than 120 lichen specimens were collected from Mayurbhanj area. The specimens were identified morphologically, anatomically and chemistry following the available literature Awasthi (1991, 2000), Divakar & Upreti (2005), Nayaka (2004) and Joshi (2008). The colour tests were carried out with aqueous potassium hydroxide (K), Steiner`s stable paraphenylenediamine (PD) and aqueous calcium hypochlorite (C). The identified samples deposited in the lichen herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG).

RESULTS AND DISCUSSION

A total of 19 species belongs to 15 genera and 8 family are reported from 4 major location (Badadaposi, Badsole, Digposi, Aktapal) of Jashipur area (Table-1). Trypetheliaceae, Garphidaceae, Caliciaceae are the dominant family. Trypetheliaceae represented by 4 species, belongs to 4 genera, followed by Graphidaceae which represented by 4 species belongs to 2 genera, Caliciaceae represented by 4 species and 3 genera, Ramalinaceae represented by 2 species 2 genera, Arthoniaceae represented by 2 species and 1 genera, Letroutiaceae represented by 1 species and 1genera, Lecanoraceae represented by 1 species and 1 genera, Parmeliaceae represented by 1 species and 1 genera. From Figure-2. it reveals that Trypetheliaceae, Caliciaceae, Graphidaceae are most dominant family among all family, each family contain 4 species i.e. Trypetheliaceae family contain species *Astrotheliumindicum* (Upreti & A. Singh) Aptroot & Lucking, *Nigrovothelium bullatum* Lucking, Upreti & Lumbsch, *Nigrovothelium tropicum* (Ach.) Lucking, M.P. Nelsen & Aptroot, *Trypethelium eluteriae* Spreng, this family contain all crustose lichen. Caliciaceae family contain 2 crustose lichen and 2 foliose lichen.family contain crustose lichen species *Cratiria obscurior* (Stirt.) Marbach & Kalb, *Amandinea submontana* Marbach, foliose lichen species *Dirinaria aegialita* (Afz.) B.J. Moore, *Pyxine cocoes* (Stirt) D.D. Awasthi. Graphidaceae family contain 4 crustose lichen species the species are *Graphis filiformis* Adaw. & Makhija, *Dyplolabia afzeli* (Ach.) A. Massal, *Sarcographa maculosa* Zahlbr, *Pyxine cocoes* (Stirt) D.D. Awasthi. Ramalinaceae and Arthoniaceae family is the second highest dominant family, each family contain 2 species. *Bacidia convexula* (Mull. Arg.) Zahlbr, *Bacidia incongruens* (Stirton) Zahlbr beongs to family Ramalinaceae and *Tylophoron*

nidulans Stirt, and *Tylophoron protrudens* Nyl present in the family Arthoniaceae. Letrouitiaceae, family contain 1 species, Lecanoraceae family contain 1 species and Parmeliaceae family contain 1 species.

CONCLUSION

It is important to understand the pattens of abundance and diversity distribution of lichens inorder to determine the level of disterbances and antropogenic interferences within a ecosystem. The lichen communities are not only affected by the various abiotic factors such as tempreture, rainfall and elevation but seem to be greatly influnced by the local land practices such as cattle grazing and the movement and for aging patterns of the wild herbivores. The present knowledge remains far from understanding the processes giving rise to these patterns. Further research is therefore needed to understand the realationship between lichen species and different types of microclimate, to correlate lichen distribution pattern and community structure with the different environmental stresses and to list some sensitive and tolerant species that can be used for rapid assessment of change of environmental condition. However the present study reveals that area of Jashipur is comprises of high diversity of lichen due to its rich forest canopy and rich diversity. From the present study I have collected 120 samples from different location. A total of 19 species belongs to 15 genera and 8 family are reported from 4 major location (Badadaposi, Badsole, Digposi, Aktapal) of Jashipur area (Table-1). Trypetheliaceae, Garphidaceae, Caliciaceae are the dominant family. Trypetheliaceae represented by 4 species belongs to 4 genera, followed by Graphidaceae4 species belongs to 2 genera Caliciaceaebelongs to 4 species and 3 genera, Ramalinaceae belongs to 2 species 2 genera, Arthoniaceae belongs to 2 species and 1 genera, Letroutiaceae belongs to 1 species and 1genera, Lecanoraceae belongs to 1 species and 1 genus, Parmeliaceae belongs to 1 species.

ACKNOWLEDGEMENTS

The authors are thankful to the authorities of Centurion University of Technology and Management, Odisha, India for providing lab facilities and other essential arrangement during the research investigation.

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Table 1: Species list in different area of Jashipur, Mayurbhanj, Odisha

SERIAL NUMBER	LICHEN TAXA	FAMILY	STUDY AREAS			
			A	B	C	D
CRUSTOSE						
1	*Astrothelium indicum* (Upreti & A. Singh) Aptroot & Lucking.	Trypetheliaceae	+	-	-	-
2	*Nigrovothelium bullatum* Lucking, Upreti & Lumbsch.	Trypetheliaceae	+	-	+	+
3	*Nigrovothelium tropicum* (Ach.) Lucking, M.P. Nelsen & Aptroot.	Trypetheliaceae	-	-	+	-
4	T*rypethelium eluteriae* Spreng.	Trypetheliaceae	+	-	+	-
5	*Graphis filiformis* Adaw. & Makhija	Graphidaceae	-	-	-	+
6	*Dyplolabia afzeli* (Ach.) A. Massal.	Graphidaceae	-	+	-	-
7	*Sarcographa maculosa* Zahlbr.	Graphidaceae	+	-	+	-
8	*Graphis scripta* (L) Ach.	Graphidaceae	-	-	-	+
9	*Bacidiaconvexula* (Mull. Arg.) Zahlbr.	Ramalinaceae	+	-	+	+
10	*Bacidia incongruens* (Stirton) Zahlbr.	Ramalinaceae	-	-	+	-
11	*Tylophoron nidulans* Stirt.	Arthoniaceae	-	+	-	-
12	*Tylophoron protrudens* Nyl	Arthoniaceae	+	-	+	+
13	*Letrouitia transgrassa* (Malme) Haf. & Bellem.	Letroutiaceae	-	-	+	-
14	*Lacanora achroa* Nyl.	Lecanoraceae	-	+	-	-
15	*Cratiria obscurior* (Stirt.) Marbach & Kalb.	Caliciaceae	+	-	-	+
16	*Amandinea submontana* Marbach	Caliciaceae	+	+	-	+
FOLIOSE						
17	*Dirinaria aegialita* (Afz.) B.J. Moore	Caliciaceae	-	+	+	-
18	*Pyxine cocoes* (Stirt) D.D. Awasthi.	Caliciaceae	-	+	-	+
19	*Parmotrema tinctorum* (Despr. ex. Nyl.) Hale	Parmeliaceae	+	+	-	+

Note: + Present, - Absent, A- Badadaposi, B- Badsole, C- Digposi, D- Aktapal

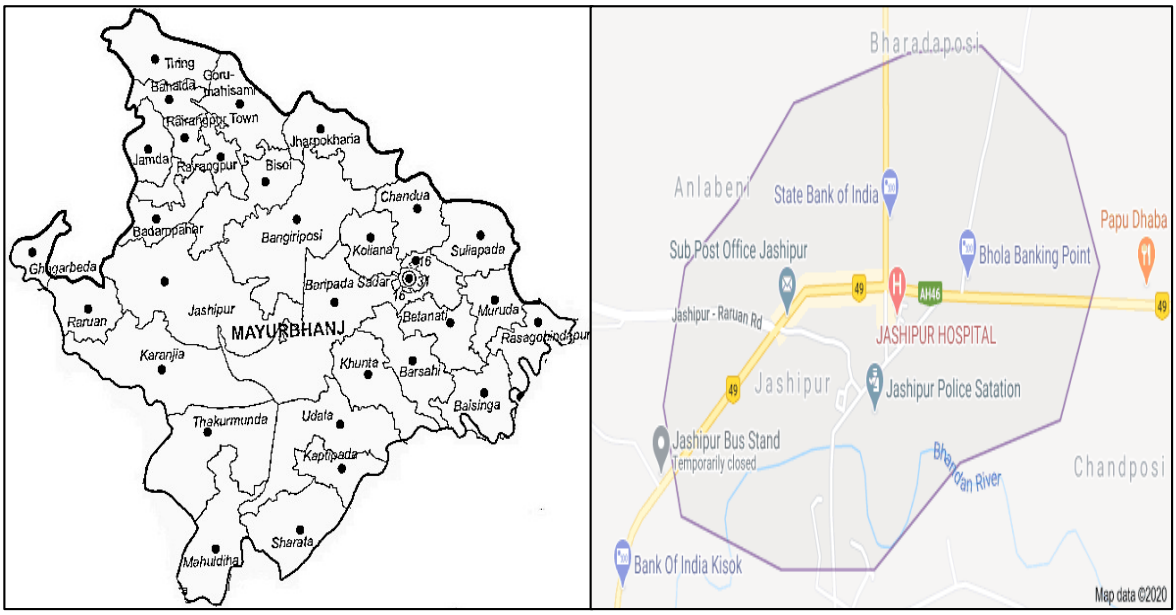

Figure 1: Study site

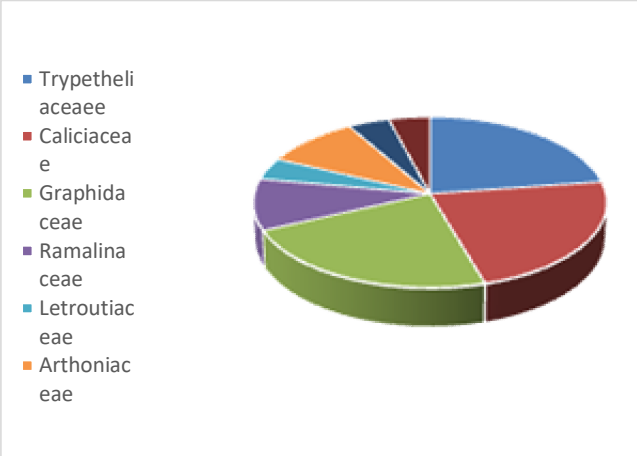

Figure 2: Species abundance in different family

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

REVIEW ARTICLE

A Comprehensive Review on the Synthesis and Application of ZnO based Nanocomposites

Amrita Palei and Dojalisa Sahu*

School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 05 Feb 2020 Revised:09 Apr 2020 Accepted: 11 May 2020

***Address for Correspondence**
Dojalisa Sahu
School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
Email: dojalisa.sahu@gmail.com

ABSTRACT

Nanotechnology has been emerged as a major field of research having application in all fields of technology to make human effort easier. The amazing potential of nanomaterials has made it initiate technologies which deliver to wide spectrum of application ranging from medicine to food processing. Nanocomposites are multiphase soild materials having size in the range of 1 - 100 nm. These are new class of materials showing novel properties which are significantly different from the properties of individual components forming the composite. Owing to its exclusive physical & chemical properties, nano ZnO is regarded as a multifunctional material. Although, ZnO shows interesting properties due to its wide direct band gap and high excitonic binding energy, nanocomposites of ZnO with other metal oxides such as; TiO_2, SnO_2, MnO_2, Fe_2O_3 have shown new and extraordinary structural, optical, electrical, magnetic and mechanical attributes. In this short review, we have studied many of the latest research papers and present the essentially significant methods of preparation of ZnO based nanocomposites in terms of physical and chemical methods. The applications of such nanocomposites such as photocatalytic and antibacterial efficiency have been studied and discussed. The current development in the particular area of fabrication and applications of ZnO based nanocomposites has gained value attention of many researchers

Keywords: Zinc oxide, nanocomposite, antibacterial activity, Photocatalytic property

INTRODUCTION

Nanotechnology is a multidisciplinary as well as an interdisciplinary area of inquisition and function. Due to its wide spectrum of application in diverse field such as irrigation, energy, medication, milieu, textile, transportation, water treatment etc., helps it to emerge as a progressive science in this modern epoch [1]. In a broad sense, they can

be defined as the science and engineering involved in the design, synthesis, characterization, and application of materials and devices whose smallest functional organization in at least one dimension is on the manometer scale, ranging from a few to several hundred nanometres [2]. The concept of nano technology was introduced by Richard Feynman in 1959, when he gave a talk called "there is plenty of room at the bottom". Nanomaterial is sought to be critical constituent of nanotechnology due to its ability to exhibit enhanced characteristics at small dimension. Nanoparticles are considered as basic component of nanomaterials which show huge potential for various uses owing to its incomparable surface properties [3, 4]. Nanoparticles are particles whose size ranges between 1 and 100 nanometer. Nanoparticles parade exceptional physical, chemical and biological properties due to bigger surface area to volume ratio, higher strength in chemical process and increased mechanical strength [5-7]. Nanocomposites can be defined as multicomponent materials comprising multiple different (nongaseous) phase domains in which at least one type of phase domain is a continuous phase and in which at least one of the phases has atleast one dimension of the order of nanometers [8]. Nanocomposite possessing uniqueness in design possibilities and unusual combination of property which craft it as bigger performance material regarded as conventional composite. Many nanocomposites including zinc oxide (ZnO), stannous oxide (SnO_2) have exposed to have good photocatalytic and antibacterial properties. Metal oxide based nanostructured semiconductor got maximum attention due to Morphological, functional, bio-compatible, non-toxic and catalytic properties.

ZnO is n-type metal oxide semiconductor. ZnO nanoparticle took great interest because their synthesize process are easy, safe and inexpensive. Zinc oxide, with its unique physical and chemical properties, such as high chemical stability, high electrochemical coupling coefficient, broad range of radiation absorption and high photostability, is a multifunctional material [9, 10]. Zinc oxide act as a semiconductor of group II-VI, whose covalence present between boundary of ionic and covalent semiconductor. Zinc oxide nano particle exhibt excellent semiconducting properties with broad energy band (3.37eV), large exciton binding energy (60 meV) are high catalytic activity, optic, UV filtering properties, anti inflammatory & wound healing properties Owing to its UV filtering properties, it has been widely used in cosmetics like sunscreen lotion [11, 12]. It has an enormous range of application in biomedical field such as delivery of drug, anticancer, antidiabetic, antibacterial, antifungal properties. ZnO nano particles show piezo & pyroelectric properties. ZnO nano particles considered as significant material in the ceramic industry due to its hardness, rigidity, piezoelectric constant while it took important position in biomedicine & pro ecological system having low toxicity & biodegradability property. Nano metric zinc oxide arises from array of structure. It can occur in one dimensional, two dimensional, three dimensional structures. One dimensional structure consists of enormous group comprising needles, helixes, nano rods, ribbons, belts, wires & combs. Zinc oxide take place in two dimensional structures like nano pellets, nano sheets or nano plates. The three dimensional structure of zinc oxide constitute snow flakes, dandelion, flower etc. [11-34]. ZnO can be synthesized by using different methods such as vapour deposition, hydrothermal synthesis, the sol–gel process, micriemulsion precipitation & mechanochemial process which helps in possibility of obtaining particles with different shape, size & spatial structures. Stannous oxide seems to be a latent photo catalyst for treating waste water containing dye owing to its non toxicity, low cost of synthesis method & chemical stability. The stannous oxide has a band gap energy value is of 3.6 eV [36] and it is and n-type semi conductor. It is widely applied in the field of photocatalyst.

The industrial waste water treatment containing organic pollutant has become matter of great concern of current years [33]. The organic chemicals in waste water undergo photo degradation by irradiation of photo catalyst semiconductor has proved to be novel path. The two factors that influence photo catalytic activity are: (1) photo-generation of electrons (e^-) and holes (h^+) pair; and (2) the effectual ability to separate the e−/h+ pairs [34, 35]. Zinc oxide is a versatile material broadly studied as photocatalyst to decompose dissipate stream comprising organic chemical as it is low cost & has good optoelectronic and &catalytic properties. While irradiating UV light on the zinc oxide, it bring about transition of electron from valence band to conduction band, therefore creating electrons in the conduction band &holes on the valence band. The charge species are very unstable quickly which leads to rapid recombination of generated electrons &holes. To overcome above disadvantage, a lot of coupled semiconductor system [37, 38] has identified as photocatalyst such as ZnO-SnO_2, ZnO-TiO_2 etc. ZnO proved to be good electon

acceptor than TiO_2 due to more positive conduction band. So it is a good candidature for coupling with ZnO which effectively enhance photocatalytic efficiency and reduces photo generated electron-hole pair recombination.The photocatalytic performance of coupled ZnO-SnO_2 semiconductor is better than compared to pure ZnO or pure SnO_2 nanocomposite. The combination of ZnO and SnO_2 nanocomposite is well explored in the industrial and medical field.

SYNTHESIS PROCEDURE OF NANOCOMPOSITE

There is a vast research concern in the area of nanotechnology to develop an expedient method for the production of nanomaterials over an array of sizes and chemical composition. As far as structure is concern, the processing of nano particles or nano powders into shape of bulkiness by retaining nano sized properties has become exigent price even if combination & association of nano particles provide complementary tools for nanotechnology [39]. The synthesis & strategy of congregation of nanoparticles mainly contain starting material from different phases such as liquid, solid or gas by occuping chemical & deposition of physical approaches or rely on either chemical reactivity or physical compaction to incorporate the nanostructure construction block within the final material structure [40]. The synthesis procedure for nanometal & metal oxide substance involves significant synthetic initiative. Even though a balanced method is adopted to synthesize nanoparticle, there is persistently an element of concurrence [41, 42]. In the past few decades, array of nanomaterials are synthesized but still plentiful synthesis mode are either being developed or modified to improve the properties & to diminish cost of production. There were various techniques for the synthesis & fabrication of nano structures which are classified under 2 general approaches named as top – down & bottom- up.

Top-down approaches

It is the destructive method used for the reduction of a bulk material into nanometric scale particle [43]. The large no. of nano structures used in this approach & physical force come into action through the self assemblage process by combining basic units into larger stable structures. Some of the examples are mechanical milling, laser ablation, nanolithography, sputtering etc.

Bottom–up approaches

It is the constructive method used to assemble up of material atom to clusters to nanoparticles [43]. Some of the examples are sol-gel, chemical vaporisation method, spinning, pyrolysis etc. These synthesis procedures are further classified into three categories namely physical mode, chemical modes & bio - assisted method.

Physical synthesis method

In this method the amalgamation of nanoparticles initialized by using bulk counterpart that leaches analytically bit-after-bit leading to the generation of fine nanoparticles. Physical methods pertaining to mechanical pressure, high energy radiation, thermal energy or electrical energy to cause material abrasion, melting, evaporation or condensation to create nanoparticles. These techniques are generally drive on top–down approach & has advantage of generating uniform mono disperse nanoparticles & free of solvent contamination , simultaneously huge waste are formed during synthesis which make it less economical. Some of the most habitually used physical technique to create nanoparticles are high energy ball milling , laser ablation, electron spraying, inert gas condensation, physical vapour deposition, etc [44, 45].

High energy ball milling technique

In the early days, nanomaterials are prepared by a plain method named ball milling. It was first introduced by John Benjamin in the year 1970. In this process the K.E is transferred from moving balls to the milled materials which have broken their chemical bond & bursting of milled substances into minor pieces. Sometimes this process used to stand condition of very high local temperature & pressure & so it is known as mechanochemical synthesis process [46]. Now- a-days, high energy ball milling with surfactant is used to be proficient method for the manufacture of

nanoparticle with exact size & definite surface characteristics. Surfactants are the surface active agents containing both hydrophobic & hydrophilic properties & can be classified as anionic, cationic, zwitter ionic & non ionic depending upon the surface charge characteristics of their hydrophilic group. The adsorption of surfactant molecules on material surface produce electrostatic forces which alleviate the milling particles & seduces the uncontrolled fracturing of particles. The surface energy of the newly created nanoparticles was lowered by surfactant & long range capillary force is introduced which lower the energy for crack propagation.

Electron beam lithography

Lithography is the process of printing a required shape or on a light sensitive material that selectively removes a portion of material to create the desired shape structures. It is the process to transfer a pattern from one media to other & constitute electron irradiation of a surface that is covered with a resist sensitive is by means of a focused electron beam. This process has ability to generate submicron structures constituting 3 steps: relevance of sensitive material, growth of the resist & sample outline transfer [47]. In corollary , the shape & characteristic of the electron beam , the energy & intensity of electrons , the molecular structure & electron solid interaction from structure design to the beam deflater was found in terms of dimension, feature definition etc.

Inert gas condensation synthesis technique

This technique is developed by adopting high pressure & molecular weight leads to enhancement in mean particle size. So, this procedure is used to fabricate ample array of nanomaterial in commercial scale. Another process is employed known as Chemical Vapour Condensation on which chemical reaction take place in opposed direction to former one by keeping organic metallic precursor in carrier gas [48].

Physical vapour deposition method

It is a series of processes mostly used to fabricate nanoparticles & to set down thin layers of materials characteristically in the range of few nanometers to several micrometers [49, 50]. It is an eco-friendly vaccum deposition system comprising of 3 elementary steps:The material is vaporised to form a solid source .The vaporized material undergo transportation.The growth & nucleation to create thin films & nanoparticles.The frequently used PVD method are sputtering, electron beam evaporation, pulsed laser deposition, vaccum arc etc.

Laser pyrolysis procedure

This method is classified as vapour phase synthesis route for the generation of huge no. of distinguished oxide & composites. In this novel way, the fabrication of nanoparticle begins when an abundant degree of super saturation of condensable products reached vapour phase [51, 52].

Chemical synthesis method

These technique follow bottom – up approaches to prepare nanoparticles & constitute sol-gel method, micro-emulsion technique, hydrothermal synthesis, polyol synthesis, microwave assisted synthesis etc [53].

Sol-gel process

Sol-gel is a slant for generating minute particles in material chemistry. The sol is a colloidal solution of solids suspended in a liquid phase and the gel is a solid macromolecule submerged in a solvent It is the generally favoured bottom-up method used to synthesize metal oxide owing to its simplicity,cost-effective feasibility & low temperature process which help to bring control over the composition of the product. In this process, initially the monomers are converted into sol which become fore runner for the gel formation. It is a wet chemical method constituting a chemical solution which acts as a pioneer for an incorporated system of distinct particle. Metal alkoxides & chlorides are generally used as precursor in sol-gel process. Rare earth element & organic dyes with little proportion are used as dopant in sol whose constituency is maintined in final product. Sol- gel is made up of two key reactions: hydrolysis of alcoholic group & its condensation. The starting material is diffused in a host fluid with the help of

shaking, stirring or sonication & resulting system comprise a liquid & a solid phase. The different methods like sedimentation, filtration, & centrifugation are used in phase separation to recuperate nanoparticles followed up by removal of moisture by drying. Sol–gel synthesis involves steps like mixing, casting, gelation, aging, drying& densification [54-55].

Hydrothermal routes

It is the facile & fast process for the fabrication of nano particles. This technique is used to generate metal oxide, iron oxide & lithium ion phosphate nanoparticles by controlling the characterstics of particle with varing the properties of near or super critical water at the condition of different pressure & temperature. This method comes into action in two types of system such as batch hydrothermal or continuous hydrothermal process. The earlier system has capability to hold required ratio phases while last one allows an elevated rate of reaction to be achieved at a short span of time. This method has an advantage of fabricating enormous number of nanoparticles having optimised size, morphology, composition & surface chemistry which is reasonably in expensive [56].

Polyol method

The polyol route belongs to production in liquid phase in which ethylene glycol act as a simplest monomer to create nanoparticle. The significant characteristics of the polyol are water equivalent solubility which helps in using simple, low cost metal salt as precursors. By comparing water solubility, the lower polarity is compensated by chelating properties. The chelating effect of polyol however is advantageous in controlling particle nucleation, particle growth, agglomeration of nanoparticles & act as colloidal stabilizer. This process involve synthesis of metal containing compound using polyol as the reaction medium which plays a role of solvent, reducing agent & simultaneously act as protecting agent [57]. This chemical technique was used to synthesise wide array of metal nanoparticle, metal oxide nanoparticle, nanoscale metal chalcogenides & non-metal main group elements.

Solvothermal method

Solvothermal synthesis technique is considered as versatile method due to its control over morphology of definite nanomaterials. The nanoparticle is fabricated by employing this technique in sealed container where increase in autogenously pressure raises the temperature more than boiling point of solvent by comparing unexpected reaction with classical synthesis route in terms of solubility & reactivity of reagent promoted by increase in temperature &pressure. This method is developed to synthesize conventional advanced material & widely used in waste treatment [58]

Microwave assisted synthesis technique

Microwave is defined as electromagnetic waves as vaccum wavelength ranging between 0.1 to 100 nm or equivalently with frequencies between 0.3 to 300 GHz. By microwave heating the energy is directly supplied to the sample rather than via media. In current decades this synthesis technique has achieved interest due to its direct energy supply characterstics. Dielectric heating become the basis of microwave heating which means permanent dipole moment is shown by molecule will align to applied to electromagnetic field ensuing rotation. Friction &collision in the molecule.This technique exhibt non-quantum mechanical effect & achieved volumetric heating of sample which made it a convenient method for the synthesis of huge number of nanocomposite [59].

Bio- assisted methods

This synthesis procedure is also named as biosynthesis or green synthesis as it adopts an eco-kindly, low-toxic, cost-effective & proficient protocol to prepare nanoparticles. This technique employ biological system like bacteria fungi, yeast, viruses, plant extract etc to fabricate metal & metal oxide nanoparticles [60]. This process is aptly is divided into three categories:

i) Biogenic synthesis using micro-organism

ii) Biogenic synthesis using bio-molecule as templates

iii) Biogenic synthesis using plant extracts

APPLICATIONS OF NANOCOMPOSITE

In particular, zinc, gold, silver, tin etc nanonmaterial acquires exceptional physicochemical properties which attract ample amount of attention in biomedical applications while silver in gas sensor. Owing to its miscellaneous properties in both physical & chemical zinc oxide has broad usage in various areas. It plays asignificant role in provision of application ranging from agriculture to pharmaceuticals & from chemicals to paints [61].

Photocatalytic application

In current years, nanocatalysis is considered as promising field of science due to its high activity, selectivity & productively. In current years abundant scientific work has done in the field of photo catalysis. Many significant factor attributed to the high activity of nanocrystals comprises raised surface area to volume ratio, surface geometric effect, electronic effect and effect of quantum size. In this procedure, on the surface of the catalyst, an electron-hole pair is generated below the intensity of light by means of oxidation & reduction reactions [62-64]. An organic pollutant in the presence of catalyst can be oxidized directly by means of a photo generated holes or indirectly through a reaction with characteristic reactive groups. Zinc oxide in nanometric dimension offers better stability, crystallinity & fewer defects whose visible range is improved by adding different components [65].

Antibacterial activity

ZnO nanoparticle shows various morphologies which plays an important role in the antibacterial activity over broad array of bacterial species [66, 74]. In recent age ZnO is demonstrated as an antibacterial agent in both microscale & nanoscale range.ZnO exhibits considerable antimicrobial activities when particle size is reduced to he nanometer range, then nano-sizedZnO can interrelate with bacterial surface or with bacterial core where it enters inside the cell, & consequently exhibits diverse bactericidal mechanisms [71]. Bacteria are mainly characterized by a cell membrane, cell wall & cytoplasm. The cell wall is composed of a homogeneous peptidoglycon layer which lies outside the cell membrane. Gram–positive bacterium is made up of one cytoplasmic membrane with a multi layer of peptidoglycon layer whereas gram-negative bacterium is composed of a two-cell membrane [75]. A bactericidal is considered as an antibacterial reagent as it kills bacteria or inhibits their growth. Various techniques have been adopted for the assessment & investigation of antibacterial activity in vitro. These methods comprise of disk diffusion, broth dilution, agar dilution & microtiter plate- based method [76]. The antibacterial activities of zinc oxide nanoparticles are influenced by essential physiochemical & structural factors and finally have potential impact upon the resultant toxicity mechanism [77-79].

SYNTHESIS OF ZnO BASED NANOCOMPOSITE

Hydrothermal method

(Cao et al. 2017) has prepared cocoon like ZnO decorated graphitic carbon nitride hybrid nanocomposite by facile hydrothermal method. The synthesised sample undergo characterisation by the help of XRD, FTIR, TEM & XPS technique & results elucidate that ZnO nano crystals with hexagonal wurtzite structure posses the cocoon like configuration with distinctive length of 200-300 nm & 30-50 nm in diameter. The g-C_3N_4/ZnO shows impressive gas sensing characteristic toward ethanol & act as a promising applicant for usage in ethanol sensor [80]. ZnO & CuO have gained$_3$ attention for their potential usage in gas sensor & follow limitation of high operating temperature & poor sensitivity. (Qin et al. 2018) have synthesised CuO-ZnO/g-C_3N_4ternary composite by hydrothermal method & characterized by XRD, SEM, FTIR, UV-VIS & XPS technique. The created sample show elevated sensing properties to ethanol which was 1.34 & 2.17 times higher than of that of CuO-ZnO & CuO respectively. The improving gas sensing properties were related to the valid p-n junction of CuO-ZnO & excellent substrate of g-C_3N_4nanosheet [81].

The ZnO nanorods, sulphur powder & cadmium salts are utilized as precursors to prepare one-dimensional ZnO/CdScore/shell nanocomposite through hydrothermal route (Yonglan Luo 2018). The formation of core/shell

nanostructures was influenced by concentration, room temperature& parameter was examined. The photoluminescence data of ZnO/CdS unfold transferred of photogenerated electron from conduction band of CdS to conduction band of ZnO& leaded to the blue shift of band to band transition [82].

Liet al. 2017 has synthesized ZnO/reduced grapheme oxide by a facile one-step hydrothermal method. ZnO/reduced grapheme oxide was proved to made of flower like ZnO nanocrystals enwrapped by reduced grapheme oxide voiles. The PL analysis mechanism verified that the synergistic effect between the two constituent parts plays significant role in modulating the PL peak position& restaining the transport& transmission process [83]. In this manuscript ZnO/CeO2 heterostructure nanocomposite (HSNCs) is obtained directly from $CeCO_3OH$ & $Zn_5(Co_3)_2(OH)_6$ precursor with facile, low cost hydrothermal technique. (HSNCs) was subjected to UV-visible & flourosence emission spectroscopy and detailed investigation show larger Ce/Zn molar ratio of ZnO/CeO_2 exhibt stronger transparency in the UV-visible light region&weaker in UV-absorption. The comprehensive analysis on the optical performances of HSNCs with different cu/zn molar ratio ZnO/CeO_2-0.004 HSNCs could behave as UV absorber material and have visible transparent properties make it appropriate for personal care cosmetics (He et al. 2011).

Over past few decades polymer nanocomposite create a position in scientific community due its multifaceted, multifunctional capabilities appropriate for wide array of application & several alluring properties such as low weight, cost effective etc. In this paper (Botsi et al. 2019) reported the development of ZnO/polymethyl methacrylate (PMMA) by facile, low cost hydrothermal method. The study aims at detailed investigation on the final shape & size of the produced nano structure. The synthesized ZnO/polymethyl methacrylate (PMMA) were coated into Si-based inter digited electrode device to explore their electrical characteristics & asses their potential to be employed for sensing application [84]. (Alzouli et al. 2018) has reported the preparation of ZnO nano wire by/ graphene oxide hybrid on silicon substrate at low growth temperature by adopting low cost optimised hydrothermal process. The fabricated nano composite undergo XRD, SEM, and FTIR, UV visible analysis to investigate structural, optical& electrical characteristics. The UV visible spectra reveal that above nano composite show optimum absorption band at 380nm. ZnO nanowires by grapheme oxide exhibit optimum electrical & optical properties at the ratio of 1:5 relatively & these findings to be promising for potential enhanced UV detector & flexible opto electronic device. (Turkylmaz et al. 2017) demonstrated that hydrothermal method is applied to fabricate ZnO & metal doped ZnO (M/ZnO) (M=Ni, Mn, Fe, Ag) & characterized by XRD, FESEM, FTIR & UV visible spectroscopy.

The result obtained by photo catalytic degradation of tartrazine in aqueous solution reveal photo catalutic activity is higher in Ni/ZnO & lower in Mn/ZnO. By comparing the photo catalytic activity, Ni &Ag show synergistic effect while Fe & Mn show antagonistic effect. Ni /ZnO have degraded tartrazine to maximum rate of 98.2% in 60 min [85]. (Zhou et al. 2009) has studied preparation of Cu_2O/Cu nano composite by hydrothermal process & it is used to degrade methylene blue & methyl orange under UV visible light. From experimental it is concluded that Cu_2O/Cu nanocomposite exhibit enhanced photo catalytic activity than pure Cu_2O by maintaining the homogeneity of phase composition. At the end it is noted that Cu_2O/Cu nano composite are good applicant for processing of pollutant water [86]. (Noothang kaew et al. 2018) adopted low temperature hydrothermal method followed by anodization technique to synthesize CuO/ZnO nanocomposite on indium doped tin oxide coated on the glass substrate. Generated sample were characterised by FESEN, XRD, UV visible spectroscopy. All result indicates the deposition of CuO on the surface of ZnO nano rod arrays. At the end it is concluded that CuO/ZnO nanocomposite show high responsivity, photo current gain & good reliability as compared to pure ZnO nano rod [87-95].

Microwave assisted method

(Elias et al. 2016) reported a successive additive free & fast energy efficient microwave assisted preparation of nano crystalline Ce doped ZnO/CNT & it was investigated by XRD, FTIR & UV visible which narrated structure & morphology of nano crystalline. The photo catalytic efficiency for the degradation of MB dye under UV illumination by Ce doped ZnO/CNT was achieved 96.4% where as 36.4 % efficiency by pure ZnO. The result dictates that Ce doped ZnO/CNT offer potential application in photocatalysis by removal of harmful pollutant [96]. (Vijaya

lakshmi& karthick 2014) synthesized highly crystal lined ZnO & ZnO/ CuO nano composite by facile microwave irradiation technique. The obtained powder was characterized by XRD, PL, and SEM to gain information about structural, optical & morphological properties. ZnO/CuO show enhanced intensity emission peak at 380nm. By comparing ZnO, ZnO/CuO, former one show good transparency with sharp absorbance edges. So ZnO/CuO behaves as promising material for opto electronic device [97]. (Karthick et al. 2014) adopted microwave assisted method to synthesize CDO- ZNO nano composite & characterized by XRD, SEN.FTIR. The UV visible & fluorescence spectra reveal band gap & band edge emission was 2.92 ev & 422 nm. This manuscript describes the zone inhibition of 40nm was considered to have high antibacterial activity towards gram positive bacteria [98]. Microwave irradiation has played a significant in weight chemical method as it is expensive. This paper represents ZnO/grapheme generated by microwave irradiation process (Kim et al.2017). The obtained result demonstrate the beneficial effect ZnO/grapheme for increasing the No_2 gas sensing behaviour open a new door to cost effective gas sensor [99]. (Skoda et al. 2018) has synthesized ZnO nano particle through microwave assisted reaction by using zinc acetate dehydrate as precursor in diethylene glycol at 220 & 250 degree centigrade by applying oleic acid at the surfactant. The methanol was used to wash the obtained ZnO & dried as colloidal solution redispersed in toluene. The intensity of the electro luminescence of the prepared PLED device was increased by keeping magnitude of all parameter constant [100].

(Skoda et al. 2018) generated Co_xZn 1-x (x=0.01, 0.05 & 0.01) nano particle through noble microwave assisted polyol way from zinc acetate dehydrate & Co (II) acetyl acetonate in diethylene glycol at 250° C with the application of oleic acid as surfactant. The nano composite layer exhibit auto electronic properties which were found advantageous as the active layer in PLED exhibiting & order of magnitude enhancement in electro luminescence [101]. (Hassan pour et al.2017) have synthesized CuO /ZnO hollow spherical nano composite by using rapid microwave technique in polyol solvent at 10 min & 900 w as optimum time & power. The prepared sample was characterized by XRD, FTIR, SEM etc. the CuO/ZnO helps in photo degradation of Rhodamine B [102]. Semiconductor photo catalysis give solution to number of issues related to environmental pollution & energy storage as it use solar energy to degrade pollutant & the resultant product were characterized by XRD, UV visible, FTIR. The result tells that graphite like C_3N_4 promotes photo catalytic activity of ZnO.

Sol-gel technique

(Wang et al. 2014) have prepared ZnO/SnO_2 from precursors zinc acetate & stannous chloride by sol-gel method & supercritical drying process. The analysis of nano structure show the presence of heterojunction frameworks in the ZnO/SnO_2 nanocomposite which are decorated with ZnO & SnO_2 quantum rods of size ranging from 3-7nm. The experimental study depict that photoluminescence intensity raised with increase in calcinations temperature which decreases number of ZnO / SnO_2 bond exist in the surface [103]. (Li et al. 2014) have used sol-gel spin coating technique to synthesize ZnO/SnO_2 nanocomposite with ZN/Sn molar ratio from 1:1 to 1:5 annealed under 500 degree celsious. ZnO growth is enhanced & inhibition of SnO_2 growth has occurred by by raising Zn/Sn molar ratio. With enhancement of zn/sn ratio film transmittance decreases due to scattering loss occur by pinhole & island growth occurs in the surface.

The film electrical property reveal the embedment of SnO_2 on ZnO matrix was done in proper manner &with increase in Sn content ,more number of energy level is involved between Fermi level & valence level & conductivity of carrier is enhanced. The present manuscript adopted sol-gel technique to develop ZnO & ZnO doped with SnO_2 nanocomposite. SEM analysis reveals that SnO_2 is incorpated nicely in the ZnO crystal lattice. It was noticed that ZnO/SnO_2 act as better photocatalyst than pure ZnO in the degradation of sodium alkyl benzene sulfonate. (Akhgar & Giahi 2015) ascertained effect of different parameters & determine condition for maximum degradation [104]. (Giahi & Dargahi 2016) has fabricated ZnO &ZnO doped SnO_2 nanocomposite by sol-gel method & characterized by SEM & XRD. Under UV illumination, photocatalytic degradation of phenylephrine hydrochloride as model organic pollutant on various condition of illumination time, pH, catalyst concentration was intensively studied. The experimental findings reveal that the photo degradation efficiency of SnO_2 doped ZnO was considerably higher than ZnO nanocomposite [105]. (Kumar et al. 2015) have prepared ZnO/SnO_2 nanocomposite by sol-gel method. The

prepared precipated samples undergo anealation under 600&700 degree celsious.XRD, SEM & EDX has carried out for structural &morphological analysis. The Uv-visible & photoluminescence spectroscopy is used to indicate optical properties of nanocomposite. From all the studies it was found that ZnO/SnO_2 nanocomposite have latent application in optoelectronics, photo catalysis, solar panel & gas sensor [106]. (Kose et al.2016) have fabricated ZnO/SnO_2/MWCNT ternary composite film through sol-gel spin coating route to increase the electrochemical discharge of lithium ion battery. The performance of free standing anodes assembled in the CR2016 COIN CELL TYPE Li-ion battery undergoes spectral analysis. By comparing both the prepared nanocomposite, the former one has increased efficiency of electrochemical energy storage for lithium ion. (Denisov et al. 2017) have adopted a facile one-step sol-gel method for generation of zinc oxide/carbon nanocomposite films. Amorphous carbon covered with ZnO grains present in the film was reduced from organic components of the zinc acetate based sol calcinated at 500 degree centigrade. The performances of photo catalytic study &optical transmittance/reflectance data indicated that ZnO/C nanocomposite act as promising instrument for photo induced decomposition of organic compounds [107]. (Ghamsari et al. 2018) has synthesized high luminescent ZnO particle through sol-gel route & structural & optical properties of the sample was characterized by SEM, XRD & photoluminescence spectroscopy. The surface properties of synthesized nanoparticle were modified by embedding it with epoxy matrix. The fabricated ZnO-epoxy material has provided excellent usage in optoelectronic device & light emitting device [107-113].

Solvothermal method

A group of researcher has prepared noble metal/ ZnO nanocomposite by solvothermal route & characterized by XRD, SEM & BET surface area analysis. The photo catalytic degradation of MB in aquatic bodies helps in studding photo catalytic behaviour of the samples. From experimental data it was revealed that presence of noble metal enhances photo catalytic behaviour which has significant application in environmental issues [114]. One group adopted a simple low temperature solvothermal technique to synthesize Ag with different ratio to decorate ZnO nanoparticles.The reactivity of adsorbed oxygen molecule on ZnO surface with detected gas molecule which develops sensor reaction. The photo catalytic effect of Ag nanoparticles enhances hydrogen sensing properties provides huge number of active sites for adsorption & desorption of hydrogen on ZnO surface [115].

(Zhao et al. 2019) used one- potential solvothermal thermal method to prepare $MNCO_3$/reduced grapheme oxide nanocomposite. The synthesized sample offer excellent electrochemical properties. This paper represents a facile, low cost synthesis procedure which gives guidance for the production of various transition metals/reduced nanocomposite. A new group has demonstrated successful synthesis of CdTe quantum dots dispersed in ZnO structure form novel hetro structured in three steps by solvothermal route. The XRD, TEM, SEM, EDAX, AFM, UV & PL were used to investigate the optical, structural &morphological characteristic of synthesized sample. The mechanism behind various projected nanostructure was studied on the basis of different parameter such as role of solvent, solution concentration & temperature by solvothermal route [116]. (Meng et al. 2018) demonstrate novel solvothermal route to fabricate dual porous CeO2-ZnO nanocomposite without involvement of any solvent & characterized by SEM, TEM and XPS. By comparing CeO_2 with CeO_2/ZnO, there were more oxide defects &enormousCe^{3+}/Ce^{4+} ratio on CeO_2-ZnO surface which exhibt enhanced gas reaction may be have latent application in the field of diabetes treatment& chemical detection [117-126].

APPLICATIONOF ZnO BASED NANOCOMPOSITE

Photocatalytic application

Petroleum refinery waste water (PRW) seeks the attention of scientist & industry by raising a critical call on environmental pollution due to its effect on human & ecosystem. This work describes modification method in semiconductor, effect of operating parameter, development based on ZnO-TiO_2 photocatalyst for degradation of PRW (Ani et al. 2018). So, ZnO is regarded as a multifunctional & in expensive photo catalyst. (Xue & Zou 2018) have generated reduced graphene oxide & ZnO nanocomposite simultaneously by a new one –step photochemical technique. The photo degradation efficiency of methylene blue in the presence of UV & visible light is high for this

photo catalyst. ZnO particles were uniformly anchored on reduced grapheme oxide sheet was established by electron microscopy. X-ray diffraction, FTIR spectroscopy, RAMAN spectroscopy helps in analysing the structure & quality of created nanocomposite [127].

This script reported zinc citrate dehydrate is used as starting material for the fabrication of ZnO–C nanocomposite by one-step calcinations method under a nitrogen atmosphere. The products were characterised by XRD, EDS, transmission electron microscopy & RAMAN spectroscopy which reveal that 5-10nm size of ZnO nanocomposite evenly distributed on carbonaceous layer to form ZnO-C nanocomposite.(Xue et al. 2015) has presented ZnO-C nanocomposite show elevated photo catalytic activity with 4.15 times faster than bare ZnO nanocomposite for the degradation of methylene blue under UV illumination. So ZnO-C nanocomposite has latent application in the field of photo catalytic & environmental protection as it can be easily recycled [128]. The photo catalytic efficiency is decreased by recombination of photo generated electron–hole pairs. So the ZnO is coupled with other metal nanocomposite to form hetero structure for enhancement of photo catalytic efficiency. (Yuan et al. 2010) has depicted optimised catalytic properties of produced ZnO –Pt composite with different structure are characterised by transmission electron microscopy. ZnO –Pt nano flower exhibit improved catalytic efficiency & its interface has played a significant role in the enlarged magnetic behaviour [129].

The photo catalyst design plays an important role in aquatic organic pollutant degradation. Porous grapheme is coupled with ZnO nanoparticles to promote photo catalytic performance with increase in charge separation of electron-hole pair. Then porous graphene/ZnO nanocomposite was produced be fine tuning of partial combustion where graphene oxide was uniformly covered by the Zn salt was under muffle furnance within few minutes. The synthesized porous grapheme/ ZnO nano composite exhibited improved efficiency as compared to pure ZnO under natural sunlight & 100 % degradation of methyl orange could be achieved within 150 min. the synergetic effect of photo catalysis & adsorption is main reason for excellent MO degradation of PG /ZnO nanocomposite (Li et al. 2019, 16) [130-132]. In current times the ZnO nanoparticle gained attention due to photo catalytic & antimicrobial activity in textile treatment. Though silver is a familiar & costly antibacterial material, small amount of silver is used which increases the photocatalytic & antimicrobial activity. This manuscript describes the synthesis of Ag/ ZnO nanocomposite by reducing silver on the surface of ZnO nanoparticle dispersed in isopropanol. (IBANESCUet al.2014) has studied the photocatalytic activity of designed nanoparticle applied on textile fabrics through the degradation of methylene blue dye in water under the UV illumination [133].

(Hassanpour et al. 2017) has synthesized Co_3O_4/ZnO nanocomposite through microwave assisted method. Textile, dye & plastic industries are mainly responsible for discharging methylene blue (MB) & rhodamine B (RB) dyes to water bodies. Fabricated nanocomposites exhibit outstanding photodegradation performances toward MB & RB in the presence of UV light. Photo degradation competence is calculated 80& 90% for MB & RB correspondingly [134]. (Vignesh et al. 2019) have synthesized PVP capped Cd & Ag dopped ZnO by facile microwave aided precipitation route. The produced sample undergoXRD & HRTEM analysis present moral crystalline nature & binding energy was confirmed by XPS analysis. The MB dye degradation rate by Cd: Ag: ZnO: PVP nanocomposite is 4.7 times higher than pure ZnO under visible light exposure within the 120 mins. Further Cd: Ag: ZnO: PVP nanocomposite exhibit enhanced photocatalytis properties, outstanding anti bacterial activities & high charge carrier ability due to large surface area [135]. (Taufique et al. 2017) has projected hydrothermal technique to fabricate ZnO –CuO nanocomposite which act as outstanding photocatalyst in the presence of unique condition. The structure of ZnO-CuO with varied ratio of ZnO & CuO phase content was confirmed by high resolution SEM & Rietvald analysis. The photo degradation of MB dye under UV visible illumination was taken into study for photocatalytic performances of synthesized sample which reveal best sample should acquire 56% photocatalytic efficiency [136-139].

Antibacterial application

(Rahman et al. 2016) has prepared chitosan nano ZnO composite by simple one potential route & characterized by different physico-chemical method. The dielectric constant & conductivity values show bettee performance when

nano ZnO is incorporated. Antimicrobial analysis reveal that all composite films show tremendous antimicrobial efficacy as compared to pure chitosan film & it is linearly rely on the amount of ZnO particles in the matrix [140-142]. (Hameed et al. 2018) has investigated physical & biological properties of *silybium marium* applying ZnO nanoparticles & Ag-ZnO hetero structure NPs & undergo characterisation using UV-visible, IR, XRD, potential & thermo gravimetric analysis. Ag-ZnO NPs exhibit slightly higher antimicrobial potential than ZnO NPs. biosynthesized nNPs indicated interesting biological properties & should be subjected to further research to establish their pharmacological relevance [143]. (Noshirvani et al. 2017) has elaborated casting method to prepare active nano composite based on carboxy methyl cellulose chitosan oleic acid (CMC-CH-OL) in corporate with various concentration (0.5 - 2 wt%) of ZnO NPs. FTIR confirms the interaction between ZnO NPs & polymer matrix. UV transmittance at 280 nm decreased from 17.3 % -0.2, 0.1 & 0.1 for the nanocomposite containing 0.5, 1 & 2 wt% of ZnO. Disc diffusion test revealed considerable antifungal properties of the active nanocomposites films against *Aspergillus Niger* especially in CMC-CH-OL-ZNO wt% by more than 40% fungal growth inhibition [144].

(Rahman et al. 2017) has reported portable chitosan ZnO nanocomposite as benign packaging material which serve as ellite applicant in smart packaging. Four various types of C-ZnC composite films with varying concentration of ZnO were synthesized by adapting a facile one potential route. Detailed investigation elucidate that the antimicrobial efficiency is linearly rely on the amount of ZnO particle on the composite [145-152]. The prepared pouch exhibit significant action against the microbes in raw meat owing to its complete inhibition of microbial growth on the 6th day of storage at 4degree Celsius. (Chen et al. 2015) has studied ZnO nano rods incorporated in a grapheme layer which was fascinated on silicon substrate.

CONCLUSION

Nanocomposites show novel properties which are evolved as efficient materials for fabrication of different optoelectronic device. There are several methods of preparation out of which wet chemical synthesis is regarded as simpler and cost-effective. Zinc oxide is considered as a multi-efficient material and its composite with other metal oxides show new piezo- & pyroelectric properties, a broad array of UV-absorption, enhanced photostability, biocompatibility and biodegradability. The wide range of applications of ZnO has made it suitable for different technology in the recent years. Several techniques are employed for development of crystalline ZnO nanocomposite which has made it possible for synthesizing these nanomaterials of different morphology. ZnO based nanocomposites exhibit good antibacterial activity and photocatalytic property because of small particle size with increased surface area which leads to elevated reactivity on particle surface. This review article highlights on the various methods of preparation of these nanocomposite and its possible applications.

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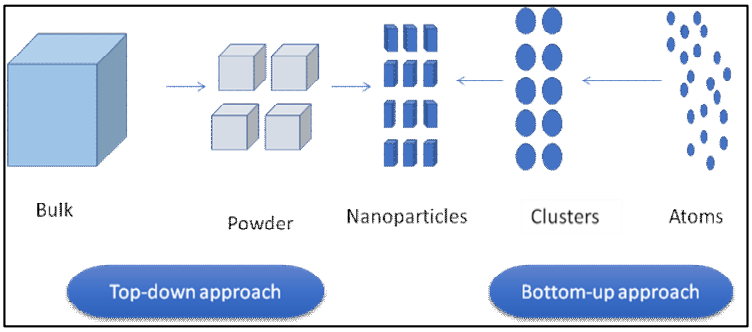

Figure-1: Top-down and bottom-up approaches for synthesis of nanomaterials

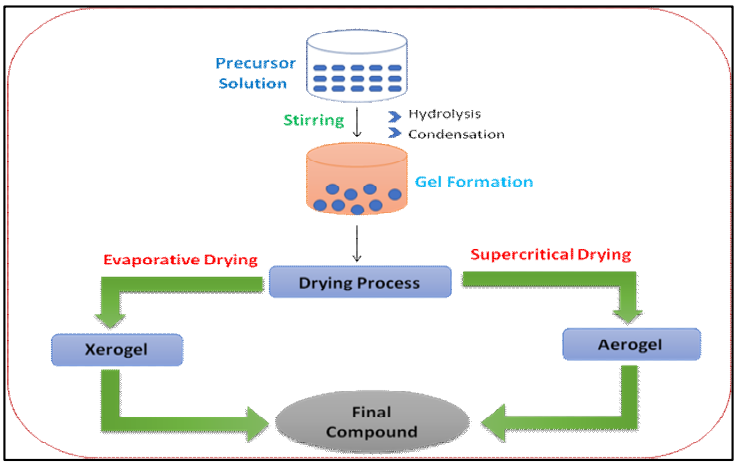

Figure-2: Sol-gel method of synthesis of nanoparticles

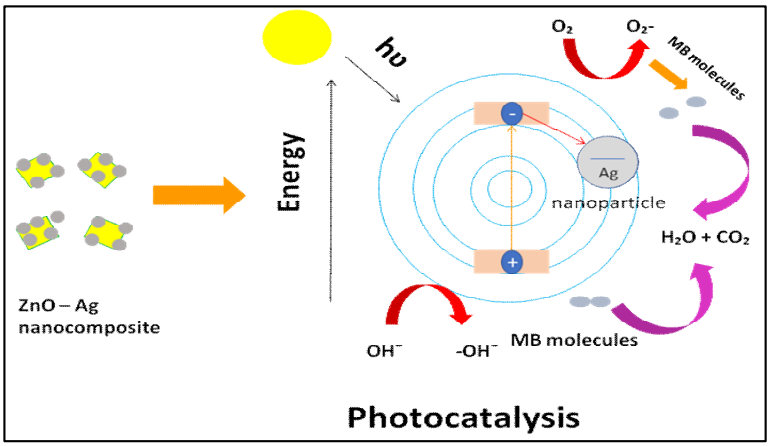

Figure-3: The mechanism of photo-catalysis

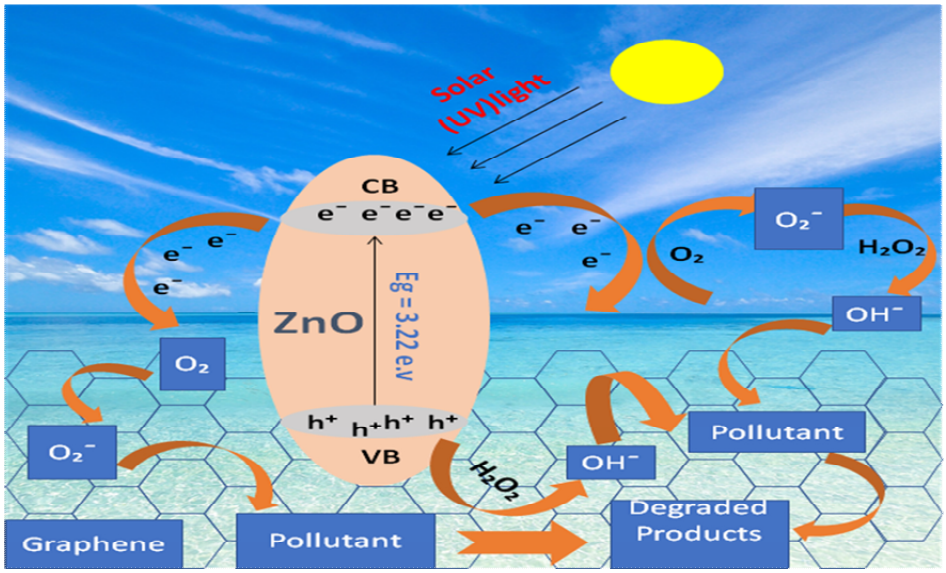

Figure-4: Mechnism of photogenerations of carriers in ZnO bandgap

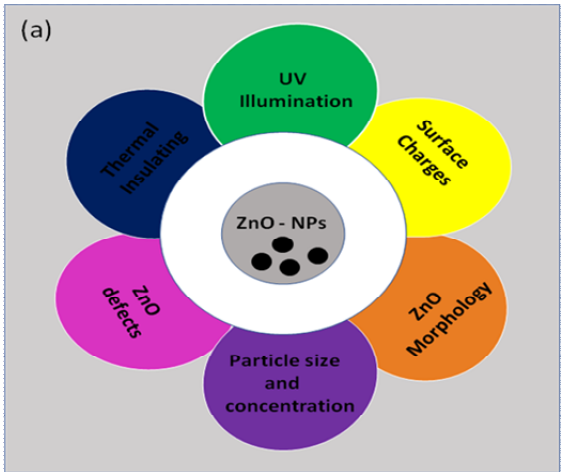

Figure-5: Correlation between the influences of essential ZnO NPs parameter on the antibacterial response

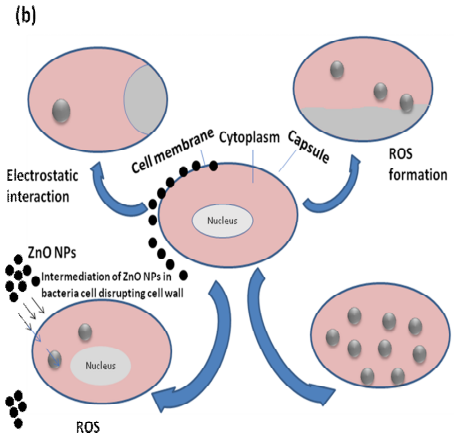

Figure-6: Different possible mechanism of ZnO NPs antibacterial activity, including: ROS formation, Zn^{2+} release, internalisation of ZnONPs into bacteria & electrostatic interaction.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Application of Integrated Single Pole Auto Tripping and Reclosing System in IEEE Benchmark Two-Area Power System

Anjan Kumar Sahoo[1]*, Manoj Samal[2], Abhinna Chandra Biswal[1], Prabhat Kumar Patnaik[3] , Sudhanshu Kumar Samal[1] and Rajesh Kumar Mishra[3]

[1]Department of Electrical Engineering, Centurion University of Technology & Management, Parlakhemundi, Gajapati, Odisha,India
[2]Department of Electrical Engineering, Birla Institute of Technology & Science, Pilani, Hyderabad, Telangana, India.
[3]Department of Electronics & Communication Engineering, Centurion University of Technology & Management, Parlakhemundi, Gajapati , Odisha,India.

Received: 21 Feb 2020 Revised: 24 Mar 2020 Accepted: 27 Apr 2020

***Address for Correspondence**
Anjan Kumar Sahoo
Department of Electrical Engineering,
Centurion University of Technology & Management,
Parlakhemundi, Gajapati, Odisha,India
Email: anjan.sahoo@cutm.ac.in

ABSTRACT

This paper focuses on the protection of three phase high voltage two area power system by using a new advanced integrated SPAT and SPAR method. It overcomes the drawbacks of conventional auto tripping and reclosing system. This paper aims in introducing a reliable and more stable two area power system. The performance of an isolated generating station connected to the load center improves through single, double and three phase transmission lines due to the planned integrated SPAR network. The interconnected system uses the same measuring functions for both fault tripping zone and fault phase identification. The proposed method is verified using IEEE kundur's two-area system. The proposed method is simulated in MATLAB/SIMULINK environment.

Key words: Integrated single pole auto reclosing, single pole tripping, phase to ground fault, two area control, automatic reclosing, single pole.

INTRODUCTION

With the innovation in technology the demand of electrical energy also increases rapidly. Hence transmission line faults are to be processed properly. Or else this may lead to poor reliability, power quality disturbances, large scale power outage etc. As per the statistics present below, the transmission line is mostly affected by single phase to ground fault i.e. 70%.Proper single pole auto reclosing [1] method can be able to clear the arcing faults successfully

which are around 70% of the single line to ground faults.The table.3 shows the single pole switching operation summary for 400kV in different CFE area of Mexico in the year 2011.The failure scheme is also notified which is around less than 1% of the total applied schemes. In most cases its value is zero.The SPAR has become most popular due to its significant step in improving system performance. Insulation failures or conducting path failures play important role in the occurrence of faults[3].Most of the transmission and distribution line faults are caused by overvoltages due to switching surges or by lightening or by external conducting objects falling on overhead lines[4]. Integrated SPAR method plays an important role in such cases.

A. This holds the reactance small between the instant when fault is cleared (opening below all three phases) and the instant when open phases are reclosed [11].
B. Significant improvements in transient stability.
C. Reducing switching overvoltages.
D. Increases the system reliability.
E. Minimize unsuccessful reclosing.

The current paper integrates both the identification of fault tripping zone and faulted phase in a single step unlike separate SPAR scheme for system stability improvement. To examine the potential of the proposed scheme, its performance / behavior is contrasted with traditional SPAR framework. The simulation result is implemented in MATLAB. The results obtained from the proposed method are there to enhance the stability of the system.The 2nd part of the article describes about the integrated single pole auto tripping and reclosing system in details.The 3rd part narrate about the two area system.The 4th part combines both i.e. the result section where the proposed scheme is validated through MATLAB SIMULINK and details are explained.The last part concludes the article.

Integrated Single Pole Tripping and Reclosing

Single Pole Auto Tripping(SPAT) and Single Pole Auto Reclosing(SPAR / SPR) are usually referred to as Single Pole Switching(SPS).Based on the working mechanism, they are of two forms like (i) Separated Scheme (ii) Integrated Scheme. In a traditional SPAR system, the following things for the treatment of the L-G faults are required to be specified.

A. Tripping zone for the fault.
B. What phase or phases are faulted?

In the first case, the single pole tripping has to decide if the fault is internal or external and therefore the fault's tripping zone. In the 2nd case, the tripping of the single pole must decide whether it is a single or multi-phase fault. It will describe which phase is fault in the event of a single phase fault. In case of multi-phase fault, the selective phase tripping scheme decides which phase or phases are faulted. The separated scheme uses one set of functions to perform 1st case and another set of function to perform 2nd case. But the integrated scheme utilizes same set of function to perform both. This is the unique advantage of the integrated scheme which consumes less time. Herewith we represent the function of Integrated single pole tripping [5] in below diagram. There are three directional ground relays (MFG) and also three directional phase distance relays (MF).

In order to operate the scheme effectively, the MFG feature must be selective among them, so that the faulted phase unit operates for every L-G fault. Any or more MF units must work in case of any multi-phase fault. From these functions the form of the fault (internal or external) can be determined [6]. If a fault occurs in the TRIP direction, an output fromOR-1orOR-2 is generated by one of the MF or MFG units, which in turn results in output fromOR-3. The output fromOR-3 informs the local transmitter of the output to TRIP and in the meantime it also sends information to AND-1. The remote end of the line sends a TRIP signal [7] for the internal fault which produces a local receiver TRIP output. From this TRIP output the 2nd input to AND-1 is given which then generates an output to indicate a TRIP

signal. This signal is fed to AND-2 to AND-5 depending on which faults are detected by the measuring units to TRIP one or more poles.

TWO AREA POWER SYSTEMS

Two control areas with interconnected tie lines between them is known as two area power system. A two-area power system's basic operating principle is that each area must be ready to monitor, control methods and equipment that are useful for normal as well as abnormal conditions.The system frequency gets affected with the change in power system load.The reactive power is not highly sensitive to change in frequency but depends on fluctuations of voltage magnitude.Hence the control technique of both real and reactive power are applied separately.The subnormal frequency has got a cumulative effect and in turn is able to make complete shutdown of the system if proper step is not taken.The main objective of the interconnected system is to maintain the balance between the real frequency and the power output. This is directly proportional to the fault occurred in the line.

RESULT AND ANALYSIS

Our proposed scheme is investigated in IEEE bench mark two area power system of distance of 220 km. The integrated single pole reclosing scheme is applied to 230KV transmission line. The lines are assumed to be transposed and the parameters per km are specified in positive and zero sequence components. The implementation of an integrated single pole reclosing scheme at this voltage level is made possible by the use of neutral inductances for the two line shunt reactances. A L-G fault is applied in the center of the 1st line. The line is simulated in two half sections of 110 km each for the implementation of the fault along the line. As soon as the fault is detected a TRIP command is sent to the faulted phase's two line breakers. The breakers are held open until some dead time of around 0.5s. This is the moment the arc is extinguished and the circuit breakers are reclosed.

The arc is prepared with either a fixed or nonlinear resistance. When it's RMS current falls below a threshold value of around 50A specified in the arc model block, the arc extinguishes. The fig.2 below shows the waveform of three phase voltages [8]. This waveform clearly distinguishes the perturbed magnitude from the faulted phase. The fig.4 shows the hike of current during the fault condition for the faulted phase [9] only.Fig.4 shows the magnitude and waveform of the arc current. How severe the arc current is is clearly visualized. Fig.5 shows the magnitude of the arc resistance [10]. It is produced by a resistance which is fixed or nonlinear.

CONCLUSION

The integrated single pole reclosing and tripping system is used for the improvement of reliability of two area systems. Any type of symmetrical or asymmetrical faults can be dealt by this scheme perfectly. This scheme is much better than other separated tripping and reclosing scheme for single pole. The beauty of this scheme is to consume less time with greater precision. The proposed method is quite better than the conventional reclosing method. The amount of information required for this proposed method is very less and it is applicable for real transmission and distribution system. It helps in the improvement of transient stability of the system. Improved reliability is another advantage of the proposed method.

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Table 1. Relative probability of occurrence of fault in percentage.

Type of Fault	L-G	L-L	L-L-G	L-L-L L-L-L-G L-L, L-G	Total
% of occurrence	70	15	10	5	100

Table 2. SPS Scheme operation in Mexico in July 2012

CFE / LINES		North western	Baja California	Eastern	Western	Central	South eastern	Peninsular	North-ern	North eastern	Total
230 kV	Lines	79	52	36	104	102	29	29	66	42	539
	Sps scheme	74	12	23	30	20	29	25	62	5	280
	%	93.7	23.1	63.9	28.8	19.6	100	86.2	93.9	11.9	52
400 kV	Lines	7	NA	78	53	65	20	4	5	50	282
	SPS scheme	7	NA	49	52	46	18	4	5	29	210
	%	100	NA	62.8	98.1	70.8	90	100	100	58	74.5

Table 3. SPS Scheme operation summary for 400kV in Mexico in 2011.

CFE / LINES		Eastern	Western	Central	Northern	South-eastern	North-eastern	North-western	Penin-sular	Total
Single phase fault		66	121	51	15	36	43	23	8	363
Correct operations	Temporary faults	45	78	31	14	34	36	23	5	266
	Permanent faults	18	43	18	1	2	7	0	2	91
	Total	63	121	49	15	36	43	23	7	357
	%	95.5	100	96.1	100	100	100	100	87.5	98.3
Scheme failure		3	0	2	0	0	0	0	1	6

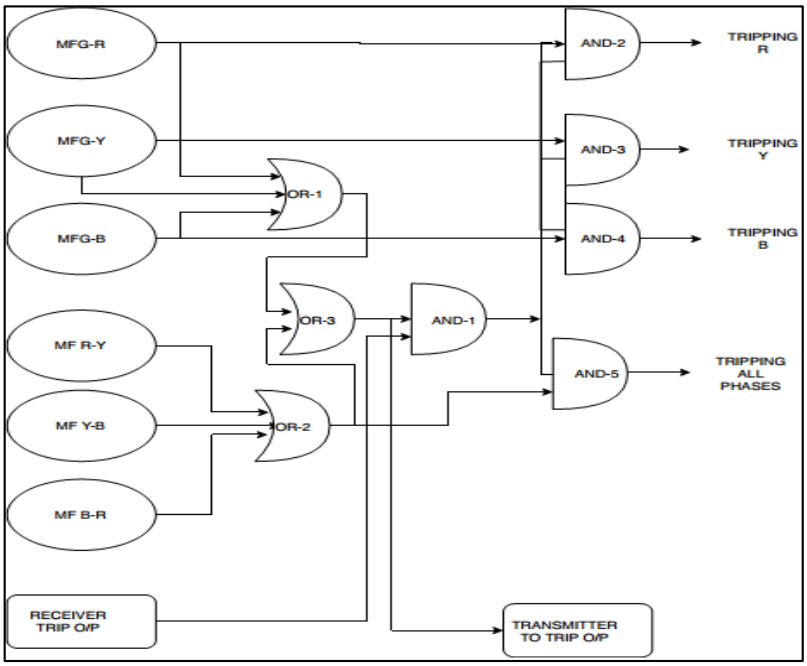

Fig. 1. Integrated SPT Scheme

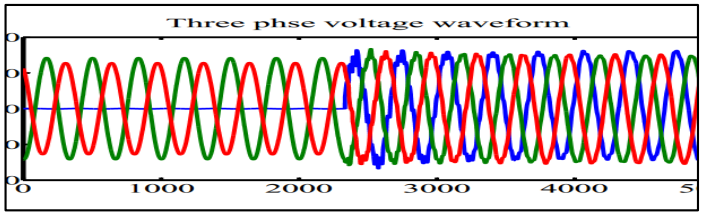

Fig. 2. Three phase voltage wave form

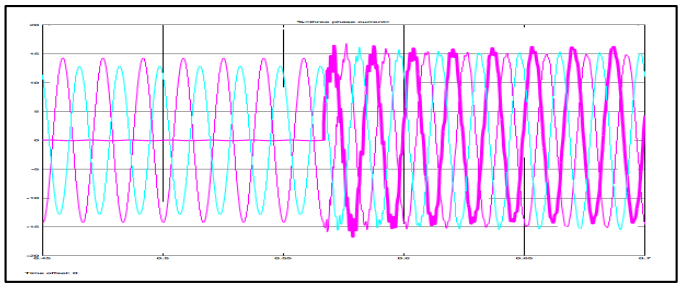

Fig. 3. Three phase current waveform of the proposed system.

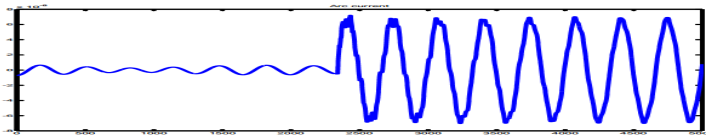

Fig. 4. Arc current of the proposed system.

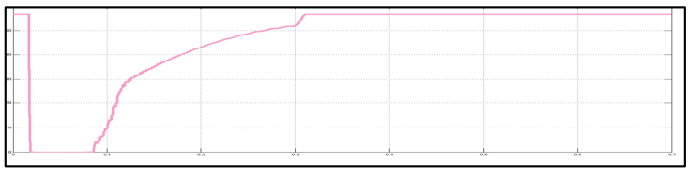

Fig. 5. Arc resistance added for fault creation.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Prevalence of Nematode Parasite of *Clarias batrachus* (Linnaeus, 1758) with Respect to Length, Weight and Sex in Odisha

Shubhransu Pattanaik* and Siba Prasad Parida

Department of Zoology, Centurion University of Technology and Management, Odisha, India.

Received: 16 Mar 2020 Revised: 18 Apr 2020 Accepted: 20 May 2020

***Address for Correspondence**
Shubhransu Pattanaik
Department of Zoology,
Centurion University of Technology & Management,
Odisha, India
Email: shubhransupattanaik123@gmail.com

ABSTRACT

Abstract-The aim of this study is to investigate the degree of nematode infection of *Clarias batrachus* (Linnaeus, 1758) in Odisha. In this study the prevalence of nematode infection is compared with the length and weight groups of *C.batrachus*. A total number of 30 *C.batrachus* were collected alive from the freshwater pond from December, 2019 to March, 2020, to investigate the prevailing nematodes. The length, weights were also measured and compared with the nematode infection rate. The comparison is done by using one-way analysis of variance (ANOVA) followed by Turkey's pair wise comparison tests. Majority of parasites were recovered from the intestine region of the catfish. Majority of longer length groups were having more infection rate (70%) than the shorter length group (45.5%). The females show a slightly higher infection rate (75%) than the males (66.6%). Study among the weight group revels that moderate and higher weight groups were having a higher degree of infection (83.33%, 66.6%) than the lower weight groups (50%, 57%). The study highlights that the higher the length and weight of fish will have slightly higher rate of infection than the shorter and lower weight groups. It is due to the different feeding habit with increase in the age of fish.

Key-words: Fish, *Clarias batrachus*, Nematode parasite, Prevalence, Sex, Weight, Length

INTRODUCTION

The Asian catfish, *Clarias batrachus* is a fresh and brackish water edible fish found in India and other Asian countries like Sri Lanka, Bangladesh, Myanmar, Indonesia etc. It is commonly called as "walking catfish" and "Magur" in India. It feeds on the clams, crustaceans and insect larvae that live in the bottom of dirty pond and especially in the muddy water. As they feed on the dead fishes and other derbies hence called as scavengers (Lal, 1980). The human is majorly affected in the diseases which are caused by the helminthic fish parasites. They includes digenetic

trematodes (flukes), cestodes (tapeworm), nematodes (round worm), and acanthocephalans (spiny headed worms). The parasites are correlated with the size of the fish body (Bell and burt, 1991). The parasites are categorized in to different types according to the physical characteristics, life cycle, host infection site; it is categorized in to two categories like ectoparasite and endoparasite respectively. There are several categories of parasites like protozoa, bacteria, algae, fungi, trematodes, nematodes, crustaceans, leeches etc. Most of them are not visible to the naked eye, so they are visualized under microscopes. Ectoparasites are the organisms which are located on the external surface of the host. They are present on the scales, skin surfaces, gills, gill rackers, oral cavity, eye lids etc. The severity of the infection in the fish can be easily marked by the coloration in the specified site of organ. It can be accessed morphologically. Especially the infection site became redder in color. The endoparasites are the microorganisms that are located in the flesh and cavities of the host organism. The host parasites choose suitable place in the host body for their nutrition and development. They grow with in muscles, organs, gut, intestine, membrane lining of the host. The fish parasite like tapeworm and round worm can be passed to the human body that eats undercooked or raw meat (Roberts, 2005).

In the two peak seasons like spring from March to June and then September to October season the parasites and diseases increase enormously in warm freshwater fish. During this season the infection rate is high according to the other seasons (Plumb, 1999). The environment and environmental factors has a great role in the fish diseases and rate of parasite development. The fish living in the optimum environmental condition are more resistant towards the diseases than the fish weakened by malnutrition or adverse environmental condition. (Hoffman, 1976). The infection rate or bacterial diseases increases due to increase in the environmental stress. In the winter season the warm water fishes are susceptible to the bacterial diseases including bacteremia caused by *Aeromonas hydrophia*, (*A.liquefaciens*). The cold-water diseases in case of salmons are caused by the *Cytophaga psychophilia* at 5-10°C. The effectiveness of cellular and humeral immunity of fish decreases in the decrease of temperature. At 10^0C i.e. in the low temperate condition in the December a corynebacterial disease of plaice (*Pleuonectusplatessa*), the disease is more severe than the higher temperature (Snieszko, 1974).

Procamallanus laevionchus and *Paracamallanus cyathopharynx* causes the multifocal lymphocytic enteritis and also atrophied crypts in the intestine of the *Clarias gariepinus.* Contracaecum spp. (3rd stage larvae) shows pathological changes such as lymphocytic enteritis persisting of dead cyst. The kidney is severely affected by the helminthic infection such as interstitial lymphocytic nephritis with severe diffuse lymphocytic infiltration and multiple interstitial hemorrhages. Myositis associated with perivascular lymphocytic and plasma cell infiltration in the skeletal muscle of *Clarias gariepinus* (Sorour, 2019). The parasitic prevalence was significantly affected by the factors like length and weight of the fish (*Clarias gariepinus*). Study reveals that more the weight and longer the length of the fish more will be the parasitic infection rate as compared to the average, low weighted fishes with lesser and average length. High weighted and long sized fish consumes various types of food stuff as their diet and travels a wider area in search of different food (Idika *et al*., 2017).

The 4 genera of nematodes- *P.laevionchus*(Wedl, 1862) (Camallanidae) and *Camallanus polypteri* (Kabre & Petter, 1997),one species of cestode, *Polyonchobothrium clariae* (Woodland, 1925) of Ptychobothriidae family and one species of digenia (*Orientocreadium batrachoides*) (Tubangui, 1931) of Orientocreadiidae family were identified in the intestinal region of *C. gariepinus* with a maximum occurrence of nematode 33.33% (Abdel- Abdel *et al*, 2015). Parasite of the fish may cause health hazard to humans, when they are taken with poorly cooked form in diet. *Eustrongylides africanus* larvae (a nematode) species infects the tilapias, and the tilapias are eaten by the *Clarias* and adult *Bagrus* and act as an intermediate host. *Clarias* is largely eaten by most of the aquatic birds (final host). So in an indirect manner is also affecting the birds. The final host may be mammals, piscivorous fishes, amphibians, reptiles and birds: cormorants, herons, snakebirds, pelicans and spoonbills (Ibiwoye *et al*, 2004). Eustrongylidosis, caused by the *Eustrongylides spp.*, affects the fishes, birds and mammals (also humans). This parasitic disease is decent problem to the fish and human population because of its zoonotic ability i.e. can be transmitted to human under certain conditions and epizootological ability i.e. spreading from one species of animal to other (Urdes *et al*, 2017).

MATERIALS AND METHODS

Study Area

The catfishes *Clarias batrachus* (N=30) were collected from the nearest freshwater pond and fish reservoir of the Khurdha town. All the fishes were collected by the help of fishermen. The Khurdha town is situated 20°10'57.65" N 85°36'58.64" E and 25km from the capital of Odisha, Bhubaneswar. All the hematological, parasitological and taxonomic experiments were done from November, 2019 to March, 2020in the Zoology laboratory.

Fish samples

A total no of 30 live catfishes (*Clarias batrachus*) were collected randomly from the fishery pond by the help of fishermen. The fishes were of different sizes and weight. The collected fishes were immediately shifted to the Zoology laboratory and transferred alive to a glass aquaria and plastic container. The container is supplied with oxygen for proper aeration.

The total length of the fish is measured by using a thread starting from its tip of snout to the caudal end of the fin and matched with the meter rule in centimeters (cm). Weight of the fish is measured by using a weighting balance in grams (g). The sex of the fish is determined by examining the genitalia. The parasitological examinations were performed by the scrapping method by using a scalpel the entire skin surface was scrapped in to a glass petri plate for examination of ectoparasite. The whole alimentary canals of fishes were dissected out divided in to two sections like stomach and intestine. Each section was put in separate petri dish filled with distilled water and then subjected to parasite recovery. Gills were dissected out and cut in to smaller pieces and transferred to the petri dish containing distilled water. All the parasites recovered from the Petri dishes were subjected to fixation, staining and mounting procedures and observed under microscope. All the data like length, weight and parasitic infection between the groups length (I, II, III), weight (I,II,III,IV,V) were analyzed and presented as mean ± standard error by using Microsoft office excel 2013. The significance of relationship between the groups and within groups were analyzed by using one way analysis of variance (ANOVA) followed by Tukey's pairwise comparison test with the help of Paleontological Statistics (PAST) version 4.01.

RESULTS

Out of 30 fishes 19 fishes were found to be infected giving a prevalence of 63.33 %. The nematode parasite recovered from the intestinal and stomach region were *Procamallanus laevionchus* and *Paracamallanus cyathopharynx* (Fig: 1, 2). It was seen that *C.batrachus* has higher percentage of prevalence in female (66.25%) than males (61.07%), (Fig: 3). The investigation in the length group reviles that the fish with the standard range of 35-40.9 cm were mostly infected groups (average of 70.8%) followed by group I (61.87%) and group II (58.3%). Similarly the fishes with weight ranging from 301-380 g have the highest infection rate of 83.3%. The lowest infection is seen in case of group I (50%) and group III (57.14%)

DISCUSSION

The taxonomic group *Procamallanus laevionchus* (Nematoda) had the prevalence of 0.83% in the intestinal region. The medium range group 30-39.9 cm has a prevalence of 15.83% with 3.78 % intensity. 3.35% prevalence is seen in the longer range group 40-49.9 cm with intensity 2.5 %. It shows that higher range groups are having more parasitic infection rate. *C.gariepinus* ranging from 450-499 g shows a prevalence of 6.66%, 500-549g (1.67%). The lowest prevalence is seen in the weight group of 400-449 and 550-599. This study from the above data shows that the prevalence of parasitic infection is a particular group is not significant, since the infection rate is highest in the medium range groups by Oniye *et al.*,(2004). A study of helminthic parasite on 90 fishes (Clarias=20, weight

1078.9±187.3 (506- 1220), length 48.3±6.4 (31.5-51)) revels four nematode species likely *Paracamallanus cyathopharynx*, *Capillaria, Eustrongylides sp*. larvae and *Contracaecum* larvae. The *P.cyathopharynx* and *P.clarias* has the highest prevalence above 80%. The *P.cyathopharynx* had the highest mean intensity of 25.5% and having a higher dominance of 68.9%. The *G.pedalum* and *P.glanduliger* had the lowest dominance of 5.4% and 2.1% respectively by Nimbalkar *et al.,* (2010).

Abdul *et al.,*(2015)stated on a research work of prevalence of helminthic parasite, got the result of 65% prevalence of parasitic helminths in *C.gariepinus*. On the basis of sex ratio the helminthic infection is higher in case of females than males i.e. (90% female > 48.33% male). This result was not statistically significant as $\chi^2 = 0.85$, $P > 0.05$. The stomach and the intestinal tract region were the highly infected regions. The intestinal regions had more parasitic prevalence than stomach. He identified 4 genera of nematodes- *P.laevionchus* Wedl (1862) (Camallanidae) and *Camallanus polypteri* Kabre and Petter(1997) (Camallanidae), one species of cestode, *Polyonchobothrium clariae.* Woodland (1925) (Ptychobothriidae) and one species of digenia (*Orientocreadium batrachoides*) Tubangui(1931) (Orientocreadiidae). The nematodes showedhighest occurrences 33.33%, cestodes showed the maximum prevalence 25.0% as the population of tapeworm dominated in the fish species. On the basis of size of the fish the infection rate was categorized as Group I, II, and III. The result was found as of following manner. Group I (Larger >29) > Group II (Medium 19-29) > Group III (Smaller < 19). The prevalence observed between sizes in relation to intestinal helminth was not significant ($\chi^2 = 5.14$, $P > 0.05$).

It was clear from this study that the major factors like age, food item and spawning behavior of fish has a crucial role in the type of the helminthic parasite infection of G.I tract of *Clarias gariepinus* studied by Oniye *et al.,* (2004). Result drawn from the survey work was the piscine coccidian (Coccidiosis) a chronic disease, having the highest mortality rate, seen in case of the *Clarias batrachus* observed by Nimbalkar*et al.,* (2010).*Eustrongylides spp.* can be transmitted to human under certain conditions and epizootological ability i.e. spreading from one species of animal to other species studied by Urdes *et al.,* (2017). The *Procamallanus* species is the major prevalent parasite seen in fishes. The parasitic infection is not common in the *Clarias* sp. some factors like sex, environmental condition of the pond, water quality, length and weight can influence the prevalence of parasites in *Clarias gariepinus* reported by Idika *et al.,* (2017). An important finding was drawn from Kawe *et al.,* (2016) that infection rate is higher in case of the shorter length group (20-30 cm – 82.4%) than the higher length group (40-50 cm – 61.5%) in *C. gariepinus*, in Abuja, Nigeria. Mostly in maximum cases the infection rate is higher in case of longer length groups, but the above result showed the reverse i.e. infection is mostly higher in shorter length fishes.

Akisayana and Otubanjo (2006) reported unbalanced feeding habit and other components can cause harmful effects in fishes. Due to this fact there is a difference seen in prevalence of infection in different fish groups. The amount of protein intake has also an impact on fish. Low protein diet causes decreased immunity, decreased growth rate, defected reproductive processes and reduced disease resistance power by Afrianto and Liviawaty, (1992). *Procamallanus sp.* and *Acanthocephala sp.* parasites were the most infective to *Clarias gariepinus* in Nigeria, They infects the digestive tract, stomach and large intestine respectively causing anemia, erratic behavior, shedding of skin lethargy, ulcerative lesions, and death as studied by Idika *et al*., (2017).

Sorour et al., (2019) stated that evisceration of *C.gariepinus* were done immediately after catching to avoid attack of 3rd stage larvae of *Contracaecum sp.* in abdominal cavity to fish muscle and disruption of other nematode life cycles.There is a direct relationship seen between length and condition factor (Kn) of *C.batrachus*, Chhattisgarh, India. In the month of July, August, September, and Octoberthe Kn was high. It shows that increase in the value of Kn indicate a good water quality and healthy organism studied by Kumar *et al.,* (2017). The obtained results of length-weight parameters has an importance in the field of fisheries and other biological surveys to obtain the length estimates from a known value of weight and vice-versa studied by Chowdhary&Srivastava (2013). The result showed that the *C. batrachus* has a higher percentage of prevalence in female (66.25%) than males (61.07%), (Fig: 3). The investigation in the length group revels that the fish with the standard range of 35-40.9 cm were mostly infected

groups (average of 70.8%) followed by group I (61.87%) and group II (58.3%). Similarly the fishes with weight ranging from 301-380 g have the highest infection rate of 83.3%. The lowest infection is seen in case of group I (50%) and group III (57.14%). In comparison of my result with other researchers it is seen that the ratio of my findings are is similar to the ratio or percentage of others in most of the cases except some exceptions. The results are consistent to the ratio and percentage of Abdel *et al.,* (2015); Oniye *et al.,* (2004) but it showed deviation with high prevalence of infection in small sized fishes than the larger fishes as reported by Kawe *et al.,* (2016).

So it was observed that among the different size group of fishes, the maximum infection is recorded in higher length groups than the lower and medium length groups. The parasitic infection is also an important concern in fish production. In some cases parasite may also infect to other animals as discussed above. As age of the fish increases, the chances of infection also increases due to various feeding habit.The infection rate is directly related to the environment of the pond, aquatic parameters, length and weight of fish. The infestation can be controlled by proper treatment to specific age groups.

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Table 1: ANOVA Length.

ANOVA: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Group I	10	282	28.2	2.742222		
Group II	10	333.7	33.37	3.171222		
Group III	10	376.2	37.62	1.221778		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	445.0927	2	222.5463	93.56948	7.23E-13	3.354130829
Within Groups	64.217	27	2.378407			
Total	509.3097	29				

Table 2: ANOVA Weight

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
I	6	990.63	165.105	34.85015		
II	6	1239.03	206.505	118.67915		
III	6	1387.86	231.31	134.4486		
IV	6	1658.63	276.4383333	211.8639367		
V	6	2145.64	357.6066667	369.2474667		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	130154.9	4	32538.73513	187.2001819	3.04E-18	2.75871
Within Groups	4345.447	25	173.8178607			
Total	134500.4	29				

Table: 3ANOVA between length and weight group.

SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Length	30	991.9	33.06333	17.5624		
Weight	30	7421.79	247.393	4637.944		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	689058.1	1	689058.1	296.0185	1.88E-24	4.006872886
Within Groups	135009.7	58	2327.753			
Total	824067.8	59				

Table: 4 Tukey's pairwise (PAST- 4.01), mean and standard error of length and weight group. (Length- 3 groups and weight-5 groups).

Factor	Group-I	Group-II	Group-III	Group - IV	Group- V
Weight	165.105±2.41	206.505 ±4.44 b	231.31 ± 4.73 b,c	276.43 ±5.94 b,c,d	357.60 ±7.84 b,c,d,e
Length	Group-I	Group-II	Group-III	-	-
	28.66 ± 0.40	33.33 ± 0.47 b,c	38 ± 0.5 c	-	-

Table: 5 Relationship between body length and sex for *C.batrachus* with the prevalence of infection.

Group of *C. batrachus*	Length of fish (cm)	No of fish examined		No of fish infected		Prevalence of infection (%)	
		Male	Female	Male	Female	Male	Female
Group-I	26-30.9 (28.2 ± 0.52)	3	7	2	4	66.6	57.14
Group-II	31- 35.9 (33.37± 0.56)	4	6	2	4	50	66.6
Group-III	35- 40.9 (37.62 ± 0.34)	6	4	4	3	66.6	75

Table: 6 Relationship between body weights with the prevalence of infection in *C.batrachus*

Group of *C. batrachus*	Wight of fish (g)	No of fish examined	No of fish infected	Prevalence of infection (%)
Group-I	150-174	6	4	66.66
Group-II	175-219	5	3	60.0
Group-III	220-250	7	4	57.14
Group- IV	251-300	6	4	66.6
Group- V	301-380	6	5	83.3

Table: 7 Comparison of obtained data with other's result

Group		My result	Abdel *et al.*, 2015	Kawe *et al.*, 2016	Oniye *et al.*, 2004
Length	High	35- 40.9 (70.8%)	29.0- 45.4 (69.21%)	20-30 (82.4%)	30-30.9 (15.83%)
	Low	31- 35.9 (58.35%)	11.9- 16.9 (58.33%)	40-50 (61.5)	40-40.9 (3.33%)
Weight	High	301-380 (83.3%)	150.32-160.10 (80.66%)	500-600 (78.6%)	450-499 (6.66%)
	Low	175-219 (60%)	115.19-112.29 (59.58%)	600-700 (58.8%)	400-449 (0.83%)

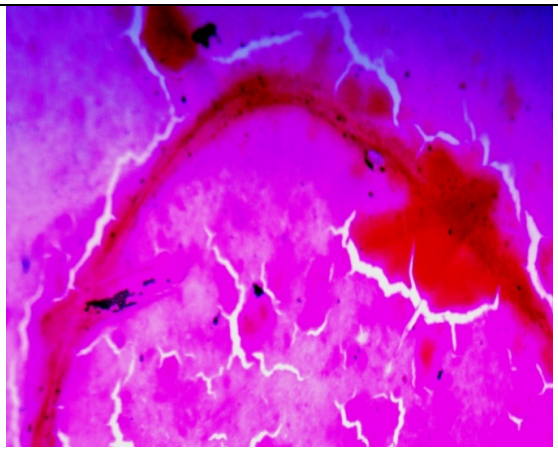

Figure 1.

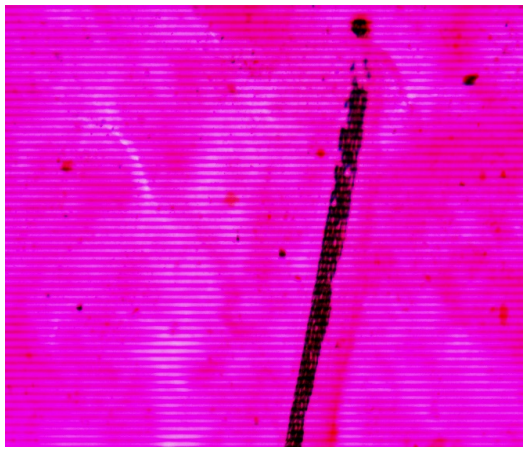

Figure 2.

Figure 1, 2: *Procamallanus laevionchus* (1), *Paracamallanus cyathopharynx* (2) isolated from the stomach and intestine region of *Clarias batrachus*

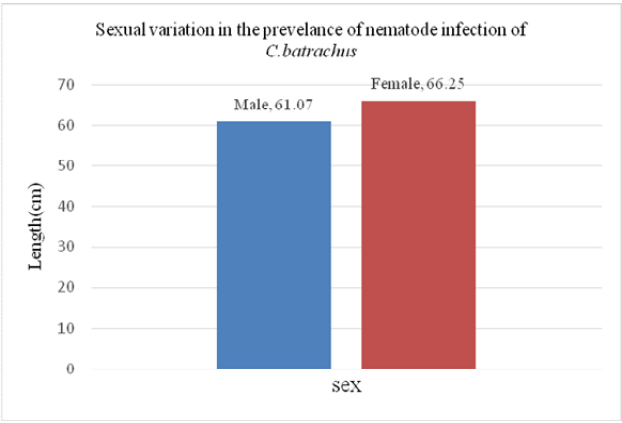

Figure: 3 Sexual variation in the prevalence of nematode infection of *C.batrachus*

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Implementation of Weighing Machine using Strain Gauge Load Cell and Monitored through Bluetooth

Subrat Kumar Pradhan*, SwarnaPrabha Jena and Debaraj Rana

Assistant Professor, Department of ECE, Centurion University of Technology and Management, Odisha, India.

Received: 16 Mar 2020 Revised: 18 Apr 2020 Accepted: 20 May 2020

***Address for Correspondence**
Subrat Kumar Pradhan
Assistant Professor, Department of ECE,
Centurion University of Technology & Management,
Odisha, India
Email: subrat.pradhan@cutm.ac.in

ABSTRACT

Bluetooth Communication is a short-range wireless communication capable of transferring information between two devices. The Bluetooth module is connected to the ATmega328 controller and it transfers the information to a smartphone. This article concentrates on the use of the HC-05 Bluetooth module for transferring the information from the load sensor to the mobile phone wirelessly. The load sensor is going to relay the weight information to the controller and that information is passed on to HC-05 that transmits it to the paired smartphone. Various other wireless techniques used areRF wireless communication, satellite communication, broadcast radio, Microwave radio, Bluetooth, Zig-bee, etc. In this paper, we discuss the wireless communication using the HC-05 Bluetooth module, Bluetooth network topology, and interfacing Bluetooth with ATmega328.

Keywords:ATmega328, HC-05, Strain Gauge Load Sensor, HX711 Breakout Board

INTRODUCTION

Many times we observe that in business the employee and the employer have a very critical relationship: trust and trustworthiness. After a quite number of surveys, it was taken into account that a system should be developed looking at the business society problems. It became necessary to develop a system that can reduce the issues or it will give a solution to solve the problem. In business, people are investing their money to get some profit. If they will not get the profit then, there is no meaning of invest money. But in this business, various types of mistakes or cheats will be the sources of losses. So now a day's monitoring of business is one of the toughest jobs by staying away from the business station.Looking at such type of problem we decide to design something in an effective manner that can give a platform for people doing business.For a quantitative approach we all are using different types of devices in our daily life which gives us, a quantity of a product, it may be the weight of the product or maybe how many numbers

of a product. Because we all want to be sure of the quantity of all products at last. From the industrial revolution, everyone is busy, to expand their business with their field. But now the expansion of business is giving the headache to the owner in terms of monitoring the business. In the case of weighing business one man might not be able to monitor the business by staying everywhere at a time. And in the case of a vehicle transportation system, one man cannot monitor the weight contain by the vehicle by staying anywhere. So due to a lack of monitoring on business, cheating is a common issue in business. One can cheat the owner by giving the wrong information about weighing data. In the case of a vehicle, if we increase the gross weight then there will be damage to the vehicle. Overloaded transportation would greatly increase the cost of maintenance and repair.

So, to avoid such types of cheats and problems we designed a system, by which one can keep eye on their weighing business by staying anywhere. A weight scale is a device for measuring weight. Many weight measurement machines have been made for a different purpose. Our machine measures the weight of a product and it will give the weighing data to the owner at that instant. So that owner of a business can monitor the business by staying anywhere. So, our project is user-friendly.Our project is generally for the people who have a no. of business but due to lack of monitoring, face the loss in business and also for vehicle transportation to track the weight contain by the vehicles. According to our project, we can get the weight of particular things and send them to the owner immediately. The main thing in our project is to reduce cheating in the business and people can continue their business with most effectively and reliably.

We put forward this technique to establish wireless communication using Bluetooth for a short distance operation. We use the HC-05 Bluetooth module to demonstrate the experiment. The Bluetooth device is used to transmit voice and data at high speed using radio waves. It is used for short-range radio communications between many different types of devices, including mobile phones, computers, and other electronics. It has a range of around 10 meters and the data transfer rate of 3 Mbps [1]. We also use the load cell, a sensor to sense the weight and provide the controller with electronic information that is interpreted as the weight. This weighing system has to be accurate to be usable. For which it is important to calibrate it concerning a standard. While calibrating various filters are used to make the load value valid [2]. Such kind of arrangements can be used at places like continuous weight monitoring in various fields e.g. bee hive weigh monitoring [3], grain drying process [4], fish drying process, etc. This technique may be utilized in different other applications like movement tracking [5]. This strain gauge system works on the principle of Piezo resistivity [6].

The complete setupvery simple model and is divided into two parts shown in Fig 1, they are transmitter and receiver section. The transmitter section is equipped with the Processor Unit, Load Cell, LCD, and Bluetooth module. The receiver section is the Android Mobile Phone with a Bluetooth enabled app installed.

METHODOLOGY

As discussed the complete setup looks very simple. It comprises many units, like Atmega328 Processor, LCD, Load cell, Bluetooth module, and an Amplifier unit. The main unit is the Atmega328 Microcontroller which takes care of the entire system. It is connected to a 10 kg loadcell having 0.02 precisionshown in Fig 5. As the load cell produces a weak signal so we need an HX711 amplifier that allows easily to measure the weight to send the signal to the controller.A 16X2 LCD module is connected to the microcontroller using male-female or male-male jumper wire. The Bluetooth module is connected to the Rx/Tx pins of the ATmega328 microcontroller.The power bank is connected through a USB cable to provide the required voltage supply of 3~5 V to the Controller.A Bluetooth enabled Android Phone is required to receive data from the transmitter unit. The load cell amplifier HX711shown in Fig 3 comes in handy.The HX711 uses a two-wire interface, Clock wire,and Data wire for communication. Nowgeneral-purpose pins of any microcontrollers can hook up with the amplifier and can work easily to read data from HX711[7]. HX711 library is easily available and to be imported in the IDE. The hook-up guide referred for detailed information which

is shown in Fig 4. The full-bridge cells come typically in the four-wire configurationis shown in Fig 2. The wires to the top and bottom end of the bridge are the excitations, the wires to its sides are the signal. The voltage difference between Signal+ and Signal− is zero under zero load and grows proportionally to the load cell's mechanical load. The individual resistors on the bridge have a resistance of 350 Ω[8]. The bridge is typically electrically insulated from the substrate. The sensing elements are in close proximity and in good mutual thermal contact, to avoid differential signals caused by temperature differences. So the main advantage of this type of circuits is to provide accurate measurements.

To set calibration we need to first find out the known weight that can be used to calculate the calibration factor. The process of finding the exact calibration factor is crucial. Initially,after setupin Fig 6when the weight is applied to the load cell it shows some random weight in the serial monitor. This happens due to the non-calibration of the load cell. So load cell calibration is very vital to get an accurate weight. To get the solution to the problem we use a few water bottles with a known weight shown in Fig 7. First, taken one known weight and the found that the weight showing is 1.302Kg but the actual weight of the bottle is 1Kg. We try to equate weight known to us and the weight showing on the serial monitor by pressing a, s, d, f to increase calibration factor by 10,100,1000,10000 respectively and z, x, c, v to decrease the calibration factor by 10,100,1000,10000 respectively. We go on setting the calibration factor and then after equating the known weight of the bottle with a serial monitor showing weight. Then open the interface program page and set the founded calibration factor to the ATmega 328 UNO. The calibration factor obtained is 417710. Using this calibration factor the known weight of other water bottles is measured and compared with the actual weight to know the error. After doing this process several times and then comparing the known weight of the bottle with the shown weight of the bottle is the same, then the calibration factor determined to be accurate. Now the weight of any other stuff can be measure using this system once the calibration is done.

As the Serial monitor is available only when we are connected to the ATmega328 UNO with a serial cable. So to have a stand-alone system and to know the real-time weight of any material, LCD is interfaced with the setup. Depending on the no of characters, the display size will vary.So two rows and sixteen columns have been taken. The Displayshowsthe Calibration factor written in the first row and the second row of the LCD weight is displayed on the weight in kg with the tag of calibration factor which is set on the program is continuously shown on the display module.When some weight is placed on the load cell, it will automatically display itsweight on the LCD module. Similarly, when the weight is removed from the load cell, zero kg will be displayed in the LCD module shown in Fig 8. In the end, an android application named “Bluetooth Terminal” needs to be installed first on the android phone shown in Fig 9. After installing the application, open it, and scan for the Bluetooth deceives. It will show different devices available but we need to select the HC-05. After selecting the module and when the connection is established between the android phone and controller the weight (kg) - is shown, and also a tag of calibration factor is shown on the connected Android Phone. When we apply weight on the load cell, it changes from 0 kg to actual weight we applied and shown on the android phone. When we remove the applied weight from the load cell it will show zero kg on the android phone.

RESULT ANALYSIS

The main aim was to reduce the cheat in weighing business. Now we can able to reduce the cheat up to a certain amount. The small scale business will keep away from the cheat within a small area due to the Bluetooth Technology used and it will give the correct weight value to the owner.In successfully establishing the connection but being using a short-range communication device only a distance of 10m was achieved as it’s the range of the Bluetooth module in the discussion. The resolution obtained was accurate to the 2nd place of decimal. The communication taking place between the devices made it quite comfortable for users to check the weight within the range of the device. After the calibration it was recording the weight very well and accurately, it was quite robust and user friendly to use.

CONCLUSION AND FUTURE WORK

Like the two sides of the coin, the experimental set-up has some advantages as well as few drawbacks. The whole process is successful in setting up a wireless display for the machine. Since using Bluetooth the range was quite short. In the future, we can use other technology like LORA, ZIGBEE as per the requirement for further enhancement of range. Even we can use the Internet of Thing for further range and application enhancement, which will allow us to access the device remotely from anywhere in the world with a network

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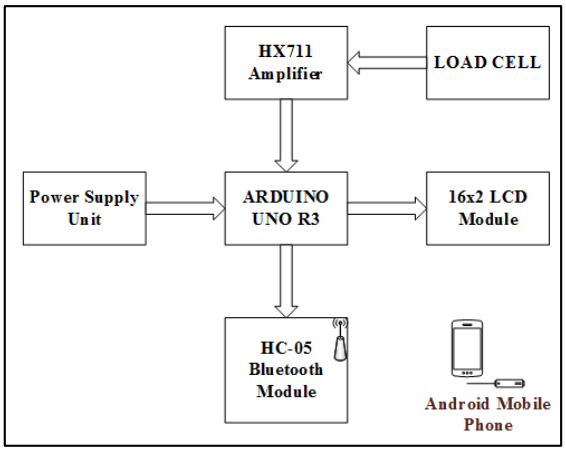

Fig 1: Block Diagram

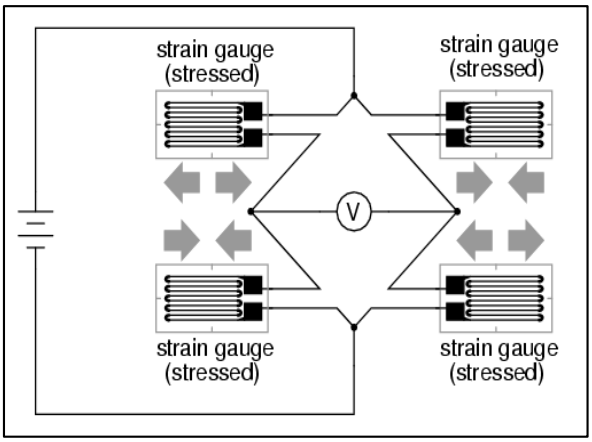

Fig 2: Full Bridge Strain Gauge Circuit

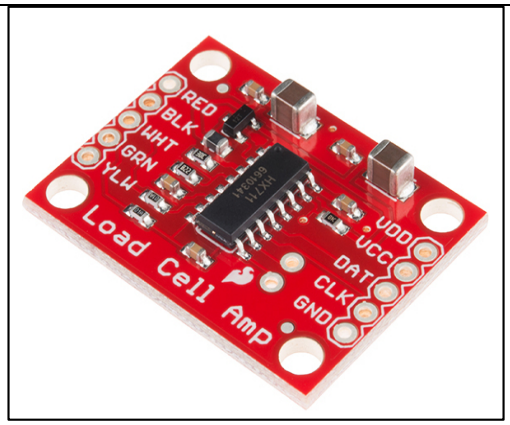

Fig 3: HX711 amplifier Breakout board

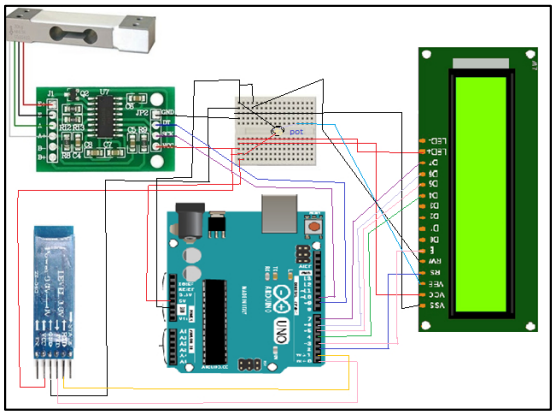

Fig 4: Hook-up Guide

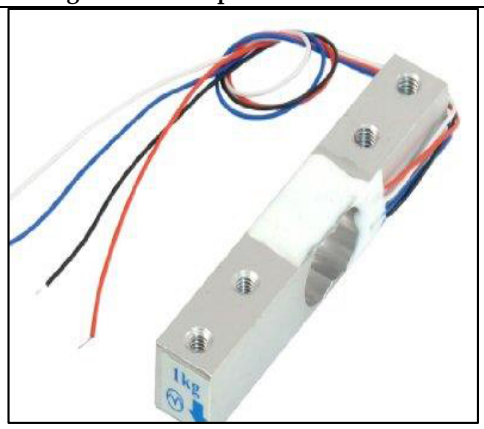

Fig 5: Load Cell

Fig 6: Calibration of the Experiment

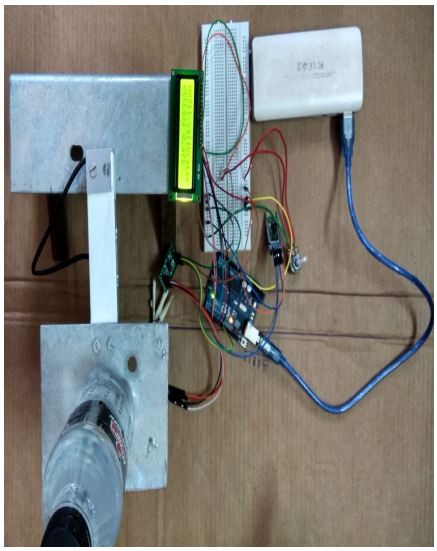

Fig 7: Displaying Weight on LCD

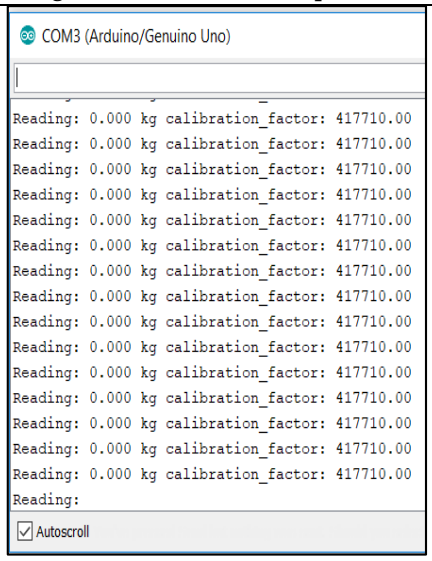

Fig 8:Zero-Weight after Calibration

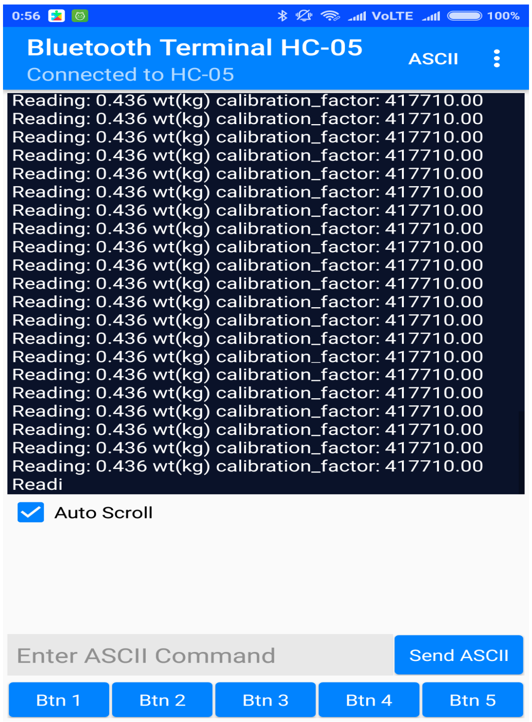

Fig 9:Result on Android phone

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Field Studies on Biology of Spider *Nephila maculata,* Near Dahuka Dam, Nayagarh Region, Odisha

Monalisa Das Jayasingh* and Siba Prasad Parida

Department of Zoology, Centurion University of Technology and Management, Odisha, India

Received: 15 Mar 2020 Revised: 17 Apr 2020 Accepted: 19 May 2020

***Address for Correspondence**
Monalisa Das Jayasingh
Department of Zoology,
Centurion University of Technology and Management,
Odisha, India.
Email: 19monalisa.dasjayasingh@gmail.com

ABSTRACT

Nayagarh district is famous for rich diversity of flora and fauna. Dahuka dam area, 5 km away from Nayagarh town was the study site. Spiders were well known for the most predatory group in the terrestrial ecosystem and for their exclusive sexual size dimorphism where males are very tiny than the females that is they show female gigantism. In this study, spiders were identified and recorded for morphological structure. This study was performed not only to document species of the small area but also find out distribution patterns, behavior of the spider *Nephila maculata* near Dahuka dam in Jadupur village in Nayagarh district, central part of Odisha, India.

Keywords: *Nephila maculata*, biodiversity, Dahuka dam, Nayagarh, Odisha.

INTRODUCTION

Nayagarh district is located in central part of Odisha state in India. Nayagarh district is surrounded by Phulbani district in west, Cuttack district in North, Boudh district in north-west, Khordha district in east and Ganjam district in south. The major rivers in the district are Mahanadi, Kusumi, Brutanga, Kuanria, Dahuka, Lunijhara, Duanto. Dahuka is a tributary of Kusumi flows near the Jadupur village which extends up to Banapur in Nayagarh district. The average area covered by Nayagarh district is 3890 km^2 among which 2080 km^2 area covered by forest. The giant golden orb spider *Nephila maculata* is a common species of spider of the invertebrate fauna that can be found in many parts of the world; specifically in the tropical and subtropical regions. The adult females are large in size with diurnal nature and build large, strong asymmetrical webs that are yellow in color made up of golden silk (Robinson and Robinson, 1973).

Female gigantism is a common phenomenon in *Nephila maculata*. They show male dwarfism. The evolutionary mechanism is well defined in golden orb spider; the mating system is based on male competition and sexual

cannibalism in females (Vollrath and Parker, 1992). The weaver spiders show sexual cannibalism that means the female have the ability to cannibalize the male. The males gone through cannibalism, when they mate for longer period and the cannibalistic females were less interest for mating. The cannibalism frequency is lesser in young males in comparison to the old males (Schneider and Elgar, 2001). The sexual cannibalism has a great impact on male morphology that leads to behavioral changes in spiders (Foellmer and Fairbairn, 2004). The shape, size and morphological variations can be well distinguished in naked eye. The adult female body length varies from just below 40mm to just above 50mm. The variation occurs due to variation in the length of the opisthosoma. I pair of legs are the longest, IV pair of legs are longer than II pair of legs where as III pair of legs are shortest (Robinson and Robinson, 1973).

The golden orb spiders are well known for their web building capacity with their silk which is very strong (Robinson et al., 1974). The size of the web is not less than one meter and it was built with the portion of prey capture, which is very near to the natural vegetation. *Nephila maculata* builds its web near the telephone poles, tunnels and trees above the ground (Harvey et al., 2007). The body color patterns of the spiders help in adaptation as well as in food capturing. The spiders capture their food in, sit and wait principle (Tso et al., 2002). The weaver spiders can accept or reject in their own way accordingly to their nature. The web structure defines the feeding history of the spiders (Herberstein and Elgar, 1998).

MATERIALS AND METHODS

Out of several places, gardens, the Dahuka dam area of the Nayagarh district, Odisha is selected for our study. The study period was carried out from October, 2019 to mid of March, 2020. The daily basis observations were carried out from morning 7 AM to 12 noon and in the afternoon 2 PM to 5 PM. The samples of female spiders were estimated by direct count. To observe and record behavioral sequences, binocular was used. Mobile phone Realme3 Pro was used for photography

RESULTS

Results of the study give some important features of the ecology and behavior features of *Nephila maculata*. The natural vegetation of the study area is directly proportional to the availability of prey for the spiders. The Dahuka Dam area of Nayagarh district is rich in vegetation as well as in diversity. These are not found in extremely grassland area. The adult female spiders built the wide web and they located at the bottom edge of the web. The webs were built with a proportion of prey capturing, which is found in the near vegetation. The size of the web varies from 1 meter to more than 5 meters that means the web size varies spider to spider as well as from day to day. In one adult female's web there are a number of male present; but it was occasionally found mature males with a web. The webs are always inclined in vertical manner. The webs were built up with silk, which are secreted from its spinnerets. The silk produced from the spinnerets are in liquid from when it was secreted, but then it hardens after drawn out. It is composed of protein and elastic in nature.

Female *Nephila maculata* is large with size of 40-50mm and male is too tiny with body size 4-6mm. Spiders are having several body parts, chelicerae, pedipalp, prosoma, opisthoma, claws, spinnerets, eyes. Four pairs of eyes as well as 4 pairs of legs present in the spiders. Parts of legs are coxa, trochanter, femur, patella, tibia, metatarsus, tarso and at the tip of the tarso there is dense hairy part known as gaiter. But in the later stage of the female the hairy structures are absent. From the morphological observation of the spider the outcome was that the I pair of legs are largest, III pair of legs are smallest, IV pair of legs are longer than II pair of legs but smaller than I pair. Female spiders are in black color with yellow lines and males are reddish orange in color, such colors helps in prey capturing. That means body coloration helps in predation activities. It was noted that the small males move faster than the big one; that means the small spiders are more chances of mating in comparison to the bigger one. It was observed that in the mating period

male's opisthosoma became larger exclusively. There is male- male competition; that means one adult female can mate with more than one male. In the female webs a large number of males present throughout the year. It was observed that the male number increases in the later weeks of study. It was recorded that the number of males present in the five webs during the study period, it is represented graphically. *Nephila maculata* is having a large number of prey ranges. Their food consists of mainly butterflies, moths, dragonflies, grasshoppers.

DISCUSSION AND CONCLUSION

Biology of *Nephila maculata* was studied by several biologists. The geographical conditions, habit, habitat have a great impact on faunal diversity. The availability of food and food intake depends on the study area this result is similar to the work done by Fritz Vollarth (1988). The biological details of the wood spider, their habitat, phylogenetic analysis, morphological behavioral character, mating activity are analyzed (Kuntner, 2005; 2006; 2007). The body coloration revels that, it helps in predation behavior. The insect catching rate is directly proportional to the morphological coloration. The foraging is also affected by the body coloration (Robinson M. H. and Robinson, 1970). In this study, the ecological analysis is elaborated. The work is constituted magnificent idea on web structure, size of web, prey capturing, weekly population distribution and tabulation, prey predator association that means predatory behavior, male female comparison and individual number with seasonal variation, body coloration, mating, and courtship of *Nephila maculata* (Robinson and Robinson, 1973). From the above information and data concluded that the report written over the world wide species of *Nephila maculata* is match with *Nephila maculata* in Dahuka dam area of Nayagarh.

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Fig-1 Study site

Fig-2 Female

Fig-3 Male

Fig-4 Both Male and Female

Fig-5 Spinneret webbing

Fig-6 Prey Capture

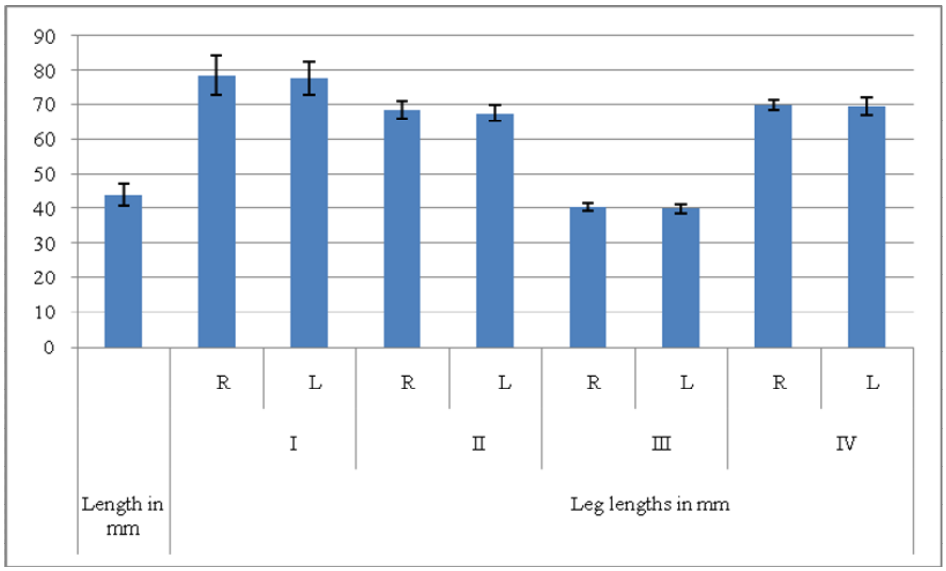

Fig-7 showing (Mean±SD) body size of adult female *Nephila maculate* with legs

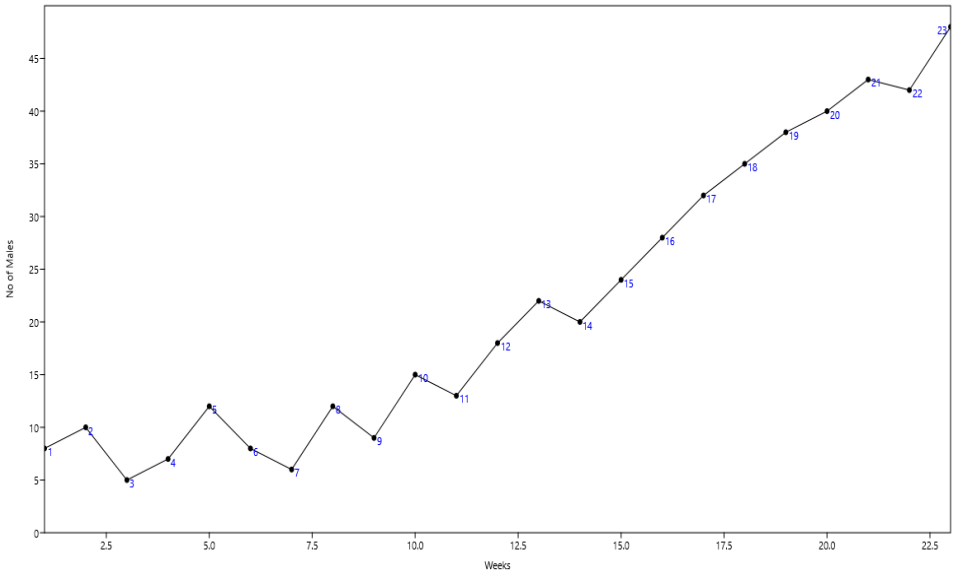

Fig-8 showing weekly distribution of males found in webs of female in study area

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

PLL Circuit using 45nm Technology for Wireless Domain

Sandipan Pine

Department of ECE, Centurion University of Technology and management, Odisha, India.

Received: 12 Mar 2020 Revised: 15 Apr 2020 Accepted: 20 May 2020

***Address for Correspondence**
Sandipan Pine
Department of ECE,
Centurion University of Technology and Management,
Odisha, India.

ABSTRACT

Phase Locked loop is a basic building block for wireless communication. People have adopted various methods to construct PLL, for example digital simulation or analog simulation following different numerical or logical analysis. A whole lot of multiple systems were adopted and analysis has been done through uncertain parameters. In real world we have demand of a crispy, cheaper and faster design. These demands can be easily obtained by application of CMOS technology. Here to design the circuit microwind 3.1 software is used in 45 nm technology. To adopt this technology high-k gate oxide is used. The gate material taken is metal and the interconnect dielectric is very low-k.

Keywords: Phase locked loop (PLL), voltage-controlled oscillator (VCO), CMOS (Complementary Metal Oxide Semiconductor Field Effect Transistor), RF(Radio Frequency), DSP(Digital Signal Processing), ODD(Optical Disc Drive)

INTRODUCTION

PLL is having huge applications in different fields such as embedded system, 4G and 5G communication, wireless area. They are being used in microwave frequency in the area of phase recovering and synthesis. Two separate signal generators are matched in frequency with this device as phase can be maintained at desired rate with the help of PLL. PLLs are preferably accepted over the other available techniques such as injection locking due to its adaptability. In versatile application like data and clock rehabilitation of communication system, creation and dispensation of clock in ARM processor, frequency blending in wireless domain monolithic PLL was a choice. Conventional RF engineering may stay as a basic technology for these wireless transmission as long as DSP technology will be able to handle completely the RF filtering and RF creating. To achieve up conversion of departing signal and down conversion of the accepted signal a wireless transceiver certainly need to produce a broad span of frequencies. As shown in fig 1 PLL is system with feedback and it comprises of a VCO, a loop filter, one phase detector. This versatile device is frequently applied in telecommunication related instruments as our cellphones. A cellphone may contain 5 phase locked loops. PLL is used to control the speed of a motor hence we found application

in DVD player as optical disc drive(ODD). A PLL can be both either analog or digital. The basic block diagram is shown in fig-1.

As the block diagram describes the phase detector gives an output which is the phase difference between the reference input signal and the PLL output. If this difference of phase is 90°, phase detector will generate a regular square wave. But if the phase difference is any value but not 90°, irregular output will be generated. This error signal will control the frequency of the oscillator, as it is voltage controlled, But before that the voltage signal need to be filtered through loop filter. The function of this filter is not eliminating noise but it changes the difference of phase into an analog voltage signal which will control the VCO and amplitude will be same as VCO. Phase detector can catch a fast change in phase and the filter is assigned to transfer this fast change to a slow signal that will be able to control the VCO. VCO is the utmost essential element of this design because this will generate clock for PLL. VCO operates at very high frequency and it consumes maximum power. CMOS technology helps here to reduce the power requirement. There are a whole lot of techniques which synthesizes the frequency but PLL is always a commanding technique in wireless domain. The ability to fabricate complete PLL circuit on integrated circuits(IC) certainly opened the solution of cheap, low power, compact design which is a need in industry.

RELATED WORK

PLL was defined initially by Appleton [l] in 1923 and de Bellescize [2] in 1932. Progress of PLL was shown in good way in communication area. Theoretically PLL was decscribed In the late 1970's [3], [4], [5], but due to lack of understanding it was very less used. In the late 70's when integrated circuit comes in the market PLL again got fast development in communication domain. From that time onwards PLL has progressed a lot now it is being used professionally in high precision instruments. Performance is enhanced, reliability is improved and the instrument become more precise.In 70's initial attention wast to control the speed of motor using [6]. After that PLL has seen very fast change for ac and dc motors' servomechanisms using analog PLL IC's [7]. In recent past, the fastest development of digital era demands the implementation of PLL using digital technology. This need to develop new controller with new technology. [7]-[13].

SIMULATION SETUP

This paper describes the implementation of total PLL circuit in Microwind 3.1 software. This software supports CMOS 45 nanometer technology. In this technology drawn channel length is 45nm and the effective length is 25nm. This version uses a metal gate and the dielectric used here is SiON. SiON is a ultrathin dielectric with negative bias temperature instability (NTBI). This technology is used to design any type of very fast device and hence is used to design this PLL. Microwind 3.1 allows us to design and simulate any circuit at the physical level. Parameter extraction is automatic in this software hence analysis is easier and the characteristics curve can be generated in line with simulation.

EXPERIMENTAL RESULTS

Layout is designed with the help of microwind 3.1 which is shown in fig-2. All the 45 nm design rules are followed and the simulation is performed by keeping all 45nm precautions in care. Simulation result is shown in fig-3. Simulation shows frequency versus time plot. Frequency here is 5GHz. And the main advantage here is power consumption is very low. As per simulation result this design takes 50.243 μW power which is vary less when compared to conventional PLs.

CONCLUSION

PLL circuits are extensively used in vary sophisticated instruments like wireless domain, any frequency synthesizer applied in anywhere starting from cell phone to missile tracking. So the main aim was to design a PLL which will be robust, very small in size, consumes very less power . Using of VLSI in this has solved all the problem at a time. Microwind 3.1 allows the circuit design in physical level and it helps to extract the parameter like power consumption, frequency response at a glance. 45 nm technology has helped to achieve very robust and small design. The circuit can be further improvised with the help of high end cad tools. We can extract more parameters and analyze them to achieve a very high performance PLL.

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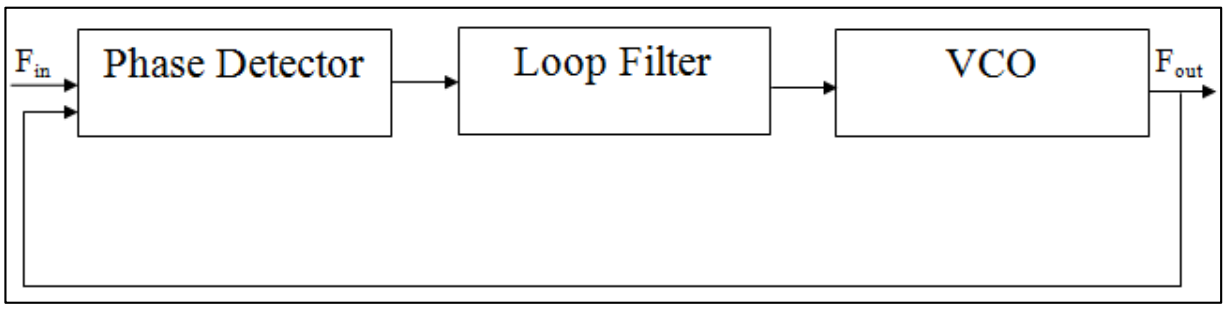

Figure 1: Basic building block of PLL

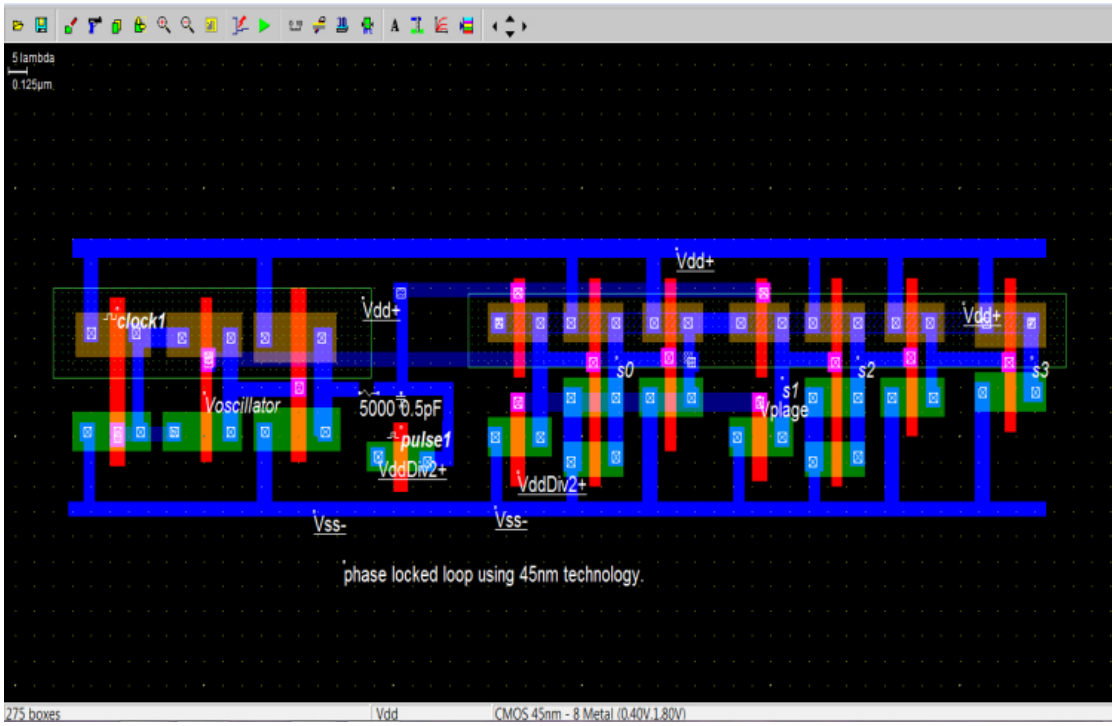

Fig 2 – Layout of Phase Locked Loop

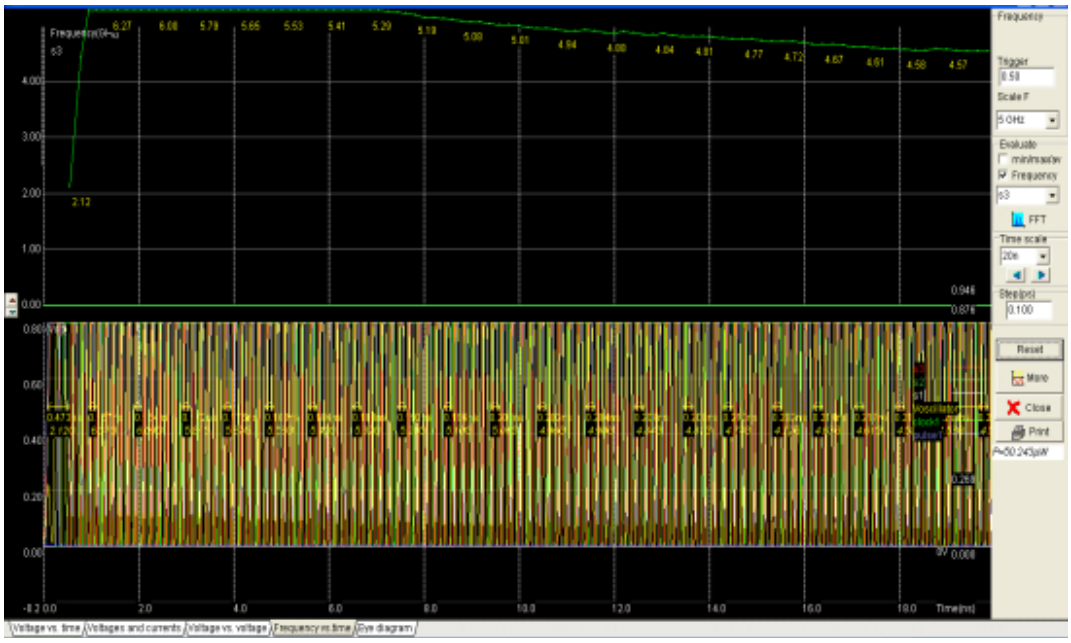

Fig: 3-Simulation result

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Burrowing and Ecological Behavior Field Observation of *Ocypode macrocera* on the Sahana Beach Near Debi River Mouth Confluence, Odisha

Sibani Nanda* and Siba Prasad Parida

Department of Zoology, Centurion University of Technology and Management, Odisha, India.

Received: 13 Mar 2020 Revised: 16 Apr 2020 Accepted: 19 May 2020

***Address for Correspondence**
Sibani Nanda
Department of Zoology,
Centurion University of Technology and Management,
Odisha, India.
E.mail: nan45nda@gmail.com

ABSTRACT

Burrowing and ecological behaviour of *Ocypode macrocera* was studied on the Sahana beach near Debi river mouth confluence of Puri, Odisha from December, 2019 to mid of March 2020. This study shows that Bay of Bengal provides regular tidal influences to this place. Burrows constructed by *Ocypode macrocera* is highly species specific and is singly occupied. Four types of burrows were identified when casting by POP was done having shapes like 'I', 'J', 'U' and 'semi-U' of varying sizes. These crabs are active both during day and night time. Scavenging nature of this species helps in balancing the shore ecosystem. Varying temperature gradient, salinity near river and sea confluences, air, water and other environmental fluctuations helps these tiny creatures to develop adaptive nature.

Key words: Red Ghost Crab, *Ocypode macrocera,* burrow, Beach ecology,Debi river, Odisha.

INTRODUCTION

Marine invertebrates like crabs of genus *Ocypode* (Weber ,1795) are semi- terrestrial and are typical inhabitants of tropical and sub-tropical sandy beaches (Dahl, 1953; Hedgepeth, 1957) there they live in noticeable burrows (Vannini, 1980a). Worldwide many aspects of the *Ocypode* species have been studied (Vannini, 1976; 1980a, Little, 1983; Atkinson & Taylor, 1988).Some studies have also been done in the eastern coast of India on the distribution pattern of brachyuran crabs in Chilika lagoon, Odisha (Sahoo et al., 2013).Also on ecology and behaviour of Ghost Crab i.e *Ocypode macrocera* in the Sandy beaches of Sagar Island, Sundarban (Haque & Choudhury, 2014).But comparatively very few studies have been done specifically on this *Ocypode macrocera* species.Supra-littoral sandy beaches are the habitat of *Ocypode macrocera* in Odisha. In this particular study the burrowing and ecological

behavior and shape & size of their burrows have been studied in the Sahana beach near Debi river and Bay of Bengal confluence in PuriDistrict,Odisha.

Burrows are made by a variety of species ranging from tiny invertebrates to huge vertebrates. It mainly provides shelter, helps in storing food and avoids extreme weather conditions. Burrowing is also helpful in many other aspects like protection from predators, from human disturbances and from harsh climatic conditions (Fellows, 1966, 1975). In case of Ghost Crabs they show multifunctionality i.e using the same set of appendages for different purposes like capturing pray, running after 4mts per second in sandy environment which make them one of the fastest land invertebrates and digging complex burrows. They use olfactory and visual hints to return to their burrows which is commonly seen in burrowing species(Huges, 1966;Lucrezi&Schlacher, 2014) and therefore show high fidelity to their own burrows.

MATERIALS AND METHODS

The study was conducted at the Sahana beach near Debi River and Bay of Bengal confluence which is located at about 69kms from Puri, Odisha; during December 2019 to mid of March 2020. The sandy beach of fine to very fine sand extends throughout the eastern coast of Puri district providing suitable burrowing places for the Ocypodes. Total four quadrates were taken at random places and numbers of each burrow were counted. The diameter of each burrow opening was measured using Vernier Caliper and openings of the burrows were arranged in six size categories >30mm, 31-39mm, 40-50mm, 51-60mm, 61-69mm,70-79mm . To know the shape and size of the burrows, casting procedure was followed. Casting was done by pouring plaster of Paris(POP) slurry (water: POP=1:2) into the burrow entrance randomly in the four quadrates. The slurry was allowed to dry for about an hour. Then the dried casts were excavated very carefully by hand and their shape and dimensions were measured. During morning hours the *Ocypodes* were caught by the help of fishing net and hand when they emerged from their burrows and put in hollow plastic buckets. Then numbers of male, female and juvenile were counted by measuring the carapace length and shape by visual observation. Sex ratio was calculated for male versus total crabs (M:T) for the four quadrates, Behavioral observation was done like feeding behavior, habitat preference and burrow architecture.

RESULTS

Habitat preference

These marine semi-terrestrial invertebrates preferred supralitoral zones of tropical and sub-tropical sandy beaches, estuarine and sand flat. They play around detritus based tidal influences and staying near the region of low-laying land subjected to occasional tidal action. Generally it burrows deep hole and stay inside during the hot time of the day to keep itself cool.

Burrowing behaviour

The *Ocypode macrocera* constructs specific borrow in the supra littoral zone and each burrow have only one occupant .Ocypode as the name suggests that the animal have first pair of unequal chelipeds with major involvement of left chela and these creatures are swift. The second and third pair of legs pulls the dirt loose and carries the sand mass outside of the burrow making a pile then in some cases setae present in the base of the second and third pairs of legs do sand sorting before excavating more sand from the hole.

Burrow morphology

The burrows having opening diameter more than 30mm were cast successfully than having smaller diameter. About 13 intact burrow casts were studied. The shapes of the casts were I, J, semi-U and 'U'as mentioned in Table-1. All the burrow entrances were oriented towards the sea whereas ended in the opposite direction of the sea. J shaped burrows are found in maximum numbers. The largest burrows were those which are maximum distance from the

sea as the depth of water is higher there in comparison to near the sea. The burrows end about 1cm above the water table.

Behavioural observation

These Ghost Crabs are active both during day and night time but are significantly more active during night time than during day time. Burrow excavation is done mostly in the first hours the day light. The size of the sand pile near the hole indicates the hole size i.e burrows of crabs which does not relocate the excavated sand to a further location were significantly larger than others and are generally of male crabs.

These invertebrates are scavengers. They are generally solitary feeders but in some instance the feeding behaviour changes. The are found to be feeding on a single large carcass of turtles and other animals. Sometimes the predate eggs of turtles and egg shells are found near the burrows. They eat on dead fish and also leftover fruits etc. during other times.

DISCUSSION

The tropical Savanna climate (Aw; Koppen Geiger Climate classification system), temperature variation [(36^0C or 97^0F) maximum during summer to (17^0C or 63^0F)during winter whereas annual temperature is 26.9^0C or 80.4^0 F, salinity of water near the estuaries and sandy beaches of Debi river confluence provide suitable conditions for the growth of *Ocypode* in large numbers. *Ocypode macrocera* are widely dispersed around the coast of Odisha due to the favorable conditions provided by Bay of Bengal. The supralittoral zone helps in providing cool temperatures to the burrows, also the summer temperature of Bay of Bengal is usually between 22^0C to 31^0C whereas salinity is low about 31 ppt in comparison to the Arabian Sea because the Bay receives lots of fresh water from the runof east flowing rivers. Both the aspects are important for providing suitable conditions for burrowing which directly provides the ghost crabs protection form environmental extremes which has been discussed by Vannini (1980a) &Esloky et al. (1988). There are no significant differences of crab density throughout the study period. The depth of the burrows increases with distance from the sea reflecting the increasing depth of the water table of sea.

The burrows terminates about 1cm above the water table. The burrow shape variation are seen in a number of Ghost Crab species which has been reviewed by Vannini(1980a) which described that the burrows of juveniles were either I,J of U shaped whereas those of adults showed greater variability & include Y and Spiral configuration in addition to I,J and U shapes. Each species show particular burrow architecture. Maximum burrow architecture of *Ocypode macrocera* was found to be 'J' shaped. Similarly Katz(1980) &Montegue(1980) also described the Uca species generally show either L or J shaped burrow.

Our study showed that this *Ocypode macrocera* species are active both during day and night time. Activities in Ocypode spp are found to be mostly nocturnal as reviewed by Vannini(1976) shown is daily activity review.Ocypode species eat on various things and the way of feeding is also different. The characteristic pellets were on the sand surface nearby the burrows indicates the feeding behaviour that they deposit the feed. The *Ocypode macrocera* comes under scavengers because they feed on animal carcases, left over fruits on the shore and remains of picnic i.e vegetable matters. They are also predators, preying upon the eggs and hatchling sea turtles. Some species take plant material ans some are active predators (vannini, 1976, 1980b; Wolcott, 1978; Eshky, 1988). Observations show that the *Ocypode quadrata* species burrows at dawn (Milne & Milne, 1946). Similar habits have been found in the study site too.

CONCLUSION

In conclusion, it could be said that, this particular study shows that *Ocypode macrocera* display varying degree of behaviour like burrow morphology, feeding and habitat selection in the study site. Further investigation is required to determine the exact reasons and influence of environmental factors on the burrow morphology and ecological behaviour of this species. This preliminary investigation serves as primer for future works on various species of the genus *Ocypode* and other studies in Odisha coast. Antropogenic impact, road ecology, effect of climate change is yet to be done. These studies will be helpful in determining the importance of this species in the beach ecosystem and also its impact on the environment in future.

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Table -1 different shapes of borrows during the field study

Quadrate no.	No. of burrows	J- shape	I- shape	U-shape	Semi U shape
A	3	1	0	1	1
B	5	2	2	1	0
C	2	1	0	0	1
D	3	2	1	0	0

Table-2 Observation of burrows used by juvenile male and female *Ocypode* in the field study

Quadrate no.	No of burrows	Juvenile	Male	Female
A	20	7	6	8
B	12	3	5	4
C	5	2	1	2
D	18	6	8	4

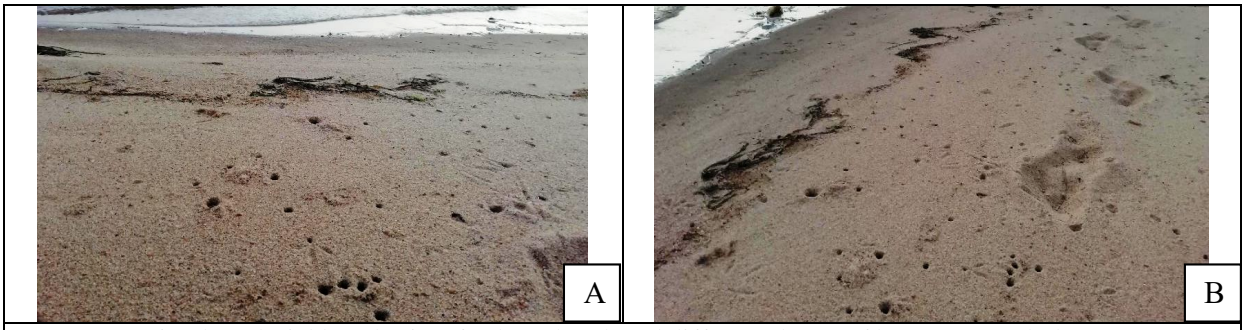

Fig-1(A&B) Field study site of Sahana beach and different shapes of borrows morphology

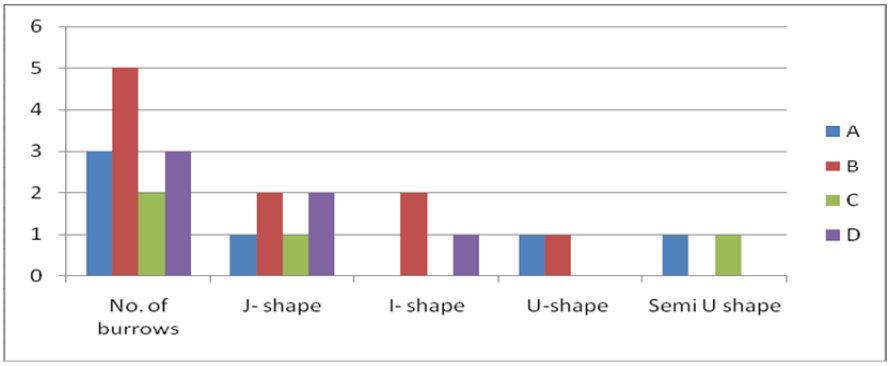

Fig-2 showing different shapes of borrows during the field study

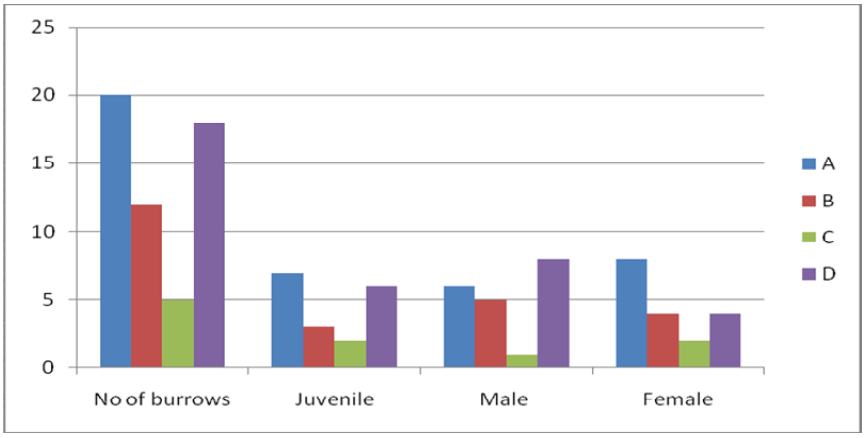

Fig-3 showing burrows used by juvenile male and female in the field study

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

An Investigation of Correlation of Morphometric and Meristic Traits of *Otolithes ruber* (Bloch & Schneider, 1801)

Prangya Parimita Nath and Siba Prasad Parida*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Bhubaneswar, Odisha, India.

Received: 09 Mar 2020 Revised:11 Apr 2020 Accepted: 13 May 2020

***Address for Correspondence**
Siba Prasad Parida
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Bhubaneswar, Odisha, India.
Email: paridasp@gmail.com

ABSTRACT

In present investigation morphometric and meristic characters of *Otolithes ruber* of family sciaenidae occurring mainly throughout the Western Indian Ocean, except possibly the Red Sea. This study was conducted to investigate the stock differentiation among the fish population. The sciaenids contribute 6% of the total landing and 22% of the total demersal catch of India. In the present study huge amount of samples of *O. ruber* were collected from Gopalpur on Sea beach and were taken to the lab of EBRC, Gopalpur. Out of all the collected samples, 15 specimens were randomly selected for further evaluation. This work was conducted from 4th February, 2019 to 17th February, 2019. During this study, 13 morphometric traits and 1 meristic trait were considered. Then, mean and standard deviation of the morphometric and meristic traits were performed by software statistica. Correlation coefficient in between HL and all other morphometric traits were analyzed. In this analysis some of the morphometric traits showed similar correlation with HL and one morphometric trait, i.e., Pectoral Fin Base Length (PFBL) showed negative correlation with HL. PAST-3 software used to analyze the variance among the morphometric traits, which shows no significant differences. Meristic character measurement shows few variations among the samples which is due to certain environmental changes during growth. This study revealed certain morphological characters which easily identify the TIGER TOOTH CROAKER " *Otolithes ruber*".

Key words: *O. ruber*, Preserve, Morphometric, Meristic, Statistics, Fishes.

INTRODUCTION

Indian marine fishery goes through a very interesting phase with several issues regarding the achievement of sustainable production which may assure its long term survival. The world marine fisheries scenario has over the

years, undergone vast changes due to the technological advancements made in the harvesting of the resources and in the post-harvest sectors and also increasing demand for seafood for growing human population because seafood forms one of the major sources for earning foreign exchange. The major fisheries of Indian waters are expected to be in a stage of transition from the current, fully exploited phase to the over exploited phase which may lead to collapses in the future (Devaraj And Vivekanandan, 1999). Sciaenids, commonly known as jewfishes/ croakers/ grunters are widely distributed in different parts of the world including tropical and sub-tropical waters of Indian Ocean (Druzhinin , 1974) and Atlantic Ocean (Lowe-McConnell, 1962). Fishes of the family Sciaenidae occupy an important position among the demersal fishery resources of India, forming 18% of the total demersalfishlanding in the country (CMFRI, 2014).

Poor understanding of the fish and fishery management can lead to dramatic changes in the biological attributes and productivity of a species. (Altukhov, 1981; Ricker, 1981; Smith *et.al.*, 1991). Studies on food and feeding habits of fishes help in understanding the various aspects of the biology of fishes such as, feeding adaptations, growth, fecundity, migration and seasonal variations in the conditions etc. Sea fishing has been an occupation with the coastal people from time immemorial. The fishing industry was developed solely by the fishermen over centuries. A meaningful move was made towards mechanization since independence and the progress achieved raised the status of industry by its recognition as a primary area of growth. In the early Nineteen Sixties, small mechanized vessels were introduced and in the Nineteen Seventies, marine fishing activities rapidly expanded in the continental shelf area. In the Nineteen Eighties, motorization of country crafts became popular and by employing these crafts with new gears, the exploitation of marine fisheries was accelerated. As the fishing fleets increased in number, stagnation in fish catch was felt and the profit from fishing begin to diminish.

Determination of age and growth of fish population is very important in fishery management. It helps to understand the composition of fish population: role of a particular brood or age groups in fluctuation of catch and length/age at capture and maturity. Many species of fish are consumed as food in virtually all regions around the world. Fish has been an important source of protein and other nutrients for humans from time immemorial. A seafood allergy is a hypersensitivity to an allergen which can be present in fish, and particularly in shellfish. This can result in an overreaction of the immune system and lead to severe physical symptoms. Most people who have a food allergy also have a seafood allergy. Allergic reactions can result from ingesting seafood or by breathing in vapours from preparing or cooking seafood. The most severe seafood allergy reaction is anaphylaxis, an emergency requiring immediate attention. It is treated with epinephrine. Some species of fish, notably the puffer fugu used for sushi, and some kinds of shellfish, can result in serious poisoning if not prepared properly.

These fish always contain these poisons as a defense against predators; it is not present due to environmental circumstances. Particularly, fugu has a lethal dose of tetrodotoxin in its internal organs and must be prepared by a licensed fugu chef who has passed the national examination in Japan. Ciguatera poisoning can occur from eating larger fish from warm tropical waters, such as sea bass, grouper, barracuda, and red snapper. Scombroid poisoning can result from eating large oily fish which have sat around for too long before being refrigerated or frozen. This includes scombroids such as tuna and mackerel, but can also include non-scombroids such as mahi-mahi and amberjack. The poison is odourless and tasteless. Sea-bound mammals are often treated as fish under religious laws – as in Jewish dietary law, which forbids the eating of cetacean meat, such as whale, dolphin or porpoise, because they are not "fish with fins and scales"; nor, as mammals, do they chew their cud and have cloven hooves, Jewish (kosher) practice treat fish differently from other animal foods. The distinction between fish and "meat" is codified by the Jewish dietary law of kashrut, regarding the mixing of milk and meat, which does not forbid the mixing of milk and fish. Modern Jewish legal practice (halakha) on kashrut classifies the flesh of both mammals and birds as "meat"; fish are considered to be parve, neither meat nor a dairy food. The preceding portion refers only to the halakha of Ashkenazi Jews, Sephardic Jews do not mix fish with dairy.

Today, fish is the only important food source that is still primarily gathered from the wild rather than farmed—with marine capture historically accounting for >80% of the world's fish supply. Total landings from marine fisheries increased ~5-fold in the 40-year period from 1950 to 1990 (Mace, 1997). More recently, however, capture fisheries

have not been able to keep pace with growing demand, and many marine fisheries have already been over-fished. In the period 1990–1997, fish consumption increased by 31% while the supply from marine capture fisheries increased by only 9% (FAO, 1999). This has intensified the pressure on the harvesters, which has translated into increased pressures on, and over-fishing of, many commercial fisheries. Nearly half of the known ocean fisheries are completely exploited (FAO, 1999), and 70% are in need of urgent management (MacLennan, 1995).

For taxonomic and evolutionary studies, the morphology of fishes is the main source of information. For morphological study various characters are used and these characters are categories into morphometric and meristic characters. (Cailliet, *et al.,*1986). The fishes of the family Sciaenidae, commonly known as Croakers or Jewfishes are widely distributed in different parts of the world , particularly in the tropical and sub- tropical waters of Indian (Druzhinin, 1971), Atlantic (Longhurst, 1964), Lowe-McConnel, 1966) and Pacific Oceans (Skajesberg,1939). *Otolithes ruber* (tiger tooth croaker) is known as the snapper knob in South Africa, corvin a dentuça in Mozambique, jew fish in India and the Malindi herring in Kenya. The present study gives information to fishery biologists about Morphometric and Meristic characters of the fish, *Otolithes ruber* collected from Gopalpur on Sea and samples were all measured at Zoological Survey of India**.** This will help to plan further conservation strategy for this fish.

MATERIALS AND METHODS STUDY AREA

The study area was restricted to Gopalpur, Odisha under EBRC, ZSI. Specimens of *Otolithes ruber* were collected from Gopalpur sea beach, Gopalpur. These specimens were contributed mainly by commercial catches of trawlers, but were kept in good condition.

Sample Collection

The present study was conducted in EBRC, ZSI, Gopalpur on Sea, Odisha from 4th February to 20th February. Specimens, without any physical damages were collected randomly from the selected fish landing centers. The collected fish specimens were placed in insulated box with ice packs. The cover was sealed with an insulated tape and was transported to the laboratory of EBRC.

METHODOLOGY

Specimens of *Otolithes ruber* (n=15) were collected for evaluation of morphometric and meristic traits having body length 19cm-21cm. 15 morphometric and meristic characters were measured. (Table-1) where morphometric characters were measured with the help of scale, tailor tape and divider and meristic characters was done byelectric microscope. The terminology of cephalic spines and the morphometric traits was followed (Knapp 1983, Murty 1975). The statistical analysis and description of morphometric ratios are tabulated in (Table-2) for comparison. Mean and standard deviation of morphometric and meristic traits were performed by software statistica. An analysis of variance (ANOVA) was performed on morphometric ratios to examine significant difference if any by using PAST 3 statistic software.

MORPHOMETRIC CHARACTERS EVALUATION

Morphometricparameters of fish species has major role to ensure whether there is any disparity between same species of different geographic region. (Naeem *et. al.*, 2012). Morphometrics can be used to quantify a trait of evolutionary significance, and by detecting changes in the shape, assume something of their ontogeny, function or evolutionary relationships. 15 specimens out of all collected specimens of different body length were washed in order to clean it perfectly and to check any damage in the samples. The entire specimens were found in a good physical condition. The specimens were placed in a clean tray and measured the morphometric traits of each of the

fish one by one in another open tray. A scale graduated up to 15 cm and also used a geometric divider for measuring traits like eye diameter, pectoral fin base length etc , for obtaining accurate value and also used a tailor tape and a thread for measuring traits like total length, standard length etc.

Meristic Characters Evaluation

Meristic counts are countable characters. Examples of meristic counts are number of fin rays, number of lateral line scales, number of opercular spines, etc. Meristic characters are used to measure intra-specific variations among the species. Among all the traits mentioned above I had only counted the number of lateral line scale present along the body axis of *Otolithes ruber*. First, I took a specimen under the electric microscope, adjusted it well with fine adjustment, then with the help of a thin needle I counted the number of lateral line scale along the body axis under the microscope.

Statistical Analysis

Statistical analysis a component of data analytics used for evaluation of collected data. First put the data in Microsoft EXCEL in order to make a sheet then found out the mean and standard deviation using the data sheet of the morphometric traits of all the 15 evaluated specimens, of *Otolithes ruber* with the help of software statistics and I also evaluated the correlation in between the head length (HL) and all other morphometric traits. A correlation coefficient is a statistical measure of the degree to which changes to the value of one variable predict change to the value of another. In positively correlated variables, the value increases or decreases in tandem. Correlation coefficients are expressed as values between +1 and -1. PAST 3 software also used to analyse ANOVA in order to determine the variation among the mean of the morphometric traits. Several sample test conducted such as one way ANOVA, Residuals, tukey's pairwise, kruskal-wallis, Mann-whitney pairwise and Dunn's post hock to explain the variation of the traits. Abbreviations like D, P, V, A, C are respectively used for dorsal fin, pectoral fin, ventral fin, anal fin and caudal fin.Spines are written using Roman numericals.

RESULTS AND DISCUSSION

Species Description: *Otolithes ruber* (Bloch and Scneider, 1801)
Synonym: *Johnius ruber* (Bloch & Schneider, 1801); *Otolithes argenteus* (Cuvier, 1830); *Otolithes rubber* (Bloch & Schneider, 1801); *Otolithoides ruber* (Bloch & Schneider, 1801); *Otolithus argenteus* (Cuvier, 1830); *Otolithus orientalis* (Seale, 1910); *Otolithus ruber* (Bloch & Schneider, 1801); *Otolithus tridentifer* (Richardson, 1846); *Otolithus versicolor* (Cuvier, 1829)

DESCRIPTION

Average head length of the specimen of *Otolithes ruber* examined is 6-7 cm, total length is 22-23 cm, eye diameter was found to be 1-1.5cm, Preopercle scarcely denticulated. Teeth-on either side of the symphysis of the upper jaw a pair of large canines, an inner villiform and, and a row of outer teeth conically curved occasionally even between the canines; in the lower jaw a central (sometimes a second) curved canine with 8 few, villiform teeth behind it, and 8 lateral row of distantly placed conical teeth. Fins- dorsal spines slender, second and third 1/2 to 4/9th the height of body and from 1/2 to 2/3rd bigger than the rays. The ventral does not reach quite halfway to the vent. First anal spine minute or wanting, the length of the secondabout 2/3rdof the first ray, base of anal fin about 1/6th of the soft dorsal. Caudal- wedge-shaped. Scales- cycloid anteriorly and ctenoid posteriorly. Lateral lines- the tubes arborescent posteriorly. colour- brownish red, shot with silvery and white, sometimes glossed with gold in lower third of body.

First dorsal stained black at its edge, sort dorsal and anal with greyish outer margins; pectoral, ventral, and anal yellow.

MORPHO-MERISTIC DIFFERENTIATION

Countable, morphological structures (fin rays, gill rakers) have served as an important basis for identifying fish stocks in the past. Countable data are discrete, thus facilitating statistical analysis. Meristic characters are controlled by both genetic and environmental factors, in unknown proportions (Barlow, 1961). However, consistent environmental influences have the potential to provide stock discrimination where a weak genetic divergence exists between actual stocks. The meristic characters were counted following the widely accepted criteria provided by Hubbs and Lagler (1958). All counts and measurements were taken from the left lateral aspect of the fish. FAO species fact sheet describe *Otolithes ruber* with its meristic characteristics such as two separate dorsal fins, the first with 9 or 10 spines, followed by a notch, second with 1 spine and 27 to 30 soft rays; anal fin with 2 spines and 7 soft rays, lower gillrakers 8 to 11. An important aspect of meristic data analysis is that the data obtained are discrete, not continuous, as results from analysis of body dimensions, that is, morphometrics (Waldman, 2005).

In the present study, meristic character of 15 specimens of the species of *Otolithes ruber* were compared. Lateral line scales of the 15 specimens were compared; there found no certain notable differences except their number. This change in the number of scales is may be due to their adaptation to various environmental conditions. The morphometric traits have not been intensively used for species distinction by earlier researchers. Some researchers have integrated morphometric traits scaled either to head length (HL) or standard length (SL). In the present study, compared 11 morphometric traits scaled to head length (HL) for determining the highlighting differences in between all the 15 considered specimens of *Otolithes ruber.* In study, correlated the head length of *Otolithes ruber* with all other morphometric traits (11) and found a similar correlation between HL/TL; HL/PDL; HL/PPFL; HL/SL and in between HL/DF; HL/PAFL. There is also a negative correlation between HL/PFBL (shown in TABLE NO- 4). An analysis of variance (ANOVA) carried forward for morphometric ratios indicate no significant difference between sample medians (Kruskal-Wallis test for equal medians). Correlation between morphometric traits also explain in Dunn's post hock method.

DISSCUSSION AND CONCLUSION

As evident from the above notable discussion on morphological meristic and shape may result in separation and differentiation of stocks. These characteristics may be more applicable for studying short-term, environmentally induced disparities, and the findings can be effectively used for improved fisheries management. The correlation between various morphometric traits was found to be positive, high and significant except pectoral fin base length. The results obtained from body morphometrics and meristics in this work indicate existence of morphologically differentiated groups of *Otolithes ruber*. The differentiation can be attributed to the ecophenotypic plasticity of the species, in response to the various hydrological conditions of the habitat. To manage a fishery effectively, it is important to understand the stock structure of a species and how fishing effort and mortality are distributed. Because a large proportion of our fisheries occur on mixed-stocks, it is essential to identify and quantify the various stock components that comprise these mixed-stock fisheries. The quantification of specific characteristics of an individual, or a group of individuals, can demonstrate the degree of speciation induced by both biotic and abiotic conditions, and contribute to the definition of different stocks of species. Further confirmation of the present finding may be confirmed employing molecular and biochemical methods. The present study highlighted that little variation in morphological characterization is a primary step for the stock structure analysis of the species *Otolithes ruber*. From the above study, It concluded that this work will definitely help one to identify the fish stock very easily and can also determine various morphometric and meristic traits of a particular fish, and this will result in increased production and employment, improved economy, upliftment of coastal fisher folk and other development.

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Table-1. Morphometric traits of *Otolithes ruber*

Acronyms	Morphometric traits	Description
TL	Total length	Distance from tip of the snout to tip of the caudal fin
DF	Dorsal fin length	Distance from the base of first dorsal fin to end of the second dorsal fin.
PDL	Predorsal fin length	Distance from the tip of the snout to base of the first dorsal fin.
HL	Head length	Distance from the tip of the snout to posterior margin of the operculum.
SL	Snout length	Distance from the tip of the upper jaw to tip of the eye.
ED	Eye diameter	Diameter of the eye along the body axis.
OS	Opercular spine number	Number of opercular spines along the body axis.
LL	Lateral line scale	Total Number of scales on the lateral line along the body axis.
PFBL	Pectoral fin base length	The vertical distance between the origin and insertion of the pectoral fin.
PFL	Pectoral fin length	Distance between the origin and posterior tip of left pectoral fin.
PPFL	Pre pectoral fin length	Distance from the tip of the snout to the origin of pectoral fin.
PVFL	Pre ventral fin length	Distance from the tip of the snout to the origin of ventral fin.
PAFL	Pre anal fin length	Distance from the tip of the snout to the origin of anal fin.
SL	Standard length	Distance from the tip of the snout and the base of caudal fin rays.

Table No-2 Measurement of Various Morphometric Traits of *Otolithes ruber*

SAMPLE	TL	DF	PDL	HL	SL	ED	PFBL	PFL	PPFL	PVFL	PAFL	SL	LL
1	21.3	10	5.8	5.9	1.3	0.5	0.8	4.2	5.2	5.3	13.2	17.8	57
2	21.9	10.9	6.3	6.4	1.2	1.1	0.8	3.7	5.9	5.5	13.2	18.3	59
3	19.3	9.8	5.4	5.7	1.1	1.1	0.7	3.1	5.1	4.9	12	16.1	51
4	23.5	9.7	6	6.9	1.2	1.2	0.8	3.1	6	5.9	16	18.2	62
5	20.7	9.8	5.8	6.4	0.8	1	1.8	2.8	5	5.6	12.4	16.7	52
6	21.7	10	5.9	6.9	1.2	1.1	0.8	3.8	5.5	5.8	13.5	18	58
7	21.6	10.1	5.7	6.3	0.9	0.9	0.5	4	4.9	5.7	13.2	18	56
8	23.2	11	6.2	6.8	1.2	0.9	0.7	4.1	5.8	6.2	14.4	19.5	54
9	21.2	10.3	5.8	6.8	1.4	1.1	0.8	3.7	5.4	5.4	12.3	17.3	52
10	23.5	11.1	6.7	7.9	1.7	1.2	0.8	4.4	6.3	6.3	14.5	20.2	56
11	22.8	11	6.6	7.3	1.7	1.3	0.8	4	6.2	6.2	13.7	19.7	52
12	23.5	11.1	6.4	7.4	1.6	1.2	0.7	3.1	6.5	6	13.3	18.8	55
13	21	10	5.9	6	1.3	1.1	0.7	3.8	5.2	5.2	11.7	16.5	54
14	23.2	11.5	6.5	6.8	1.6	1.2	0.8	4.3	6.4	6.1	14	19	50
15	21.5	10.3	6	6.5	1.3	1.2	0.7	3.6	5.6	5.9	12.7	17.3	53

Table No- 3 Mean and Standard Deviation of Morphometric Traits

MORPHOMETRIC	MEAN	STANDARD DEVIATION
TRAITS	IN CM.	
TL	21.99333	1.250409
DF	10.44	0.593777
PDL	6.066667	0.369685
HL	6.0666667	0.591205
SL	1.3	0.267261
ED	1.073333	0.194447
PFBL	0.813333	0.285023
PFL	3.713333	0.489704
PPFL	5.666667	0.534077
PVFL	5.733333	0.411733
PAFL	13.34	1.10376
SL	18.09333	1.200873
LL	54.73333	3.305119

Table No 4- Correlation between Hl and All other Morphometric Traits

CORRELATION	DATA
OF MORPHOMETRIC TRAITS	
HL/TL	0.808414
HL/DF	0.614493
HL/PDL	0.805055
HL/SL	0.66001
HL/ED	0.544713
HL/PFBL	-0.02685
HL/PFL	0.223691
HL/PPFL	0.785735
HL/PVFL	0.847061
HL/PAFL	0.582332
HL/SL	0.808561

Table No- 5 Correlation between Morphometric Traits

	TL	DF	PDL	SL	ED	PFBL	PFL	PPFL	PVFL	PAFL	SL
TL		0.3938	0.8312	0.5224	0.2008	0.08808	0.1356	0.6698	0.6698	0.2864	0.8312
DF	0.3938		0.5224	0.8312	0.6698	0.3938	0.5224	0.6698	0.2008	0.8312	0.2864
PDL	0.8312	0.5224		0.6698	0.2864	0.1356	0.2008	0.8312	0.5224	0.3938	0.6698
SL	0.5224	0.8312	0.6698		0.5224	0.2864	0.3938	0.8312	0.2864	0.6698	0.3938
ED	0.2008	0.6698	0.2864	0.5224		0.6698	0.8312	0.3938	0.08808	0.8312	0.1356
PFBL	0.08808	0.3938	0.1356	0.2864	0.6698		0.8312	0.2008	0.03301	0.5224	0.05501
PFL	0.1356	0.5224	0.2008	0.3938	0.8312	0.8312		0.2864	0.05501	0.6698	0.08808
PPFL	0.6698	0.6698	0.8312	0.8312	0.3938	0.2008	0.2864		0.3938	0.5224	0.5224
PVFL	0.6698	0.2008	0.5224	0.2864	0.08808	0.03301	0.05501	0.3938		0.1356	0.8312
PAFL	0.2864	0.8312	0.3938	0.6698	0.8312	0.5224	0.6698	0.5224	0.1356		0.2008
SL	0.8312	0.2864	0.6698	0.3938	0.1356	0.05501	0.08808	0.5224	0.8312	0.2008	

Table No-6 Kruskal-Wallis Test For Equal Medians

Kruskal-Wallis test for equal medians
H (chi2) : 10
Hc (tie corrected) : 10
P (same) : 0.4405
There is no significant difference between sample medians

Figure.1 (a, b, c). Observation of *Otolithes ruber* at EBRC

Fig 2 (a) – *Otolithes ruber*

Fig 2 (b)- Measurement of *Otolithes ruber*

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Design of SRAM Cell in 45nm Technology and Optimization for Power

Sandipan Pine

Department of ECE, Centurion University of Technology and Management, Odisha, India.

Received: 16 Mar 2020 Revised:18 Apr 2020 Accepted: 20 May 2020

***Address for Correspondence**
Sandipan Pine
Department of ECE,
Centurion University of Technology and Management,
Odisha, India.

ABSTRACT

CMOS design always gives minimum power consumption and very rapid access time. To reduce the consumptionfurther an approach is adopted here in 6 transistor SRAM technology. One new write option in the form of bit line is introduced and as a result design has become 7 transistor design. As a result it is observed a 45% reduction of output power consumption. So by adding 17% of hardware space 45% power is saved. The design is implemented in cadence platform in 45nm technology.

Keywords: Static Random Access Memory (SRAM), Complementary Metal oxide Field Effect Transistor (CMOS),

INTRODUCTION

In recent time CMOS technology have emerged a lot. Due to this today's designs are a lot denser, faster and they consume very low power also. As per moor's law device dimensions are scaled down dramatically in each technology [1]. We have achieved deep sub-micron technology in 45 nm design criterion. As the technology is shrinking, as a result leakage current is also getting increased and hence power dissipation. So the challenge in today's era is to reduce this leakage to the maximum extent possible. This is true for any processor design or SOC design. A lot of technique is followed to minimize this power loss. New design adopted, supply voltage scaled down to reduce dynamic power dissipation. But when these scaling approach was implemented in a 6 transistor cell, it shows a whole lot of problems. When power supply is reduced to ultra-level circuit stability changes a lot [2]. Power consumption is the main criterion in a lot of work [4-5].New pre-charge line is adopted to increase stability[3].A new bit line is proposed and hence a new 7 transistor cell is designed and simulated here with 45 nm technology in cadence platform. The schematic diagram of the proposed design is shown in fig 1. Layout of the same is shown in fig 2.

CALCULATION OF LEAKAGE CURRENT

When technology shrinks, leakage current of any device increases in exponential nature. So across technology power dissipation increases. For SRAM this leakage current is the primary component of static power loss. In 45nm technology mostly the source of this leakage is three major leakage component. First one is the sub threshold leakage, which contributes most of the leakage. Then comes direct-gate leakage and last but not the least band to band tunneling leakage in reverse bias. Sub threshold leakage occurs when V_{gs} becomes less than V_{th}. This is a conduction current of the MOS transistor due to weak inversion phenomenon. The equation of the leakage is as follows in equation 1.

$$I_{sub} = Ise^{\frac{q(Vgs-VT-Voffset)}{nkT}}(1 - e^{\frac{-qVDS}{kT}}) \ldots\ldots\ldots[1]$$

Where all the parameters have their usual meaning, as Is denotes reverse saturation current, k is Boltzmann's constant, T is absolute temperature, q is charge of electron, V_T is threshold voltage.

PROPOSED STRUCTURE FOR POWER OPTIMIZATION

Disconnection of the feedback path between two inverter in the design plays a vital role in selecting the extra bit line for write operation. For that reason the disconnection and reconnection of the path is established with the help of an extra NMOS transistor N_5, as described in figure-1. The circuit then rely on BL' to follow write instruction. Now as soon as N_5 is turned off, the feedback disconnected and as a result write instruction is executed. When input is complemented at BL' immediately N_3 becomes on and N_4 off. The total design seems to look like a cascaded stage inverter circuit where INV 1 is preceded by INV 2. Q2 is giving driving force to INV 2 and Q2 gets the complemented input signal from BL'. This develops Q and INV 1 produces Q'. Initially before starting writing Bl and BL' both need to be kept high which is called pre-charge. Now to write a "1" BL' need to be kept at low and to write "0" BL' need to be kept at high.Complete schematic is shown in fig 3.

RESULT ANALYSIS

Complete design is simulated in cadence environment and leakage current is plotted with and without the extra write line. Results are shown in following figures. Fig. 4 shows the output waveform of the structure with the extra bit line for write operation. Power consumption of the circuit is shown in fig 5 and Fig 6 for 6 transistor and 7 transistor design. Fig7 and 8 shows the leakage power estimation for the structure with and without the presence of extra bit line. It is clear from the simulation data that we have straightway 45% profit in power consumption in the modified design.

CONCLUSION

As mentioned in the whole approached that this method helped us to achieve almost half saving in terms of power with sacrifice of 17% area, so we can conclude that this approach is optimized for power. As power is the major concern it today's world this design can be widely used in any sort of application where supply of power is less like satellite application, remote location application etc. Using 45 nm technology allows the design to become very crisp and suitable to be integrated with other circuits.

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The leakage current and power consumption comparison is extracted from simulation result and tabulated in table-1.

Parameter	Design with extra bit line	Design without extra bit line
Technology used	45nm	45nm
Main Supply	1.8V	1.8V
Voltage required to pre-charge	1V	1V
Leakage current	1.148mA	2.311mA
Consumed power	1.146mW	2.111mW

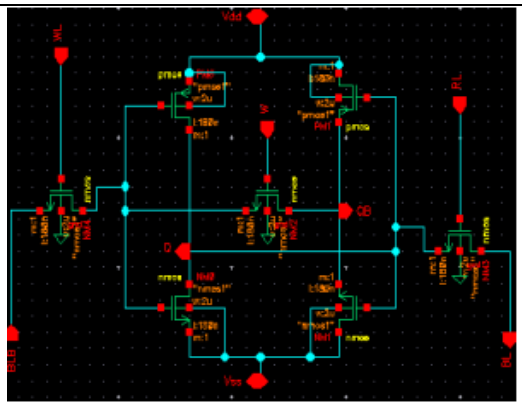

Fig. 1: Schematic diagram of the proposed design

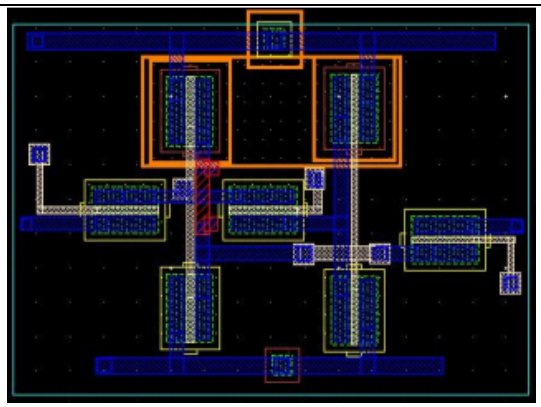

Fig. 2: Layout of the proposed design.

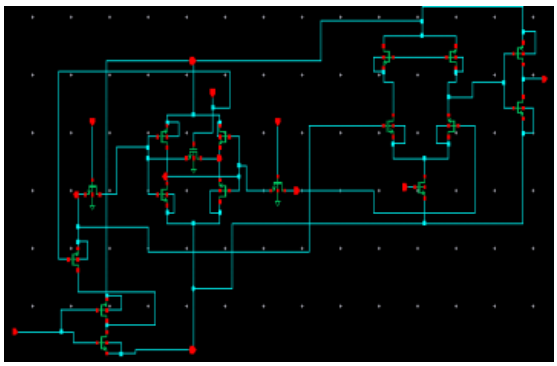

Fig.3: Schematic with extra write line

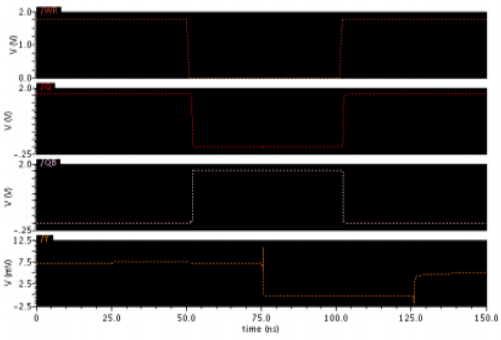

Fig. 4: Output of the proposed structure with extra write line

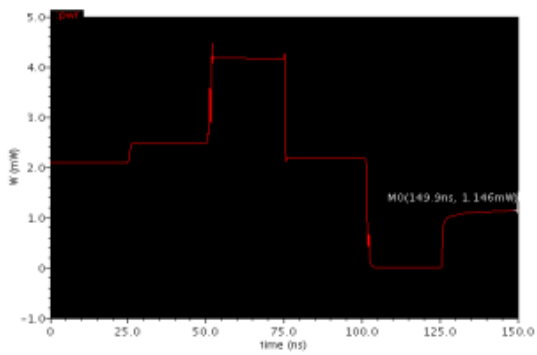

Fig. 5: Power consumption of the structure without extra bit line

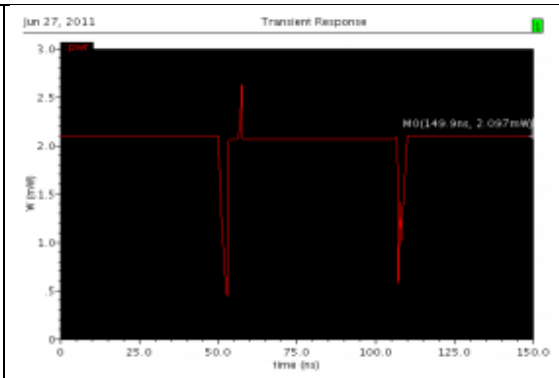

Fig. 6: Power consumption of the final structure

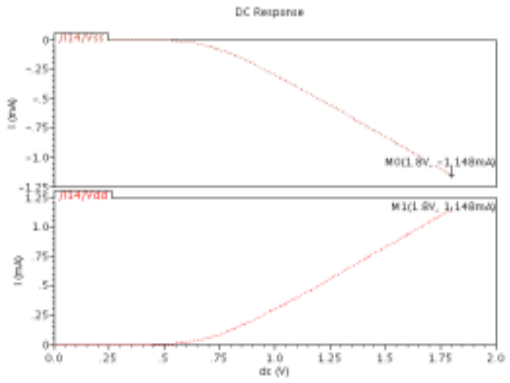

Fig. 7: Leakage power estimation with extra bit line

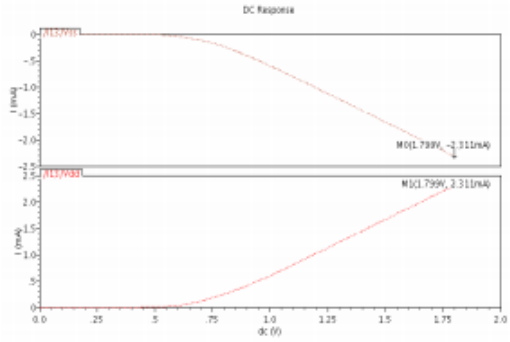

Fig. 8: Leakage power estimation without bit line.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Biochemical Investigation and Analysis of Heavy Metal Content of Ticto Barb (*Puntius ticto*) from the River Kerandi, Sunabeda, Koraput, Odisha

Lopamudra Ojha* and Siba Prasad Parida

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 16 Mar 2020 Revised:18 Apr 2020 Accepted: 21 May 2020

***Address for Correspondence**
Lopamudra Ojha
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
E.Mail: lopamudraojha96@gmail.com

ABSTRACT

The small indigenous fishes (SIFs) are rich in micronutrients and are also major source of animal proteins and vitamins. The biochemical composition of the sampled fish varies depending upon seasonal variation, migratory behaviours, sexual maturation, feeding cycle and environmental conditions. The current study was aimed to determine the biochemical investigation and analysis of heavy metals in *Puntius ticto* (Hamilton, 1822) from the river Kerandi, Sunabeda, Koraput, Odisha.The samples were collected from the Kerandi river near to Ganjam Colony, Sunabeda. The biochemical profile showed that the species is rich in proteins i.e. 15.922±0.63 than the carbohydrates i.e. 1.034±0.5. The investigation of bioaccumulation of heavy metals in this species and presence of heavy metals in river water showed that concentration of heavy metals such as Fe, Cr, Ca, Zn, Pb, Co, Cu, Ni, Cd, Hg were 952, 84, 73, 26, 7, 4, 3,2, 1.7 and 0.5 (in ppm) respectively. The concentration of heavy metals in *Puntius ticto* were such as Fe, Zn, Mn, Cr, Cd, Pb were 2359, 67, 11.2, 92, 3.2 and 38 (in ppm) respectively. Some other chloride, fluoride and nitrate ions are also present in the river water. The present study showed that though the aquatic species contains higher amount of proteins it is beneficial. But due to the polluted water intake of heavy metals was done by the aquatic specimen which may cause harmful effects to human body after consumption.

Keywords: *Puntius ticto*, bioaccumulation, heavy metals and protein.

INTRODUCTION

Several species of fishes are ingested as food all around the world. Fishes are the major source of proteins and nutrients which helps in the growth and development of human body. Fishes are rich in Omega-3 fatty acid which improves risk factors for cardiovascular diseases (Gopakumar,1997). In recent decades the nutritional value of

aquatic food has increased due to their beneficial effects. Fish is a univariate animal source food ingested by millions all around the world (Ravichandran et al., 2011). Around 60% people of developing countries took fish as food which supplies 30% of animal proteins. Approximately 60% of animal proteins intake at 18.1 kg consumed by a person per year and frequency of the consumption is far greater than that of other food resources (Belton *etal.,* 2014). Fishes are the principal source of proteins, carbohydrates, lipids, vitamins and other micronutrients which helps in the physical as well as physiological growth and development of body. According to FAO (1991) report, fish normally contains 72% water, 19% protein, 8% fat, 0.5% calcium, 0.25% phosphorus and 0.1% vitamin A, D, B & C. In 2002 American Heart Association states, the omega-3 fatty acids: eicosapentaenoic acid (EDA) and docosahexaenoic acid (DHA) were recommended for reducing triglycerides in patients. Fish consumption (1-2 servings per week) is protective against coronary heart disease and ischemic stroke and is recommended (WHO).

These ticto barb species are known to be contain ample of micronutrients and proteins, therefore it is an important component of human diet. It is also a principal source of polyunsaturated fatty acids (PUFAs). As they are eaten whole with bone, head and eye all the nutrients densely present in it was utilized. There's are an essential part of country dwellers diet; as these fishes are commonly available from local ponds, rivers, lakes having lower commercial value as compared to large fishes. Though these fishes are the alternative source of proteins, it plays a key role in averting the inducing micronutrients deficiencies and associated diseases (Pilla, 2014).

Heavy metals are the metallic chemical element that has high density having higher molecular weight than water and toxic at lower concentration. Some examples of heavy metals are Lead (Pb), Arsenic (As), Cadmium (Cd), Copper (Cu), Chromium (Cr), Mercury (Hg), Silver (Ag), Gold (Au), Zinc (Zn), Manganese (Mn), Nickel (Ni), Iron (Fe), etc. Bioaccumulation is a process of introduction of metals into the food chain or food web through different pathways causes harmful effects on the biotic components and accumulated by flora and fauna (Pandy, 2014). Heavy metals had carcinogenic, mutagenic, cytotoxic effects on aquatic species (Kamaruzzaman *etal*., 2010). Heavy metal accumulation in some fishes preferred for consumption by egrets in Odisha (Panda *et al.,* 2019).It also causes environmental pollution by which it is difficult to find a river or other water bodies having its natural environment. Their toxicity depends on different factors like doses, route of exposure, chemical species as well as the age, gender, genetic and nutritional proportion of exposed person.

This work was carried out to determine the protein, carbohydrate, mineral proportion and the heavy metal content of the flesh tissues of *Puntius ticto* collected from the Kerandi river of Sunabeda, Koraput, Odisha. The protein (Lowry*et al*., 1951), carbohydrate (Hedge and Hofreiter, 1962), Mineral and heavy metal (Fitton, 1997) content of the sample were detected.

MATERIALS AND METHODS

The desired fish sample *Puntius ticto* (n=7) were collected from the river Kerandi of Sunabeda, Koraput, Odisha caught by a local fisherman. Then the samples were cleaned with deionized water for the removing of adhering contaminant and drained through filter paper. Then the samples were brought to the laboratory for the preservation to investigating the nutrient profile and other experiments of the sample by the help of the ice insulated containers(Ravichandram, *et al*., 2009).

Preparation of samples for analysis

Before the samples were prepared for the analysis they were wrapped in aluminium foil and frozen at -4°C for two days. Then the samples were dissected and flesh tissues were separated by removing the scales, skins, head, tail, endoskeletons and other organelle of the fish body after defrosting. Then the flesh were ground by using mortar and

pestle and kept in oven at 95-105°C for drying. After the pasted sample was completely dried it was further ground into fine powder by using the mortar and pestle. (Ravichandran*etal.,* 2009).

Determination of biochemical composition

The protein estimation was carried out by Lowry method (Lowry*et al.,* 1951).
The estimation of carbohydrates is done by Anthrone method (Hedge and Hofreiter, 1962).
The heavy metal content of water and fish sample was determined by XRF method (Fitton,1997). Analysis of water parameters also done.

RESULTS AND DISCUSSIONS

Figure 1. Collection of samples

Figure 2. Water analysis

Figure 3.Measuring in weighing machine

Figure 4. Water bath in analysis

Figure 5. Incubation of sample

Figure 6. Water analysis

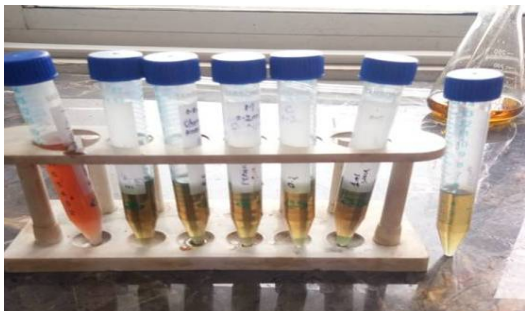

Figure 7. Centrifuge tubes during Carbohydrate Estimation.

Table 1. Parameters of water sample

Sample	pH	Conductivity (S/m)	TSS (mg/l)	TDS (mg/l)	TS (mg/l)	DO (mg/l)	BOD (mg/l)
Water	7.8	19.1	30	102	132	7.5	0.8

The heavy metals were detected in the collected sample were Fe>Cr>Ca>Zn>Pb>Co>Cu>Ni>Cd>Hg. The level of Iron is high on the water sample.

Heavy metal analysis in fish sample (*Puntius ticto*)
Fish length- 5.2 cm, Fish muscle weight- 11.8 gm (n=7)

Table 2. Concentration of heavy metals in the Kerandi river water and fish muscle tissue

Heavy metals	Water (in ppm)	Muscle tissue (in ppm)
Fe	952	2359
Cr	84	92
Cd	1.7	3.2
Zn	26	67
Pb	7	38
Mn		11.2
Cu	3	
Ni	2	
Ca	73	
Hg	0.5	
Co	4	

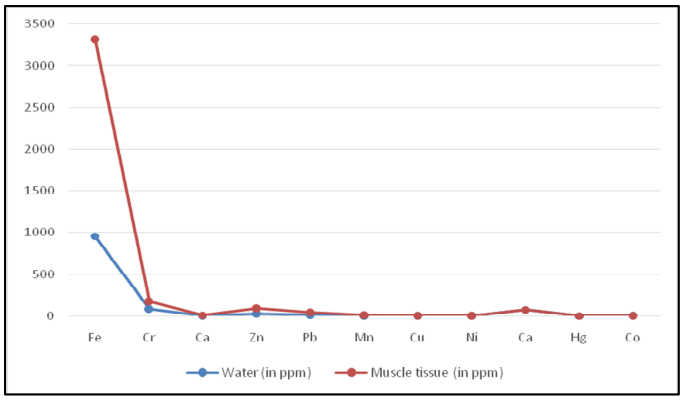

Figure 8: Comparison of heavy metals in Kerandi river water and muscle tissue of Fish

Biochemical analysis of muscle tissue of *Puntius ticto*
Table3. Protein and Carbohydrate contents of the sample *Puntius ticto*in % of dry matter basis (Mean±SD)

Sl. No.	Protein	Carbohydrate
01	15.857	1.121
02	16.619	1.009
03	15.096	0.987

04	16.116	1.020
Mean	15.922	1.034
Standard Deviation	0.63	0.058

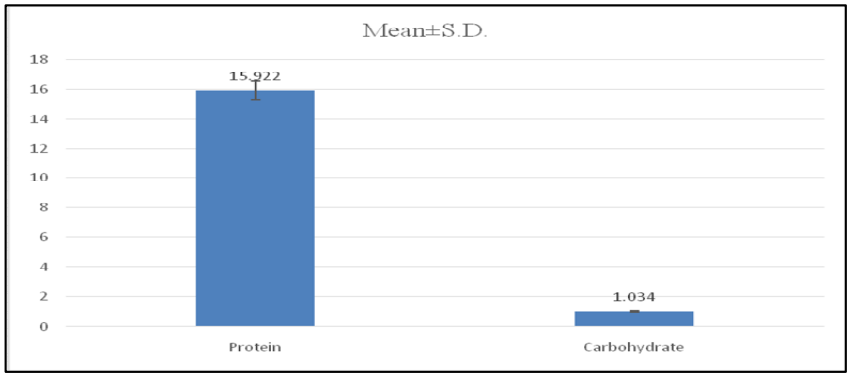

Figure 9.Graphical representation of comparison between the Means

Biochemicalcomposition of fish tissue is essential to evaluate the specified physiological demands during growth and development of individual. WHO recorded that billions of peoples are suffering from different diseases due to the deficiency of minerals and vitamins. From this study protein, carbohydrate, mineral and heavy metal content of *Puntius ticto*was exhibited in Tables respectively. The results were specified that the collected sample was rich in nutrient levels. The protein content recorded in the collected sample ofticto barb was 15.92±0.63 which shows that the projected sample containsbigger amount of proteins. The carbohydrate content recorded in the sample was 1.034±0.05. The concentration of chloride and fluoride ion is higher as river belt surrounded by mountains having mines and industries. The investigation of bioaccumulation of heavy metals in this species and presence of heavy metals in river water showed that concentration of heavy metals such as Fe, Cr, Ca, Zn, Pb, Co, Cu, Ni, Cd, Hg were 952, 84, 73, 26, 7, 4, 3,2, 1.7 and 0.5 (in ppm) respectively. The concentration of heavy metals in *Puntius ticto*was such as Fe, Zn, Mn, Cr, Cd, Pb were 2359, 67, 11.2, 92, 3.2 and 38 (in ppm) respectively.As cities are situated near to the river the domestic sewage are connected to river by which different pollutants are mixed with water. Bioaccumulation of heavy metals (Zn, Pb, Cd and Cu) was determined in the liver, gills and flesh from benthic and pelagic fish species studied by Bawuro*et al.*(2018) and Cd exhibited higher concentration in the gills, hence it is unsafe for human consumption and threat to public health.

CONCLUSION

The present study designates that the collected fish sample was rich in proteins and also contains vitamins. Carbohydrate is the main source of energy. Proteinhas major role in repairing and build up tissues; growth and developmentwas maintained by minerals which indicates ticto barb is a good source of food. But if the concentration of heavy metals increases it leads to alternation in the biochemical parameters and by consuming these human beings alsosuffers.

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Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

REVIEW ARTICLE

A Study on Feasible Base and Sub-Base for Low Volume Traffic

Swagatika Sahoo[1]*, Biswajit Jena[2] and Sagarika Panda[3]

[1]M.Tech Transportation Engineering, Centurion University of Technology and Management, BBSR, Odisha, India,
[2]Assistant Professor, Department of Civil Engineering, DRIEMS, Cuttack, Odisha, India,
[3]Assistant Professor, Department of Civil Engineering, Centurion University of Technology and Management, BBSR, Odisha, India.

Received: 17 Mar 2020 Revised:19 Apr 2020 Accepted: 21 May 2020

***Address for Correspondence**
Swagatika Sahoo
M.Tech Transportation Engineering,
Centurion University of Technology and Management,
BBSR, Odisha, India.
E.Mail: swagatikasahoo.k96@gmail.com

ABSTRACT

The depletion of natural resources in the present days which is a major issue in the Construction Sector from which the road segment cannot be excluded. The aggregate demand is so huge because of the extensive road Construction processes which cause lots of blasting, quarrying and crushing. On the other hand, the environmental and dumping problems were caused due to the industrial waste, by products and locally available unused materials which are considered non-conventional materials. So, an attempt has been made to utilize abundantly available gravel i.e. moorum on the road sub-base on the present study. By using suitable tests and techniques its gradation and other physical properties will be studied. The main objective of the study is to improve the properties of the locally available gravel soil / marginal aggregate i.e.moorum by adding cement and bitumen emulsion. The whole work involves increasing strength of gravel soil(moorum). It is observed that hard moorum have excellent properties as road aggregates and can be used in the road base and sub-base applications

Keywords: Moorum, OPC 43 Grade Cement, Bitumen Emulsion, Sieve Analysis, CBR Test, UCS Test, OMC & MDD Test

INTRODUCTION

In India, some portions of the existing rural roads are unpaved /low volume roads. These roads are affected by heavy rainfall and floods several times. So every year maintenance of these road is needed. There has been growing stress and interest in the world over on the recent years towards promoting the utilization of marginal materials in road construction to save money reduce pressure on good quality aggregate and additionally to safeguard atmosphere This study will attempt to define in the engineering terms the impact of using marginal aggregates in flexible pavements.

There are different marginal aggregates found in India but we will use the marginal aggregate i.e. moorum in this study which is a fragmented weathered rock naturally occurring with varying proportions of silt and clay. For the construction of road is considered as a low grade marginal material which is widely available on different parts of our country. It has significant variation in its qualities from one location to another in terms of its crushing and impact value, grain size, clay and deleterious content. It has generally low bearing capacity and high water absorption value in comparison to conventional aggregates. It has also less productive use as compared to other marginal aggregates.

LITERATURE REVIEW

Al-Abdul Wahab and Asi(1997): utilized moderate setting emulsified black-top and medium curing decrease black-top to settle each soil and rise sand. Lime and Portland bond (2% and 4%) were added to the settled soils to quicken the curing procedure and to reduce strength misfortune as a result of water harm. it had been found that balanced out operators increased each shear quality and imperviousness to the broke down soils to water harm. it had been watched that Portland concrete was additional compelling than lime. Razouki et al. (2002): proposed an experimental study on Granular Stabilized Roads. Bitumen was used as a stabilizing agent may act as a binder or as a water-proofing material. Soil-bitumen systems had found the greatest use in road bases and surfaces. Sariosseiri and Muhunthan (2009): investigate a way to utilization of Portland bond within the adjustment and adjustment of soils within the condition of Washington, USA. Concrete was enclosed rates of two.5, 5, 7.5, and 10%, by dry weight of the dirt. Investigator facility tests to focus the drying rate of the dirt, Atterberg limits, compaction attributes, unconfined compressive quality, and international organization itedun depleted tri hub conduct were performed. when effects of the examination indicated huge amendment in drying rate, workability, unconfined compressive feature, and shear quality options.

Yuehuan et al. (2010): worked on foamed bitumen stabilization for Western Australian pavements. Currently, the popularity of soil cement stabilization had been challenged by a new innovative soil improvement technique, known as foamed bitumen stabilization. Very few of work have been done on it and application of this type of stabilization is currently applied in flexible pavement sub grade stabilization. He found in his experimental study that optimum percentage of bitumen content utilized is 3 to 5percent. Marandi and Safapour (2012): worked on Base Course Modification through Stabilization using cement and bitumen. The main objective of this research was to analyze the use of bitumen emulsion in base course stabilization. So that it was examined as replacement with conventional pavement in regions with low quality materials.

MATERIALS AND METHODS

Material

Moorum

In this study, the primary material that is used is moorum which can be easily found in different part of our country. It is the combination of silt and clay which is considered as a low grade marginal material for road construction. It has generally low bearing capacity and high water absorption value in comparison to conventional aggregates, which can be used in the construction of base or sub-base course in rural roads of India.

Bitumen Emulsion

Bitumen emulsion is a mixture of fine droplets of bitumen and water. As the droplets are very fine they suspend in water. Therefore bitumen emulsion is a dispersed liquid consisting of three products i.e. water, bitumen and emulsion. The emulsion has a good penetration and spreading capacity. There are two types of bitumen emulsion i.e. Anionic and Cationic. In case of Cationic emulsions there are bituminous droplets which carry a positive charge and Anionic emulsion have negatively charged bituminous droplets. The principal difference between Anionic and Cationic emulsion gives up water faster than anionic emulsion.

Cement

A cement is a bender, a substance used for construction that sets, hardens, and adheres to others materials to bind them together. There are two main forms of cement i.e. Geoplymer cement and Portland cement. Here, OPC (Ordinary Portland Cement) of grade 43 is used which is based on the 25 days compressive strength of cement.

EXPERIMENTAL PROCEDURE

Specific Gravity test

The specific gravity of soil is defined as the unit weight of the soil mass divided by the unit weight of distilled water at 4°C. It is some times required to compare the density of the soil solids to the density of water. This comparison is in the form of ratio and is termed as the specific gravity of the soil. The Pycnometer is used for determination of specific gravity of soil particles of both fine grained and coarse grained soils. The determinination of specific gravity of soil will help in the calculation of void ratio, degree of saturation and other different soil properties. Clean and dry the Pycnometer. Tightly screw its cap. Take its mass (M1) to the nearest of 0.1 g. Mark the cap and Pycnometer with a vertical line parallel to the axis of the Pycnometer to ensure that the cap is screwed to the same mark each time. Unscrew the cap and place about 200 g of oven dried soil in the Pycnometer. Screw the cap. Determine the mass (M2). Unscrew the cap and add sufficient amount of de-aired water to the Pycnometer so as to cover the soil. Screw on the cap. Shake well the contents. Connect the Pycnometer to a vacuum pump to remove the entrapped air, for about 20 minutes for fine-grained soils and about 10 minutes for coarse-grained soils.

Disconnect the vacuum pump. Fill the Pycnometer with water, about three-fourths full. Reapply the vacuum for about 5min till air bubbles stop appearing on the surface of the water. Fill the Pycnometer with water completely up to the mark. Dry it from outside. Take its mass (M3). Record the temperature of contents. Empty the Pycnometer. Clean it and wipe it dry. Fill the Pycnometer with water only. Screw on the cap up to the mark. Wipe it dry. Take its mass (M4). The specific gravity of soil is determined using the relation:

$G= (M2-M1)/((M2-M1)-(M3-M4))$

Where,

M1=mass of empty Pycnometer
M2= mass of the Pycnometer with dry soil
M3= mass of the Pycnometer and soil and water
M4 = mass of Pycnometer filled with water only
G= Specific gravity of soils

Particle size distribution

Take the required quantity of the sample. Sieve it through a 4.75mm Is sieve. Take the soil fraction retained on 4.75mm IS sieve for the coarse sieve analysis and that passing through the sieve for the fine sieve analysis. Sieve the sample through the set of coarse sieves by hand. While sieving through each sieve, the sieve should be agitated such that the sample rolls in irregular motion over the sieve, the material retained on the sieve may be rubbed with the rubber pestle in the mortar, if necessary. Care shall be taken so as not to break the individual particles. The quantity of the material taken for sieving on each sieve shall be such that the maximum mass of material retained on each sieve does not exceed the specified value. Determine the mass of the material retained on each sieve. Calculate the percentage of soil retained on each sieve on the basis of the total mass of the sample, taken in step (1). Determine the percentage passing through each sieve. Take the portion of the soil passing 4.75 mm IS sieve. Oven dries it at 105 to 1100C. Weigh it to 0.1% of the total mass. Sieve the soil trough the nest of fine sieves, the sieves should be agitated so that the sample rolls in irregular motion over the sieves. However, no particles should be pushed through the sieve.

Take the material retained on various sieves in a mortar. Rub it with rubble pestle, but do not try to break individual particles. Reserve the material through the nest of sieves. A minimum of 10min of shaking is required if a mechanical shaker is used. Collect the soil fraction retained on each sieve in a separate container. Take the mass. Determine the percentage retained, cumulative percentage retained, and the percentage finer, based on the total mass taken in step (1).

Liquid Limit and Plastic Limit Test

This testing method is used as an integral part of several engineering classifications systems to characterize the fine-grained fractions of soils and to specify the fine-grained fraction of construction materials. The liquid limit, plastic limit and plasticity index of soils are also used extensively, either individually or together, with other soil properties to correlate with engineering behavior such as compressibility, permeability, compactibility, shrink-swell and shear strength.

Procedure for liquid limit

Place a portion of the prepared sample in the cup of the liquid limit device at the point where the cup rests on the base and spread it so that it is 10mm deep at its deepest point. Form a horizontal surface over the soil. Take care to eliminate air bubbles from the soil specimen. Keep the unused portion of the specimen in the storage container. Form a groove in the soil by drawing the grooving tool, beveled edge forward, through the soil from the top of the cup to the bottom of the cup. When forming the groove, hold the tip of the grooving tool against the surface of the cup and keep the tool perpendicular to the surface of the cup. Lift and drop the cup at a rate of 2 drops per second. Continue cranking until the two halves of the soil specimen meet each other at the bottom of the groove. The two halves must meet along a distance of 13mm (1/2 in). Record the number of drops required to close the groove. Remove a slice of soil and determine its water content, w. Repeat steps 1 through 5 with a sample of soil at a slightly higher or lower water content. Whether water should be added or removed depends on the number of blows required to close the grove in the previous sample. When the soil reaches the point where it will crumble, and when the thread is a uniform diameter of 1/8", it is at its plastic limit. Determine the water content of the soil.

Procedure for plastic limit

From the 20g sample select a 1.5 to 2 g specimen for testing. Roll the test specimen between the palm or fingers on the ground glass plate to from a thread of uniform diameter. Continue rolling the thread until it reaches a uniform diameter of 3.2mm or 1/8 in. When the thread becomes a diameter of 1/8 in. reform it into a ball. Knead the soil for a few minutes to reduce its water content slightly. Repeat steps 2 to 5 until the thread crumbles when it reaches a uniform diameter of 1/8 in. When the soil reaches the point where it will crumble, and when the thread is a uniform diameter of 1/8", it is at its plastic limit. Determine the water content of the soil. Repeat this procedure three times to compute an average plastic limit for the sample.
Plasticity Index (P.I.) = Liquid Limit (L.L.) – Plastic Limit (P.L.)

Residue Test for Emulsion

This test method covers the quantitative determination of residue in emulsified asphalts composed principally of a semisolid or liquid asphaltic base, water, and an emulsifying agent. To determine the percentage of asphalt residue a sample of emulsified asphalt is heated in an oven at 163 + 3°C in an open top beaker. This residue may be tested from the evaporation as required. To achieve the homogeneity all the emulsified asphalts should be stirred properly before testing. the weight of each of three beakers should be determined which contains a glass rod to 0.1 g weight 50 + 0.1 g of thoroughly mixed ,emulsified asphalt into each of three beakers. The beakers containing the rods and

sample in the oven were placed which has been adjusted to 163 + 3.0°C, for 2 h. Remove each beaker at the end of this period and the residue should be stir thoroughly . For 1hr replace in the oven And then remove the beakers from the oven, then allowed to cool to room temperature, and weigh with the rods.

Residue, % = 2(A – B)

Where, A = weight of beaker, rod, residue
B = tare weight of beaker

Compaction test

Compaction is the process of densification of soil by reducing air voids. The degree of compaction of a given soil is measured in terms of its dry density. The dry density is maximum at the optimum water content. A curve is drawn between the water content and the dry density to obtain the maximum dry density and the optimum water content. Compaction test of soil is carried out using Proctors test to understand compaction characteristics of different soils with change in moisture content. Compaction of soil is the optimal moisture content at which a given soil type becomes most dense and achieve its maximum dry density by removal of air voids. Take about 20 kg of air-dried soil. Sieve it through 20mm and 4.7 mm sieve. Calculate the percentage retained on 20mm sieve and 4.75mm sieve, and the percentage passing 4.75mm sieve. If the percentage retained on 4.75mm sieve is greater than 20, use the large mould of 150mm diameter. If it is less than 20%, the standard mould of 100mm diameter can be used. The following procedure is for the standard mould. Mix the soil retained on 4.75mm sieve and that passing 4.75mm sieve in proportions determined in step (2) to obtain about 16 to 18 kg of soil specimen. Clean and dry the mould and the base plate. Grease them lightly. Weigh the mould with the base plate to the nearest 1 gram.

Take about 16 – 18 kg of soil specimen. Add water to it to bring the water content to about 4% if the soil is sandy and to about 8% if the soil is clayey. Keep the soil in an air-tight container for about 18 to 20 hours for maturing. Mix the soil thoroughly. Divide the processed soil into 6 to 8 parts. Attach the collar to the mould. Place the mould on a solid base. Take about 2.5kg of the processed soil, and hence place it in the mould in 3 equal layers. Take about one-third the quantity first, and compact it by giving 25 blows of the rammer. The blows should be uniformly distributed over the surface of each layer. The top surface of the first layer be scratched with spatula before placing the second layer. The second layer should also be compacted by 25 blows of rammer. Likewise, place the third layer and compact it. The amount of the soil used should be just sufficient to fill the mould ad leaving about 5 mm above the top of the mould to be struck off when the collar is removed. Remove the collar and trim off the excess soil projecting above the mould using a straight edge. Clean the base plate and the mould from outside. Weigh it to the nearest gram. Remove the soil from the mould. The soil may also be ejected out. Take the soil samples for the water content determination from the top, middle and bottom portions. Determine the water content. Add about 3% of the water to a fresh portion of the processed soil, and repeat the steps 10 to 14.

Normal wet density = (weight of wet soil in mould grams) / (volume of mould cc)
Moisture content (%) = ((weight of water grams) / (weight of dry soil grams)) 100 %
Dry density ¥d (gm/cc) = wet density / (1+ (moister content/100))

California Bearing Ratio Test

The California Bearing Ratio (CBR) test is a measure of resistance of a material to penetration of standard plunger under controlled density and moisture conditions. It was developed by the California Division of Highways as a method of classifying and evaluating soil- subgrade and base course materials for flexible pavements. CBR test may be conducted in remolded or undisturbed sample. Test consists of causing a cylindrical plunger of 50mm diameter to penetrate a pavement component material at 1.25mm/minute. The loads for 2.5mm and 5mm are recorded. This load

is expressed as a percentage of standard load value at a respective deformation level to obtain CBR value. Sieve the sample through 20mm IS sieve. Take 5 kg of the sample of soil specimen. Add water to the soil in the quantity such that optimum moisture content or field moisture content is reached. Then soil and water are mixed thoroughly. Spacer disc is placed over the base plate at the bottom of mould and a coarse filter paper is placed over the spacer disc. The prepared soil water mix is divided into five. The mould is cleaned and oil is applied. Then fill one fifth of the mould with the prepared soil. That layer is compacted by giving 56 evenly distributed blows using a hammer of weight 4.89kg. The top layer of the compacted soil is scratched. Again second layer is filled and process is repeated. After 3rd layer, collar is also attached to the mould and process is continued. After fifth layer collar is removed and excess soil is struck off. Remove base plate and invert the mould. Then it is clamped to baseplate. Surcharge weights of 2.5kg is placed on top surface of soil. Mould containing specimen is placed in position on the testing machine. The penetration plunger is brought in contact with the soil and a load of 4kg(seating load) is applied so that contact between soil and plunger is established. Then dial readings are adjusted to zero. Load is applied such that penetration rate is 1.25mm per minute. Load at penetration of 0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 7.5, 10 and 12.5mm are noted.

Table 1. Standard load in different penetration

Penetration(mm)	Standard Load(kg)
2.5	1370
5.0	2055
7.5	2630
10.0	3180
12.5	3600

Unconfined Compressive Strength

The unconfined compression test is by far the most popular method of soil shear testing because it is one of the fastest and cheapest methods of measuring shear strength. The method is used primarily for saturated, cohesive soils recovered from thin-walled sampling tubes. The unconfined compression test is inappropriate for dry sands or crumbly clays because the materials would fall apart without some land of lateral confinement.

Place the sampling soil specimen at the desired water content and density in the large mould. Push the sampling tube into the large mould and remove the sampling tube filled with the soil. For undisturbed samples, push the sampling tube into the clay sample. Saturate the soil sample in the sampling tube by a suitable method. Coat the split mould lightly with a thin layer of grease. Weigh the mould. Extrude the sample out of the sampling tube into the split mould, using the sample extractor and the knife. Trim the two ends of the specimen in the split mould. Weigh the mould with the specimen. Remove the specimen from the split mould by splitting the mould into two parts. Measure the length and diameter of the specimen with Vernier calipers. Place the specimen on the bottom plate of the compression machine. Adjust the upper plate to make contact with the specimen. Adjust the dial gauge and the proving ring gauge to zero. Apply the compression load to cause an axial strain at the rate of ½ to 2% per minute. Record the dial gauge reading, and the proving ring reading every thirty seconds up to a strain of 6%. The reading may be taken after every 60 seconds for a strain between 6%, 12% and every 2minutes or so beyond 12%.Continue the test until failure surfaces have clearly developed or until an axial strain of 20% is reached. Measure the angle between the failure surface and the horizontal, if possible. Take the sample from the failure zone of the specimen for the water content determination.

For medium grained soil,

U.C.S. = P / 7854 N/mm^2 = P / 78.54 Kg/$c.m^2$

Where, P = maximum recorded load in N / Kg

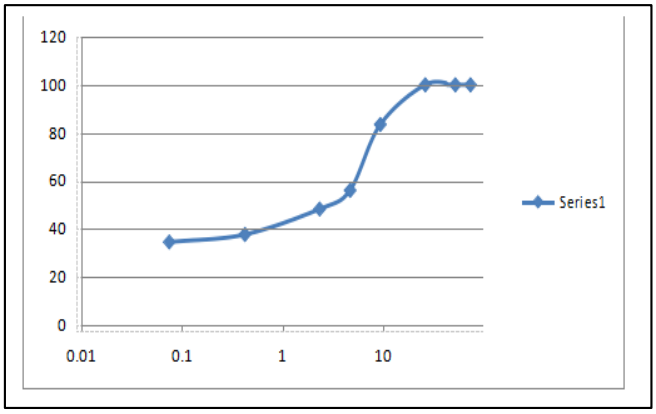
Durability test

These test methods determined the soil-cement losses, water content changes, and volume changes (swell and shrinkage) produced by repeated wetting and drying of hardened soil-cement specimens. Before the cement hydration the specimens are compacted in a mould to maximum density at optimum water content using the compaction procedure described in Test Methods. ASTM D-559 and ASTM D-560 methods are used for determining the durability of a stabilized sample. Two identical set (containing 3 specimens each) were prepared of UCS specimen which are cured in a normal manner at constant moisture content for 7 days. One set is immersed in water while the other set is continued to cure at constant moisture Content at the end of 7 days period. They are tested for UCS when both sets are 14 days old. The strength of the set immersed in water as a percentage of the strength of set cured at constant moisture content is calculated. This index is a measure of the resistance to the effect of water on strength. If this value is lower than 80 percent it is considered that the stabilizer content is low and its value should be increased.

RESULT AND DISCUSSION

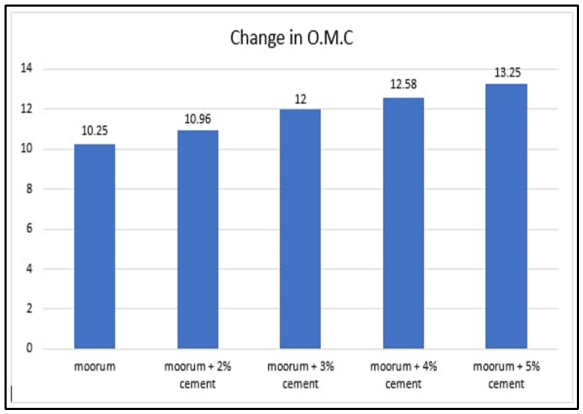
Table 2. The basic physical properties of gravel i.e., moorum used in this study are determined and are given in Table below

S.N	Property	Test Result
1.	Specific gravity	2.63
2.	Liquid limit %	30.2
3.	Plastic limit %	21.18
4.	Plasticity index%	8.95
5.	O.M.C%	10.2
6.	M.D.D%	2.05

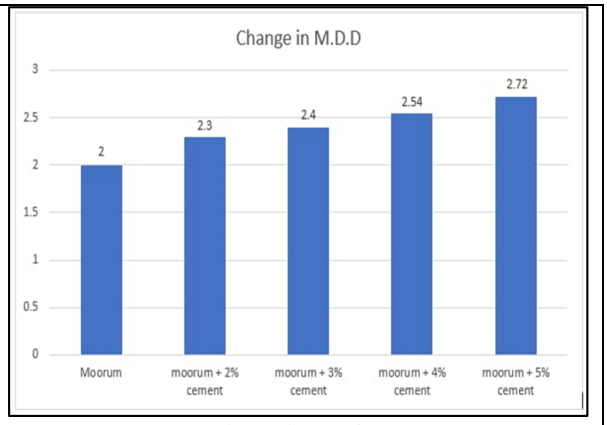


Graph 1:- Grain size distribution graph

After Addition of Cement change in Different Properties of Moorum in terms of O.M.C and M.D.D

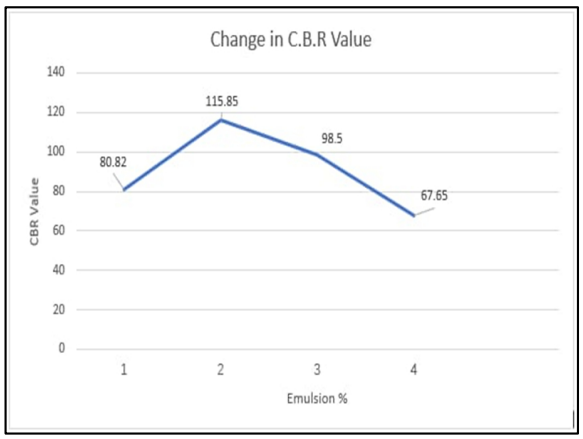


Graph 2. Change in O.M.C

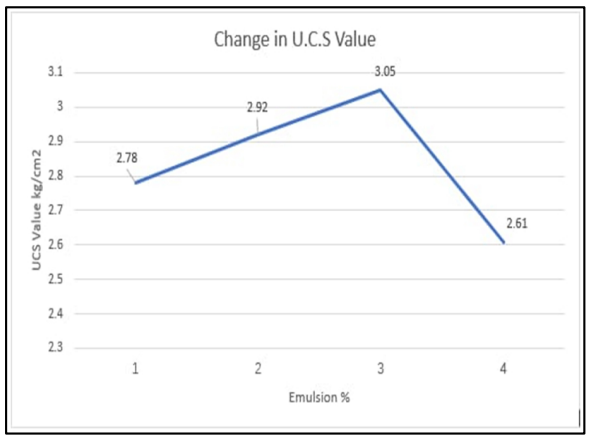


Graph 3. Change in M.D.D

CBR and UCS Test After addition 3% Cement and varying % of emulsion changes in properties of Moorum



Graph 4 Changes in C.B.R Value



Graph 5. Change in U.C.S Value

CONCLUSION

In this chapter a study has been done to enhance the quality of moorum by adding the cement and bitumen emulsion to it to make it suitable for utilization in sub-base course of low volume roads .in this study moorum contains more fine materials and can be suitable for dense grading applications which can replace the conventional aggregates. There is an extensive increment in the number of suitable proportionate standard axle load (esal) due to the extensive utilization of cement and bitumen emulsion which builds the bearing limit of moorum .therefore there is an increment in the lifetime of the road. From the above study it's concluded that moorum has better strength than that of the conventional crushed aggregates.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Evaluation of Gerbera (*Gerbera jamesonii* L.) Cultivars for Growth, Yield and Flower Quality under Protected Cultivation

Sagar Maitra*, Tanmoy Shankar, Masina Sairam and Sandipan Pine

Centurion University of Technology and Management, Paralakhemundi, Odisha, India.

Received: 18 Mar 2020 Revised:21 Apr 2020 Accepted: 23 May 2020

***Address for Correspondence**
Sagar Maitra
Centurion University of Technology and Management,
Paralakhemundi, Odisha, India.
E.Mail: sagar.maitra@cutm.ac.in

ABSTRACT

Gerbera (*Gerbera jamesonii* L.), a high-value cut flower of the family Asteraceae is used as fresh and dry flower, aesthetic decoration, making of bouquet with high demand in the domestic as well as export market. In topical and sub-tropical environment it is grown under protected cultivation. An experiment was conducted to evaluate the performance of six cultivars of gerbera, viz., Stanza, Dana ellene, Intense, Dune, White House and Artist for growth, productivity and floral quality under forced ventilated polyhouse with fan-pad cooling system and micro-climate managed by internet of things (IoT). The present investigation was carried out during 2018-2019 at the Protected Cultivation Unit of M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha. The experiment was placed in Randomized Block Design and replicated four times. Among the cultivarsconsidered, there was significant difference interms of vegetative growth, floral characteristics and yield. The maximum plant height (45 cm) was found with Stanza and the cultivar White House recorded the highest number of leaves (30.3) during 100 days after planting. But the cultivar Dana ellene showed its superiority in terms of floral characters like stalk length (62.3 cm), basal girth of the stalk of flower (0.70 cm) and flower diameter (12.8 cm) with more yield.

Keywords: Gerbera, protected cultivation, growth, yield, flower quality

INTRODUCTION

Gerbera (*Gerbera jamesonii* L), perennial herb of the family Asteraceae is native to tropical Asia and Africa. Gerbera is one of the important high-value cut flowers used as fresh and dry flower, aesthetic decoration, making of bouquet with high demand in the domestic as well as export market (Singh *et.al.* 2017a). Gerbera is a leading flower and ranks among the top ten cut flowers of the world with wider applicability in the flower industry as cut flower and potted plant. It is a dwarf perennial herbaceous plant, growing in clumps with solitary flower heads on long slender stems which grow well above the foliage. The flowers come in wide range of colour including yellow, white, red, orange,

pink, maroon, crimson and intermediate shades of these colours. Under high temperature conditions, physiological disorder may occur and hence, there is a need of partially controlled environment to grow the crop successfully. In tropical and sub-tropical environment, gerbera can be grown with desired quality under polyhouse conditions with different degrees of climatic control. Further, choice of suitable cultivars is pre-requisite to achieve sustainable productivity under growing conditions (Sangma*et.al*. 2017). In this regard, information is not available on production of gerbera under protected cultivation in south Odisha conditions. Therefore, the experiment was carried out to appraise the performance of gerbera cultivars under forced ventilated polyhouse with fan-pad cooling system.

MATERIALS AND METHODS

The present investigation was carried out during 2018-2019 at the Protected Cultivation Unit of M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha under typical tropical climatic conditions.To evaluate the differentcultivars under force ventilatedpolyhouse. The experiment was laid out in Randomized Block Design and replicated for four times. Six cultivars *viz*., Stanza, Dana ellene, Intense, Dune, White house and Artist were selected for this study. Theseedlings were planted raised beds of 45 cm height with a bed width of 65cm.In each bed, 2 rows of seedlings were planted on January 28, 2018 with a row x plant spacing of 35 cm x 30 cm. The standard package of practices was followed for raising the crop. The micro-climate inside the polyhouse was maintained by need based operation of drip irrigation, fogger, fan-pad cooling system, and shade net and for smooth operation of control system the help of sensors based Internet of Things (IoT) was adopted. Observations on different growth parameters, floral quality and yield were recorded and statistically analyzed.

APPLICATION OF IOT

In this work cost effective soil moisture sensors, temperature and humidity sensors, are used. These sensors consistently scan the condition of the area and send it to the web server through Raspberry Pi deviceand receiver and Ethernet connection at receiver ends. These received data are stored in database. The web application is sketched in a manner to examine the collected data and to look over the threshold values of moisture, humidity and temperature. The decision is taken at the server itself based on feedback to start or stop irrigation. The block diagram of the system is shown in figure 1.

RESULTS AND DISCUSSION

Growth characteristics

The plant height was increased steadily up to 100 DAP which showed thatthe maximum plant height (45 cm)was found withStanza andthe cultivar being statistically at par with Intense registered significantly taller plants than other cultivars(Table 1 and Figure 2). However, the minimum plant height was recorded with the cultivarWhite House during all the growth stages. The plant height being genetically factored, it is expected to vary among the cultivars. Earlier researchers also noted similar observations (Singh *et al*., 2017a; Soni and Godara, 2017).Gerbera cultivars showed significant variation for number of leaves per plant (Table 2) and the cultivar White House recorded the highest number of leaves (30.3) during 100 DAPwhich was significantly higher than all other the cultivars, but it was statistically at par withStanza and Intense,whereasthe leastnumber of leaves per plant (20.3) was recorded in the cultivarArtist.The number of leavesof any cultivar greatly depends on morphological and genetic make-up and such variation in number of leaves was noted by earlier experiments (Sil*et al*., 2017; Singh*et al*., 2017b).

Floral characters

The floral characters related to quality of gerbera differed significantly among the cultivars (Table 3 and Figure 3). The longest stalk lengthofgerbera was found from Dana ellene (62.3 cm) while the shortest was found with the

cultivarArtist (50.07 cm). Stalk length is a very important quality character for gerbera cut flower and it indicates more reserved food in the stalk which will later be available to the flower for longer period. Further, being a genetic factor stalk length varied among the cultivars tested in the study and the similar was noted in earlier works (Ahlawat*et al.,* 2012; Sarmah*et al.,* 2014). The maximum basal girth of the stalk of flower was notedwith the cultivar Dana ellene (0.70 cm) which was significantly higher than other cultivarsexcept Stanza, however, least girth of the stalk was noted with the cultivars Dune and Artist (0.54 cm).The flower diameter showed significant variation among the gerbera cultivars andmaximum flower diameter was recorded from Dana ellene (12.8 cm) while minimum was recorded with White house and Stanza(11.8 cm). The floret diameter is a quality a parameter whichmight be obtained due to bigger ray florets and the results are in conformity with the findings ofMahmood*et al.*(2013).Moreover, the cultivar Dana ellene produced more suckers per plant at 100 DAP (2.6) which was significantly superior to other cultivars.

Yield

The yield of gerbera (plant^{-1}) of different cultivars were recorded and presented in Table 4 and Fig.1. There was significant variation among gerbera cultivars in production of gerbera flowers andmaximum number of total flowers per plant was recorded withDana ellene (14.04) during the period from May to October, 2019 which was significantly superior to other cultivars studied, whereas least number of total flowers washarvested form the cultivar Whitehouse (11.01) during the mentioned period. The results corroborate with the findings of Sarmah*et al.* (2014) and Sil*et al.* (2017) who recorded variation of gerbera productivity among cultivars under protected cultivation.

CONCLUSION

The experiment clearly indicated that Dana ellene resulted in the maximum productivity with satisfactory flower quality which was closely followed by the cultivars Dune and Artist. From the present study, it may be concluded that the gerbera cultivar Dana ellene,Dune and Artist may be chosen under forced ventilated polyhouse in south Odisha conditions.

ACKNOWLEDGEMENT

The authors are grateful to the authority of Centurion University of Technology and Management and KF Bioplants Private Limited for providing necessary facilities and quality seedlings respectively.

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Table 1.Plant height of gerbera cultivars under forced ventilated polyhouse

Hybrids	Plant height (cm)				
	20 DAP	40 DAP	60 DAP	80 DAP	100 DAP
Stanza	23.0	33.5	33.7	41.3	45.0
Dana ellene	21.2	29.6	32.2	36.4	40.5
Intense	18.5	29.5	32.3	33.9	41.5
Dune	22.2	30.2	31.9	32.3	39.1
White house	17.9	29.0	30.3	31.5	38.1
Artist	19.6	30.2	32.8	34.4	42.1
S Em (±)	0.5	1.2	0. 8	1.0	1.2
C D at 5%	1.8	3.8	2.5	3.0	3.7
C V (%)	5.8	8.0	5.2	5.8	6.0

Table 2.Number of leaves per plant of gerbera cultivars under forced ventilated polyhouse

Hybrids	Number of leaves/plant				
	20 DAP	40 DAP	60 DAP	80 DAP	100 DAP
Stanza	7.4	10.1	15.8	21.9	28.9
Dana ellene	6.8	8.8	15.4	20.3	21.2
Intense	7.4	10.1	15.7	21.2	29.0
Dune	7.0	9.8	15.3	18.8	24.9
White house	7.8	10.5	16.3	21.4	30.3
Artist	6.1	8.3	13.6	18	20.3
S Em (±)	0.39	0.5	0.7	1	2
C D at 5%	1.20	1.7	2.1	3.0	6.3
C V (%)	11.27	11.6	9.4	9.8	16.7

Table 3.Floral characters of gerbera cultivars under forced ventilated polyhouse

Hybrids	Floral characters			
	Length of stalk (cm)	Basal girth of the stalk (cm)	Diameter of flower (cm)	No of suckers/ plant at 100 DAP
Stanza	53.0	0.68	8.8	2.1
Dana ellene	62.3	0.70	9.6	2.6
Intense	56.0	0.60	9.1	2.3
Dune	59.1	0.54	9.1	2.0
White house	51.0	0.58	8.8	2.1
Artist	50.0	0.54	9.1	2.1
S Em (±)	1.96	0.14	0.08	0.04
C D at 5%	5.92	0.43	0.25	0.12
C V (%)	7.19	3.19	7.57	13.68

Table 4.Yield of gerbera (plant^{-1}) gerbera cultivars under forced ventilated polyhouse

Hybrid	Yield of gerbera plant^{-1}							
	May, 2019	June, 2019	July, 2019	August, 2019	September, 2019	October, 2019	Total (6 months)	Monthly average
Stanza	1.57	1.68	1.94	2.05	2.19	2.58	12.01	2.00
Dana ellene	1.75	1.94	2.16	2.43	2.61	3.15	14.04	2.34
Intense	1.43	1.61	1.92	2.10	2.31	2.39	11.76	1.96
Dune	1.56	1.69	1.87	2.18	2.38	2.72	12.40	2.07
Whitehouse	1.43	1.57	1.76	1.89	2.04	2.32	11.01	1.84
Artist	1.56	1.73	1.98	2.11	2.34	2.59	12.31	2.05
S Em (±)	0.03	0.04	0.05	0.05	0.06	0.07	0.23	0.03
C D at 5%	0.10	0.13	0.16	0.16	0.19	0.22	0.70	0.09
C V (%)	5.6	6.0	5.2	4.7	4.7	6.1	4.7	3.8

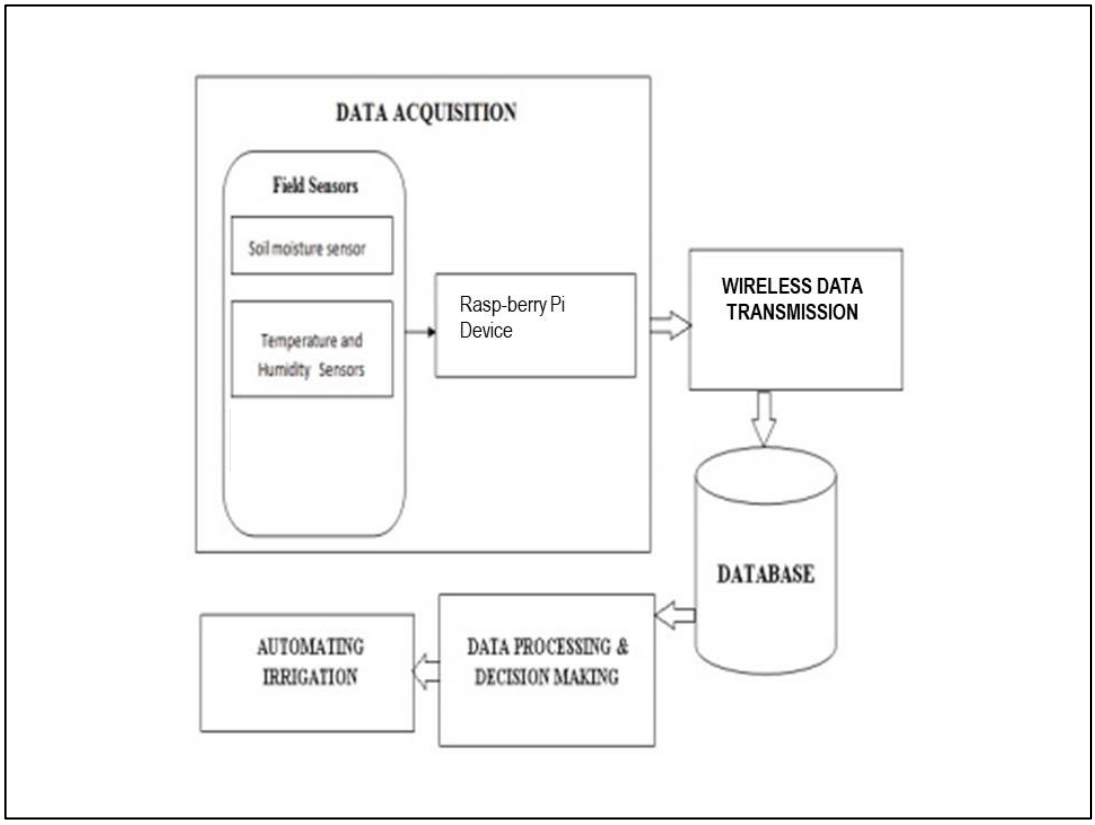

Figure 1: Block diagram of the IOT system

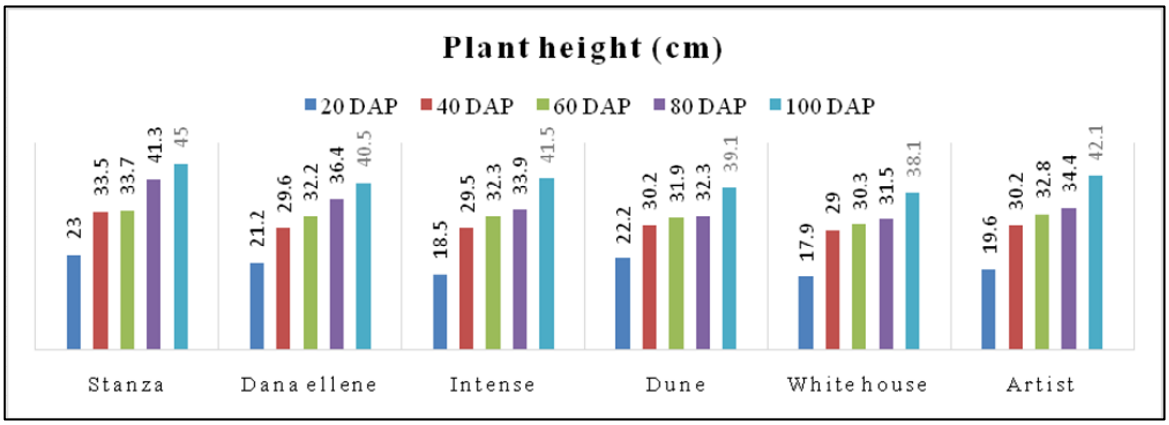

Figure 2. Plant height of gerbera cultivars at different growth stages (20, 40, 60, 80 and 100 days after planting)

Figure 3: Flower of gerbera cultivars

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Design and Implementation of Pipeline Architecture in Cadence Platform

Satyanarayan Padhy and Chandra Sekhar Dash*

Department of Electronics and Communication Engineering, Centurion University of Technology and Management, Odisha.

Received: 15 Mar 2020 Revised: 17 Apr 2020 Accepted: 19 May 2020

***Address for Correspondence**
Chandra Sekhar Dash
Centurion University of Technology and Management,
Bhubaneswar, Odisha, India.
E.Mail: Chandrasekhar.dash@cutm.ac.in

ABSTRACT

In pipeline basically the multiple instructions are divided into number of stages and can be connected with each other to form structure like pipe in which the set f instructions can be entered from one end of the pipe and exists from another end of the pipe. Basically the parallel programming is used in pipeline concept frequently in the multiprocessor applications but it has lack of workload characteristics studies. This paper presents the implementation of pipeline model in cadence tool for studying the workload behavior of multiprocessor to help the developers to understand the load behavior of multiprocessor application

Keywords: structure, pipe, program, multiprocessor, sequence.

INTRODUCTION

In pipelining the root level program is executed. Basically in program the smallest execution packet is the instruction set. The instructions containmultiple numbers of operations. In case of processors which are simple scalar, in each clock cycle multiple number of instructions are executed bit only contains single operation. To get the expected result the execution of instructions is done in sequence of phases. In pipeline during the execution process the multiple numbers of instructions are getting overlapped. So in pipeline it is divided in to multiple numbers of stages and getting connected with each other to form structure like pipe in which it follows the rule of first in first out (FIFO). The throughput of the instruction can be increased using this pipeline structure. In each segment there are registers to hold the data at the input followed by circuits which are combinational in nature to perform required operations. The combinational circuit outputs are applied to the next segment input side containing input registers.

Evaluation of Pipeline

The most critical parameter which considered while evaluating are the throughput and required hardware resources as well as power consumptions. To measure the hardware resource tool established metrics does not exists in cadence platform. So to address this issue two areas of measurement are readily apparent logic gates and CLB slices. The CLB slices in hardware resources may not be utilized fully by the place and route software to relieve congestion of routing. As a result the slice of CLB numbers increases with respect to increase of number of gates. For achieving better utilization of chip measure, the numbers of slices considered are the major area measurement. Thus throughput per slices metrics can be used to measure the cost associated with the hardware resources. Thus the implementation with optimization can display higher throughput and can have throughput per slices in large number. It can be noted that throughput per slices is inversely proportional to classical time area product. Hence having larger throughput per slices is the advantage.

Operation of pipeline architecture

As discussed the multiple number of phases are concurrently performed which are always treated as independent of number of operations and it can also be overlapped. So multiple operations can be done simultaneously while each of the operation are in its own phase which are independent. Considering the instruction are in independent nature the pipeline processor can execute one operation in each phase at given instant of time. Basically the initial phase is Fetch phase. So at the start of the clock cycle one operation is fetched. On the arrival of next clock the first operation goes to the decode phase from fetching phase. As a result now the fetch phase is empty so the next operation goes to fetch phase. On the arrival of next clock the operation which is in decode phase now moves to execution phase and whichever operation is in fetching stage goes to decoding phase as shown in the fig.2.

In this way all the instruction are concurrently executed and after required clock cycle the processor obtains output. If all the instructions are sequentially executed, then instruction which is first fetched go through each phase and then next instruction is fetched. So for execution each instruction takes six number of clock cycles and if there are P number of operation to be executed it will be taking p*6 number of clock cycles. Bit in a pipeline processor as the execution done concurrently only 1st operation takes n clock cycles while the rest operations executed one per each cycle hence overall execution time is reduces and so as the processor speed increases. In pipeline as phases are independent of multiple operations and it can be overlapped and hence simultaneously multiple operation can be done having each of the operations in its own phase which are independent

Design and Simulation of Pipeline Architecture Using Cadence Tool

For Implementing the pipeline architecture cadence tool has been used. Both front end and back end analysis is done. For Frontend Verilog code for pipeline is being executed in NC LAUNCH and RTL compiler to obtain the RTL of the system and it has been tested through the Test bench code. For backend design Encounter tool has been used for converting RTL to GDSII. All the synthesis reports such as cell report, timing report, power report has been generated to validate the result.

RESULTS AND DISCUSSION

The following section shows the results obtained for pipe line architecture.

RTL of Pipeline Architecture

Fig.3 shows the result for RTL of the piline structure obtained using Encounter tool in the cadence platform. The RTL validation is done through running a test benchas shown in below.

Simulation Output

Following figure shows the simulation output obtained using test bench waveform (Fig.4)

Layout of Pipeline Architecture

Following figure shows the Layout of Pipeline Architecture obtained using test bench waveform (Fig.5)

CONCLUSION

This paper presented an overview of the pipeline programming model, its implementation alternatives on multiprocessors and the challenges faced by developers. To analyse how pipeline parallelization affects the characteristics of a workload. Results show that workloads that use the pipeline model have systematically different characteristics. A major reason for the changed characteristics is differences in the sharing behaviour. Our results suggest that researchers should consider adding pipelined workloads to their mix of benchmark programs for computer architecture studies.

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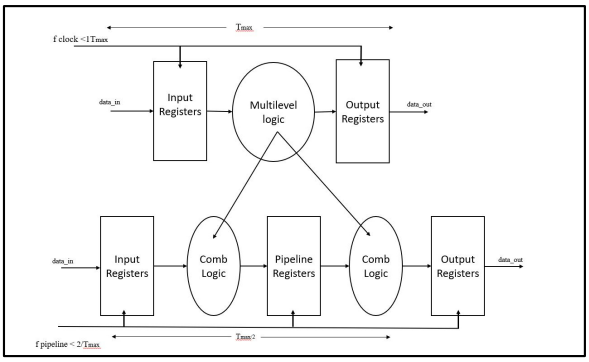

Fig. 1. Block Diagram of Pipeline Architecture

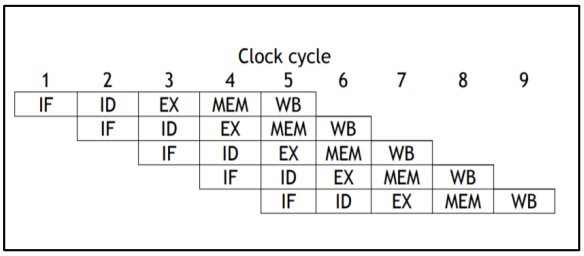

Fig.2 Execution of Operations Concurrently in Pipeline

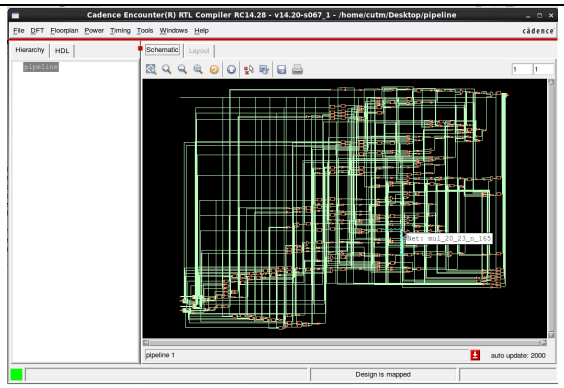

Fig.2 RTL of Pipeline Structure

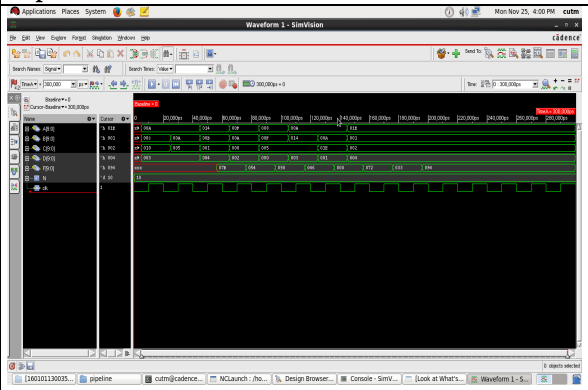

Fig.3 Simulation Output

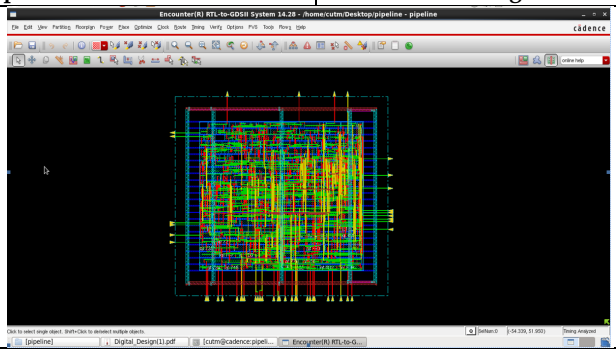

Fig. 4 Layout of Pipe Line Architecture

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Additive Manufacturing: A Boon for Medical Applications

Kula Bhusan Pradhan* and Binayak Sahoo

Centurion University of Technology and Management, Odisha, India

Received: 16 Mar 2020 Revised: 20 Apr 2020 Accepted: 22 May 2020

***Address for Correspondence**
Kula Bhusan Pradhan
Centurion University of Technology and Management,
Odisha, India.
E.Mail: kulabhusan.pradhan@cutm.ac.in

ABSTRACT

Additive Manufacturing (AM) is considered as the manufacturing revolution in the field of medical application. Additive manufacturing is generally referred to as three dimensional printing (3D Printing). The recent advancements in the additive manufacturing determined a path for the production of Bio-materials or health care products with patient specific solutions. By using the AM technologies any complex shaped and sized objects can be designed and produced by using different variety of materials like metals, polymers, ceramics and bio-inks. AM technologies attracted everyone's attention due the manufacturing of products for dental, implant areas, bone applications, drug delivery devices, tissue issues, prosthetic limb and medical tools. This review work mostly focuses on the use of Bio-fabrication for the various medical applications such as bone substitutions, dental implants, hearing aids, orthoses ans prostheses and cardiac surgery with the key AM technologies.

Keywords: Additive Manufacturing, 3D Printing, Bio-materials, Dental implants, Hearing aids, Orthoses and prostheses, Cardiac surgery.

INTRODUCTION

Additive manufacturing refers to the process of obtaining one component from the 3D model data by using the layer upon layer deposition of materials. AM process is just the reverse of machining process, during machining materials are removed layer by layer to get the final product and in AM the materials are added layer by layer to get the final product. The applications of AM is limitless as any complex and intricate shaped components can be manufactured with greater precision and accuracy.

AM systems includes the the solid based, liquid based and powder based manufacturing systems. In solid based manufacturing system the building material is in the solid state, the processes like fused deposition modelling(FDM) and selective deposition lamination(SDL) comes under this system. Similarly, in liquid based manufacturing system the building material is in liquid state, the processes like stereolithography apparatus(SLA), solid object ultraviolet-

laser printer(SOUP) and polyjet 3D printing comes under this system. In powder based manufacturing system the building material is in grain form, the processes like selective laser sintering (SLS), colour jet printing (CJP) and electron beam melting (EBM) falls under this system[1]. Today, AM systems are being used in industrial sectors like medical, dental, automotive, aerospace, architectural, energy, tooling, marine, electronic, foot wear, terrain modelling, furniture and jewellery. The newly innovative applications are also constantly developing. The key AM technologies like stereolithography apparatus (SLA), fused deposition modeling (FDM) and selective laser sintering (SLS) which are used for medical applications are briefly discussed in the following paragraphs.

Fused Deposition Modeling (FDM)

In FDM process first one layer of the semi solid materials are extruded through a heated nozzle and immediately solidified after the extrusion. Then the successive layer by layer deposition of materials results into a required component. The material is available as thermoplastic filament, wounded around a coil and at the time of need the coil unreeled to supply the materials to the liquifier or extrusion nozzle head. A resistive filament is present in the nozzle head which heat the material and bring it to the molten state. These molten materials are extruded and solidified. Servo mechanisms are used to control the movement of extrusion nozzle head, working plat form and also controls the flow of materials [2].

Stereolithography Apparatus (SLA)

In SLA process, photo polymerization principle is used. A large tank or vat is used to hold the photo curable acrylic liquid polymer and these polymers are when exposed to ultraviolet lights, they gets solidified. Then the solidified portions moves down by one layer thickness through the elevator. The whole process is again repeated until the desired 3D component is obtained. At the end of the process the acrylic liquid polymer is drained out from the vat leaving the final component in the vat[3].

Selective Laser Sintering (SLS)

The SLS process, carried out inside a closed chamber which filled with nitrogen gas to prevent oxidation and degradation of powder or grain form material. The powder is maintained at slightly below the melting temperature. The elevated temperature around the part to be formed is maintained by infrared heaters. Then a focused laser beam is moved on the bed and the slice cross section is formed after thermally fusing the powder material. Then the fabricated sliced cross section moves downward as one layer thickness and the process repeated until the desired component is formed [1].

Additive manufacturing in medical field

Medical science is influenced by AM, mostly for designing and development of medical devices and instruments. Due to reduced development time for intricate shape with better functional performance AM is considered before any other production technologies [4]. Mostly three things like treating more people which was not possible previously, obtaining the patient specific outcomes and consumption of less time under the direct case of medical specialists are considered as the pillar of AM[5]. So AM, enables the medical specialists to treat more numbers of patients without sacrificing their results [6]. The direct applications of AM in the field of medical are as follows:

Additive manufacturing for bone substitutions

Bone is considered as the key element in human body as it provides the required structure to the body, protects different organs of our body and mechanically takes all the loads of other body parts. When ever the bone is got

damaged or need replacement due to any disease, previously only two methods have been used where natural biomaterials are used [7]. First one is autografts, in which from the same person the bone replacement is collected and implanted, which is considered as the gold standard for bone treatment [8]. But the available graft material is limited and the sources for autograft are ilia, fibulae and ribs which are low in strength [9]. Secondly, allografts, in which bone replacement is done from a donor [10]. In allograft case the risk of disease transmission, delayed union and nonunion are there [11]. So, As per the need of bone replacement artificial biomaterials are manufactured by AM and implemented in medical field.

AM technologies such as powder bed fusion, directed energy deposition, sheet lamination, binder jetting , material extrusion are being used to produce metallic, ceramics and polymer biomaterilas for bone replacements[12]. Metals such as Ti, Mg and Fe are now a days mostly used as biomaterials for bone substitutions[12]. Ceramics are used for tissue engineering that focuses on tissue repair and regeneration[13]. Polymer resins are also being used through vat photo poly-merisation process to solve the problems of bone replacement[14]. Knee replacement, jaw reconstruction, skull for human and other animals are some examples in which bone biomaterials were produced by AM. Everyday new design and technologies are under developing process for the next best bone product.

Additive manufacturing for dental implants

AM helps in the artificial replacement of teeth known as dental implants. Dental implants are in use successfully for many years. AM is the fastest method for manufacturing of biomaterials for dental imparts with the use of materials like Titanium, Titanium alloys and Zirconia, stainless steel, aluminium due to their weight ratio, high strength, corrosion resistance, low density and mechanical strength. AM provides the biomaterials for dental imparts with greater precision and reduced surgery time [15]. A simple four steps are involved in the manufacturing and use of dental implant using by using fuse deposition modeling (FDM) process, the steps are shown in figure 5: The major applications of additive manufacturing in dentistry includes replacement or repair of damaged tooth, 3D printed dental impart, fabricate crown and dentures and design and development of surgical tools[17].

Additive manufacturing for hearing aid

A hearing loss person or a partially deaf person uses some small amplifying devices on their ear which are designed to improve the hearing by making the sound audible to the person, these small devices are known as hearing aid and these are considered as the medical devices. Hearing is improved by AM. Before the arrival of AM the hearing aids took more than a week for production, now a days due to AM hearing aid manufacturing process is converted into only three steps i.e, scanning, modelling and printing which takes time less than a day[21].

Additive manufacturing for orthoses and prosthesis (excluding bone substitutions and dental implants)

Orthoses is the artificial external device which provides comfort to the limb, spines and other body parts by restricting movements and absorbing the shocks. Prosthesis is the term used for the artificial body parts. When a missing body part is replaced by an artificial device that is known as prosthetic implant. AM helps in restoring the normal functions of our missing body parts. Through AM, artificial fully functional body parts are manufactured from the 3D model. The nomenclature of ortho-prosthesis includes upper limb orthoses, lower limb orthoses, spinal orthoses and prostheses (above elbow, below elbow, above knee and below knee) [22].

Additive manufacturing for cardiology

AM is considered as a powerful tool in the medical field before doing any complex and complicated surgery. Heart disease is the most sensitive case in the field of medical science. Heart surgery is always considered as a challenging task due to the high variability of the patients. AM technologies plays an important role in the cardiac field, a 3D model heart of any cardiac patient can be printed by taking the data from the CT scan or MRI[23,24,25]. So before doing the actual surgery the doctors are going through this 3D model of the heart and discuss the anatomical structures and everything in details about the concerned cardiac patients heart. So it saves the times of the doctors for actual surgery of the heart. By using AM, the scientists and technology developers are on the way to the replacement of the damaged heart so that the need of heart transplant will be no more [26]. Varieties of materials like metal, composite, plastic, wood and powder are being used for the manufacturing of 3D model of heart by AM with complete colour of heart for proper understanding of every parts of it before surgery [27].

CONCLUSIONS

Additive manufacturing has shown a greater potential in the filed of medical application and medicine. Everyday new developments are arising in order to make the medical industry work with more ease, less time consumption, increase curable rate and better patient and doctor satisfaction. All the five application such as bone substitutions, dental implants, hearing aids, orthoses and prostheses and cardiac surgery discussed in this review open up new domains in the medical field. In the recent years due to AM many lives saved after the critical and complex cardiac surgeries, many people can run, walk and work due to the developments of orthoses and prostheses, many people enjoyed the desired food due to dental implants, the hearing loss persons are able to hear and many damaged bones have been repaired and implanted. As the expectations are always unlimited, today there are numbers of problems are still exists in the medical field which can be solved by AM technologies soon. AM has the potential to show the world a new era by implementing the advanced materials with the help of advanced technology that was not thought by anyone.

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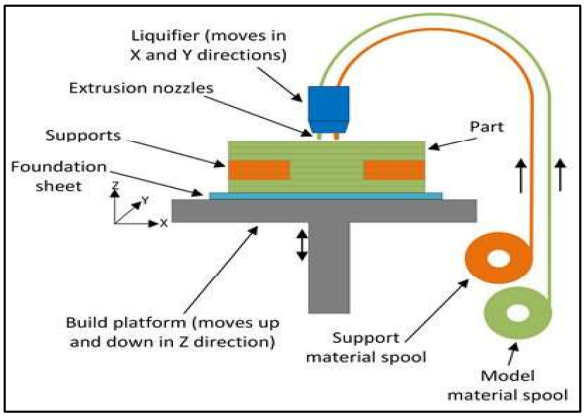

Fig.1 Fused deposition modelling(FDM) working set up

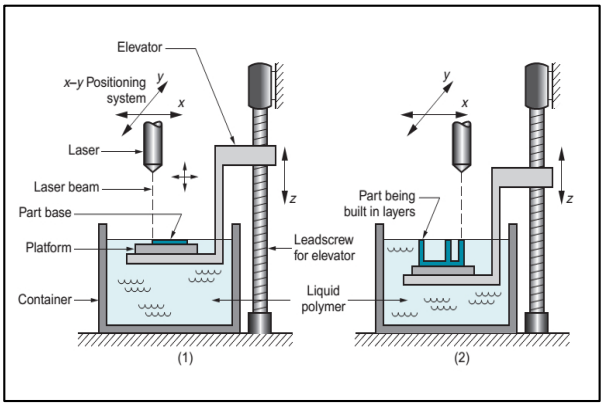

Fig.2 Stereolithography apparatus set up

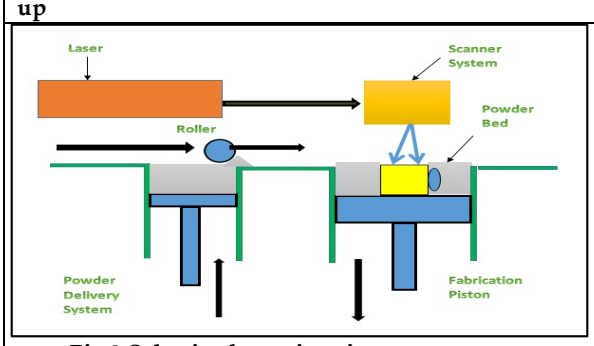

Fig.3 Selective laser sintering process set up

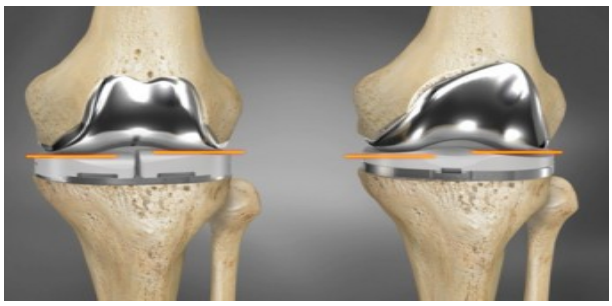

Fig.4 Additive manufacturing biomaterials for knee replacement

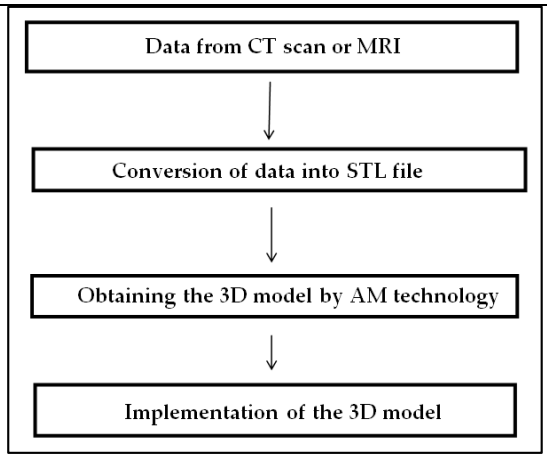

Fig.5 Additive manufacturing flow diagram for dental implant[16]

Fig.6 3D printed dental implant model

Fig.7 Hearing aid 3D model

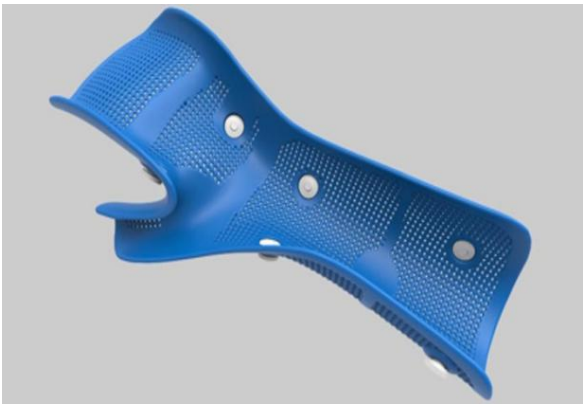

Fig.8 Orthoses 3D model

Fig.9 Prostheses 3D model

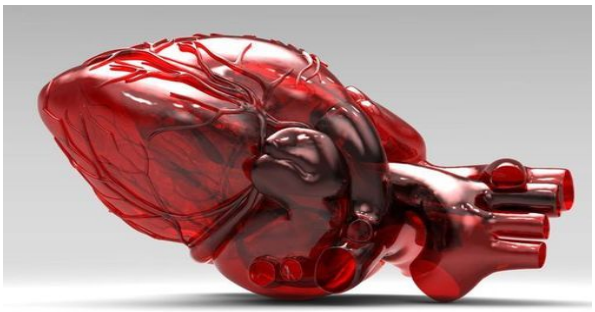

Fig.10 3D model of a heart

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Theoretical Study on Polymer based Organic Solar Cell Device for the Charged Particle Detection by SRIM Simulation

Sk Najmul Islam*, P.K. Rath, Satyanarayan Dhal, Arpita Patro and Madhuchhanda Swain

Centurion University of Technology and Management, Odisha, India.

Received: 14 Mar 2020 Revised: 19 Apr 2020 Accepted: 22 May 2020

***Address for Correspondence**
SK Najmul Islam
Centurion University of Technology and Management,
Odisha, India.
E.Mail: najmul.islam@cutm.ac.in

ABSTRACT

A monte-carlo based simulation has been performed using the existing code SRIM/TRIM software to understand the properties and suitability of a newly designed semiconductor for the experimental purpose. The detailed simulation presented reveals that a polymer based solar cell can be used as a charged particle detector.The interesting part of the result is regarding the defect generation which is less in these polymer-based semiconductors compared to that of silicon-based. In addition, it has also been found that the Pulse height defect is less in polymer-based semi conductor. A sign of good hope to use the newly polymer-based semiconductor in an experiment has come up.

Keywords: Pulse Height Defect, SRIM, Montecarlo Simulation, Solar Cell, Polymer

INTRODUCTION

The rapidly growing global population, living standard, and economic development has triggered mankind to think of a new alternative way to find renewable energy sources. The most abundant and efficient alternative energy source is solar energy [1]. Various energy production systems have been developed by utilizing the sunlight in the past decades. Among them, conventional silicon-based solar cells are mostly efficient [2-3]. Crystalline silicon-based inorganic solar cells perhaps can fulfill the energy demand but due to its high cost and low solution processability, they are not accessible for common use. "Due to this, π- conjugated polymer based" solar cells (PSCs) have received enormous interest as a cheap renewable energy resource in recent years [4-9]. Among the different organic photovoltaic (OPV) devices, solution-processed bulk heterojunction (BHJ) OPV devices are of increasing attention due to their cost-effective, lightweight, ease of fabrication by large scale, and feasibility of flexible devices [10-18].

In addition, / blends offer better flexibility in controlling solution viscosity, an essential criterion in large scale solution processes for film coating. Therefore, the development of all solar cells is essential, which may eventually give rise to higher power conversion efficiency (PCE) via proper selection and combination of donors and acceptors.

In addition, with the energy generation from solar power, the same semiconductor detectors can also be used for the detection of charged particles if it can be configured and a proper electrical connection will be provided with a read-out system.

As the detection of the charged particle is very important in experimental nuclear physics, so in many laboratories in India and also abroad, scientists generally rely on many varieties of detectors for nuclear physics. Out of which one popular and important detector is the solid-state detector. The most commonly used solid-state detector is the silicon semiconductor detector. They are highly potent for charge particle detections as detection in the efficiency of SSB (silicon surface barrier detector) is ~100% for the charged particle but a single detector after using many times for so many experiments, the detection performance reduces which leads to a situation to change the detector completely. This makes it expensive and far from the reach of the normal laboratory. To overcome this situation a new design of semiconductor has been investigated. The newly proposed detector is a polymer based solar cell. The different Layers of this cell has been shown in Fig.1. One can see that there are many layers but none of the layers have Silicon [6]. It is very important to study the different characteristics and comparison with the existing Silicon detector in order to find its application practically. The present report is based on the simulation studies to understand the characteristics.

When the semiconductor will be in reverse biased condition, there will be no free charge carrier. At that instance, if any charge radiation (say proton, alpha, and fission) will fall on the junction it will create electron-hole pairs. The movement of these electrons and holes in the opposite direction leads to a signal pulse. These signal pulses will provide all the information on the incident charged particle radiation on the detector. A monte-carlo simulation has been performed using the code SRIM [5] to understand its properties like efficiency and the suitability of it in nuclear experiments. The same simulation has also been performed for existing SSB [6] detector which normally people use in experiments. The comparison has been shown in Fig.2 and Fig.3.

It is evident from Fig. 2 that the efficiency (i.e. the generation of electron and hole) is nearly the same for both the detector. The calculation has been performed by shooting by 10000 ^{120}Sn ions having energy 30 MeV. The high mass and the high energy have been chosen as in the case of fission experiment, the conventional detector goes bad very fast as the mass of the fission fragments is very high and the energy associated also becomes very high ~20-30 MeV. When this high mass and high energetic ions will cross the reversed biased junction area by creating electron and holes, they produce defects and those defect sites are occupied by the other ions which have been shown in Fig 3. For the case of a Silicon-based detector, the defects are occupied by a large number of the Al atoms which means that the junction will not be devoid of defects for a longer period. Whereas at the same time the newly proposed polymer-based semiconductor detector has fewer defects and the occupancy of the Al atom is also small. This indicates that the longer longevity of the detector for the heavy-ion case.

Another important investigation relating to the plasma effect has also been carried out. When the high mass and incident heavy charge ion with high energy will cross the detector, it creates the plasma in the track. If the track is narrow, the plasma density will be very high as the distribution is not uniform which leads to the more pulse height defect [7]. Fig.4 indicates that the plasma distribution for polymer-based semiconductors is widespread i.e. the density is not localized in the narrow region which indicates the quick collection of the electron and hole as soon as they will create. This is very important as it reduces the pulse height defect which is one of the main drawbacks of the existing semiconductor detector.

CONCLUSION

The detailed simulation has been performed using SRIM/TRIM software to understand the properties and suitability of the newly designed semiconductor for the experimental purpose. The detailed simulation has been compared for

both the cases. Electron hole generation efficiency has been found nearly the same for both the cases. We have also found the defect generation is less in newly designed polymer-based semiconductors compared to silicon-based. In addition, it has also found that the Pulse height defect is less in polymer-based semiconductor compared to silicon-based. All these properties indicate the suitability of the polymer based semiconductor. More experimental data will be required to validate our founding strongly which is our next motivation.

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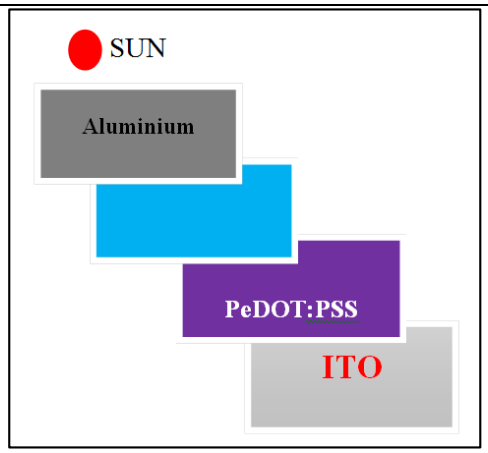

Fig. 1 Schematic diagram of -based Solar Cell (polymer based Solar cells). There is no silicon inside it but a modified polymer

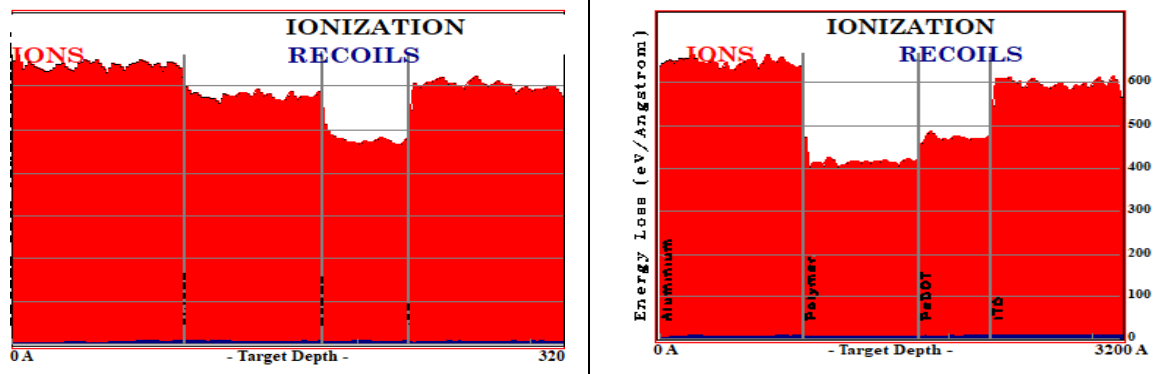

Fig. 2: (Left) the SRIM calculation of standard Silicon detector and (Right) The same calculation for newly proposed semiconductor detector. The generation of the electron and hole are nearly the same in both. A small increase can be seen in Si-based detector which is expected.

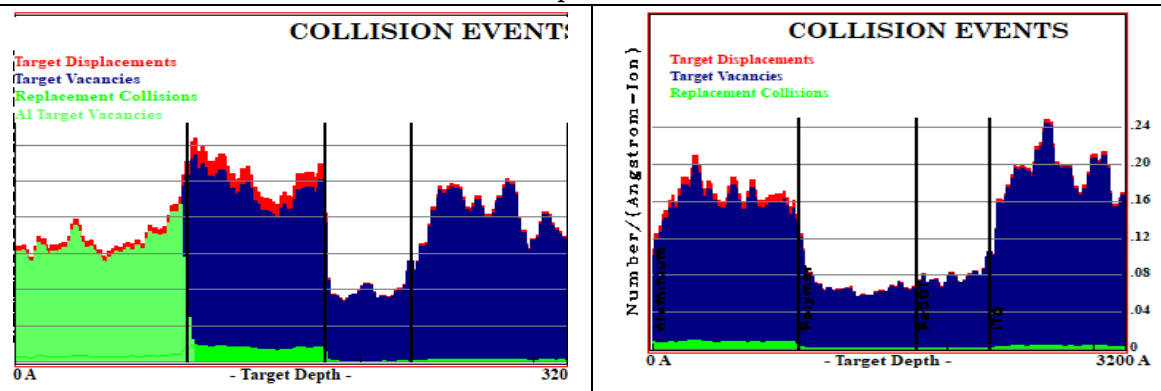

Fig. 3: (Left) the TRIM calculation for standard Silicon detector and (Right) The proposed polymer-based semiconductor. One can see the generation and occupancy of the vacancies by the A atoms (green) are more in the case of a Silicon-based detector compared to polymer based

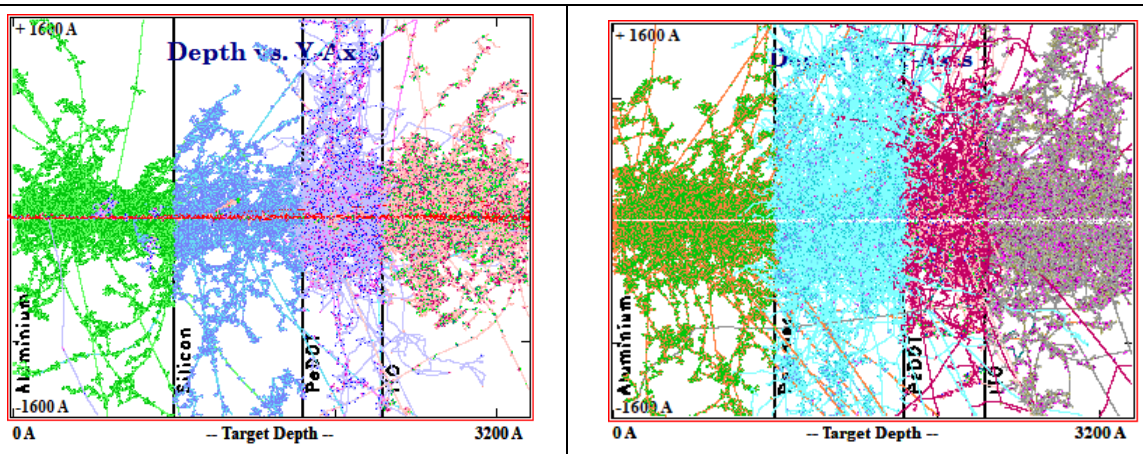

Fig. 4: (Left) the TRIM calculation for standard Silicon detector which shows the distribution of the energy loss spread. (Right) The same energy loss spread for proposed polymer-based semiconductor. One can see that the track is narrow in conventional Silicon whereas widespread in the proposed polymer.

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Does Sanitation have Association with Health Outcomes? Evidence from India

Bibhunandini Das[1*] and Amarendra Das[2]

[1]Associate Professor, School of Management, Centurion University of Technology and Management, Odisha, India.
[2]Reader F, School of Humanities and Social Sciences, National Institute of Science Education and Research (NISER), Bhubaneswar, Jatni, Khordha, Odisha, India,

Received: 17 Mar 2020 Revised: 20 Apr 2020 Accepted: 23 May 2020

***Address for Correspondence**
Bibhunandini Das
Associate Professor, School of Management,
Centurion University of Technology and Management,
Odisha, India.
E.Mail: bibhunandini.das@cutm.ac.in, bibhu31@gmail.com

ABSTRACT

In this paper we have attempted to unravel the disparity in sanitation facilities across rural and urban regions of Indian states and the impact of sanitation on health outcomes. Based on the 69th National Sample Survey data set which covers more than 95 000 households we find a wide disparity in the access to sanitation facilities across Indian states. While the north-eastern and southern states perform better in sanitation indicators, the eastern and central part of India performs poorly. So far as the relationship between the sanitation and health outcome is concerned our analysis shows that better sanitation facilities do have a positive impact on the health outcomes. From our analysis of two diseases- stomach problem and malaria, that are more caused due to sanitation facilities we observed that better sanitation facilities in terms of access to toilets and bathroom access to regular safe drinking water, practice of storing drinking water in metal or non-metal container, absence of flies and mosquitoes, having separate kitchen and proper disposal of wastes reduces the incidence of diseases.

Key Words: Sanitation, Health, Disease, Drinking water.

INTRODUCTION

The World Health Organisation (2008) argues that almost one tenth of the global disease burden could be prevented by improving water supply, sanitation, hygiene and management of water resources. Similarly, the Ministry of Drinking Water and Sanitation, Government of India points out that the effects of poor sanitation seep into every aspect of life – health, nutrition, development, economy, dignity and empowerment. It perpetuates an

intergenerational cycle of poverty and deprivation.The United Nations recognises that water and sanitation (W&S) related improvements are crucial to meet the Sustainable Development Goals (SDG), reduce child mortality, and improve health and nutritional status in a sustainable way. In addition, they [W&S] induce multiplesocial and economic benefits, adding importantly to enhance well-being (Prüss-Üstün& WHO, 2008). Contradicting the popular notion on the impact of sanitation on health outcomes, Clasen et al (2014) have found that increased latrine coverage may not necessarily reduce the exposure to faecal pathogens and prevent disease,based on a cluster-randomised controlled trial between May 20, 2010, and Dec 22, 2013;in 100 rural villages in Odisha; India. They concluded that as efforts to improve sanitation are being undertaken worldwide, approaches should not only meet international coverage targets, but should also be implemented in a way that achieves uptake, reduces exposure, and delivers genuine health gains.In this context we feel that there is a greater need to undertake more empirical research to examine the impact of sanitation on health outcomes. Using the large scale household survey data collected by the National Sample Survey Office of India, in this paper we attempt to examine the association between sanitation on various health outcomes.

The remainder of this paper is organised as follows. In section 2, based on the insights from literature weexplain how sanitation associates with health outcome. Section 3 presents the methodology employed in analysing the factors that determine the likelihood of diseases.Section 4 discusses the data sources and variables used in the analysis.Section 5 presents Indian sanitation scenario followed by discussion on state wise conditions of households in terms of diseases. The section also discusses the results of maximum likelihood estimation of different diseases. Section 6 summarises findings of the study and provides some concluding remarks.

Insights from Literature

It has been time and again argued that sanitation plays a critical role in improving human health and overall well-being. This section briefly outlines the role of sanitation in health by reviewing the existing literature. Studies mostly focus on the consequences of open defecation and unsafe drinking water. WHO considers water, sanitation and hygiene are the most basic human needs among others and prerequisite to human wealth and development. Further, it estimates that improving water, sanitation and hygiene could prevent around 9.1 per cent of the global burden of disease and 6.3 per cent of all death (WHO, 2012). Open defecation is considered to be the reason of persistent burden of diarrhoea and intestinal parasite infection among children, specifically below 5 years (Patil et. al, 2013). Patilet. al. (2013) in its randomized controlled study of a rural sanitation behaviour change programme in Madhya Pradesh found that toilet use has clearly lagging behind toilet construction. There needs to improve a lot in both toilet construction and sanitation related behavioural change in the intervention villages. By measuring the economic impacts of inadequate sanitation in India the Water and Sanitation Programme of the World Bank found that the total annual economic impact of inadequate sanitation in India was $48 per person in India which accounts 6.4% of India's gross domestic product (WSP, 2011).

Study based on five states of India- Bihar, Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh;Coffey *et.al*(2014) presented that open defecation has dire consequences on health and human capital crisis. Another recent study by Bedi*et.al* (2015) on health and economic impact of unsafe drinking water shows that the per capita economic cost of water-related diseases leads to extra monetary burden on the households.Barnard *et.al*(2013) in their study on impact of Indian Total Sanitation Campaign (TSC) on latrine coverage and use in Orissa found that among the households with latrine, more than a third was not being used by any member of the household.Chambers and Medeazza (2013) linked the persistent under-nutrition largely with open defecation and explain that much of the under-nutrition would disappear in India with hygienic conditions.Bhutta*et.al* (2008) in their study showed that sanitation and hygiene not only prevent but also reduce stunting. Hence to improve the nutritional status, effective Water, Sanitation and Hygiene (WASH) interventions are vital. Gupta (2005) emphasised on improvement of public health services through assuring food safety, vector control, monitoring waste disposal, water systems and health education

to improve personal health behaviour. Other than India, there are studies which discuss about the water and sanitation in other countries. Esrey (1996) analysed data from 4 Sub-Saharan Africa (Burundi, Ghana, Togo and Uganda), 1 from Asia (Sri Lanka), 1 from North Africa (Morocco) and 2 from America (Bolivia and Guatemala) to test whether incremental health effects regarding diarrhoea and nutritional status result from incremental improvements in water and sanitation conditions. From the study, the author conclude that '*improvements in water and sanitation together were synergistic in producing larger impacts than either alone, particularly in rural areas*'.

Drawing insights from the literature we can argue that access to latrine and its use, provision of quality and purified drinking water, better garbage disposal mechanism, better drainage system will have strong health implications particularly diseases like stomach problem and malaria. Use of toilets by the household is not sufficient to ensure own health. Non-utilisation of toilets by other households can have negative externality effect on the households using toilets also. Therefore, universal use of toilet and provision of purified drinking water is crucial in order to reduce the stomach ailments and malaria. The economic literature showing the association between water and sanitation and health outcomes using large scale data in Indian context are sparse. In this paper we show the disparity in the access to water and sanitation across Indian states and the associations of water and sanitation on health outcomes.

METHODOLOGY

In order to establish the relationship between sanitation and health outcomes first of all we have provided the state wise scenario of access to (i) drinking water from protected sources throughout the year, (ii) access to latrine and (iii) access to bathroom. We have also provided the state wise scenario of prevalence of two diseases (i) stomach problem and (ii) malaria. Then in order to establish how in-access to drinking water and sanitation facilities increases the vulnerability of stomach problem and malaria, we have done two regression analysis; one with the dependent variable whether at least any one member of the household had stomach problem in last one month or not and other with incidence of malaria. If the members have suffered from that particular disease (stomach problem or malaria) then it is one, otherwise zero. In the key explanatory variables we have taken several indicators of access to drinking water and sanitation. We have also taken a number of other socio economic indicators as the control variable of the household.

The regression equation for stomach problem is specified as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + U_i \ldots\ldots\ldots (1)$$

Y= Stomach problem
X_1 =Use of latrine by the household
X_2=Proportion of households using toilet in the state [captures externality of toilet use]
X_3=Quality of drinking water used by the household
X_4=Purification of drinking water
X_5=Use of bath room
X_6=Presence of flies and mosquitoes
X_7=Drainage facility
X_8= Education of male household head
X_9=Separate kitchen [for care for food hygiene]
X_{10}=Religion
X_{11}= Social category

X_{12}= Monthly Per capita Consumption Expenditure [proxy variable for income]

In model 1 we have taken first four variables as the treatment variables and other eight as the control variables. In order to assess the explanatory contributions of control variables we have carried out log likelihood ratio test for these two set of variables. The empirical exercise has been executed in STATA 10 software.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_3 + \beta_9 X_9 + \beta_{10} X_{10} + U_i \dots \dots \dots (2)$$

Y= Malaria incidence
X_1 =Presence of flies and mosquitoes
X_2=Proportion of households facing flies and mosquitoes problem in the state [capturesmalaria prone region]
X_3=Deposit of garbage
X_4= Drainage facility
X_5=Use of latrine
X_6= Education of male household head
X_7= Religion
X_8= Size of the household [total members in the family]
X_9=Monthly Per capita Consumption Expenditure [proxy variable for income]
X_{10}= Social category

In model 2 we have taken first four variables as the treatment variables and other six as the control variables. Like the case of first model we have carried out log likelihood ratio test for these two set of variables.

Data and Variables

The study uses secondary data from a large scale survey collected by the National Sample Survey Office (NSSO), under the Ministry of Statistics and Programme Implementation, Government of India. NSSO carried out a special comprehensive survey covering a total 95,548 households all over India to gather data on drinking water, sanitation, hygiene and housing condition of households during July, 2012 to December, 2012. This included 53,393 households from rural and 42,155 from urban area. Due to large sample size covering all over the India, the chance of selection bias is minimised and hence the estimations are very much robust. It is noteworthy that NSSO is known worldwide for the scientific sampling design and large scale data collection.

Hypothesis and Variable Construction

The key goal of public health services is to reduce a population's exposure to disease through well sanitation, assuring food safety, vector control, monitoring waste disposal and water systems (Gupta, 2005).It has also been highlighted that the persistent under-nutrition is mainly due to open defecation, population density, lack of sanitation and hygiene (Chambers and Medeazza, 2013). Against this backdrop, the present study attempts to understand the effects of access to water and sanitation on two diseases stomach problem and malaria.It is hypothesised that poor sanitation, drinking water along with other household characteristics affects the health of the household members.

Use of latrine

The NSSO provides data on access to latrine and use of latrine. The access to latrine variable provides 5 sources of access to latrine and no latrine. The use of latrine variable covers the subset of households who have access to latrine only. Therefore we have created the variable use of latrine by adding the households those do not have access to latrine and the households those do not use the latrine in spite of having access to at least one source. Only 397 households who have access to latrine reported not using it. The households that use the toilets are coded one and others zero.

Proportion of households using toilet in the state [captures externality of toilet non-use by other household]

The non-use of toilets by other households may have negative health impact on the households that use toilets. In order to capture the negative externality of non-use of toilets on the households that use toilets we have taken proportion of households using toilet in a state. Thus for all the households in a state this will have the same number and will differ only across states.

Quality of Drinking Water

The data source classifies the quality of drinking water in four different categories: bad in taste, bad in smell, bad in taste and smell, bad due to other reasons and drinking water without defect. For the analysis, the variable has entered as dummy variable and we have clubbed the four categories into two groups: bad quality drinking water,taken as zero and drinking water without any defect, taken as one. We are hypothesising that households with good quality drinking water (without any defect) will be less likely to have illness.

Drinking Water Purification

The variable has entered as dummy variable in the analysis and households that are not purifying the drinking water are taken as the base category. We are hypothesising households those purify the drinking water are less likely of illness.

Use of Bathroom

Here we take a dummy variable which takes one if the households use the bath room or else zero.

Garbage Deposit

After removing the garbage from the households, if it is not deposited properly and openly dumped,the chances of diseases increase. Hence, we have includeda variable that explains the site where garbage is deposited. If it is deposited in bio-gas plant or manure pit, it is taken one while if garbage is deposited in community dumping spot, households' individual dumping spot or any other it is taken zero. It is hypothesised that if the garbage is deposited to bio-gas plant or manure pit, then they are less likely to suffer from diseases.

Flies or Mosquito

The dummy variable takes the form one if the household faced the problems of flies or mosquito and zero if not. Our data has categorised the households who are facing the problem of flies or mosquito in two groups: households those are facing severe problem of flies or mosquito and those are facing moderate problem of same. In our analysis, we have clubbed these two groups into one group.

Proportion of households affected by flies and mosquitoes [effect of malaria prone regions]

Some states might be prone to malaria because of more prevalence of mosquitoes and flies. In such cases household characteristics may not be sufficient to explain the malaria disease. In order to capture this effect we have taken state wise variable proportion of households reported flies and mosquitoes problem.

Drainage Systems

We take a dummy variable which takes one if the households have well drainage systems that is underground or covered pucca, and zero if the households have open or no drainage systems.

Disposal of Waste Water

Other than drainage systems, we have included another variable that explains how the households disposing waste water. The variable is entered in dummy form and we have given one if the household is reusing safely after treatment of waste water and it takes zero if it is disposed to open low land areas, ponds, river, drain or other places.

Education

We have taken education of the male-household head as majority head are male. The data provides head of the household in two groups- male and female and the education level in 10 groups. We clubbed the education level in three groups- households those have primary or secondary education, households those have higher secondary education and households those are illiterate. Illiterate households are taken as base category.

Separate Kitchen

To be disease free the households are not only required to access safe drinking water but also need to have quality food. To maintain the quality food, it is required that food should be cooked in hygienic conditions. We have attempted to capture this variable by taking a proxy variable that explains whether the households have separate kitchen in the house or not. It is hypothesised that if the households will have separate kitchen with or without water facility then the quality of food will be relatively better and the members will be less likely to diseases.

Religion

The variable religion implies whether the household belongs to Hindu, Muslim, Christian or any other religion.

Household Size

Household size implies total number of members living in a household. The variable is entered as continuous variable in the equation. Other than variables that explain the water, sanitation and hygiene conditions of the household, we have taken some of the households' characteristics in our analysis as the unit of observations are households.

MPCE

The income of the household determines the economic status of that particular household (Das, 2014). As our data source does not provide information in income of the household, in order to capture the economic conditions, we have taken consumption expenditure of the household as proxy to income. The monthly per capita consumption expenditure is taken as to specify the economic conditions of the households.

Social Group

In our study, we have taken social group as one variable that explains the caste of the households. The variable has four groups- schedule tribe (ST), schedule caste (SC), other backward class (OBC) and others. Households that belong to schedule tribe are considered as base category.

Age

The variable age implies the head of the household's age. The household head's age is given in two group- one if the head of the household is less than 18 years and two if the head's is 18 or more than 18 years. Household head's age below 18 years is the base category in the analysis.

RESULTS AND DISCUSSION

Access to Water and Sanitation across Indian States

In this section we attempt to position Indian states in different sanitation indicators. Our study relies on three different sets of sanitation indicators-source of drinking water, access to latrine and bathroom. Table 1 presents the state wise percentage of households that have access to latrine, bathroom and safe drinking water and provides the rank of each state among 28 states. At all India level, out of 100 households more than 89 households are using drinking water from protected sources (Our data source has provided 13 principal source of drinking water. We have clubbed these sources into safe and unsafe sources of drinking water. Households that are relying on bottled water, piped water into dwelling, piped water to yard, public tap or standpipe, tube well, protected well and spring are clubbed into households that rely on safe source). In Punjab out of 100 households, more than 99 households are getting drinking water from protected sources. In Kerala, only 40 per cent of households have access to safe drinking water. However, this data needs to be read carefully because in Kerala, most of the households use warm water for drinking purpose. Out of 28 Indian states 16 have a greater proportion of households that have access to drinking water from safe sources than the national average; those are Andhra Pradesh, Arunachal Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Maharashtra, Mizoram, Punjab, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand and West Bengal.

At national level the rate of access to latrine is only 61.1 per cent which implies 39 per cent of households defecate openly. In terms of access to latrine, the north eastern state Mizoram shows impressive performance where 99 per cent households have access to latrine followed by Manipur and Nagaland. The states that have higher percentage of households having access to latrine higher than the national average are Arunachal Pradesh, Assam, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Tamil Nadu, Tripura, Uttarakhand and West Bengal. At national level only 54 per cent households have access to bathroom. Mizoram ranks first with more than 92 per cent households have access to bathroom followed by Goa (90.6 per cent) and Sikkim (90.0 per cent). The other states that have higher access to bathroom than the national average are Andhra Pradesh, Arunachal Pradesh, Assam, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Sikkim, Tamil Nadu and Uttarakhand.

Prevalence of Disease across Indian States

Table 2 shows the prevalence of two diseases-stomach problemand malaria, across 28 Indian states.In five states, namely Arunachal Pradesh, Assam, Bihar, Jharkhand, and Uttar Pradesh, more than 30 per cent of the households have reported stomach problem during the survey. Bihar (39.36 per cent) reported the maximum incidence of stomach related diseases and Tamil Nadu reported the least (4.58 per cent) incidence of stomach disease. The states that reported less than 10 per cent stomach related disease are Andhra Pradesh, Gujarat, Karnataka, Kerala, and Tamil Nadu. At all India level it is reported that out of 100 households, only 19 have reported to have stomach problem, The percentages of households reporting malaria are relatively lower as only 5 per cent households reported of having malaria.The states that have reported relatively high incidence of malaria (greater than 10 per cent) are Arunachal Pradesh, Jharkhand, MadhyaPradesh, Odisha, and Rajasthan. The states that have reported less than one percent incidence malaria disease are Jammu and Kashmir, Karnataka, Kerala, Nagaland Sikkim and West Bengal. Arunachal Pradesh reported the highest incidence of malaria disease (14.13 per cent) and Sikkim reported the least (almost zero) incidence of malaria.

Effect of Water and Sanitation on Diseases

In order to establish the relationship between water and sanitation and incidence of diseases we have undertaken two logistic regression analysis considering the incidence of disease as the dependent variable and the access to

water and sanitation along with some socio economic variables as the independent variables.Tables3and 4present the maximum likelihood estimationsfor the incidence of stomach problem and malaria respectively.

Incidence of Stomach Problem

Table 3 explains the maximum likelihood estimation of stomach problem which are basically the results of regression equation 1 presented in earlier section. We have considered the first four explanatory variables as the key explanatory variables and rest as control variables. All key explanatory variables have shown signs in expected direction and are significant. In order to test the explanatory contribution of control variables we have also conducted likelihood ratio test. This gives us significant result.

The results of logistic regression analysis convey that households using latrine have eight percent less chances of reporting stomach problem compared to the households that do not use latrine. There is also a negative externality from the latrine use by the other households. The use of toilets by larger proportion of households in the states reduces the chances of stomach problem by at least one per cent. Quality of drinking water has a greater impact on the incidence of stomach problem. Access to good quality of water without any defect (smell and taste) reduces the incidence of stomach problem by 46 per cent compared to the households that do not have. Similarly, purification of drinking water in any form reduces the incidence of stomach problem by at least 28 per cent. Households using bath room have 15 per cent less chances of reporting stomach problem compared to that do not use. The prevalence of mosquitoes and flies in the surrounding increases the chances of having stomach problem by 83 per cent. Proper drainage facility also helps reducing the incidence of stomach ailments by at least 18 per cent. The variable education of the male head of the household has shown results not in the expected direction. Households with secondary and higher secondary level of educated heads have higher chances of reporting stomach problem. This could be due to higher reporting by the educated households than the illiterate household heads. Households having separate kitchen with water tap are 31 per cent less vulnerable to stomach ailments compared to those do not have any. Compared to other religions (other than Muslim and Christians) Hindus have 28 per cent less incidence of stomach problem. The living standard of the household which has been captured through monthly per capita consumption expenditure seems to not have any effect on the stomach ailment with the odds ratio one. So far as the social categories of the households areconcerned OBC households have 16 per cent less chances of stomach problem compared to the ST households. However there is no difference between the other category households compared to ST households in prevalence of stomach problem.

Incidence of Malaria

Table 4 discusses the maximum likelihood estimation of malaria which are basically the results of regression equation 2 presented in earlier section. In this analysis we have included those sanitation indicators that facilitate the spread of mosquitoes. In this regression analysis the four key explanatory variables have yielded the results in the expected direction except the variable drainage facility. The prevalence of flies and mosquitoes in the locality increases the chances of malaria by more than five times compared to the households that do not face the same problem. Mere provision of drainage does not reduce the chance of malaria. Garbage deposit in own biogas plant or manure pit increases the chances of malaria compared to the households that dump in the community dumping yard. Households in the malaria prone regions have 28 per cent higher chances of facing malaria problem.

This result is important for the policy implication that taking own precaution is not sufficient for preventing malaria. Use of latrine by the households reduces the incidence of malaria by at least 25 per cent. Households with male heads having at least secondary level of education have reported 12 per cent higher incidence of malaria. This could be interpreted like the previous model on stomach problem. The higher educated households may report easily compared to the illiterate households. Compared to other religions (other than Muslims and Christians) Hindu households have 20 per cent less chances of malaria incidence. The bigger households have 11 per cent higher chances of malaria incidence. This could be due to less care received by the individuals in larger families. The living

standard also does not affect the incidence of malaria. This could be due to fact that in spite of best possible precaution taken by the rich households they could be prone to malaria because of poor sanitation in the locality and malaria prone regions. Other category households have 16 per cent less chances of malaria incidence compared to the ST households.

CONCLUSION

In order to ascertain the association of water and sanitation facility on two important ailments –stomach problem and malaria – we used the survey data collected by the NSSO, of India. This data base provided us the access and utilisation of various water and sanitation indicators for 95,548 households and their reporting of diseases. In order to establish the statistically significant influence of the water and sanitation on stomach problem and malaria we did two logistic regression analysis with important water and sanitation indicator as the key explanatory variables and other socio economic variables as the control variables.

The regression analysis ascertains the strong association of utilisation of better water and sanitation facility on the stomach ailment and malaria. For reducing stomach ailments use of latrine, quality of drinking water and purification of drinking water by the households play very crucial role. There is also negative externality from the non-use of toilets by other households. Therefore, this result strongly points towards the importance of universal utilisation of toilets. Irrespective of the education and income levels use of f toilets, quality of drinking water and purification of drinking water reduces the incidence of stomach problem or in access to these facilities increases the vulnerability of stomach problem significantly. For the incidence of malaria, problem of flies and mosquitoes, improper garbage disposal mechanism and malaria prone regions increase the vulnerability of households. Along with this use of latrine also plays a very crucial role in reducing the incidence of malaria. Like the case of stomach problem, malaria is more influenced by the water and sanitation facilities irrespective of the education and income level of the households.

Thus our analysis provides strong policy implication for the universal provision of latrine, and ensuring the use of latrines, quality and purified drinking water. The scope of the analysis was however constrained due to data unavailability on the individuals such as incidence of disease for individuals. This could have helped us establishing accurate linkage of education and income variables with incidence of disease. The data set also did not provide us information on the use of toilets by individual case. Similarly information on hygiene behaviours such as washing hand before eating could have enriched the analysis. These issues can be addressed in further research in this domain.

ACKNOWLEDGEMENTS

We would also like to thank the participants of 52nd annual conference of the Indian Econometric Society, held at IIM Kozhikode, Kerala, India during 4-6 January 2016.

Funding

The study has not received any funding and grant to conduct this particular research. This is an independent contribution by the authors.

Declaration of Conflicting Interests

The authors declare that they have no conflict interests.

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Table 1: State wise Performance in Water and Sanitation Indicators

States	Safe Drinking Water		Latrine		Bathroom	
	% HH have	Ranks	% HHs Have	Rank	% HHs Have	Rank
Andhra Pradesh	93.60	11	58.30	19	64.30	13
Arunachal Pradesh	98.90	2	85.90	8	74.70	8
Assam	87.20	21	87.90	7	62.00	15
Bihar	97.60	3	34.50	26	23.20	27
Chhattisgarh	95.90	6	41.90	25	35.40	23
Goa	89.20	17	79.50	10	90.60	2
Gujarat	91.90	14	59.30	18	57.90	18
Haryana	93.10	12	78.50	12	81.90	6
Himachal Pradesh	96.60	5	73.20	14	69.70	11
J & K	87.80	20	71.00	15	72.90	10
Jharkhand	74.00	26	32.50	27	30.20	25

Karnataka	94.70	8	54.80	20	63.20	14
Kerala	40.30	28	92.70	6	87.00	5
Madhya Pradesh	89.10	19	44.30	23	46.60	21
Maharashtra	91.80	15	62.90	17	59.70	17
Manipur	64.60	27	98.70	2	61.10	16
Meghalaya	79.30	25	96.60	5	68.50	12
Mizoram	90.90	16	99.40	1	92.40	1
Nagaland	84.00	23	98.50	3	89.80	4
Odisha	86.60	22	30.50	28	22.90	28
Punjab	99.30	1	79.10	11	73.90	9
Rajasthan	83.70	24	45.00	22	53.60	20
Sikkim	89.20	18	97.70	4	90.00	3
Tamil Nadu	93.90	9	51.90	21	54.60	19
Tripura	92.00	13	82.90	9	27.60	26
Uttar Pradesh	97.50	4	42.60	24	34.50	24
Uttarakhand	93.80	10	77.50	13	78.30	7
West Bengal	95.60	7	68.90	16	44.80	22
All India	89.6		61.1		54.3	
Source: Unit level data of 69th Round, NSS						

Table 2: State wise Prevalence of Diseases

States	Stomach	Malaria
Andhra Pradesh	7.20	2.23
Arunachal Pradesh	29.78	14.13
Assam	38.92	2.04
Bihar	39.36	3.75
Chhattisgarh	16.78	8.67
Goa	11.81	2.43
Gujarat	5.76	4.12
Haryana	20.96	6.49
Himachal Pradesh	15.11	1.13
J & K	27.31	0.46
Jharkhand	32.02	12.80
Karnataka	6.86	0.49
Kerala	5.55	0.13
Madhya Pradesh	24.59	12.76
Maharashtra	12.39	3.70
Manipur	14.80	1.48
Meghalaya	25.88	9.46
Mizoram	19.05	8.52
Nagaland	22.57	0.81
Odisha	15.12	11.17
Punjab	25.09	2.73
Rajasthan	20.13	10.75
Sikkim	11.98	0.00
Tamil Nadu	4.58	0.88
Tripura	13.12	2.61

Uttar Pradesh	34.00	9.06
Uttarakhand	26.91	2.25
West Bengal	24.03	0.84
All India	**19.39**	**4.86**
Source: Unit level data of 69th Round, NSS		

Table 3: Maximum Likelihood Estimation of Stomach Problem

Explanatory Variables		**Dependent Variable: Did any members of the household suffer from stomach problem in last 30 days?; No-0, Yes-1**			
		Coefficient	**Odds Ratio**	**Standard error**	**P>|z|**
Constant***		-0.64	0.53	0.092	0.00
Latrine Use***		-0.08	0.92	0.023	0.00
Externality of latrine use [Proportion of households using latrine in the state]***		-0.01	0.99	0.000	0.00
Quality of Drinking Water***		-0.61	0.54	0.023	0.00
Purification of Drinking Water***		-0.33	0.72	0.019	0.00
Use of Bath Room***		-0.16	0.85	0.023	0.00
Prevalence of flies and mosquitoes***		0.61	1.83	0.066	0.00
Drainage Facility***		-0.20	0.82	0.023	0.00
Education of male headed household	Illiterate (Reference)				
	Secondary***	0.23	1.26	0.025	0.00
	Higher Secondary***	0.23	1.26	0.031	0.00
Presence of separate kitchen	No separate kitchen (Reference)				
	Separate kitchen with water tap***	-0.37	0.69	0.034	0.00
	without water tap	0.03	1.03	0.019	0.14
Religion Category	Others (Reference)				
	Hindu***	-0.33	0.72	0.045	0.00
	Muslim	0.04	1.04	0.050	0.43
	Christian***	0.15	1.16	0.057	0.01
Monthly Per capital Consumption Expenditure [MPCE]***		0.00	1.00	0.000	0.00
Social Group	Scheduled Tribe (reference)				
	Scheduled Caste	0.02	1.02	0.032	0.53
	OBC**	-0.17	0.84	0.030	0.00
	Others	-0.03	0.97	0.032	0.36
Number of observations = 95548 Log likelihood = -45529.311 LR $chi^2(18)$ = 2922.90 Likelihood-ratio test , LR $chi^2(14)$ = 1148.66; Prob> chi^2 = 0.0000					
Note: * Statistically significant difference means at the 1 per cent**					

Table 4: Maximum Likelihood Estimation of Malaria

Explanatory Variables		**Dependent Variable Did any members of the household suffer from Malaria in last 30 days?; No-0, Yes-1**				
		Coefficient	**Odds Ratio**	**Standard error**	**z**	**P>|z|**
Constant***		-6.03	0.00	0.001	-27.96	0.00
Flies & Mosquitoes***		1.63	5.09	1.002	8.27	0.00
Drainage		-0.06	0.94	0.040	-1.36	0.17
Garbage deposit***		0.24	1.28	0.069	4.49	0.00
Malaria prone region [Proportion of households reported malaria in the state]***		0.19	1.21	0.005	49.03	0.00
Use of latrine ***		-0.28	0.75	0.029	-7.48	0.00
Education of the male head of the household	Illiterate (Reference)					
	Secondary***	0.11	1.12	0.053	2.31	0.02
	Higher Secondary***	-0.02	0.98	0.056	-0.31	0.76
Religion	Others (reference)					
	Hindu	-0.23	0.80	0.064	-2.86	0.00
	Muslim	-0.12	0.88	0.081	-1.34	0.18
	Christian	-0.09	0.91	0.092	-0.9	0.37
Size of the Household		0.10	1.11	0.006	17.88	0.00
Monthly Per capita Consumption Expenditure (MPCE)		0.00	1.00	0.000	0.28	0.78
Social Category	Scheduled Tribe (reference)					
	Scheduled Caste	0.00	1.00	0.055	-0.02	0.99
	OBC	-0.03	0.97	0.049	-0.69	0.49
	Others***	-0.18	0.84	0.049	-3	0.00
Number of observations = 95548 Log likelihood = -16453.242 LR $chi^2(15)$ = 4245.40 Likelihood-ratio test LR $chi^2(11)$ = 491.65, Prob> chi^2 = 0.0000						
Note: * Statistically significant difference means at the 1 per cent, ** at the five per cent and * at the 10 per cent level.**						

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

REVIEW ARTICLE

Sorghum-based Intercropping System for Agricultural Sustainability

Sarath Kumar Duvvada and Sagar Maitra*

M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha, India.

Received: 19 Mar 2020 Revised: 21 Apr 2020 Accepted: 23 May 2020

***Address for Correspondence**
Sagar Maitra
M. S. Swaminathan School of Agriculture,
Centurion University of Technology and Management,
Paralakhemundi, Odisha, India.
E.Mail: sagar.maitra@cutm.ac.in

ABSTRACT

Sorghum (*Sorghum bicolor* L. Moench) is one of the important cereals of arid and semi-arid regions of Asia and Africa. Sorghum is a multipurpose cereal, mainly used as food, feed and forage. In India, it is cultivated under resource-poor conditions with inferior management as rainfed crop in drylands. In the present scenario of climate change, agricultural production faces different hindrances leading to crop failure. Intercropping of sorghum with legumes and other crops is advantageous because of more productivity, efficient use of available resources, conservation and improvement of resources and thus beneficial for agricultural sustainability. In the study, information was gathered based on available literature on potential and advantages of sorghum-based intercropping for agricultural sustainability.

Keywords: Sorghum, intercropping, productivity, advantages, sustainability

INTRODUCTION

SORGHUM-BASED INTERCROPPING

Sorghum (*Sorghum bicolor* L. Moench), also known as great millet, is one of the important cereals of arid and semi-arid regions of Asia and Africa. Sorghum is originated in Africa and disseminated worldwide among poor farmers of dry region. Under the dry and fragile ecological conditions where production of other crops is difficult, sorghum can be produced with satisfactory yield. Sorghum is mainly used as food, feed and forage crops, but other uses are also noted as preparation of alcoholic drink and value added food products, bio-fuel, wallboard for house building, biodegradable packaging material and so on. Further, sweet sorghum is cultivated for food, fuel, feed, fiber and seed (Arshad and Ranamukhaarachchi, 2012). Sorghum grains are nutritionally rich and each 100 gram grain contains 329 Kcal energy, 10.62 g protein, 3.46 g fat (of which 1.37 g polyunsaturated fatty acid), 72 g carbohydrate, 1.43 g ash and 6.7 g fiber (USDA, 2019). Moreover, it contains different vitamins. Sorghum is cultivated in 42.14 million ha area with a production of 59.34 million tonnes. The United States if the largest producer of sorghum followed by Nigeria,

Sudan, Ethiopia and India (FAOSTAT, 2018). In India it is cultivated in 4.96 m ha and production is 4.95 m tonnes with productivityof 998 kg/ha (GOI, 2018). The productivity of sorghum in India is low because the crop is cultivated under inferior management in mostly rainfed situations. In the present scenario of climate change, rainfed crops are more vulnerable in dry ecological conditions. Rise of temperature and erratic monsoon are very common phenomena in tropics where sorghum is mainly grown in India. Being a C4 plant, sorghum has the capacity to tolerate adverse weather conditions, such as high temperature and drought. The fast growth and considerably more biomass production helpsorghum to overcome unfavuorable environmental conditions (Reddy and Sanjana, 2003), and the short duration supportsgrowing of the crop in different cropping system on marginal soils (Nahar, 2011).Though sorghum is an ecologically hardy crop, risk in cultivation under fragile ecological conditions may be minimized by adopting suitable sorghum-based intercropping systems. Intercropping is growing of two or more crops spatially and temporally which is very common among small farmers across the world. The combination of cereal-legume is very common in intercropping and in association with legumes; the cereal crop sorghum gets several benefits. In the present study, information on benefits of sorghum-based intercropping has been gathered and presented.

Benefits of Sorghum-Based Intercropping System

In general, intercropping is beneficial in many ways like greater resource use, reduction of population of harmful biotic agents, higher resource conservation and soil health and more production and sustainability of the system (Maitra*et al*., 2019; Maitra*et al*., 2020). The crops grown together efficiently use soil nutrients (Yang *et al*., 2018; Dai *et al*., 2019), soil moisture (Chen *et al*., 2018; Singh *et al*., 2020), greenhouse gas flux (Collins *et al*., 2017) and sunlight (Kermah*et al*., 2017; Raza*et al*., 2019). Further, intercropping system checks run-off of water (Dass and Sudhishir, 2010), reduces soil erosion and nutrient loss from the soil. Combination of cereal + legume in intercropping increase soil fertility enhancement (Choudhary and Choudhary, 2016), facilitates diversity of beneficial soil microorganisms (Maitra and Ray, 2019). In intercropping system, complementarity among the species cultivated is very much important for increasing crop yields (Ngwira*et al*., 2012; Pappa*et al*., 2012). Under dryland conditions intercropping system provides a natural insurance against total crop failure and thus production sustainability (Chai *et al*., 2014). In other words, it may be stated better ecosystem service is created by intercropping system which leads agriculture towards sustainability (Powlson*et al*., 2011). The sorghum based intercropping system also showed multi-faced advantages like more yield, greater resource use efficiency, improvement of resource quality and economic gain (Sharma *et al*., 2009;Undie*et al*., 2012; Pal *et al*., 2014; Crème *et al*., 2016; Berhanu and Hunduma, 2017; Arshad*et al*, 2020).

Yield advantage

Intercropping of sorghum with cereals produces moreyields compared to sole cropping of sorghum. Intercropping sorghum with groundnut (Tefera and Tana, 2002), cowpea in 45 cm spaced double-row strips (Zougmore*et al.* 2000) and redgram (Tripathi and Kushwaha, 2014) and dolichos in 2:1 ratio planting (Rathor, 2016), recorded more yield in intercropping than pure stand of sorghum.The forage sorghum also yielded more in polyculture as noted with cowpea + multi-cut sorghum at 2:2 ratio (Sharma *et al.* 2009) and alfalfa + sorghum at 3:1 rows (Chaichi*et al.* 2007). There was a slight increase in the yield of alley cropped sorghum with *Acacia saligna* (Lehmann *et al.* 1999).

Resource use efficiency

The reason of yield advantage of intercropping are mainly that environmental resources such as water, light and nutrients can be utilized more efficiently in intercropping than in the respective sole cropping systems (Liu *et al*., 2014).Forage sorghum grown in association with forage legumes (mungbean, clusterbean, cowpea and sesbania) utilized the resources efficiently (Ahmad *et al*., 2006). When sorghum intercropped with legumes the nutrient content in the soil and nutrient use efficiency (NUE) were gradually improved (Li *et al*., 2003; Crews and Peoples 2004). Enhanced P uptake was reported by different researchers under various intercropping system where legume was considered as a component, for example, pigeon pea + sorghum intercropping (Ae*et al*., 1990). In the intercropping

system of sorghum with palisade grass (*Urochloa brizantha*) in a wider row spacing of 0.90 m significantly increased the NUE which resulted in higher forage production (Borghi*et al.* 2013b). Singh, *et al.* (2020) reported that sweet sorghum + phillipesara (*Phaseolus trilobus*) recorded the advantage over sole sweet sorghum in relation to content and uptake of nutrients (N, P and K), but this improvement was significant only for the content and uptake of phosphorus over pure stands. Higher uptake of macro nutrients was noted in sorghum + redgram intercropping system than sole sorghum cropping (Tripathi and Kushwaha, 2014). Nitrogen uptake was more under sorghum + greengram with 2:1 row ratio compared to their pure stands (Rao *et al.* 2009).

The intercropping of sorghum-cactus pear revealed that water use efficiency (WUE) was higher under severe drought condition because of less evapotranspiration (Lima *et al.* 2018). Sorghum + legumes cropping systems enhances water use efficiency as greater extent of soil cover reducing the evaporation losses, and also different root lengths of main and component crops which favours for uptake of moisture from different soil profile zones. Sani*et al.* (2011) concluded that intercropping system of cereal + sorghum (1:1 row ratio) was effective in improving the WUE as more biomass was produced by using the same quantity of water compared to sole cropping. Enhancement of WUE was noticed under sorghum + cowpea and sorghum + bottle gourd (54.65% and 46.98%, respectively) compared to sole cropping (Chimonyo*et al.* 2016). Residual intercropping system had significantly influenced the water productivity of wheat with the highest water under residual sorghum + *Sesbania* (green manuring) while significantly lowest water productivity was noticed under residual sole sorghum (Tanwar*et al.* 2014).

Land equivalent ratio (LER) is defined as the land area essential as sole crops to obtain the same yield from intercropping under the similar management levels (Willey, 1979). An LER value of 1.0 indicates that intercropping produces the same yields as of sole cropping, and the value above 1.0 denotes greater yields in intercropping over pure stands. Intercropping of sorghum with legumes resulted in greater LER values than unity indicating spatial yield advantage (Table 1).

Improvement of resource quality

Plant cover in intercropping plays a major role reduce runoff which could cause soil erosion and it is one of the best agricultural practices in erosion-prone areas (Sharaiha and Ziadat, 2007).Sorghum-cowpea intercropping reduced runoff by 20- 30% compared to a sorghum monoculture and by 45- 55% compared to a cowpea monoculture. Soil loss was also reduced with intercropping by at least a half compared to pure stands of sorghum and cowpea.In sloppy areas when sorghum is grown as sole crop which leads to soil erosion of 14 t/ha but when sorghum intercropped with alfalfa only 1 t/ha soil loss was occurred andmore plant population per unit area which helped to increase the ground cover and decreased the soil loss (Iqbal*et al.* 2019).

Legumes complementarities with cereals and its capacity to fix nitrogen (N) biologically from the atmosphere, helps in improvement of soil fertility (Rusinamhodzi*et al.* 2012; Undie*et al.*, 2012). Before the process of nitrification by microorganisms the component and main crops obtain nutrients from soil which results in competition for nutrients. To overcome this competition Iqbal*et al.* (2017) suggested postponing the legumes sowing for a few days after the sowing of sorghum results in optimum crop establishment, growth and productivity. Aminifar and Ghanbari (2014) stated that intercropping systems maximizes use of resources by facilitating the availability of nitrogen from legumes and the inorganic phosphorus which was fixed in soil made available through nitrogen fixation by legumes. In an intercropping system, nitrogen fixation process by legumes is the low cost method and sustainable way for contributing nitrogen to non-legumes. Intercropping helps to reduce the leaching of nutrients from the soil as the both crops use the soil nutrients efficiently than the sole cropping (Zhang and Li, 2003). When sorghum intercropped with cowpea, increase in nitrogen utilization was noticed and this resulted in utilization of resources in NO_3 form by non-legumes and in N_2 form by legumes (Cong *et al.*, 2015). In addition to nitrogen fixation, intercropped legumes also enhance the accessibility of other nutrients including phosphorous (Crème *et al.*, 2016), reduce nutrient loss (Cavagnaro*et al.*, 2015), support in metal phytoremediation (Chen *et al.*, 2015) and also enhancement of population of beneficial microbes in the soil (Wahbi*et al.*, 2016). Continuous cultivation of sorghum + *Sesbania* (as green/brown

manuring) markedly enhanced SOC over initial status (0.37%) and over that recorded under sole sorghum (Tanwar*et al.* 2014).

Efficient weed management

Weeds are menace to crop growth and yield as they grow along with crop and compete for all the available resources (Chalka and Nepalia 2005; Satheeshkumar*et al.* 2011). Sorghum-legume intercropping is the decent practice to diminish the weed population which helps to reduce the crop weed competition (Reda*et al.* 2005). For weeds, component crop provides a less area for weeds to get a base or reduces weed biomass through competition or allelopathy. Forage sorghum was susceptible to competition by weeds before it extended to knee height stage, but intercropping with legumes condensed weed infestation, which improved its growth (Khan *et al.*2007). It was reported that sorghum + food legumes inhibited witch-weed (*Strigahermonthica*) concentration (Machado, 2009).

Less incidence of pests

The insect-pest population is regulated by adoption of intercropping because of functional diversity created in polyculture. In marginal farming mixed cropping is chosen because of low incidence of insect pests (Nickel, 1973). The crop mixture attracts beneficial insects which have the potential to maintain the harmful pest population below threshold level (Maitra and Ray, 2019). Growing of sorghum as an intercrop significantly reduced the incidence of bud necrosis disease of groundnut (Narayanaswamy*et al.*, 1988). In Nigeria, the weboorm (*Antigostra sp*.) caused less damage to sesamum when intercropped with sorghum (Litsinger and Moody, 1976).

Economic benefits

Agricultural production system for small farmers targets more yield and economic return from limited available resources (Surve*et al.* 2012). Iqbal*et al.* (2016) perceived that a 57% higher in monetary benefits in a Sorghum-soybean intercropping system when grown in a replacement series. A greater enhancement of monetary value in an intercropping system of sorghum + ground nut in 2:2 rows (Langat *et al.* 2006) and forage sorghum + guinea grass (Borghi*et al.* 2013b) than sole cropping of sorghum. Maximum net returns were obtained under sorghum + green gram–wheat compared to sole sorghum-wheat cropping system (Tanwar*et al.* 2014). The 2:1 row intercropping od sorghum with cowpea increased the profit than sole cropping (Oseni, 2010). Intercropping of sorghum with greengram in 2:1 row ratio produced more net return than monocropping of sorghum (Rao*et al.* 2009; Pal *et al.*, 2014).

CONCLUSION

The research evidences clearly revealed that sorghum-based intercropping system fulfills multiple benefits like enhancement of yield under challenged ecological conditions with more economic return. Moreover, intercropping of sorghum with legumes and other crops ensures greater use and conservation of resource along with qualitative improvement. Under resource poor soil and erratic weather conditions, successful raising of crops is a great challenge and sorghum-based intercropping is one of the suitable options for uninterrupted productivity, agricultural sustainability and livelihood security of small scale farmers in arid and semi-arid regions.

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Table 1: Land equivalent ratio from experimental results

Intercropping system	Proportion	LER	Country	References
Sorghum + green gram	2:1	1.32	India	Rao *et al.*, 2009
Sorghum + cowpea	2:1	1.08	Nigeria	Oseni, 2010
Sorghum + limabean	100% + 20%	1.26	Iran	Reza *et al.*, 2012
Sorghum + sesbania	2:1	1.06	Syria	Kurdali*et al.*, 2013
Sorghum + Redgram	1:1	2.37	India	Tripathi and Kushwaha, 2014
Sorghum + cowpea	100% + 50%	1.41	India	Pal *et al.*, 2014
Sorghum + soyabean	1:1	1.40	Nigeria	Alfa, 2015
Sorghum + Dolichos	2:1	1.07	India	Rathore, 2016
Sorghum + Ground nut	1:1	2.10	Ethopia	Derejee*t al.*, 2016
Sorghum + Ground nut	30 cm×20 cm	1.31	Ethopia	Berhanu and Hunduma, 2017
Sweet sorghum + mung	1:1	1.80	Pakistan	Arshad*et al.*, 2020

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Biomanagement of Eggshell Waste by the Action of *Eisenia foetida*

Arya lopamudra and Sunita Satapathy*

Department of Zoology, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Received: 19 Mar 2020 Revised: 21 Apr 2020 Accepted: 23 May 2020

***Address for Correspondence**
Sunita Satapathy
Department of Zoology, School of Applied Sciences,
Centurion University of Technology and Management,
Odisha, India.
E.Mail: sunita.mishra@cutm.ac.in

ABSTRACT

With rapid increase in population, the generation of municipal solid wastes or organic wastes have increased several folds during few years. More production of organic waste was major problem in India. It is a Major wastes as household kitchen wastes and domestic waste .Each household of four family members generates 0.5 - 0.75 kg kitchen wastes per day (Kale 1998). Under the present condition of environmental degradation level is high. Vermicomposting technology offers recovery of valuable resources like manure from biodegradable waste. Eggshell is one of the solid waste with production of thousands tones per day and estimated 13.5% of waste is recycled and 5.5 % is composted today. The disposal of chicken eggshell waste is an environmentally and economically challenging problem found in different sourceslike household, school and college hostels, hotels, fast-food restaurants, factories etc. By vermicomposting it can reduce the disposal of organic waste. In present study different proportions such ascontrol, L1, L2, L3, L4, experimental (ESw) of mixture of soil, cow dung and eggshell wastes were taken and performed vermicomposting process by using earth worm species *Eisenia foetida*.The present study was revealed that the vermicompost produced from eggshell having high yield enriched nutrient for sustainable plant growth and it was estimated through different physico-chemical parameters.

Keywords: Vermicomposting (VC), *Eisenia foetida*, Egg shell (ES),Physico-chemical parameters

INTRODUCTION

Rapid explosion of population leads to development of globalization and Industrialization in the world, the quantities of solid waste has been generated in large amounts in past few decades. In most of the countries, the sustainable management of solid wastes remains as a major challenge by population explosion. In recent days, the world has experienced rapid population growth which has resulted in large scale expansion of urban areas, massive

loss of cultivable land and increased agricultural land use intensity this was the major problem for society. In urban India about (377 million people) generates 62 million tons of municipal solid waste each year, of this about 43 million tons (70 %) is collected and 11.9 million tons (20%) was treated. About 31 million tons (50%) was dumped in landfill sites. Currently, about 2.01 billion metric tons of municipal solid waste were produced annually worldwide. An estimated 13.5% of today's waste is recycled and 5.5% is composted.

Vermicomposting is the process of producing compost by utilizing earthworms to turn the organic waste into high quality compost that consists mainly of worm cast product in addition to decayed organic matter (Ismail 2005; Devi and Prakash 2015).It can be regarded as a sustainable technology for managing non-toxic waste when space is a constraint.It is an economical technique that produces astabilized humus like substrate known as vermicompost, which contains high nutrients in the forms that readily taken up by plants.Vermicomposting is a natural and an economical biotechnology of bio-converting agro- industrial residues through the mutual action of earthworm, micro-organisms, and enzymes to stable compounds for safe disposal and bio - fertilizer production (Suthar and Gairola 2014 ; Bhat et al. 2015 ; Musyoka et al. 2019).

Household kitchen waste is one of the major source of municipal solid waste. In India, domestic waste is mostly of organic nature and contributes 70% to 80% of urban solid wastes (Kale 1998). Each household of four family members generates 0.5 - 0.75 kg kitchen wastes per day (Kale 1998) . Under the present condition of environmental degradation vermicomposting technology often recovery of valuable resources like manure from such biodegradable waste. The disposal of chicken eggshell waste is an environmentally and economically challenging problem. Eggshells waste materials from hatcheries homes, fast food restaurant or industries (Phil and Zhihong, 2009; Amu et al., 2005) school and college hostel and hotels . Eggshell waste disposal contributes to environmental pollution challenges associated with disposal sites, odour, flies and abrasiveness (Phil and Zhihong, 2009) Shell membranes consist of collagen as a component. The collagen is extracted and has diverse uses in medicine, biochemical, pharmaceutical, food and cosmetics industries. These use minimize their effect on environmental pollution. The eggshell and shell membranes make up 10.2% of the whole egg. The eggshell comprises of calcified shell and shell membranes including inner and outer members. Mac Neil (1997) developed a patent for separating eggshell membranes from the eggshell.The organic matter of eggshell or shell membranes contains proteins as major constituents with small amounts as carbohydrates and lipid (Burley and Vadehra,1989). The composition of the egg shell is approximately 98.2, 0.9, 0.9% calcium carbonate, Magnesium and phosphorus (phosphate) respectively (Romanoff et al., 1949). Shell membranes comprises of approximately 10% collagen (Froning 1998). Eggshells contain calcium and trace amounts of the micro elements i.e. magnesium, boron, copper, iron, manganese, sulphur bi silicon and zinc (Bee, 2011). Eggshell calcium is probably the best natural source of calcium and it is about 90% absorbable (Bee, 2011). It is a much better source of calcium than limestone or coral sources.

Eggs were delicious and nutritious. Most people throw away the shells which is the best part for plants at least. Instead of throwing away this resource , consider using it to improve the soil in the garden , as eggshells are a good source of calcium for plants and can help make a great fertilizer .calcium is not mobile in the plant .It is an important constituent of cell walls and can only be supplied in xylem sap . If the plant runs out of a supply of calcium, if cannot remobilize calcium from older tissue. Sometimes transcription is reduced for any reason, the calcium supply to growing tissue will rapidly become inadequatecalcium also helps to maintain chemical balance in soil reduces soil salinity, and improves water penetration. It plays a critical metabolic role in removal of carbohydrates and neutralizes cell acids.

The vermicompost promotes plant growth from 50 - 100% over converted compost and 30 - 40% over chemical fertilizers. In addition to providing soil organic carbon. Vermicompost also provides enzymes and hormones which stimulate plant growth. It enhances soil biodiversity by promoting the beneficial microbes which, in turn, enhances plant growth regulating hormones and enzymes, controlling plant pathogens, nematodes and otherpests. Wastes are degraded by over 75% faster than conventional systems and compost produced are cleansed of harmful micro -

organisms and toxic substances, and enriched with nutrients and beneficial soil microbes. Vermicomposting efficiency is measured by the worm number and biomass produced and by the vermicompost yield in a certain period of time. To get the maximum efficiency of vermicomposting, the compost worms must be provided with the five basic things that they need. These are favorable living environment, usually called "bedding", food source; correct moisture of the substrate (not too low, not too high); adequate aeration; and protection from too high or too low temperature different characteristics. The same is true with materials that can used as food source for the worms. The differences can affect directly the reproduction and growth of worms, and the amount of substrate that can be broken down by worms into compost. The bedding materials should provide a hospitable environment and the food source, nutrition for the worms. In this study it was hypothesized nutrient (bedding materials, food source) will affect the efficiency of producing worms and compost.

MATERIAL AND METHODS

Collection of Materials

The present experimental work was initiated by collection of materials such as the soil and cow dung from the dairy farm of CUTM campus, Bhubaneswar, Odisha, India. The eggshell waste were collected from Hostel canteen of CUTM, Campus Bhubaneswar, Odisha.

Drying, Crushing and sievingof collected materials

The collected cow dung ,soil and eggshell were dried up in bright sun for air drying .The process of drying was monitored everyday in regular interval till dry by turning upside down .The large pieces of cow dung and soil were chopped into small pieces during drying process.The dried materials were sieved through a sieve having diameter 2.3 mm before weighing and collected in bags.

Collection of earthworm

The earthworm species that was used in this study i.e. *Eisenia foetida* werecollected from the vermicomposting unit CUTM campus Bhubaneswar, Odisha.

Preparation for vermicomposting

The completely dried and sieved cow dung, soil and egg shell were brought into weighing site for setting up experiment by measuring different proportions. Measurement of all materials like cow dung (C.D.),soil (S), eggshell waste (ESw.) were taken in 6 different proportions labelled as control (1:1) ,L1 (4:1), L2 (3:2) , L3 (2:3) , L4 (1:4) , ESw (100%) as experimental for 6 labelled plastic containers. All the proportions were kept into their respective labelled containers of 14 cm length,9 cm breadth and 6cmheight .All proportion of container were mixed properlyat dry stage and then allowed to add water by sprinkling upto reach a well moisture content. The mixture is allowed for precomposting upto a week. At least 2 gms.of both dry and wet of each proportion were collected and keptfor analysis of various physico-chemical parameters.

Process of vermicomposting

The various proportion of mixtureafter precomposting were used to make layers adding in between a layer of slurryin labeled containers and kept in shaded area for beginning of the process vermicomposting. Three numbers of earthworm species *E.foetida* of various length from 7 cm to 11 cm were putinto each container. After introducing of earthworm into containersthe nutritionas slurry regularly fed with an interval of 1-2 days for it's survival. Sprinkling of water was carried out in regular interval of time every day in the preliminary stage of vermicomposting and in the due period of processing it was done within 5-6 days of gap to maintainmoisture regularly.Regular monitoring of vermicompostingprocess was observed and recorded till the process was conducted for 60-70 days.

Measuring of physico-chemical parameter

During vermicomposting analysis of physico-chemical parameters of waste were measured like pH, temperature, and moisture content .Determination of pH was done by digital pH meter, electrical conductivity by a conductivity meter using 1:20 (w/v) and moisture content was determined by calculating the difference of dry mixture from wet mixture for each container.All the parameters were recorded an interval of 15 days of entire process.

RESULT AND DISCUSSION

Various proportions of eggshell were utilized in the present study by using a recycling technology vermicomposting for production of enriched organic manure and faster the degradable rate of eggshell by consuming and passing through the gut of earthworm.The physico–chemical variables like temperature, electro-conductivity, pHand water holding capacity were easily controlled and indicated progress of vermicomposting are figured and tabulated by different graphs and tables. Graphical analysis of pH, electro-conductivity, moisture and temperature were observed and studied. From the present experimental work it was found that each proportion varies with their physico–chemical variables studied and observed with respect to electro conductivity, pH, and moisture content.The pH value of each proportion mixed with eggshell powder in this experiment was ranged from 6.8 to 7.6 where the eggshell mixture reduced the acidity of soil may due to presence of rich calcium.It was shown in Table-4 and Fig.3 that the slightly acidic soil when mixed with eggshell powder converted towards alkaline may due to addition with cow dung during the process of composting and then in vermicomposting with combiningaction of microbes and earthworms changed the pH towards alkaline within 7.5 which is suitable for survival of earthworm and plant growth((Nisha Jain,2016))The electro-conductivity was increased from the initial value during vermicomposting might have added salinity to each proportion due to composting of calcium carbonate of egg shell.

The water holding capacity was slowly increased due to the wriggling action of earthworm in the soil and each proportion was maintained with proper amount of moisture as compared to whole mass of eggshell proportion.The temperature range was recorded below then 35^0C that indicated the survival and population growthof earthworm which aided formation of vermicompost(Taiwo and Oso, 2004). Besides all proportions in whole eggshell mixed with cow dung was shown expected result with granular vermicompost. The result from all aspects was favored towards the small proportion of eggshell i.e. L1, L2 including control whereas in L3, L4 and in eggshell-100% it was shown slow processing for vermicomposting. This study was reflected that all the physico-chemical parameters were favored for the process of population growth which enhanced the production of vermicompost

CONCLUSION

From the present study it was observed and studied that the eggshell waste produced vermicompost by using the technique vermicomposting wereessential for growth of the plants. Eggshell contains calcium, magnesium, phosphorous, potassium and sodium were consumed by earthworm during vermicomposting produced nitrogenous rich nutrient manure for sustainable plant growth. The normal soil convert to enriched soil with high fertility composition by vermicomposting for increasing growth, yield and quality of the plant.

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Table 1. The survival of Earthworm in related to various proportion

Sl. No.	Proportional Set up	Initial No. of earthworm	Survival of earthworm In 15 days	Survival of earthworm in 30 days	Survival of earthworm in 3rd 15 days	Survival of earthworm in 4th15 days
1.	Control (1:1)	4	Survive	Survive	Survive	Survive
2.	L1(4:1)	4	Survive	Survive	Survive	Survive
3.	L2(3:2)	4	Survive	Survive	Survive	Survive
4.	L3(2:3)	4	1 Death	Survive	Survive	Survive
5.	L4(1:4)	4	1 Death	Survive	Survive	Survive
6.	ESw(100%)	4	Survive	Survive	Survive	Survive

Table 2. The Population Growth of Earthworm in related to various proportion

Sl. No.	Proportional Set up	Initial No. of earthworm	Survival of earthworm In 15 days	Survival of earthworm in 30 days	Survival of earthworm In 45 days	Survival of earthworm In 60 days
1.	Control	4	6	11	17	26
2.	L1	4	5	7	10	19
3.	L2	4	4	4	9	13
4.	L3	4	3	5	6	11
5.	L4	4	3	4	6	8
6.	ESw	4	4	6	11	14

Table 3.Measurement of Physico-chemical parameter during vermicomposting

Sl No.	Observation	Electro-conductivity			pH			Moisture content			Temperature ^{0}C	
	Experimental set ups	Initial	Final	Difference	Initial	Final	Diff.	Before vermic ompost	After vermic ompost	Diff.	Initial	Final
1	Control	0.886	0.875	0.011	6.92	7.22	0.3	0.383	0.484	0.101	34.2	29
2	L1	0.606	0.875	0.269	6.85	7.26	0.41	0.170	0.324	0.154	35.1	26.2
3	L2	0.611	0.727	0.116	6.98	7.29	0.31	0.185	0.317	0.132	31.6	23.2
4	L3	0.643	0.787	0.144	6.89	7.48	0.59	0.235	0.412	0.177	31.4	23.9
5	L4	1.033	1.227	0.194	7.32	7.68	0.36	0.446	0.476	0.03	34	26.1
6	ESw	1.063	1.421	0.328	7.39	7.54	0.15	0.450	0.492	0.042	36	27.3

Table 4. The growth of Earthworm in different proportion through Mean ± SD

Experimental setup	Length in cm		Diameter in cm		Perimeter in cm	
	Mean	SD	Mean	SD	Mean	SD
Control	3.2	0	0.2	0.141421	0.6	0.34641
L1	2.3	0.476095	0.2	0.08165	0.575	0.221736
L2	2.225	0.917878	0.275	0.206155	1.6	1.334166
L3	2.475	0.485627	0.2	0.11547	0.65	0.191485
L4	2.925	0.877021	0.225	0.095743	0.75	0.310913
ESw	5.525	1.463728	0.575	0.05	1.975	0.377492

N.B: (EC-Electro-conductivity, ESw-Egg shell waste, EW-Earthworm)

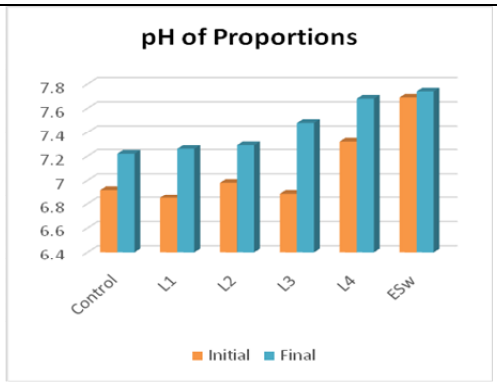

Fig.1 Graphical presentation of pH during Vermicomposting

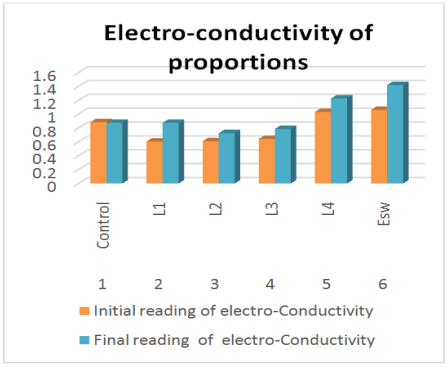

Fig.2 Graphical presentation of EC during vermicomposting

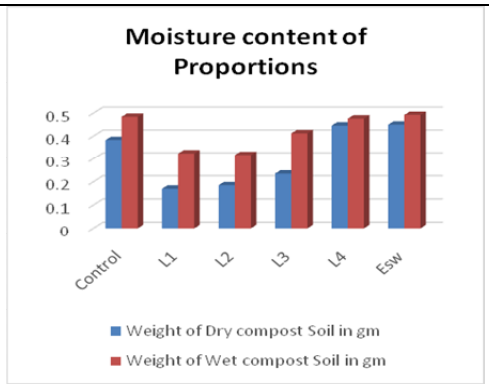

Fig.3 Graphical presentation of moisture content During vermicomposting

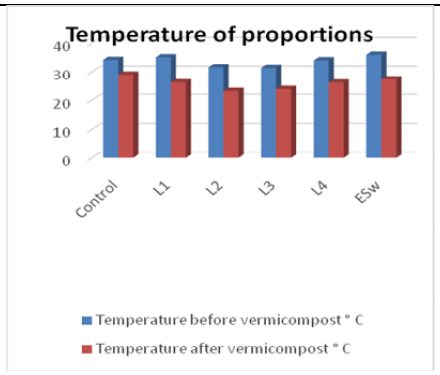

Fig.4 Graphical presentation of Temperature during vermicomposting

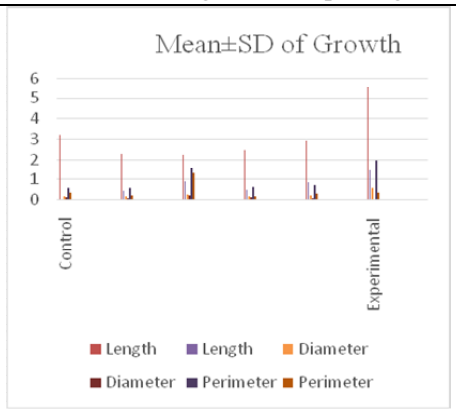

Fig.5 Graphical presentation of population growth of EW during vermicomposting

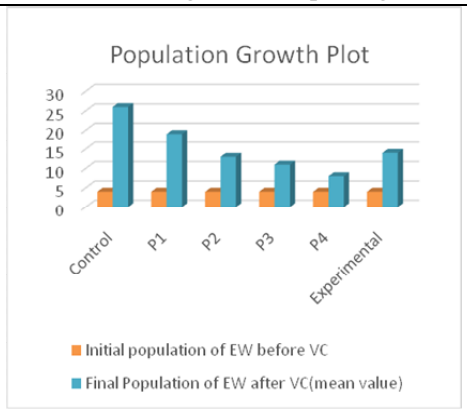

Fig.6 Graphical presentation of growth during vermicomposting

Fig.7. Earthworm in egg shell vermibed during vermicomposting

Fig.8 Growth of earthworm and changes in structure of vermibed during vermicomposting

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

In silico Analysis: Blocking SARS-CoV 2 Main Protease Enzyme of COVID 19 by taking *Allium sativum*

Somalika Pradhan

Centurion University of Technology and Management, Odisha, India.

Received: 22 Mar 2020 Revised: 24 Apr 2020 Accepted: 26 May 2020

***Address for Correspondence**
Somalika Pradhan
Centurion University of Technology and Management,
Odisha, India.
E.Mail: somalika.pradhan@cutm.ac.in

ABSTRACT

Novel coronavirus 2019 disease was first reported in china, now it has significantly affected the whole world and this ongoing epidemic affecting millions of people every day. It is a transmitted disease produced by Severe acute respiratory syndrome coronavirus 2(SARS-CoV-2). Most common symptoms of this disease are fever, dry cough, headache, sore throat, difficulty in breathing etc. Preventive measures include covering mouth when cough, hand washing and social distancing. For this disease till now no vaccine or drug has been developed. To exceed this hindrance researchers are trying to develop drugs in traditional processes. Mainly this study focuses on developing drugs from medicinal plants or from its product. In this work phytochemicals of garlic have been taken which is expected to cure COVID19.Main protease enzyme of SARS-CoV-2 is reported to be very significant for the existence of the organism. Phytochemicals and the enzymes get interacted by the process of molecular docking in the discovery studio of biovia software. The potent of high interaction was confirmed by -C Docker energy value. High positive value of different phytochemicals of garlic may successfully inactive the enzyme biological pathway by scattering the life cycle of coronavirus.

Keywords: Phytochemicals, SARS-CoV-2, COVID 19, Biovia

INTRODUCTION

Covid 19 is an infection disease caused by a newly discovered coronavirus. These viruses are a group of RNA viruses which have RNA as its genetic material. [1] An RNA virus injects its RNA into a cell like other viral diseases like polio, flu and SARS. Coronavirus typically have single stranded RNA but also contain double stranded RNA which causes diseases in mammals and birds. [1,2]This virusbelongs to the family coronaviridae and constitute the subfamily orthocoronavirinae and cause respiratory tract infections in humans that can range from mild illness to death of a human. Coronavirushave virus particles of 120nm in diameter. [1,2] Club shaped glycoprotein gives the viruses a crown like appearance. The nucleocapsid is formed by a protein shell called as a capsid which has viral

nucleic acid in it and has a helical structure.[3] Corona disease causes highly contagious respiratory problems and is characterized by symptomsof fever, cough, muscle ache with difficulty in breathing. For this viral disease till yet no vaccines or antiviral drugs are there to prevent humans from coronavirusinfection[3,4].From the ancient time it has been shown that the healing is with medicinal plants. Our planet is full of tremendous medicinal plants which may beused as drug for human ailment. Since from the old time people search for drug in nature, At that time people are unaware about for the illness and also not sure regarding which kind of plant could be treated as a drug but now a days with advanced science and research work the reason for choosing a specific medicinal plant for treatment of particular diseases were being discovered. Thus, the medicinal plant and its product plays a vital role in our environment.Our country India has a wide range of medicinal plants and it has been recognized for the spices and its contribution towards medicinal importance. Mainly a spice is a plant product that may be a fruit, Root, Bark and dried seed or flower which is used in small quantities for colour and flavour of a substance. [5,6] From ancient times many types of species were used in our daily routine. Many of these spices are also used in traditional medicines. Somewell-known spices which have a wide range of medicinal contribution towards human lives are garlic, ginger, cloves, cardamom, mint, coriander etc.

In the present research work is on to develop a prevention for COVID 19 by using biochemicals of one plant spice product i.e. Garlic has some antiviral properties and also has immunity effects.Allium Sativum is spices belongs to family Amaryllidaceae which is commonly known as garlic is an herb that have antiviral, antimicrobialproperties, Garlic have some medicinal value and also enhance the body immunity.[7] Garlic consist of high amount of water and very few amount of carbohydrate,protein,fatty acid and trace elements with more quantity of sulphur containing compounds as it is have pungentodour.[7,8] Garlic consist of organ sulphur compounds like Alliin, Allicin, Diallyl sulphate andAjoene[9,10]. Out of these compounds the main compound which belongs to the sulphur compound is Alliin.Besides the organo sulphur compound other phytochemicals named as saponin are being recognized for their importance in the biological process. Saponin also has been found to have many more biological and pharmacological activities.Phytochemicals of garlic which are going to treat as a small molecule against the main protease enzyme of COVID 19 areAlliin, Allicin, Ajoene, Diallyldisulphide and Saponin

MATERIALS AND METHODS

Software used

Biovia discovery studio was used for analysis of molecular docking and pharmacophore screening as it is validated science application. This software gives how a small molecule can bind with a protein molecule with considerable advantages. This software can predict the extent of molecular interaction as it has machine learning techniques.

METHODOLOGY

Phytochemicals Screening

Phytochemicals are chemical compounds produced by various plants through its metabolism of primary and secondary metabolism. Phytochemicals have biological activity in the plant host and play an important role in the plant growth also contribute towards destruction of predators or pathogens. Phytochemicals originated to help plants from bacteria, fungi, viruses and cell damage. Plants and its products like vegetables, food items and also spices have some phytochemicals.so these organic chemicals may beused as traditional medicines for most of the diseases.Garlic consists of phytochemicals likeDiallyl-disulphide, Alliin, Ajoene, Allicin and Saponin. So, these phytochemicals are treated as ligands against main protease enzyme of Corona virus. Ajoene is a colourless organo sulphur compound found in garlic extracts. It contains a functional group of sulfoxide and disulphide.

Alliin is a natural constituent of a fresh garlic, Basically a sulfoxide. When raw garlic is chopped the enzyme alliinase convert alliininto allicin (Fig :1). It is a chemical compound found abundantly in various plant species. They are amphipathic glycosides grouped and produces foam when shaken with aqueous solution (Fig :2). It is an organosulphur compound derived from garlic and a measure compound of garlic with strong garlic odour. It is a yellowish liquid which is insoluble in water (Fig :3). It is a species belonging to family Alliaceae and an organ sulphur compound obtained from garlic.It is produced when garlic is crushed and consists of sulphur compounds. It has antioxidant properties so it is beneficial for human health.(Fig :4) COVID 19 is caused by the virus name SARS-CoV-2 and this pandemic in India was reportedin the month of January which originated from china. From someresearchwok and published paper, it has been concluded that the main protease enzyme of SARS-CoV-2 is involved in RNA synthesis. Like other microbes it has some metabolic pathway and biological activities for its existence. These metabolic pathways need some particular enzyme for completion of its life cycle and deactivation of these enzymes may destroy the virus.(Fig :5). SARS-CoV-2 causes COVID 19 which is a contagious viral infection and primarily affects the throat then to lungs. Inside the virus genetic materials produce more copies of itself. Spike protein in it acts as a key and gets inside the human body to be attached with a receptor molecule. Once this virus enters into the human body it gets contaminated with cells of the throat, nose and lungs cell first. Then this virus gets into a receptor molecule of healthy cell membrane and moves to the cell nucleus and finally develops a new cell inside the human body(Fig :6).

Enzyme found in SARS- CoV-2 main protease

It has been already stated that COVID 19 is caused bySevere acute respiratory syndromecoronavirus2 (SARS-CoV-2) which is a viral disease. For its survival there are many more metabolic cycles that are completed by different biological reactions shown in the above fig (6). These cycles are carried out by different enzyme molecules. Brenda enzyme database has been used to determine the different enzyme found in SARS CoV-2.The database shows the main protease enzyme of coronavirus having protein data base code (PDB CODE 2VJ1) which is involved in the synthesis of RNA.Now this enzyme will act as a receptor molecule to form a high positive interactions with the stated phytochemicals of garlic (Fig :7).

Molecular docking

Molecular docking is a type of modelling which forms a stable adduct by the interaction of two or more molecules one is ligand and other is a target molecule. This process gives a prediction of 3D structure of any complex molecule. The receiving molecule is mostly a protein or a biopolymer. In this molecular docking it predicts the preferred conformation or orientation of one molecule to another when bonded to each other to form a stable complex. Molecular docking is a method of ligand and receptor interaction where phytochemicals from the plant or plant product act as a ligand and interact with microbe protein by covalent bond formation. The discovery studio of biovia software was used to perform molecular docking. The phytochemicals of garlicwere downloaded from different websites. Protein of enzyme 3D structure was downloaded from RCSB websites. The enzyme was first opened in a discovery studio. If the protein molecule has any hetero atom or water in it then by deleting that compound will leads to better results in Docking. To identify the active sites of the enzyme by clicking the receptor-ligand interaction menu. Active sites of the enzyme are characterized by one sphere. As it is a protein ligand interaction so C-Docker will be chosen for further processing and the number of ligands can be browsed by clicking dock ligands under Receptor-ligand menu. After 10 to 15 minutes the docking process is completed by giving some positive values. Molecular docking is validated by two energy values i.e. -C Docker energy and -C Docker interaction energies.The high positive value of -C Docker energy and less difference between -C Docker and -C Docker interaction energy value indicates the powerful interlinkage between small molecule i.e. ligand and the receptor molecule i.e. enzyme.

RESULTS AND DISCUSSION

The docking process was estimated or validated by C Docker energy which was obtained by the internal ligand strain energy and receptor ligand bonding interaction. Docking is like a key and lock model of the enzyme. Various algorithms are there for its execution. CDockeralgorithm is mainly a simulated based docking which has been used for the prediction of dug for human ailment. Below figure-8 shows the molecular docking of the ligand of garlic with the main protease enzyme of COVID 19 after the ligand gets bonded with the enzyme molecule and the above sphere in it shows the active site of main protease enzyme. The best molecular docking value was selected by absorbing high positive value of -C docker energy and less energy difference between -C Docker and -C Docker interaction energy. These two-energy values indicate the extent of molecular docking.

Above results show the output of molecular docking of the main protease enzyme with phytochemicals of garlic run in the discovery studio. As this docking process is validated by two energy factors i.e.-C Docker energy value and small energy difference between -C Docker and -C Docker interaction energy.so from this table it has been found that two ligands i.e. Diallyl disulphide and Allicin with negative energy and rest three ligands i.e. saponin, Alliin and Ajoene have positive energy. The C Docker energy value where it is negative, It may concluded that the ligand with this negative energy may not completely interact with the receptor molecule that means it may have incapable to deactivate the binding sites of that enzyme molecule.so from validation information of molecular docking it may state that high positive C Docker value and small energy difference has been given by ligand saponin. Table:1 shows that saponin is one of the small molecules giving the high positive value of -C Docker energy of 29.65 with a small difference of 1.06 between -C Docker and -C Docker interaction energy. So, the result of docking process shows that saponin can mostly deactivate the active sites of main protease enzyme of SARS-CoV-2 and may block the biological process involve in it.Result part confirmed that saponin was most effective ligand towards the blockage of SARS-CoV-2 main protease enzyme and may destroy the virus.

CONCLUSIONS

Garlic contains lot many compounds with protein and medicinal characteristics.From the old time garlic has been used popularly for its medicinal importance and it is believed that garlic has some health benefits compounds in it.It can reduce blood pressure, risk of cancer, common cold and improve cholesterol level in human body. Apart from that it has some anti-inflammatory, pharmacological effects and also enhances the body immune system. Basically eating 2-3 garlic cloves per day becomes beneficial for human health but high intake of garlic can be toxic for the human body. So, in this work phytochemicals of garlic have been taken for making a preventive drug for COVID19.This study gives the assumption values as it was taking place in abiovia discovery studio which was in silico analysis.From the result it has been observed that saponin gives a best result towards blocking the active sites of the main protease enzyme of SARS CoV-2. As saponin bonded strongly with that enzyme molecule shows a high positive value of -C Docker energy which was followed by other four values of corresponding ligands. Small energy difference with high positive values only has been shown by saponin. Thus,the above work gives the information that saponin may be treated as pharmacophore for getting replacement drugs.

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Table-1: Molecular docking energy

Sr No.	Small molecule (Ligand Molecule name)	-C DOCKER energy Value	-C DOCKER interaction energy Value	Difference between two energy value (between -C DOCKER interaction energy and -C DOCKER energy)
1	Saponin	29.65	30.71	1.06
2	Alliin	13.02	18.10	5.08
3	Diallyl disulphide	-4.63	11.83	16.46
4	Allicin	-5.22	15.37	20.59
5	Ajoene	1.48	22.33	20.85

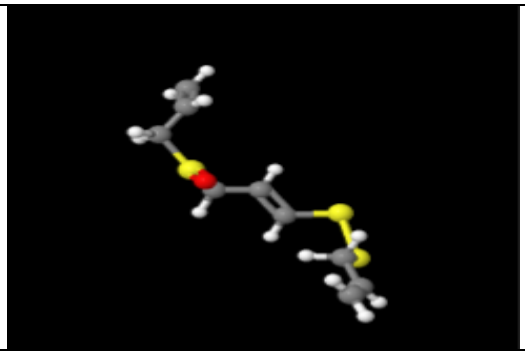

Fig :1 (Ajoene $C_9H_{14}OS_3$), Molecular mass :234.4 g/mol

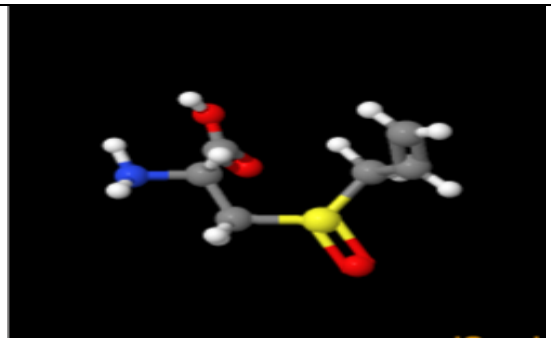

Fig :2 (Alliin $C_6H_{11}NO_3S$), Molecular mass :177.22 g/mol

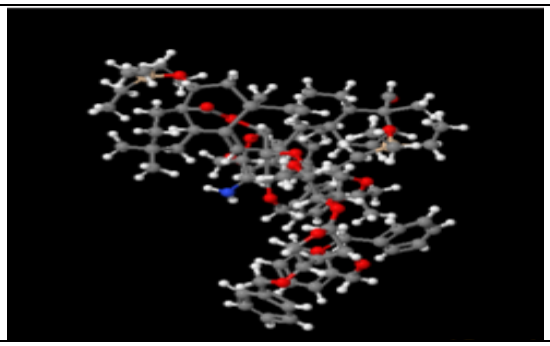

Fig :3(Saponin $C_{58}H_{94}O_{27}$), Molecularmass:1223.3 g/mol

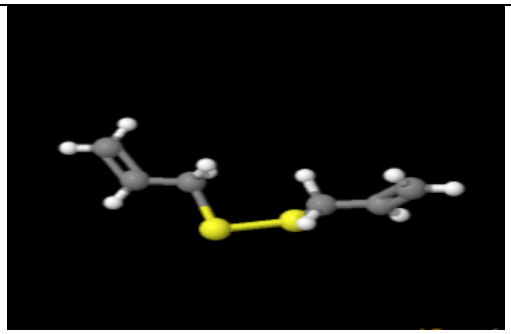

Fig :4 (Diallyl disulphide$C_6H_{10}S_2$),Molecular mass : 146.28 g/mol

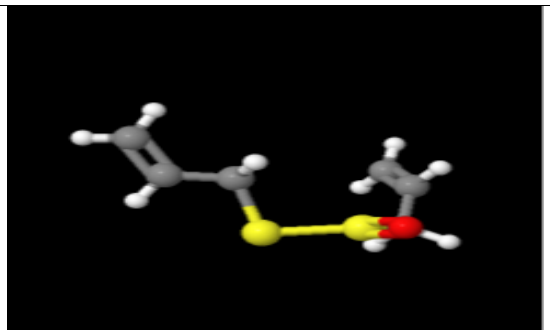

Fig :5(Allicin $C_6H_{10}OS_2$), Molecular mass: 162.28 g/mol

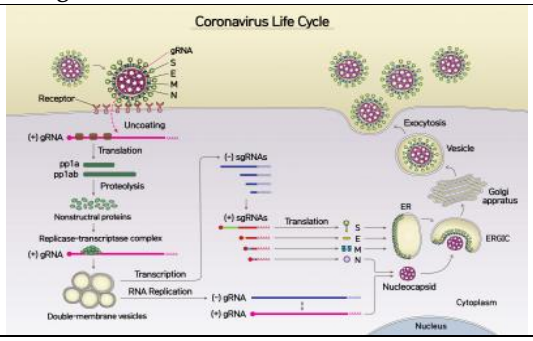

Fig :6 Life cycle of corona virus

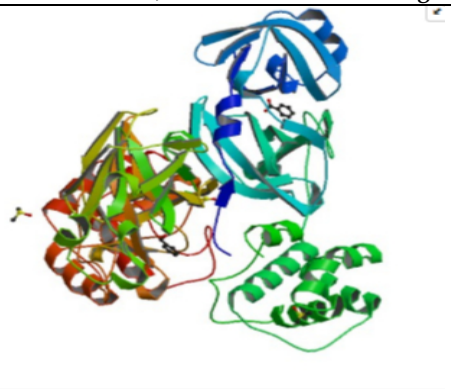

Fig :7:Main protease enzyme SARS CoV 2(PDB Code: 2VJ1)

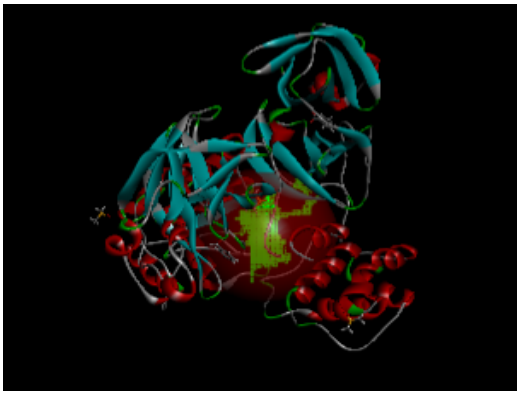

Fig-8: Active sites of main protease enzyme

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Consequence of Inadequate Sleep in Impairing the Scholastic Performance of the University Students

Suchismita Nayak

Centurion University of Technology and Management, Odisha, India.

Received: 21 Mar 2020 Revised: 23 Apr 2020 Accepted: 26 May 2020

***Address for Correspondence**
Suchismita Nayak
Centurion University of Technology and Management,
Odisha, India.
E.Mail: Suchismita.nayak@cutm.ac.in

ABSTRACT

A good sufficient amount of sleep is highly essential for all to have a better mental and physical health. This is a study based on poor sleep quality found especially in the students which leads to impairment of mind as well as body that substantially limits one or more major life activities and fail to promote better academic result. The aim of this article is to diagnose the relationship between sleep quality with human body and to navigate several associated factors leading to sleep depreviation that hampers the academic performance of the students.

Keywords: academic, mind, study, performance, students.

INTRODUCTION

Sleep is the natural phenomenon which reoccurs in the state of mind and body. It is to take rest sustained by interruption of discretionary bodily functions and the natural suspension, complete or partial, of consciousness, cease being awake. It has been well said by Thomas Hood "Sleep is the best meditation". Adequate sleep not only offers the body a chance to recover from wear and tear of daily life and plays a role in immune function, but also facilitates learning & memory. Individuals sleep pattern & habits vary determining on their age, professional stipulation, community participation, psychological and somatic conditions, and also individual physiological features. Inadequate or insufficient and disturbed sleep give on to decision impairment, anxiety, ill-temperedness, and incompetence to executeparticulars in short term as well as in long term, it couldgive rise to cardiometabolic disarray and even intensify mortality. As seven to nine hours of sleep is recommended for young and adults every night. A study states that 20% of health risk increases with every night of inadequate sleep, where one of the high-risk groups, are students who suffer from bad impact of sleep disorder. A high propensity has been seen in young students attending different courses in the university because of several aspects related to lifestyle, levels of personal and social well-being and academic performance and satisfaction.

Study says 60% of university students suffer from poor sleep quality.Poor sleep affects the ability of processing and learning and memorizing new information in the students, which leads to poor academic performance of the students. Undergraduate students of universities those ranging in the age group of 18-21 are in their transitional phase of growth and development between childhood and adulthood. As this is an important phase of development in the human body, it is very important to have adequate and healthy sleep. It has been found that the cause of poor sleep quality in university students vary from individual to individual from first year to final year students. However reasons are many and need to be find out, how can this perilous malady be checked and at the same point of time initiatives must be taken like offering sleep health education to the university students, for their well being which leads to better performance in academic discipline, which will further motivate them to build a great nation.

Why do we sleep?

The question why do we sleep has perplexed theresearchers for ages.As we all know that food, air and water are important for all individuals to survive, in the same manner sleep also plays an important role for our survival.Sleep is required because it enable us to sustain cognitive skills like memory, speech with new ideas and creative thoughts.It is believed that sleep also helps in the development of the brain by conserving energy which has been used for the activities performed the whole day long.The body recover or recoup the energy by the help of sleep.It is considered to be the natural phenomenon, that gives an opportunity to restore the powerin our mind and body. Sufficient sleep leads to proper functioning of the body and insufficient sleep or poor sleep quality lead to poor performance of the brain and body.If we remain awake for longer period of time without giving a rest or break to our body and brain,then that will lead to serious health hazards.Some of the grounds below specify that why we sleep.

Energy conservation

Sleep is very much essential to execute things better.Sleep is believed to be an energy conservation procedure.The metabolic rate decreases when the body is at sleep phase which helps in energy conservation.Sleep helps to lessen the wear and tear of the body and also conserve energy by permitting a significant duration of rest or pause to the whole body.At the time of sleep the energy conservation takes place and works as recharging the energy which has been discharged.Research says that the degree or intensity of heat present in the body and unit of energy in nutrition insistence diminish at the time of sleep in contrast to the state of awake.Glycogen present in the brain acts as combustion which is used by our brain for energy is reduced during the day time and fill-up at the night.It makes a clear sense that the energy recharge when the body sleep[1].Thus, we can say that when we sleep , the energy conservation process take place and this conservation of energy is very important for individual person.

Brain function

As we all know sleep plays a major part in the operation of the brain. It helps in setting up new tracks and handles facts. [2]Brain performs task actively and precisely.Every individual perform better if they take required amount of sleep which helps the brain to trigger on all the activities to be performed when we are in conscious state. The ability to ponder and riposte become quick with very low intensity of doing errors[3].This is possible because sleep provides a good time for the nerve cells to take rest and restore themselves for having been used the whole day and getting prepared for the next day again, else the nerve cells won't be able to respond effectively and positively.Sleep also helps in striking out the toxicants from our brain, that develop when we are in awakened state and allow the brain to function properly.

Prevents depression

Depression is co-related with sleep.Depression is a feeling of severe despondency and dejection, that acts as a disease in the brain and which has negative impact on the functioning of the brain and add on many more unfavourable effects in our body.A body requires a good amount of sleep that works in a very effective manner to come out of this deadly disease of depression.Maintaining a good sleep habit helps in reducing or preventing depression and the key to remain healthy, fit, active and energetic, which is vital for all including students by helping them to improve their academic performance.

Improves memory

Sleep is said to have significant impact on memory.The nature and amount of sleep has a very powerful effect on learning and memory. Sleep during night, reinforce our memory and helps in procedure of forming new information.Sleep helps in strengthening psychological element in our memories and stimulates creativity.To be in a healthy state of mind it is very much essential to have good and proper amount of sleep to grab the particulars that we get through out the day time.To keep the information for a longer period of time in our memory, a good night sleep is very much essential.Sleep helps in making memory stronger.It converts short term memory to long term memory.Sleep also work as an aid in merging new ideas and thoughts developing wonderful instances.Improving memory is very important for all, specially for better academic performance of the students.Therefore sleep is considered to be helpful to memorize all those stuffs that we learn during the day time.

Sharpens concentration

Sleep has great impact or it can be considered as one of the factor to sharpen our concentration level.It has been experienced that absence of adequate sleep develops anger and make us feel disturbed[6].This happens because the brain gets tired and unable to function well due to the deficiency of oxygen and leads to shortage of concentration.Especially students need to have proper sleep which helps the brain to function properly and sharpen their concentration level.

Strengthen immune system

Immune system is our body comprises of different types of biological compositions and shapes which safeguard us against diseases.It has been stated by the researchers that good sleep help in strengthening the immunity system in our body.Reports of German scientist states that good sleep progress and develops immune cells named as "T "cells and these cells fight against different virus infected cells such as HIV,flu ect[7].So sleep helps in improving and strengthening the immune system in our body.

What is sleep depreviation?

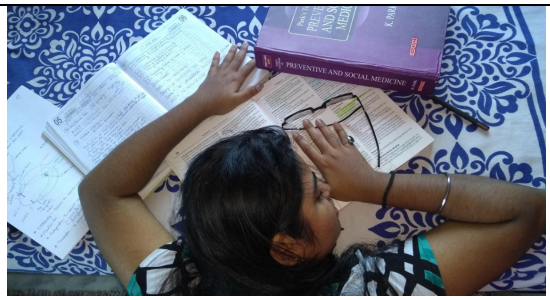
Sleep depreviation is the situation or condition of suffering from shortage of sleep.It has become customary in this modern world.With the rapid changes taking place in the community, it has brought lots of changes in our lifestyle so as to our sleeping habit.Sufficient sleep is required by individuals and if they fall in short of it then it leads to sleep depreviation which has negative impact in our body.Sleep depreviation mostly in teenagers are observed because of

unintentional behaviour as well as intentional behaviour and they fail to understand the worth of sleep.Some of the reasons are cited below which indicate the causes and consequences of sleep depreviation.

Stress, anxiety and depression

Stress is a state of mental or emotional strain or tension due to certain circumstances which has negative influence in our body and affect our sleep quality and its duration.This insufficient sleep raise the level of stress in a human body and this leads to mental and physical health issues[8].Our immune system needs to be strong to avoid our body from any type of negative effects like flu,herpes etc and it is possible ,if our body gets adequate amount of good sleep to release the stress and which will finally help to increase the immune system and have positive impact in our body.

Now a days stress has become a part and parcel in every individual's life.It has been observed that students at the university level suffer from stress and anxiety due to increase academic burden with all new commitments and experiences with unpredictable set of circumstances and challenges introduced in this competitive world [9]. Every one wants to go ahead and succeed but it becomes quit difficult when introduced to this unanticipated condition.This results in pressure, which develops stress and anxiety leading to depression and it further leads to poor sleep quality, affecting the immune system causing mental and physical health issues and this leads to poor performance in the academic field.



The above pictures indicate the increase in Stress level due to a academic pressure putting impact on sleep quality

Depression

Another factor responsible for sleep depreviation is depression.The frequency of depression in our society is increasing at a very faster rate over the past years[10] and this indicates that students persuing their academic course suffer a lot from this deadly disease of depression which is said to be genetic, that gets transferred from parents to their children which increase the risk of sleep depreviation with mental and physical disorder.Break -up in relationships has now become the most contributing element for depression and it brings lots of changes in the sleeping habits[11] further affecting the mental and physical imbalance of the body give rise to negative ordeals affecting the academic performance of an individual student.

Pictures indicate the signs of Depression resulting in sleep disorder

Family problem

This is also considered to be one of the reason which leads to sleep depreviation. If there is any issue or problem in a family, this throws a bad impact on every individual in that family.Specially the teenagers and the youth get more affected by it that leads to the path of poor sleep quality and lack good amount of sleep and their social communication and the academic performance decrease, because poor sleep quality weakens the memory power, as the brain does not get time to restore the energy level which has been used and discharged during the whole day.Here the brain fails to get adequate oxygen and the nerve cells don't get sufficient time to restore themselves and to prepare themselves for the next day.

Noise caused by room mates

According to the research and observations, 52% of students fail to have good sleep and suffer from sleep depreviation due to the noise caused by room mates in hostels.It is quit obvious that students who reside in hostel suffer from inadequate sleep as the room they stay is not meant for a single person, it may be two persons or more than two in a hostel room.Students fail to sleep when there is too much of noise in the surrounding made by their fellow roommates, which affect the sleep quality of the students.It is impossible to avoid the disturbance or stop the noise caused by the roommates as the fellow roommates may listen or may not listen to the individual who gets disturbed. This entire process not only affect one individual student but to all fellow mates leading to sleep depreviation and welcoming diseases to affect their life,leading to poor presentation in scholastic field.

Room Odour

We often find it difficult to have a good sleep if the space or environment is not hygienic enough to inhale properly.Poor room odour can be considered one of the key factor which leads to sleep disorder.Students sharing the same room in the hostel get affected by sleeping disorder because of the room scent which occurs due to perfume used by the fellow mates, the smell of the sweat, and the tobacco smoke etc of the fellow roommates. This unhygienic odour give rise to sleep depreviation and the students get affected both physically and mentally.

CONCLUSION

Sleep helps in conservation of energy which the whole body uses during the work time.It is a natural process that the body needs to accept and follow to function properly.If the amount of sleep that we take is not sufficient or if the quality of sleep is very poor then it causes harm to the entire body which gets attracted to different diseases and also give birth to new diseases.Thus there is the necessity to increase the awareness programme of sleep depreviation among the students by including benefits of good sleep habit and drawbacks of poor sleep quality in the universities and in different educational organizations which may have positive impact on the students leading to good health, developing good hygienic practice and better academic performance.

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Biosynthesis and UV Characterisation of Silver Nanoparticles using *Aloe vera* Gel Extract

Bikash Samantaray

Centurion University of Technology and Management, Odisha, India.

Received: 19 Mar 2020 Revised: 21 Apr 2020 Accepted: 26 May 2020

***Address for Correspondence**
Bikash Samantaray
Centurion University of Technology and Management,
Odisha, India.
E.Mail: bikash.samantaray@cutm.ac.in

ABSTRACT

Nanoparticles have unique material characteristics, therefore different methods used to synthesize nanoparticles. Silver nanoparticles have been extracted due to their unique properties like size and shape, antimicrobial activities and electrical properties. There are a variety of methods for synthesis of silver nanoparticles like gamma radiation, chemical irradiation, photochemical methods etc., but the biological method to extract silver nanoparticles is a very cheap and easiest method. This study is an eco-friendly synthesis of silver nanoparticles from aloe vera gel extract which requires a few days to synthesize. The obtained silver nanoparticles are characterized by uv-vis spectroscopy to confirm the presence of nanoparticles of silver in aloe vera gel extract. The absorption peak shows at 350nm and lowest at 200nm.40ml of aloe vera gel extract deposited 0.0003mg of silver nanoparticle. Antimicrobial properties of silver nanoparticles may contribute towards the pharmaceutical industry due to its medicinal value.

Keywords: Biosynthesis, AgNPs, Aloe vera gel extract, characterisation.

INTRODUCTION

The word nanoparticle is used to express size of the particles between 1 to 100 nanometres in dimension. Now a days, nanoparticle-mediated researches have been mostly exhibited and penetrated into the interdisciplinary sciences with nanotechnology due to their prospective applications [1–9]. Main focus of Nanotechnology on the synthesis, design of structure [1].For specific functioned nanosized particles, nanotechnology combines the principles with physical and chemical procedures. Biological synthesis of nanoparticles is a eco friendly and cost-effective method in comparisons to physical and chemical methods which are costly and toxic. Therefore, nanomaterials are mostly synthesized by using microorganisms and plant extracts.[1].In the pool of nanoparticles synthesis methods, Biosynthesis of nanoparticles is an thrilling addition to the large and now nanoparticles have set foot in commercial exploration period. Zn, Cu, Ag, and Au have been used mainly for the synthesis of stable dispersions of nanoparticles, which are helpful in areas like optoelectronics, photo catalysis, piezoelectric devices, fluorescent tubes, photography, sensors, biological labelling etc. [2–4].

These days, to enhance different properties of material coatings like high mechanical, resistant to corrosion , electro catalytic, nanotechnology methods are used, which makes nanostructured coatings a primary candidate in oil and gas for applications requiring high corrosion protection coupled with high mechanical properties [5, 6]. For the treatment of various diseases, different plants have been used as a source of indigenous medicine for decades. Various types of medicinal plants serve as excellent source of phytochemicals with strong antioxidant properties (10). Aloe Vera is a succulent plant which grows mainly in the dry regions and in India, it is found in Andhra Pradesh, Rajasthan, Gujarat, Tamil Nadu and Maharashtra.[8]The plant has fleshy leaves with serrated edges, each leaf is composed of three layers. It is a significant source of many chemical compounds like glucomannans, amino acids, lipids, anthraquinones and glycosides also it has been used worldwide for its skin care, beauty, health and medicinal properties. [8].

Currently there is a huge demand of nanoparticles in various sectors like medicine, chemistry, energy and catalysis. Silver Nanoparticles (AgNPs) have been known for many decades for its strong perniciousness against extensive micro organisms like bacteria and fungi. consequently, there is enormous requirement for the evolution of clean and bio stability along with sustainable and cost-effective process for synthesizing AgNPs. In this study, aloe vera leaf inner fresh gel was used. There is still little information on the use of aloe vera gel. so, the work provides information on synthesis of nanoparticle from Aloe Vera gel extract.[7]

MATERIALS AND METHODS

Silver Nitrate was used from university Chemistry lab and Aloe vera leaves were collected from the Botanical garden, Centurion University of Technology and Management, Odisha, India.

Preparation of the Aloe vera Gel Extract

The Aloe vera leaves were washed and the fresh gel was extracted into a clean beaker. Then 20-30 ml of alovera gel solution was prepared. The alovera extract was added to 20 ml of 1Mm silver nitrate solution. It was heated for 10-15 minutes then kept in a dark condition for its reduction for about 48 hours. After two days the colour of the solution changes to light yellow to dark brown and that is confirmedby the formation of silver nanoparticles. Then it was centrifuged to get the supernatant at an RPM of 3000 to 5000 for 25 minutes. The supernatant was subjected to UV-VIS analysis.

UV-VIS characterization

The UV characterization is a spectroscopically analysis where the solution is contacted with a light source to give a uv-vis spectral reading. For the nanomaterials the physiochemical properties are important for their stability and efficacy. So, characterization of silver nanoparticles is the most important process to get the functional value of nanomaterials. Uv-vis spectroscopy is the common and easiest technique to validate the formation of nanoparticles. The spectrum obtained from uv-vis spectroscopy of silver nanoparticles synthesized using silver nitrate solution and aloe vera gel extract is a reducing agent in aqueous solution.

RESULTS AND DISCUSSION

The results obtained from uv-visible spectral analysis is described below. Multiple wave lengths have taken from 250nm to 800nm with reference to distilled water. Synthesis of silver nanoparticles from aloe vera gel extract is a reduction process, the change in colour of the solution from light yellow to dark brown confirmed the presence of silver nanoparticle. Metals have free electrons. The electrons of silver nano metal are mutually vibrated in resonance with light to yield a surface plasmon resonance absorption band. The absorption peak shows a gradual decrease towards high wavelength. On increasing wavelengths absorbance rate decreases. It shows a high peak at 350nm and afterwards it decreases.

CONCLUSION

This present study represents the biological synthesis of silver nanoparticles from aloe vera gel in an eco-friendly and low-cost method. Brown colour precipitation confirmed the presence of silver nanoparticles in its reduced form. Silver nanoparticles were characterized by uv-vis spectroscopy which confirmed the surface plasmon resonance. This study explores a broad scope for the application of silver nanoparticles in the field of biochemistry and agriculture. The number of nanoparticles obtained from 40 ml of alovera gel extract was 0.0003mg.

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Table-1(UV–visible absorption spectra record)

No of Observation	Wavelength in nm	Absorbance
1	250	0.12
2	300	0.15
3	350	0.6
4	400	0.16
5	450	0.15
6	500	0.13
7	550	0.13
8	600	0.12
9	650	0.13
10	700	0.13
11	750	0.12
12	800	0.12

Fig. 1. *Aloe vera* Gel Extract

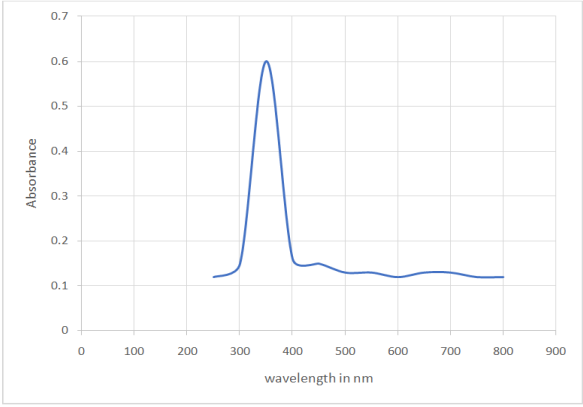

Fig. 2. UV–Visible spectra of silver nanoparticles

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

In silico Analysis of Polyvinyl Alcohol and Silicon Oxide Compatibility in a Blend

Somalika Pradhan* and Bikash Samantaray

Centurion University of Technology and Management, Odisha, India.

Received: 22 Mar 2020 Revised: 24 Apr 2020 Accepted: 26 May 2020

***Address for Correspondence**
Somalika Pradhan
Centurion University of Technology and Management,
Odisha, India.
E.Mail: somalika.pradhan@cutm.ac.in

ABSTRACT

A hydrogel is a material that has been used in a different kind of applications varying from industrial technique to drug delivery. This Hydrogel material will be a soft and valuable material as well as water soluble due to mixing of a polar polymer i.e. soluble in water. The present work is a prediction of hydrogel composite by taking one polymeric substance i.e. polyvinyl alcohol and another is an inorganic compound i.e. silicon oxide. These two substances have been taken for a good blend formation in the material studio of biovia software. Blend is a process of formation of a homogeneous mixture of two materials and result in compatibility information of the taken materials. This work is a silico analysis of polyvinyl alcohol and silicon oxide for the formation of good hydrogel composites.

Keywords: Polyvinyl alcohol, silicon oxide, Blend

INTRODUCTION

The polymers, a word derived from the Greek word which means many parts and it has organic or inorganic molecules which is composed of multiple repeating units. Polymer is a class of synthetic or natural substances composed of very large molecules, called macromolecules that are multiple number of simple and single units called a monomer [1]. Polymers are broadly used to improve materials. Which are found mostly in every material used in our everyday life. The importance of polymers in our daily life has been higher pointed due to their applications in various superiority of modern technologies and industry [1]. The rapid increase in demand of new material produces a greater number of polymers. Nowadays both organic and inorganic polymers contribute highly towards human life styles [1,2]. Organic polymers are made up of carbon and hydrogen atom mostly along with some hetero atom like Nitrogen, Oxygen and Sulphur etc but inorganic polymers typically made up of Silicon, Phosphorus, Boron, Carbon or Nitrogen atoms [3]. Polymers of both organic and inorganic materials are sometimes called a hybrid polymer. These hybrid polymers may have a better coordination to give a composite material [3]. The probability of

mixing of both organic and inorganic material may proceed out in the blend module of the material studio of biovia software. A blend is mixing of two materials in one phase to give a stable composite which is then used in various processes. In this work polyvinyl alcohol an organic polymer and silicon oxide an inorganic material has been taken for the blend analysis study of it.

Polyvinyl alcohol is a water-soluble polymer produced commercially from polyvinyl acetate. The acetate groups of polyvinyl acetate get hydrolysed by ester and exchange with methane in the presence of aqueous sodium hydroxide. Polyvinyl alcohol is a colourless and odourless, low toxicity and is used in the textile and paper industry [4]. Polyvinyl alcohol has some good biocompatibility nature so it is used in a medical application specially used in cartilage replacement, contact lenses and eye drops. It also has adhesive and emulsifying characteristics as a water-soluble protective film [5]. As this polymer has some positive results towards other material formation so it can be taken as a starting material for the synthesis of other polymers.

Silicon oxide (SiO_2) is synthetically produced by the thermal process yielding silica or by a wet process yielding silica gel or silica [6]. It is an amorphous substance with tetrahedral geometry and one silicon atom is bonded to four hydrogen atoms. It has bridging and non-bridging oxygen atoms which are bonded to silicon atoms. If all oxygen atoms are bridging then regular crystal structure will be formed [7]. Silicon oxide is used in the construction industry to produce concrete. In its crystalline form it is used in the production of silicon elements and also used in hydraulic fracturing. Silicon oxide is a transparent, odourless crystalline or amorphous solid which is insoluble in water and acid [7].

Experimentally it has been proved that a composite of hydrogel can be synthesized from polyvinyl alcohol and silicon oxide. These two substances have excellent biocompatibility so it can produce a good composite after its homogeneous mixing. The polyvinyl alcohol and SiO_2 composite hydrogel are favourable in a variety of biomedical applications like biosensor, artificial cartilage and drug discovery [8]. Thus, this present work is based upon compatibility data analysis of polyvinyl alcohol and silicon oxide in the blend module of material studio biovia software.

MATERIALS AND METHODS

Software used

Material studio of Biovia software was used to prepare the blend of given two substances. It is a software for simulating and modelling of materials. It is a research software for computational chemistry, molecular dynamics and quantum mechanics. Material studio is a complete modelling and simulation based designed to allow the researchers to predict the molecular structure with its behaviour This has been used in advanced research areas like polymer, nanotube, crystal and ceramic etc.

Methodology

Two substances have been taken for the formation of a good composite in blend module of material studio biovia software. One is organic polymer polyvinyl alcohol and another is inorganic material silicon oxide was used to form a homogeneous mixture in one phase. For the preparation of polyvinyl alcohol in the material studio build menu was selected and from the monomer box vinyl alcohol was selected. Then it will proceed to fore cite geometrical optimization and silicon oxide was drawn in biovia draw as it was not available in monomer box. After that silicon oxide fore cite geometrical optimization occurred. The result obtained from it will move to blend calculation. It will give the mixing result of polyvinyl alcohol and silicon oxide. Then for analysing the result of two polymers blend analysis has been chosen. In the analysis module there are so many parameters for showing the compatibility of two

materials. The compatibility can be confirmed by analysing the data obtained in the graph in blend analysis material studio biovia software.

RESULTS AND DISCUSSION

In this work the result of a blend of polyvinyl alcohol and silicon oxide was based upon the data obtained from the various parameters in the form of a graph. All the graphs were discussed below.

Mixing Energy

For mixing any kind of materials energy is needed. In case of homogeneous mixture the interaction between solute and solvent is uniform throughout the solution as it is distributed ideally but in case of polymer it is not possible for uniform interaction as polymers have long chain carbon compound with a large structure so it is not possible to react with other substances uniformly at a low temperature. For mixing of the materials temperature is required and the temperature range is depending upon the types of materials. Less energy for any system will maintain its stability so the material which needs a small amount of energy for its mixing will form a good composite.

The above fig-2 shows the graphical information of mixing energy of polyvinyl alcohol and silicon oxide. From the graph it can be stated that with rise in temperature the mixing energy of two components is decreasing. The mixing energy of polyvinyl alcohol and silicon oxide will be less at 480K. Thus, at this temperature these two materials can be mixed together to form a good composite.

Free Energy

Polymeric materials have a wide range of applications in everyday life. Blending of a polymer is the best way for providing a favourable material with a full set of desired products. If two polymers are mixed, the common result is a complete phase separation due to repulsive coordination between two different substances. A blend can be prepared if there is a homogeneous mixing of two materials. Completely miscibility of two materials requires the following condition in case of free energy.

$\Delta G_m = \Delta H_m - T\Delta S_m$ ----------(1)

Where ΔG_m is free energy of mixing
ΔH_m is enthalpy change during mixing
T is absolute temperature
ΔS_m is entropy change during mixing

For one phase criteria the equation should be

$\Delta G_m < 0$ ----------(2)

For miscible polymer blend of two materials must be a homogeneous mixture with negative free energy change for a spontaneous process. The value of change in entropy will always be positive as the value of entropy increases on mixing. Thus, the value of ΔG_m is always depending on the value of change in enthalpy for mixing. The pair of polymers mix to form a single phase when the entropy contribution to free energy exceeds the enthalpy contribution. i.e.

$\Delta H_m < T\Delta S_m$----------(3)

The above fig-3 shows that free energy for mixing polyvinyl alcohol and silicon oxide. It shows with increase in temperature free energy value decreases which will favour the formation of a good composite as it has been cleared from equation 1, 2 and 3. The graph shows that at temperature 612.5K the free energy of mixing is -2 to -4 Kcal/mol. Hence it will give a good blend with high compatibility.

Phase Diagram

A phase diagram represents the various phases in a chemical system at equilibrium with respect to composition and temperatures. It is a graphical representation of the substances under different conditions of temperature and pressure. It is an important parameter for any material or polymer which can predict the phase changes at a particular temperature and pressure. For a good composite the phases of the two materials should be in one phase with lower temperature. At higher temperature mixing or blend can not be favourable for the formation of a good composite. In phase diagram the critical temperature is important at which two phases of a substance initially become indistinguishable from the other. In a phase diagram for different degrees of miscibility there are three regions like single phase, spinodal region and metastable region. The phase diagram has two critical points for mixture of two components i.e. lower critical solution temperature (LCST) and upper critical solution temperature (UCST). Thus, the polymer blends usually show either LCST or UCST.

Above fig-4 shows that phase diagram for polyvinyl alcohol and silicon oxide. In the graph the red colour point indicates the miscibility of the above two materials above 600K. Thus, it concludes the polyvinyl alcohol and silicon oxide can form a good blend as the temperature is not very high.

Energy Distribution for blend

The blend is a molecular simulation that calculates compatibility of the mixture. The formation of different confirmation using this method may lead to distribution of different energy levels. Below fig-5 shows the curve of energy level against frequency P (E). The following distribution is in a symmetric manner. The frequency peaks totally fall with energy direction from energy value -2.8kcal/mol to -0.2kcal/mol and shows a highest frequency peak at around energy value of -1.4 kcal/mol.

Chi-Parameter

BIA polymer blend chi-parameter is contributing towards the material by knowing the value of it. The thermodynamic properties of a polymer solutiondepending upon the composition of mixture is expressed in terms of a parameter called Flory-Huggins or chi-parameter. For a one phase miscible material this parameter must be negative in nature i.e. less amount of chi-parameter will favour the formation of a good composite.
For a binary mixture the Flory-Huggins equation is

$$\Delta Gm = RT\left[\frac{\emptyset 1}{r1} ln\emptyset 1 + \frac{\emptyset 2}{r2}\, ln\emptyset 2 + X\emptyset 1\emptyset 2\right] \text{----------(4)}$$

Where R is the universal gas constant.
T is the absolute temperature.
r is the number of polymer segment.
Φ is the volume fraction of the component.

This equation-4 is depending on entropy of mixing and enthalpy mixing. For infinite molecular mass of a polymer the entropy value is very small and the miscibility or immiscibility of the component is totally depending upon the value of enthalpy. The miscibility is maximum when the value of the chi-parameter is negative.

From the above fig-6 it shows the variation of chi-parameter with temperature. As increase in temperature value of chi-parameter decreases. The decrease value of chi-parameter is falls in between 300K to 480K. The less chi-parameter value will give a good blend polymer whereas a high value of it may lead to poor mixing of polymers.

CONCLUSIONS

The chance of formation of polyvinyl alcohol and silicon oxide blend was predicted in the material studio of biovia software. The various parameters are used like free energy change, mixing energy, phase diagram, chi-parameter etc which validate the obtained results. Phase diagram shows that above 600K good blend can be obtained. Free energy change indicates the negative free energy with increase in temperature which will be helped in formation of good blend. Chi-parameter value is also decreasing which will favour the formation of a good homogeneous blend. As both the materials can form a good mixture so it will give a favourable result in the formation of a hydrogel of polyvinyl alcohol and silicon oxide.

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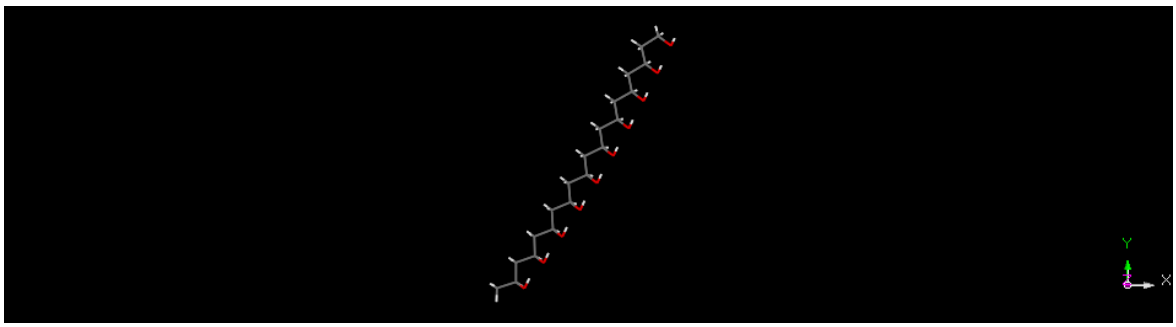

Fig- 1 Polyvinyl alcohol

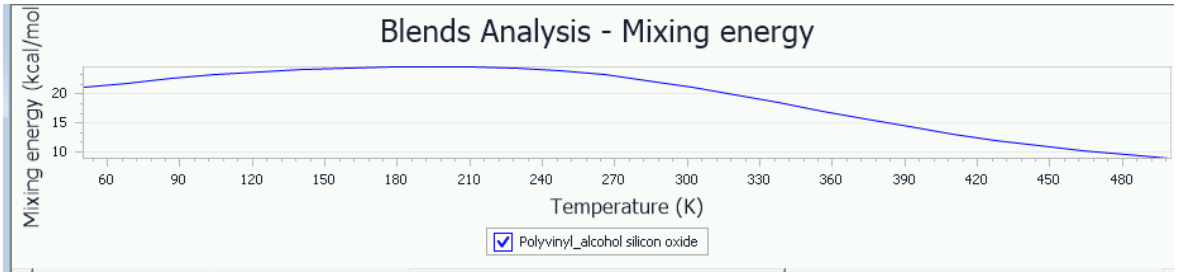

Fig- 2 energy of mixing

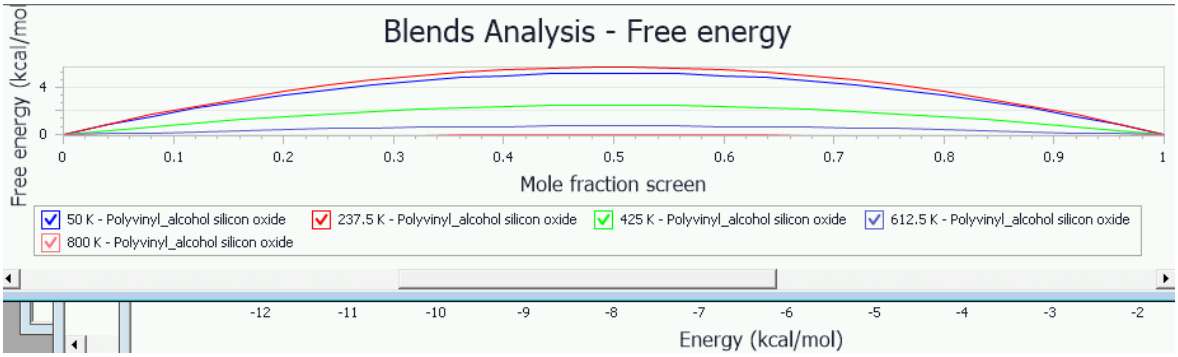

Fig- 3 Free energy of mixing

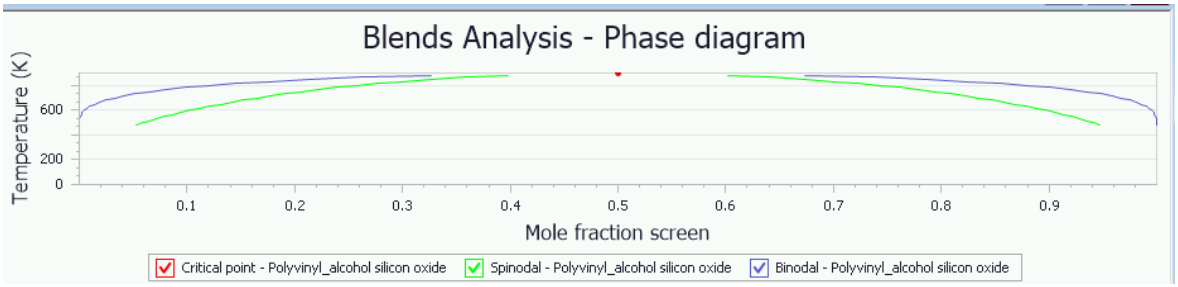

Fig-4 phase diagram

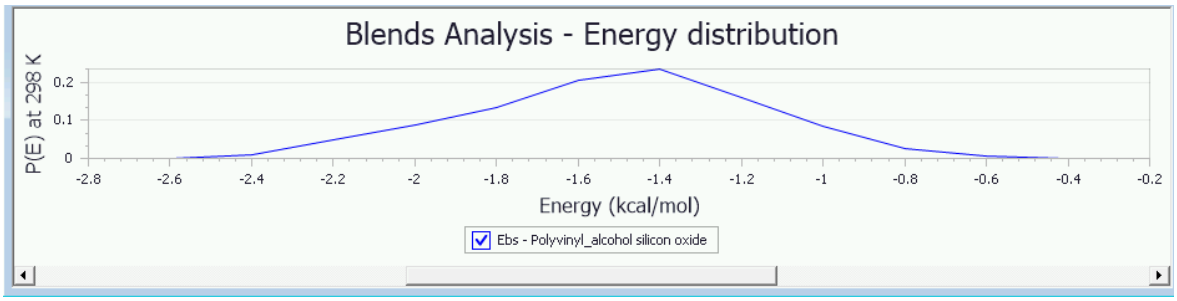

Fig-5 Blend energy distribution

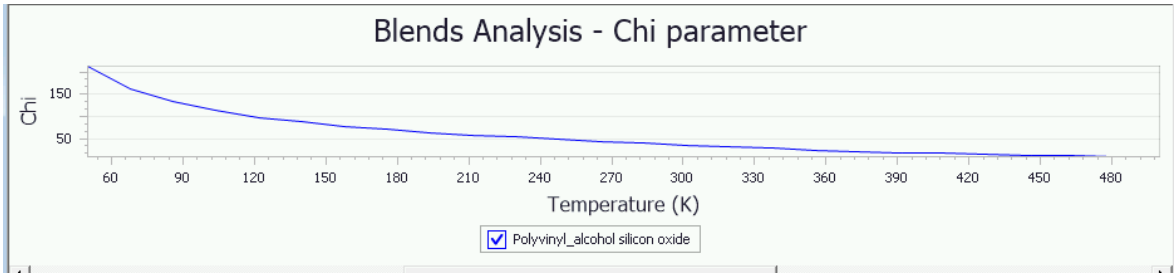

Fig-6 Chi-parameter variation with temperature

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

REVIEW ARTICLE

A Comprehensive Review on Condition Assessment of Induction Machine using FPGA

Sanjay Kumar[1]* and R. K. Saket[2]

[1]Department of Electrical & Electronics Engineering, Centurion University of Technology and Management, Odisha, India.
[2]Department of Electrical Engineering, Indian Institute of Technology (BHU), Varanasi, Uttar Pradesh, India

Received: 18 Mar 2020 Revised: 22 Apr 2020 Accepted: 26 May 2020

***Address for Correspondence**
Sanjay Kumar
Department of Electrical & Electronics Engineering,
Centurion University of Technology and Management,
Odisha, India.
E.Mail: kumarasanjay@gmail.com

ABSTRACT

Condition assessment of induction machines is a rapid emerging automation for online identification of incipient failures. This assessment scheme mostly used in process industries for sustaining reliable and secure plant operation. A field programmable gate array-based realization offers an online, system-on-chip solution for condition monitoring in real-time. This manuscript has addressed on divergent works progressing in domain of condition assessment of induction machine using FPGA (field-programmable gate-array) technologies. This manuscript has elaborated the works going on in the field of FPGA based condition assessment with its limitation in real time platform. The authors conceivably described the accompanying problems with feasible mitigation in the circumstance of condition assessment which promising immensely beneficent for destiny researchers active in these regards and coming roadmap would be distinctly reflected.

Keywords : Condition Assessment; Induction Motor; FPGA;HDL

INTRODUCTION

Induction motors (IMs) are widely used electrical motors in production industries. Almost 80% of the industrial machines comes under these category, main reason behind its popularity are lower cost, ruggedness, low maintenance requirement, robust in construction, ease of availableness and ability to give service under stringent working environment[1]. Any failure or faults in the machine affects the whole operation of industry. Early identification of faults in machine is seriously desirable which indispensable monitoring in condition based for

reducing idle time, reliable, and secure operation. This kind of early detection of fault can enhance machines availability and performance; reduce consequential damage and breakdown maintenance. The key issue regarding condition monitoring of motor is fault diagnosis of motor. A reliable diagnosis technique furthermore helps in elongating machine's life. In view of this, modern inclination in the industry is getting on for condition-based precautionary and predictive maintenance instead of traditional temporal maintenance. A prevailing practice of condition assessment of induction motors require expensive device like professional computer basically with a lone sensor input for accomplishing tests at well ordered intervals, which is proficient of executing frequency analysis on a lone detector input. Furthermore, this essentially needed an expert for identifying the failures in induction machine. These tests are carried out normally after immensely long interval of time, there may be considerable delay for taking prompt action and this solution is expensive.

Traditionally most exploration in research have been developed in area of condition assessment by plying specific signals which may be mechanical (speed, toque) as well as electrical (flux, current, voltage). Motor stator current is effortlessly used amidst these signals and these have been utilized for detection of dissimilar failures like rotor bar, stator, and defect in bearing. The detection of motor failures have been accomplished by different signal processing methods for instance, Fourier transform [2-3], wavelet analysis [5], Hilbert transform [4] etc. The recent trends are to aid artificial intelligence schemes in addition to signal processing for identification and diagnosis of failures in industries. These methods are capable to detect and diagnostic the failure automatically in machine part. These automatic approaches needed the signals from the motor by adding the DAQ card and other linkages. Signal processing methods extracted the feature from the signals that are utilized by the flourished intelligent scheme to identifying and diagnosis the failures in machines. Although these schemes are proficient in detecting and diagnosing the failure in machine but are deficient in practical realization in industry for real time.

These difficulties have been overcome by DSP and signal processing on hardware namely FPGA for identifying the dissimilar failures in machine. These units guarantee that this implementation in real time is easy and cost-effective. FPGA technology is currently useful in different application areas such as image and signals processing [6-7], wired and wireless telecommunications [8], where throughputs take benefit of still increasing chip density. More in modern times, another field of application is such as robotics [9-11], medicinal equipment [12], embedded control used in space and aircraft [13] and automotive [14] and among these applications, thermal management and packaging [15], reduction in power consumption [16], protection in opposition to solar radiations [17] and reliability [18] and are of major importance. Finally, due to the ever rising expected level of performance, industrial systems are also of appreciable interest, while simultaneously minimizing the cost of control systems [19].

Definitely, FPGAs have previously been employed in variety of electrical applications for example, multilevel converters [20],power converter control (PWM inverters [21], [22], matrix converters [23], power factor correction [24], STATCOM [25] and soft switching [26], [27]) and electrical machines control (induction machine drives [28]-[33], motion control [34], [35], multi-machines systems [36], SRM drives [37], speed measurement [38]. Fuzzy Logic control of power generators [39]. Since FPGA are now used in various fields, this paper presents divergent works progressing on in field of FPGA based condition monitoring of induction motor.

FPGA with its Tools

Basic Structure of FPGA

FPGA is a member of the family of PLCs [40]-[43]. Matrix of CLBs (sequential and/or combinatorial) form a FPGA that is interlinked with interconnected network which are entirely programmable. Logic blocks and connections can be managed by memory cells thus needful application specifications can be accomplished by the components. At most reprogrammable (EPROM, Flash, SRAM) technologies are of delight because they permit similar flexibility same as microprocessor. Hence, the remaining articles have discussed FPGA technology which is SRAM-based [42]-

[43], which is mainly used [46]. However Space and aircraft applications use Flash-based technology [44]. Even when power is off Flash technology conserve the pattern of the FPGA and the chip is again set to function immediately after powered up. Elementary architecture of FPGA based on SRAM is depicted in Fig. 1 [47]. Nowadays FPGAs are developed by employing a 65-nm copper process. The densities are greater than 10^7 gates per chip. FPGAs use system clock frequencies of 500 MHz or greater than that. Altera and Xilinx are the two main manufacturers of FPGA [42]-[43]. The basic architecture of FPGA is consists of a CLBs matrix, with order of matrix is nearly 192x116.The matrix is surrounded by IOBs which are configurable. Communications between these resources are achieved using a programmable interconnected network. Currently, it has been found that these architectures also contain different committed blocks like DSP accelerators, RAM, ARM or Power PC [42]-[44] and Micro blaze [43],[45], Nios [42] or even though the former generic architecture is not replaced by this SoC trend, still it can be used as a complement for the root matrix. The structures of CLBs consists 2, 4 or more cells (logic elements). Basic structure of a logic cell is shown in Fig.2.

The logic cell composed of LUT (look-up table) of 4-bit, which may configured either like a RAM, ROM (16x1) or combinatorial function. To build efficient arithmetic operators a carry look-ahead data path is incorporated. A flip-flop generally D-type, with all its control inputs allows recording output of logic cell. Because the output which is registered can be designed as input of same cell of logic, this type of architecture is similar to a micro state-machine.

Hardware Description Languages and FPGAs

In the beginning, FPGAs have been used for combining glue-logic generally dedicated to TTL logic circuits. Applications have been described by the easy CAD tools. These days, very complex functions are realizing by the FPGA, previously it was unexpected to realize a whole digital system consisting ALU, memories, communication unit and so on in single FPGA. This development has its inception in modern advancement in VLSI still it is because of improvement in proper design tools and schemes , which are in beginning kept to ASICs. These tools are usually based HDLs, Vhsic VHDL [48] or Verilog [49]. As per IEEE standards [50] the utilization of HDLs have been extended and formation, the advancement of elevated performance CAD in microelectronics have been allowed. As a result, designer can make use of HDLs for building one's own circuit. This circuit uses modular and hierarchical approach at dissimilar abstraction level by adding "top-down methodology" [51]-[52].This equivalent design flow have been divided into four steps:

(a) System level, which contains the specifications of circuit;
(b) Behavior level, where the algorithmic illustration of circuit is given;
(c) Register Transfer Level (RTL), which contains circuit description in concern of it's components;
(d) Physical level, in which circuit has been physically presented by target hardware.

At every abstraction level, forthcoming circuit is expressed in VHDL otherwise in synthesized VHDL. The endmost description provides accurate presentation of variables and operators of terminal circuit. For simulating and validating the digital circuit functionality, miscellaneous test benches have been write-down and executed. Furthermore, it is viable to simulate at every stage of abstraction, circuit functionality by exposure of analog HDLs like, VHDL-A, VHDL-AMS, Spectre HDL, [53], while considering its analog circumstances [54].

Fig.3 presents top-down approach of design along with its hierarchic flow and environment of HDL. In recent times, FPGA manufacturers [42]-[43] have developed a software package that allows simulation as well as automatic translation of a design in hardware. This software is having the ability to run in Matlab environment. The results of simulations are authentic. These simulation results are similar as obtained from the implementation in hardware. These types of scheme gives a fast prototype platform which is FPGA based [57].

FPGA BASED CONDITION MONITORING

Syaiful Bakhri et al. [55] developed an inexpensive model using multiple sensors for evaluating the condition of machine in continuous operating mode. Authors have used the FPGA on the platform of Lab VIEW software. For showing the performance in real-time failure conditions the authors have done the various tests in this suggested approach. Alejandro Ordaz-Moreno et al.[56] developed an online identification method for recognition of broken bar failure and proper optimization carried out on FPGA which is low cost. The suggested method has less computation complexity as compared to earlier reported schemes. The authors have used the DWT on the transient current at the starting. To indicate the motors condition (either healthy or unhealthy) a weighting function is determined based on a single mean-square computation. For validating the proposed algorithm, various tests were performed and demonstrated the feasibility of suggested algorithm for automatic online diagnosis an FPGA implementation was also developed. Rodriguez-Donate et al. [57] have developed an innovative embedded system to identifies the broken bar fault detection in IMs.

This system has been implemented using cost-effective FPGA for approach of system on chip. This system has an add-on feature sending obtained result to a central unit which will aid in decision-making on whole production process. Compared with other methods which are off-line this scheme has the merits of being on-line estimation. Results thus obtained from the suggested methodology correctly detect the condition of motor for e broken bars. Jose de Jesus Rangel-Magdaleno et al. [58] proposed a methodology in which current as well as vibration signal for identifying the half-broken-bar failure in mechanically loaded as well unloaded mode of operation. This method gives a SoC solution in online operation by using a low-cost FPGA. E.Caba et al. [59] developed and implement this suggested approach to indentifying the multiple failures in IMs. This method analyzes the vibration and current signals by adding FFT with wavelet during steady state and starting transient. This method incisively identifies different types of failures like broken bars, rotor unbalance, misalignment, and outer race defects in bearing. Cesar et al. [60] explained a novel method in real time measurement of vibration with analysis instrument which combines vibration as well as current signal analysis for improving the delectability of IM under unloaded mechanical condition. A simple low-cost FPGA based DSP hardware has been realized for online measurement, detection, and analysis of data.

This method does not require a skilled expert to diagnosis the condition of machine. Luis Miguel Contreras-Medina et al. [61] used a multichannel vibration analyzer to develop a FPGA, able to detect the motor condition using continuous online monitoring. Induction motor of 746 W has been used for experiment purpose to validate the functionality of the proposed vibration analyzer. The proposed method has been able to identify the failures like unbalance, broken bars and looseness. This proposed method has added features for communication and display of the result. Li jing-kui [62] presented a method by using fuzzy system to monitor the state of stator in real time. This suggested scheme has been executed on FPGA board. This system which is designed in VHDL was implemented on FPGA permits this configuration of system for measuring various states by taking dissimilar types of machines on same hardware platform. Erhan Akin et al. [63] proposed a scheme in real time to identify the state of the induction motor. Prognosis of instantaneous faults can be obtained by designing a neural network. By designing fuzzy logic the stator failures have been identified. Rene J. Romero-Troncoso et al. [64] explained a novel method suitable for hardware realization by combining the entropy of information with fuzzy inference for detecting the failures like unbalance, defects in bearing, broken rotor bars, and also composite of these failures.

This method takes the analysis of single phase steady current in the stator. This novel method gives satisfactory results of single and multiple combined through its hardware implementation on a FPGA kit. Shahin Hedayati Kia et al. [65] proposed a method to identify the tooth damage of gear using the frequencies of failures in SCSVIF band in real time for condition assessment of IM in mode of online operation and same has been implemented with the aid of the FPGA and real-time processor. Panigrahy, P.S et al. [66] reported a fused DWT-FFT scheme for detection of broken bar in IM. The time-frequency perseverance quality has been realized using DWT technique in FPGA. By using Haar wavelet, burden of computation and usage of resource are reduced in comparison to earlier reported

techniques. The 'Haar' wavelet is able to detect broken bar failure with an acceptable level of precision. Kia, S.H. at al [67] reported a statistical exploration deployed on space vector of stator current to detect failure on surface of tooth of the gear in online mode in a realistic platform. The effectiveness of the suggested algorithm is realized in real scenario. The authors have taken a SCIM of 250W for both tooth surface of wheel as well as pinion failure detection in real time for giving the potency of suggested scheme. Angel Sapena-Ba˜no et al. [68] proposed a novel method using a novel diagnostic quantity, the reduced envelope of stator current for fault identification and diagnosis of induction motors. Present on-line diagnostic methods can be improved using the proposed method for an IM operating at a slip of very low value. The reason of the effectiveness of suggested method is that it allows the use of low-cost diagnostic devices, simultaneously the complexity of anti aliasing hardware filters can be reduced by using a high sampling rate and by implying a high time of acquisition high resolution of spectral has been achieved.

CONCLUSION

At present the aids of digital logic devices are more concern to researcher and scientists in the era of condition assessment of IMs. In the area of offline condition assessment for various types of failures, various methodologies have been implemented. Nevertheless condition monitoring for real systems in online mode is still challenging task for the researchers. Since FPGAs are immensely reconfigurable and fast, it allows growth of parallel scalable architectures without alteration of interior hardware for analysis in multichannel, may be considerate for condition monitoring in online. In this manuscript efforts have been made by the authors to present the works in brief, going on in the area of FPGA based assessment of the state of IM in real time.

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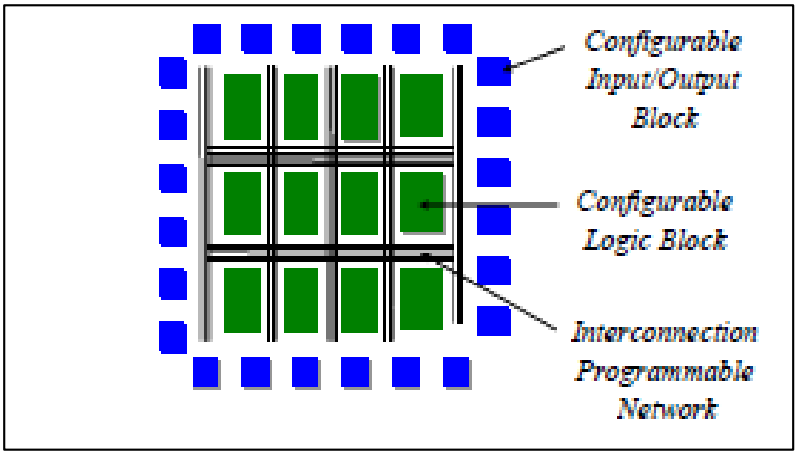

Fig.1.Elementary architecture of FPGA

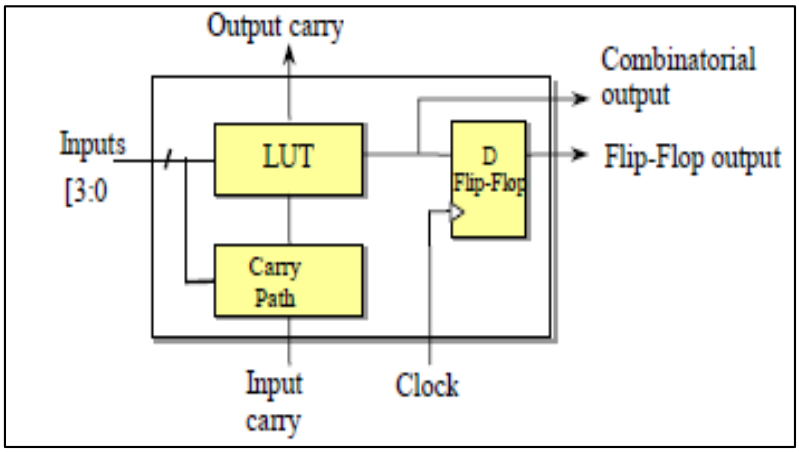

Fig.2. Structure of Logic cell

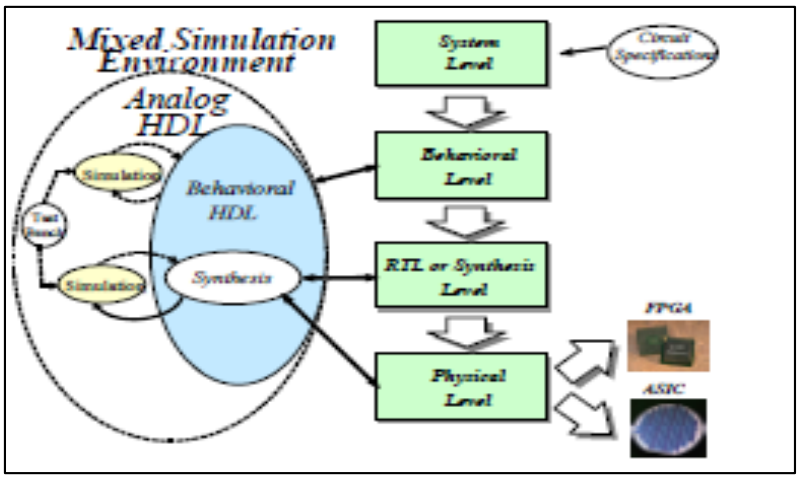

Fig.3.Top-down design approach

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

REVIEW ARTICLE

Waste: The Raw Material for Wealth

Kula Bhusan Pradhan*, Binayak Sahoo and Bikash Samantaray

Centurion University of Technology and Management, Odisha, India

Received: 19 Mar 2020 Revised: 23 Apr 2020 Accepted: 26 May 2020

***Address for Correspondence**
Kula Bhusan Pradhan
Centurion University of Technology and Management,
Odisha, India.
E.Mail: kulabhusan.pradhan@cutm.ac.in

ABSTRACT

Day by day the rate of population growth is increasing, which directly increases the use of every commodities in our daily lives to fulfill the basic needs. By fulfilling the needs, we are generating a huge amount of waste across the globe. These wastes if not processed and decomposed in a proper way then that will pollute our environment. So these wastes can be collected, treated, managed, reused and recycled for creation of new products by using different technologies. So in this world nothing is waste, this is the raw materials for generating wealth. The waste to wealth thought also influenced the industrial sectors for the design and production of new machines that can be used for processing, treating and recycling of wastes. Also the waste to wealth idea provides the scope of livelihood for the entrepreneurs and importantly for the unschooled and poor people where they can work on the collection of wastes. This review work mostly focuses on collection and recycling process of the solid wastes like paper wastes, plastic wastes and metal wastes.

Keywords: Waste, Reused, Recycled, Wealth, Industrial sector, Unschooled, Plastic wastes, Metal wastes.

INTRODUCTION

In this world nothing will be considered as waste if the proper ways to process and recycle it into the usable products are known to us. A loss of material and energy occurred when ever wastes are generated. Today the 5Rs principle is being implemented globally which refers to refuse, reduce, reuse, recycle and recover. the term refuse indicates to say yes the items that required least packaging, least resources to manufacture, biodegradable and multiple time usable product and vice versa. Reduce signifies to avoid the over consumption of everything that leads to the production of wastes and order any items as per the proper requirements only. For an example if we require one plate of rice then we shouldn't order more, if we order more then it leads to wastage. Reuse, means us to use the resources in their existing form for multiple times without processing it further. Example the water used for washing the fruits and vegetables can be used for cleaning the house floor or can be used for watering the flower plants. Recycle, means transforming anything into a new product which can be used for a purpose by using some

techniques. Example recovering of plastics and aluminium from drink containers. Recover, it leads us to recover resources from wastes like compost can be made from food waste.

Reuse and recycle of the paper waste is the oldest and common method across the globe. Paper can be reused to produce some paper craft items. The recycling processes depends upon the users of recycled paper products. Present days, after the availability of electronic media also paper is used for large number purposes. The consumption of paper is increasing, so it is better not to involve in the deforestation and accept the recycling process of papers. By this process the environment is protected, climatic change is reduced and waste papers are again converted into usable papers[1]. The paper wastes are recycled for certain numbers of times after that they are disposed [2].

Plastics are considered as the most usable products in the society due to its properties like low density, good strength, corrosion resistance, complicated design and fabrication and low cost. Plastic word is derived from a Greek word 'plastikos' which means different shapes can be formed[3]. Starting from the household products to automobile products everywhere plastics are being used abundantly. In the last 50 years the production of plastic is multiplied 20 times and in 2015 it reached 322 million tonnes[4] and by 2050 it might be 4 times of 2015. This higher rate of consumption generates plastic wastes. Plastics are having numbers of benefits with several environmental hazards as they are manufactured from fossil fuels. The recycling of the recovered plastics allows to manufacture a new product that can be again used by everyone. Recycling of the plastic is the most environment friendly work. Due to the recycling of plastic wastes, in our ecosystem we are having less waste and more products [5].

Today, metals and alloys are being used in enormously in automobile, building structures, rail, bridges, chassis, electric wires, cold drinks container, computer chips, smart phones, jewellery and medical instruments due to its strength, anti corrosive properties, complex shapes, intricate design and reliability [6]. A huge amount of scraps are generated from these manufacturing industries and also after the uses of metals products. Release of the metal waste into the environment is hazardous, therefore recycling of metal wastes were implemented to extract resources from these waste and to minimize overall waste [7]. Pyrometallurgical processes and hydrometallurgical processes are being used to extract metals from the e-waste [7]. The recycled metals are also called as secondary metals, which are having less production cost than the primary metals [8]. The recycling of the metal wastes also boost the economy as the need of providing primary metals are lower.

Recycling of paper waste

Generally, recycling process of waste paper begins with the collections of paper waste, then the collected paper wastes are sorted according to their types. The sorted paper wastes are then converted into raw materials and these raw materials are used to produce recycled paper. The following 8 steps are followed by major paper recycling units:

PulpingCleaning

I. Screening
II. Disperson
III. Bleaching
IV. Rolling
V. Drying
VI. Paper making

Pulping

Pulping is the first process of the waste paper recycling where water and chemicals are mixed with paper in correct ratios to achieve the best pulp. A rotor is used to rotate and create the mixture. The main objective of this process is to create a mixture such that the removal of the contaminants and large debris from the pulp without affecting the fibre can be done in the successive processes. A complete pulping arrangement is shown in fig.1.

Cleaning

Cleaning is the second process, where impurities like rock, staples, metal, sand, ink, adhesives, plastics, foam and dirt are removed after the pulping process. Generally a centrifugal cleaner is used. This cleaner works basing upon the density, where due to the centrifugal force denser particles are moves radially outward from the centre and where it can be trapped and removed.

Screening

Screening operation removes the contaminants based upon the sizes. In a machine different sizes of the holes are made across the wall and the pulps are allowed to enter at one point, as different sizes of the holes are made so the contaminants ranging from 0.152mm to 2.7mm can be removed. Screening process divided the pulp into two categories i.e, accepted pulp and rejected pulp. The accepted pulp is used for further processing.

Disperson

Disperson operation helps in decreasing the size of the contaminants by using the mechanical processes. Both rubbing and shearing actions are carried out by machines for the breaking and conversion of large particles into fine particles.

Bleaching

Bleaching operations carried out to destroy the chromophores, lignin, increase the brightness and reduce the colour. Some oxidative bleaching like chlorine dioxide, oxygen and peroxide are used. Also some reductive bleaching like hydrosulfite and fomamidine sulphinic acid are used for the bleaching purpose.

Rolling

Two Rolling operations carried out during the recycling process. First rolling operation is done before the drying operation to remove the extra water present in the pulp, before that the pulps are spread over a clothes where water can be removed easily and the clothes along with pulp spread over it allowed to pass through the rolls. The second rolling operation is done after the drying operation to make the dried pulp straight by refining the grain structure by applying mechanical force through the rotating rolls of the rolling machine.

Drying

After the rolling operation the pulp with the cloth are dried under sunlight or by using some drying machine for some hours. When, it is completely dried then it is pressed by a press machine as shown in fig.2.

Paper Making

Paper making is the final operation of the waste paper recycling procedure. After getting the dried and rolled paper with cloth, the cloths are removed and once again the dried and hard paper is pressed under the rolls. Then they are cut and used according to the need or packaged and delivered.

Applications of recycled paper

The recycled paper are used for different applications such as cardboard, office papers, toilet papers, greeting cards, newspaper and used to make different paper crafts to decorate home and offices[9,10].

Recycling of plastic waste

Plastics are the result of combination of polymers and additives. The plastics are mainly classified into two types, thermoplastics and thermosetting plastics. The thermoplastics melts when it is heated and can be reshaped and recycled easily. Thermosetting plastics cannot melts so they cannot be recycled easily. But the life period of thermosetting plastics are more and the thermoplastics are less. The following 5 steps are involved in the recycling of plastic wastes:

i. Collection of plastic waste
ii. Separation or sorting
iii. Cleaning and drying
iv. Sizing
v. Manufacturing

Collection of plastic waste

The general procedure of the recycling of plastic waste started from its collection from homes, offices, school area, pits and from the persons those who are involved in picking plastics for their livelihoods. By the transportation all the recyclable wastes are deposited at the manufacturing plant.

Separation or sorting

First the thermosetting and thermoplastics are separated out and only thermoplastics are used for the recycling purposes. Then the thermoplastics are sorted according to their families such as PP, PET, PVC, because each family is having separate chemical compositions. If they are mixed together and melted then the properties of the final product is not that much good.

Cleaning and drying

After sorting the plastic wastes are cleaned because it contains food debris, oils, dirt, grease, chemicals. After cleaning it is dried naturally or artificially by some drying machines.

Sizing

The plastic waste materials are converted into small sizes by mechanical process. Crushing machines are used to convert the different sizes of the waste into a required smaller size.

Manufacturing

The manufacturing process for the plastic wastes are classified into three types i.e, mechanical recycling, chemical recycling and energy recovery.

Mechanical recycling

The melt processing operation is completed by taking three processes melting, forming and solidifying. Different manufacturing processes like extrusion and injection moulding formed the plastic products by using these three simple steps. The plastic wastes are heated and brought into molten state, then these melted plastics are extruded through the holes made in the extrusion machine. Then the extruded molten plastics are are allowed to cool and solidify. After solidification these plastic pellets are used in the factories for production of final product. This recycling process is the most cost effective and efficient.

Chemical recycling

In this process the polymers are converted into monomers by some chemical reactions. The chemical reactions such as hydrolysis, pyrolysis and thermal cracking are used. The resulted monomers can be used for the production of original or related polymeric product. But this chemical recycling process is not fully developed and used by small number manufacturing companies and it is limited to condensation polymers.

Energy recovery

Energy recovery process, as the name suggest recovers the energy present in the plastic waste. The waste plastics are burnt and according to the calorific value it releases the energy. Now a days the electricity is being produced from the plastic wastes by using the energy recovery techniques.

Applications of recycled thermoplastics

The recycled plastics are having a huge numbers of applications such as drink bottles, plastic tubes, food packaging, detergent bottle, carpet fibre.

Recycling of metal wastes

Metal production is done from two resources i.e, primary resources and secondary resources. Primary resources means ores, from the earth's crust extraction of metals occurs by different processes and mechanism. Secondary resources means the scrap metals, the scraps are again subdivided into old scrap and new scrap. New scraps are the metal wastes available from the manufacturing factories and old scrap are the metal wastes of the used metallic products. The following 8 steps are generally followed for the recycling of metal wastes:

I. Collecting
II. Sorting
III. Crashing
IV. Shredding
V. Separation of ferrous and nonferrous metals
VI. Melting
VII. Purification or refining
VIII. Solidification

Collecting

The recycling of metal wastes starts with the collection of scraps. The collection of scraps are not like collection of paper wastes or plastic wastes due to high value[11]. The scraps are generally sold to the scrap yards. The scraps are mainly collected from the construction industry, railways, steel industries and automobile dump yards. From theses places the scraps are transported to the metal recycling plant.

Sorting

In this process the collected metal wastes or scraps are separated according to which scraps can be recyclable or which are non-recyclable. Presently magnets and sensors are used for separation and sorting purpose [11]. First the non metals like plastics, paints or papers are removed by blowing high velocity hot air. Separation is most important because it will affect the end recycled product.

Crashing

After the sorting or separating, the metal scraps are crashed by using the crashing machines and brought into the compact sizes. Crashing is the official beginning of the metal recycling process. Crashing makes the process more efficient by minimizing the volume of batch of the scrap metals.

Shredding

Shredding is done after crashing of metal scraps. The compact sized metal scraps are now crushed and broken into smaller pieces so that it can be processed by the conveyor belt for the next processes. These smaller pieces occupy less space and also requires less energy for process and due to this reason the emission of carbon dioxide is also minimized .

Separation of ferrous and nonferrous metals

After the shredding, the smaller metal pieces are passed through the conveyor belt and at the end of the belt the ferrous and non ferrous metals are separated by using some techniques like magnetic drums and eddy current separator.

Melting

In Melting process different types of furnaces like electric arc furnace, cupola furnace and induction furnace are used to heat the metal and convert the solid forms of the metals into the molten state. Some amount of energy is consumed in this process for the operation of furnaces. For different metals the time taken for melting is different because of difference of melting point temperature.

Purification or refining

Purification or refining is done to remove the impurities, dirt, debris or any unwanted particles from the molten metals. If these particles are not removed from molten metals then they will affect the quality of the final product. So different refining technologies like electrolysis and zone refining are used for removal of unwanted particles[53].

Solidification

In this process the molten metals after purification is allowed to cool and solidify. For obtaining different shapes of the final solid product, different shapes of the containers are used. The cooling process involved may be natural cooling or artificial cooling. After solidification process the final recycled product can be used for further use.

Applications of recycled metals

The recycled metals can be used as raw materials for any product. The recycled metals are used for many purposes like automobile, aircraft, packaging items, home appliances and plumbing [12].

CONCLUSIONS

This review work demonstrated the recycling processes of the paper waste, plastic waste and metal wastes, along with the applications of the recycled product. Recycling is the only way where the materials like paper, plastic and metals can be used again and again for several times. The recycling of these three solid wastes providing the way for earning for livelihood for millions of the people across the globe. The protection of the environment can be achieved by a greater extent due to the recycling of these three types of solid wastes as they are not used for land filling so the pollution of soil is controlled. Also these are not directly burned due to which the air pollution is controlled. Paper recycling process saved millions of trees from being cut which takes many years to grow. Plastics are purely chemicals, due to the recycling process these chemicals are again converted into chemical, so that they are not exposed to atmosphere and pollute it. By recycling the metal scraps the final product of the recycling can also be used as virgin raw material for a new product. By recycling of the metal wastes, the materials present in the earth crust is saved by some extent. Also the overall waste around the world is minimized due to the recycling process. In the coming days it is assumed that the new technologies will be arrived, by using which, more rapidly the recycling process will occur without involving more chemical processes and leaving less hazardous impurities to the atmosphere.

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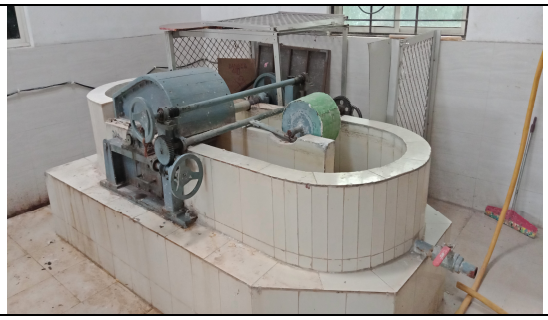

Fig.1 Pulping Arrangement

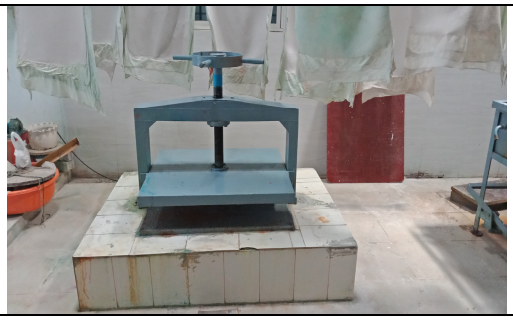

Fig.2 Screw Press

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Study the Effect of Alcohol on Heart Rate of Chicken Embryo

Manisha Panda and Yashaswi Nayak*

Department of Zoology, School of Applied Sciences, Centurion University of Technology & Management, Odisha, India.

Received: 11 Mar 2020 Revised:13 Apr 2020 Accepted: 15 May 2020

***Address for Correspondence**
Dr.Yashaswi Nayak
Department of Zoology, School of Applied Sciences,
Centurion University of Technology & Management,
Odisha, India.
Email: manishapanda07697@gmail.com / yashaswi.nayak@gmail.com

ABSTRACT

A 5 day chicken embryo was collected from Bhubaneswar Hatchery Pvt Limited, Patrapada, and Bhubaneswar to determine the effect of alcohol on the heart rate of chicken embryo. The embryo was extracted from the egg and placed in a petri dish, where the heart rate was taken using a heart rate. The process was finished by windowing of an egg and picking the in vivo heart rate. The alcohol concentration that is, 5%, 10%, 13%, 15% was added to the embryo and the heart rate was noted down 3 times after adding the alcohol concentration. After increase in consumption of alcohol, the heart rate of embryo decreased and entered cardiac arrest. In some cases there were atrial flutter and tachycardia, which caused a rapid heartbeat that may be regular or irregular. Alcohol affected sinus venosus, which means without correct impulses the heart cannot beat properly. This application suggests that, alcohol had very harmful effect on the 5 day chicken embryo heart rate and also in the development of the embryo.

Key words: chicken embryo, alcohol concentration, cardiac arrest, tachycardia.

INTRODUCTION

For this experiment chicken has been select as a dummy because it has the same four chambered heart similar to that of human heart. In human heart, there are 4 chambers; 2 ventricles and 2 auricles. Right atrium and right ventricle receives deoxygenated blood from the body and send it to the lungs similarly the left atrium and left ventricle receives oxygenated blood from the lungs and sends it to the body. The chicken heart is also the same developmental patterns like the human heart.The chicken embryo takes 21 days or 3 weeks of incubation for the complete development, which emerges as a chick. The transformation of egg to the chick is the greatest supernatural process. To know the development of the chick embryo, at first we must have to know, whether the egg is fertilised or

unfertilised. In unfertilised egg, the embryonic disc bears a white material at its centre. In fertilised egg, the embryonic disc bears lighter colour at its centre and looks like a ring. The cardiac structure appears till 5th day of development, which begins to beat. Also the embryo body takes a C shape with the extension of limbs.

The paired heart vesicle of chick embryo starts to combine from the anterior and posterior end. This happens between 25 and 30 hours of incubation period. This forms one continuous mesenchymal tube. The mesenchymal tube has 4 parts; contruncus, ventricle, atrium and sinous venosus. The tube bends and forms an S shaped bend, after 33 hours of incubation. By 48 hours, the heart folds and forming a single loop. After 72 hours, the atrium expands and turning into left and right atria. The sinus venosus begins to act as pacemaker with the beating of heart, after the heart rudiments have finished fusing.

Here we used a desi breed of chicken egg for my experiment. The egg was incubated for 5 days. The breed is Asil or Aseel. The Aseel hens are not good layers. The Aseel laid around 40 eggs in a year.Here I used ETHANOL (EtOH) which is a main component of alcohol. Here I am trying to clarify the impact of alcohol on chick's embryo heart rate which is as like as the human foetus. Alcohol has been directly affect the heart rate and blood vessel in humans [1]. High level of drinking of alcohol cause cardiac arrhythmias such tachycardia, fibrillation and atrial flutter. If a parent ingests more alcohol, then the foetus can be directly influenced by alcohol in vivo. Ethanol's effect on cardiac development is also determined by fetal genetic [3]. Alcohol is the teratogenic agents which adversely affect the developing embryo. Alcohol is consumed frequently irrespective of gender. Some females consume alcohol during pregnancy, which result to Fetal alcohol syndrome (FAS). Other experiment describes that, if we using chicks, there can be a detectable difference in beak length, head diameter and body size [5].

MATERIALS AND METHODOLOGY

Preparation of alcohol

The first procedure of this experiment was to make a serial dilution of alcohol. Using 50% stock solution, 5%, 10%, 13%, 15% alcohol concentrations was produced.

Windowing of an egg

The windowing of eggs was first used by Cruz et al, 1933 [2]. The use of the chick embryo as an experimental model is very useful to study the development. It is important to open the eggshell and reseal it without disturbing the embryo's growth. On the half of an egg, the scotch tape was placed and near the bottom portion of the egg a hole was poked by using a scissor. The excess yolk was removed by a syringe, and to expose the embryo an ovoid opening was cut. At fifteen seconds interval the in vivo heart rates were taken three successive times by using a stopwatch[4].

Extraction of embryo

To extract the embryo from the egg, the Cruz et al, 1993 method was used [2]. A filter paper doughnut was allowed to sit the vitelline layer of the embryo for 15 seconds. Then the vitelline layer was cut and the embryo was removed from the egg. The embryo was set into the petri dish, filled with Ringer's solution. Then the in vitro heart rate was noted down for 3 times at 15 seconds interval.

Administration of alcohol

The final procedure of this experiment was the administration of alcohol. The 5% of alcohol concentration was ingested to the embryo and let the alcohol to absorb for 30 seconds. Then the heart rate was noted down three times at 15 seconds intervals. The process was repeated for the 10%, 13%, 15% alcohol concentrations. The entire procedure was repeated for five different embryos.

RESULTS

When the concentration of alcohol increased, there was a gradual decrease in the heart rate of the embryo. The experimental studies were explanted as a graph in figures 1-6. For embryo #1, the in vivo heart rates were same i.e.) 84 beats per minute (bpm). The in vitro heart rates were comparatively decreased to 62, 50, 50bpm (figure 1). Again with the application of 5% alcohol concentration the heart rates gradually decreased to 48, 54 and54bpm. Similarly the heart rates dropped again for 10% alcohol concentration i.e.) 30, 36 and 42bpm. When 13% alcohol was added the heart rates suddenly increased to 48, 42 and 38bpm.

For embryo #2, the in vivo heart rates were 130, 122, 124bpm (figure 2). The in vitro heart rates were decreased again to 86, 98 and 66bpm. There was a sudden change in the heart rates of chick embryo with the application of 5% alcohol concentration. The heart rates were 32, 56 and 64bpm. The embryo showed the sign of atrial flutter. With the application of 10% alcohol concentration the heart rates were 128, 114 and 14bpm. That means the embryo showed sign of tachycardia. Suddenly the embryo entered cardiac arrest.

For embryo #3, the in vivo heart rates were 134, 118 and 126bpm (figure 3). Then the in vitro heart rates decreased to 106, 104 and 98bpm. There was a sudden decline in the heart rates of embryo after the addition of 5% alcohol concentration. The heart rates were 46, 48 and 54bpm. After 10% alcohol concentration the heart rates decreased to 42bpm for all the three studies. With the application of 13% alcohol there was an increase in the heart rates with the signs of tachycardia, which means the heart rates increased to 130, 114 and 74bpm. Again with the addition of 15% alcohol the heart rates dropped again to 22, 38 and 36bpm.

For embryo #4, the in vivo heart rates were same for all the 4 trials i.e.) 102bpm. The in vitro heart rates were 62, 40 and 34bpm (figure 4). Now the heart rates were decreased with the application of alcohol concentrations. For 5% alcohol concentration the heart rates were 26, 26 and 20bpm. Then for 10% the heart rates were 22 for all trails and for 13% the heart rates were also same for all trials i.e.) 24bpm. For 15% alcohol concentration the rates were remains low but constant heart rates with 28, 22 and 24bpm.

For embryo #5, the in vivo heart rates were 82, 64 and 64bpm (figure5). After extraction of embryo the in vitro heart rates were 84, 74 and 50bpm. The heart rates suddenly decreased and started showing the sings of atrial flutter and tachycardia. The heart rates for 5% alcohol concentration were 20, 14 and 6bpm. For 10% alcohol concentration the rates were 46, 6 and 12bpm. The embryo enters cardiac arrest with the application of 13% alcohol concentration. The heart rates were 0, 24 and 0bpm. The heart rates for 15% alcohol concentration the rates increased to 14, 0, 42bpm with the signs of atrial flutter.

Figure #6, indicates the averages for in vivo, in vitro and alcohol affected heart rates of five 5 day embryos. All the in vivo, in vitro and alcohol implanted heart rates were decreased. One embryo undergoes cardiac arrest and various arrhythmias occurred throughout the procedure.

DISSCUSION

In this experiment it was proved that, the 5 day chicken embryo would increase heart rates and enters cardiac arrest when there was addition of alcohol to the embryo. When the embryos were explanted to the higher concentrations then there was decrease in the heart rates. These heart rates were much lower than the original in vivo and in vitro heart rates. The embryo #5, noted cardiac arrest.After addition of 5% alcohol concentration the average heart rates of the embryos were increased due to cardiac arrhythmias. There was gradual decreased in the heart rates of embryos after addition of 10% and 13% alcohol concentration. Then with the application of 15% alcohol concentration the heart rates increased suddenly with the symptoms of atrial flutter because the heart rates were beat rapidly.

Suddenly the rates were slow down and near to stop. Some previous research proves that exposure of alcohol affect the beak length, head diameter and body size [5].

CONCLUSION

In conclusion, this study demonstrates that the treatment of 5-day chicken embryo with alcohol decreases the heart rate resulting in cardiac arrest. This study also suggests that alcohol is harmful for blood vessel in humans. If a parent ingests alcohol then the fetus can also affect by the alcohol directly. Collectively, the data provides an insight into the understanding of effects produced by alcohol.

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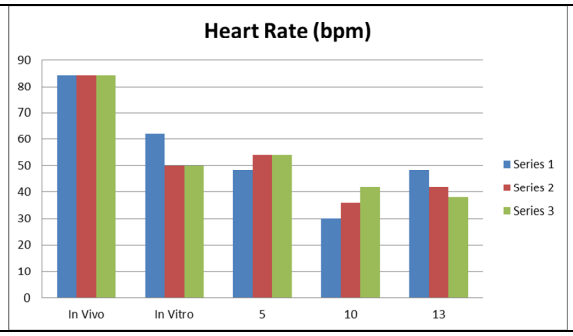
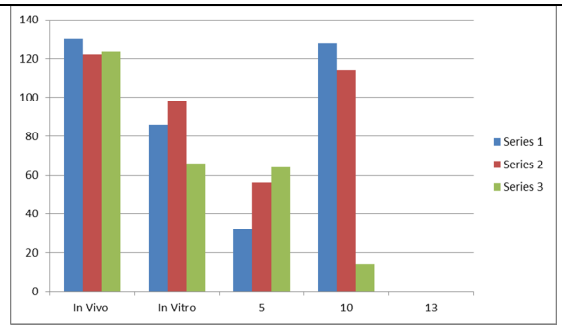


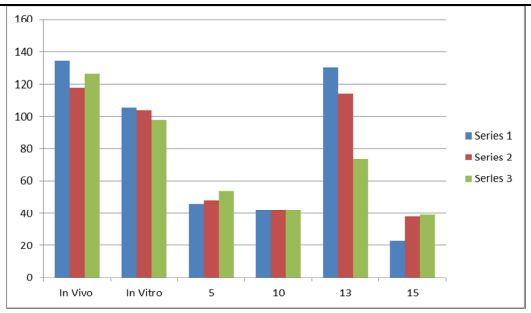
Embryo #1

Figure 1.Shows the *In Vivo, In Vitro* and Different Alcohol Concentrations [5%, 10%, 13%] Heart Rates



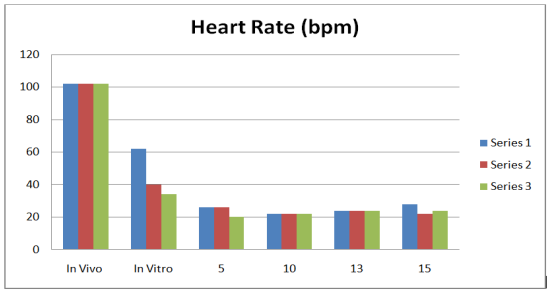
Embryo #2

Figure 2. Shows the *In Vivo, In Vitro* and Different Alcohol Concentrations [5%, 10%, 13%] Heart Rates. With the application of 13% alcohol the embryo entred cardiac arrest.



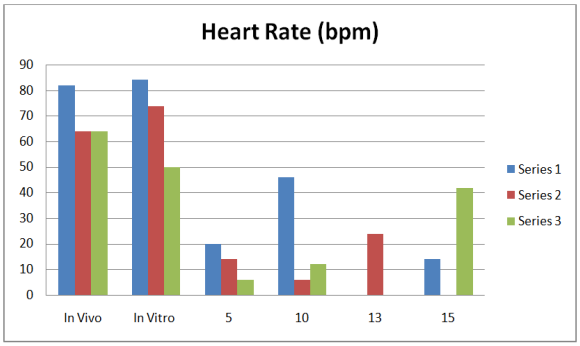
Embryo #3

(Figure 3, Shows the *In Vivo, In Vitro* and Different Concentrations [5%, 10%, 13%, 15%] Heart Rates. The heart rates of 5% and 10% were decreased gradually but then there was increase in the heart rates with the application of 15% concentration



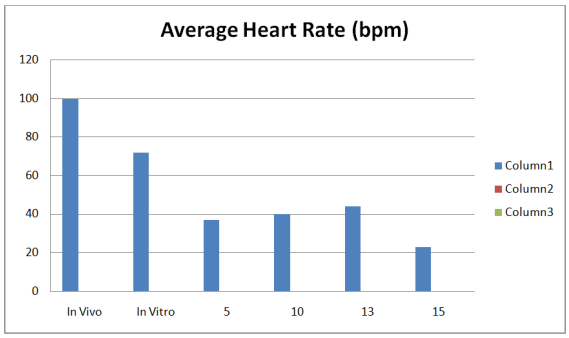
Embryo #4

Figure 4. Shows the *In vivo, In vitro* and different alcohol concentrations [5%, 10%, 13% and 15%] heart rates. The alcohol applied heart rates were much lower than that of in vitro heart rates



Embryo #5

Figure 5.Shows the *In vivo, In vitro* and different alcohol concentrations [5%, 10%, 13% and 15%] heart rates. The embryo entered cardiac arrest with the exposure of 13% alcohol concentration



Embryo #6

Figure 6.Shows the Avearge *In Vivo, Iv Vitro* and Different Alcohol Concentrations Heart Rates

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Vol.10 / Issue 60 / June / 2020 *International Bimonthly* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Impact of Mining Activities on Butterfly Diversity in and Around Areas of Bharatpur Open Cast Project, Talcher, Angul, Odisha, India

Udayanath Sahoo and Yashaswi Nayak*

Department of Zoology, School of Applied Sciences,Centurion University of Technology & Management, Odisha, India.

Received: 08 Mar 2020 Revised:12 Apr 2020 Accepted: 15 May 2020

***Address for Correspondence**
Yashaswi Nayak
Department of Zoology, School of Applied Sciences,
Centurion University of Technology & Management,
Odisha, India
Email: manishapanda07697@gmail.com / yashaswi.nayak@gmail.com

ABSTRACT

Butterflies are the most magnificent insects which act as biodiversity indicators.They belong to order Lepidoptera. Due to habitat destruction for human development butterflies are fast disappearing and at present their survival is under threat.The objective of present survey is focused on the assessment of butterfly with vegetation composition of habitat and conservation priorities on the study areas.A total number of 1878 Lepidopterans belonging to 7 families and 38 species were recorded during May-2018 to December-2019 in the peripheral villages of Bharatpur Open Cast Project, Talcher, Angul, Odisha.Nymphalidae was recorded as the most dominant family in terms of number of species represented by 16 number of species.Sweep nets and butterfly traps were used for sampling in the revegetated and unmined sites.We concluded that revegetation has potential to restore the biodiversity by bringing back the species which were lost during the mining activities.This suggested that mined areas should be ecological restored for rejuvenation of deteriorated niches.They are pollinating insects and are active during day time. A wide range of work has been carried out regarding the loss of biodiversity in the mining pockets of Talcher, but information about diversity and distribution of Lepidopterans are scare. Thus in the present study an attempt has been undertaken to study the regimen of Lepidopterans in peripheral areas of Bharatpur Open Cast Project, Talcher, Angul, Odisha. Shannon – Weiner index (H') was 3.22 in Danara village, followed by 3.25 in Solada village & 3.26 in Damol and Tileipasi Village. Margalef's richness (Dmg) index found to be 5.3 in Danara Village, 5.51 in Damol Village, 5.35 in Solada and 5.06 in Tileipasi Village. The presence of Lepidopterans is easily perceived from this study that shows that ecosystem health is proportionate to Butterfly diversity. Hence revegetation can restore the biodiversity and also the population of Lepidopterans belonging to 7 various families. In toto, mined areas should be ecologically restored, so that rich diversity of these elegant insects can be conserved.

Key words: Biodiversity,Lepidopterans, Mining pockets,Revegetation,Talcher.

INTRODUCTION

The order Lepidopterans comprises of butterflies and moth which is a very large group of insects except beetles. About 120,000 different butterflies have been found which are divided into over 135 families. Loss of biodiversity due to anthropogenic activities is global issue. Recovery of degraded land due to mining activities is a precedence area in conservation biology [1-2]. Restoration of degraded land mainly concerned with the return of degraded land into its natural state, reestablishing the integrality of an ecosystem comprising the flora and fauna. [3]. Structure of biodiversity is greatly influenced by environmental disturbance [4]. The achievement of ecological renovation depends not only on production of vegetation cover, but also on the recolonization of the restored site by adequate gathering of fauna that can be compared with the undisturbed reference areas[5].Excavation of coal from peripheral villages of Bharatpur Open Cast Project causes ecosystem degradation by demolition of the natural ecosystem [6]. Mining activities alters the physio-chemical properties of the soil which is the root cause for loss of flora & fauna. Alteration of terrestrial ecosystem influence both chordates and non-chordates community [7, 8, 9]. Structure and function of invertebrates respond to minor changes in environment more rapidly than vertebrates due to their higher diversity, smaller size, more productivity and shorter life span. However invertebrate like insects are more efficient bio indicators of environmental degradation [10].

The adult butterflies are also act as good pollinators after bees and dependent on nectar and pollen as their food while the caterpillars are dependent on specific host plants for foliage [11] and few are predaceous to small insects. There are about 18,000 species of butterflies in the world [12] out of which 1504 species are reported from Indian sub-region [13-17] which constitute 65% of total Indian fauna. In central India, 177 spp. of butterflies have been reported by [18], while [17] reported 166 spp. from Vidarbha and 65 species from Kolamarka Conservation Reserve by [19], a sub-region of the Central India. However, still a systematic study of butterflies has not been carried out in many regions of the central India having potential to sustain high biodiversity [20].They prefer specific habitats and their diversity is restricted to different seasons [21, 22]. They are highly sensitive to environmental alterations so much that they have been considered as excellent bio indicators of climate [23- 28] and can be used as surrogate to assess the conservation threat to the biodiversity [29]. Apart from being bio indicators of climatic changes, butterflies are potential pollinating agents of host plants and their abundance usually indicates a healthier ecosystem [30]. These day flying insects are often confused with their fellow lepidopterans, moths. The main characteristics that differentiate them include club shaped antennae and overlapping rows of tiny scales on their wings [31]. Butterflies are widely distributed, totaling more than 17000 species all over the world [32]. The diverse climate and vegetation of the Indian subcontinent hosts about 1504 species of butterflies and out of which peninsular India hosts about 351 species [33]. Nearly 200 species of butterflies have been reported in Odisha (India) out of which 170 species are found in Bonai forest division of Sundergarh district [34].

Loss of Biodiversity has been studied extensively in Talcher mining corridor but no information is available regarding fauna, particularly Butterflies. Therefore the present study was conducted for the first time to explore the abundance, species richness and diversity of Butterflies around the peripheral villages of Bharatpur Open Cast Project i.e. Danara, Damol, Solada & Tileipasi.

MATERIALS AND METHODS

Study area: Talcher coalfields is located in the bank of Brahmani river in Angul District in the Indian state of Odisha. It covers an area of 500 km^2. It lies in the latitude of 20^{0}53′ to 25^{0}12′ North and longitude 84^0 to 85^{0}23′East. Coal was discovered in Talcher Coalfields at Gopal Prasad in 1837. Before industrialization, it was rich in biodiversity.

There are about 9 open cast projects and 3 underground mines locked in Talcher Coal corridor. Bharatpur Open Cast Project was opened in 5th April 1985 to supply coal to the various power sectors of Angul District as well as Odisha and India. Its Production Capacity is 20 million Tonne per annum. It has covered 1629.11 hectares of area, the climate of this region is generally dry and arid except in monsoon season. The Coal field is drained by the Brahmani River flowing along eastern fringe of coalfields. Singhidajhor, Nandira, Tikira and Bangarunala are important tributaries of Brahmani River. Study area covered Danara, Damol, Solada & Tileipasi. Vegetation areas which are adjacent to Bharatpur Open Cast Project within 15 km radius. Coal mines have extended their ghost hand to degrade biodiversity but in turn population of Lepidopterans have increased in manifold due to increased moisture, pollution, humidity in certain areas.

Study design: Four regions were selected from the peripheral areas of Bharatpur Open Cast Project on the basis of habitat which may be important according to Clark and Swamy. Study regions were divided into four areas as follows.

1. Area-I-Danara Village
2. Area -II- Damol Village
3. Area -III-Solada Village
4. Area -IV-Tileipasi Village

As they are poikilothermic and being temperature sensitive and conscious, mostly they operate between 10am. and 4pm. whose exposure improves momentum with increase in temperature. On the Basis of their availability, Lepidopterans can be categorized as very regular (VR,>50views), regular (Re, 11-50 views), Rare (Ra, 2-10views) and unexpected (UE, <2views).

Sampling and identification: Sampling of Lepidopterans were carried out during October 2018 to December 2019 in different study areas in and around Bharatpur Open Cast Project. Random sampling was carried out by direct searching methods following Sutherland(Sutherland, 1996) [18]at thirty days interval during the period of 10 am to 4 pm because Lepidopterans are found most active during middle of the day. Identification of Lepidopterans were carried out with the help of Lepidopterans identification guide (Fraser, 1933)(Fraser, 1934) (Fraser, 1936) (Subramanian, 2009) [6-8, 17]Most of the species were photo documented. Photographs were taken by Nokia 32 MP camera with micro lens. Suspected species were collected through entomological nets and preserved in alcohol. Later on, all were identified with the help of Fraser (Fraser, 1933) (Fraser, 1934) (Fraser, 1936) [6-8] Subramanian[17]Nair[14] and Kiran C.G. & David V.R [11]. Some were identified by Google lens.

Data Analysis

Abundance, Species richness, Diversity and Evenness of butterflies were studied around the peripheral villages of Bharatpur Open Cast Project.

Species Richness : Margalef diversity index (Margalef, 1958) (D_{Mg}) can be calculated as follows

$$D_{Mg} = \frac{S-1}{\ln N}$$

Where 'S' is the no. of species and 'N' represent the total no. of individuals in the study area. It explains the species richness of the study area.

Species Diversity : The Shannon- Weiner index (Shannon and Weiner, 1949) is used to calculate the diversity of species in different areas adjacent to Bharatpur Open Cast Project. The Shannon-Weiner index (H') is calculated as follows:

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

Where$pi = ni/N$, n_i = No of Individuals of a Species at Time i, N= Size of the whole community and ln = Natural Logarithm

Evenness of Butterflies: Evenness of a species was calculated by using [27, Pielou EC.] which is defined as

$$J' = \frac{H'}{\ln S}$$

Where S= No. of Species present in the site, ln = Natural logarithm and H' is the diversity Index.
The Value of J varies from 0 to 1.

RESULTS AND DISCUSSION

The present study documents 1878 individuals of Butterflies out of which 38 species under 8 families *viz*: Pieridae, Nymphalidae, Papilionidae, Lycaenidae, Hesperiidae, Erebidae, Saturniidae and Sphingidae were observed in and around villages of Bharatpur Open Cast Project, Talcher.(Table 1). The photographs of observed butterflies are given in the plate (1). Basing on the number of collected species, Highest number was recorded from family Nymphalidae (14 Species, 36.84%) followed by Pieridae (6 Species, 15.78%). Papilionidae with Lycaenidae (4 species each, 10.52%) and Erebidae with Hesperiidae (3 Species each, 7.89%). Saturniidae and Sphingidae comprises least species (1each, 2.63%).

Among these recorded species 4 were recorded as unexpected species (*Spirama sp.,Daphnis nerii, Asota caricae, Antheraea pernyi*), 3 as rare species (*Panoquina ocola , Giant skippers, Creatonotos gangis)*, 15 are regular (*Phoebis argante, Aphrissa statira, Eurema alitha , Catopsilia pyranthe, Delias eucharis, Catopsilia florella, Papilio polytes, Pachliopta aristolochiae, Papilio clytia, Papilio crino,Zizula hylax, Cigaritis lohita, Castalius rosimon, Luthrodes pandava, Eudamini clarus)* and 16 are very regular (*Junonia atlites, Melanitis leda, Euploea midamus, Ypthima huebneri, Minois dryas, Elymnias hypermnestra, Ideopsis vulgaris, Euthalia lubentina, Hypolimnas sp., Tanaecia sp, Neptis Sappho, Neptis hylas, Euthalia aconthea, Ariadne, Danus genutia, Hamadryas laodamia)* the preference of butterflies for particular habitat is associated with the availability of larval host plant and adult nectar plant. The flora in peripheral villages Bharatpur Open Cast Project is of mixed type with herbs and shrubs. Trees like Kadamba, Sal, Mahua, Arjuna, and Chakunda have provided diverse habitat, food and breeding site for butterflies. Species abundance, richness, diversity and Evenness of different butterflies were also studied in Peripheral village of Bharatpur Open Cast Project. Out of 38 Species, 35 were found in Damol village with Total abundance, n=479 followed by 34 species in Danara Village, n= 462, 34 species Solada village n=479 and 32 in Tileipasi Village with n= 458(Table 1).The Damol and Tileipasi Village recorded highest diversity index with 3.26 each followed by Solada (3.25)and Danara (3.22). Similarly Evenness is highest in Tileipasi (0.94) followed by Damol with Solada (0.92each) and Danara (0.91).Larger size, diverse habitat and availability of natural and artificial water bodies might be the causes of maximum diversity of Lepidopterans in the peripheral villages of Bharatpur Open Cast Project. The size of water bodies stands as an important factor to determine the species richness and diversity of Lepidopterans (Parag et al., 2010) (Subramanian, 2005) (Suhling et al.,2004) [15,19,20] However, the study also revealed that, the Lepidopterans and their habitat are under threat under due to excessive anthropogenic activities like habitat alteration, coal excavation, pollution, deforestation etc.

CONCLUSION

Total numbers of 1878 Lepidopterans were observed in peripheral areas of Bharatpur Open Cast Project. According to IUCN red list data, Lepidopterans are least concern about natural changing of environment. From present data, Lepidopterans population have decreased due to anthropogenic actions like coal excavation and habitat

fragmentation in Talcher Area which could be a danger signal for disappearance of this glorious creature specially in Talcher. So far, fewer studies have been carried out on the jeopardy of these glorious organisms, vigorous studies are essential.

ACKNOWLEDGEMENTS

I express my heartfelt gratefulness to the Supervisor Dr. Yashaswi Nayak, Deptt. of Zoology, CUTM, Odisha for her constant and constructive guidance. I also extend my heartfelt gratitude to the Horticulture Department. Of Talcher, Dist. Angul for extending their hands of support in the identification of Lepidopterans. I also extend my heartfelt gratitude to the Mining Department for providing Information about peripheral villages of Bharatpur Open Cast Project.

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Table. 1.List of butterflies and their Diversity Status at surrounding areas of Bharatpur Open Cast Project, Talcher, Odisha, India

Sl. No	Scientific Name	AREA - I	AREA - II	AREA - III	AREA - IV	Status	Total
Order - Lepidoptera							
Family - Pieridae (Genus - 5, Species - 6)							
1	*Phoebis argante(Fabricius,1775*	9	11	8	9	Re	37
2	*Aphrissa statira(Crammer,1777)*	8	12	13	10	Re	43
3	*Eurema alitha (Felder,1862)*	5	9	11	13	Re	38
4	*Catopsilia pyranthe(Linnaeus,1750)*	9	8	5	15	Re	37
5	*Delias eucharis(Drury,1773)*	12	10	9	11	Re	42
6	*Catopsilia florella(Fabricius,1775)*	7	9	8	9	Re	33
Family - Nymphalidae (Genus -14, Species - 16)							
7	*Junonia atlites (Linnaeus,1763)*	20	27	30	18	VR	95
8	*Melanitis leda (Linnaeus,1758)*	13	18	12	21	VR	64
9	*Euploea midamus (Linnaeus,1758)*	11	8	19	13	VR	51
10	*Ypthima huebneri(Kirby,1871)*	34	31	45	32	VR	142
11	*Minois dryas (Scopoli,1763)*	14	21	19	20	VR	74
12	*Elymnias hypermnestra(Linnaeus 1763)*	40	32	45	37	VR	154
13	*Ideopsis vulgaris (Butler,1874)*	27	38	21	25	VR	111
14	*Euthalia lubentina (Hubner,1819)*	15	18	11	15	VR	59
15	*Hypolimnas sp.(Hubner,1819)*	11	19	21	20	VR	71
16	*Tanaecia sp.(Butler,1869)*	19	11	17	19	VR	66
17	*Neptis Sappho (Pallas,1771)*	25	22	19	21	VR	87
18	*Neptis hylas(Linnaeus,1758)*	23	21	27	21	VR	92
19	*Euthalia aconthea(Crammer,1777)*	31	19	20	22	VR	92
20	*Ariadne ariadne(Linnaeus,1763*	32	38	29	20	VR	119
21	*Danus genutia(Cramer,1779)*	21	19	11	18	VR	69
22	*Hamadryas laodamia(Cramer,1717)*	29	23	15	23	VR	90
Family - Papilionidae (Genus -2, Species - 4)							
23	*Papilio polytes (Linnaeus,1758)*	4	3	8	7	Re	22
24	*Pachliopta aristolochiae(Fabricius,1775)*	5	6	9	8	Re	28
25	*Papilio clytia (Linnaeus,1758)*	3	5	6	8	Re	22
26	*Papilio crino(Fabricius,1792)*	8	10	4	3	Re	25
Family - Lycaenidae (Genus -4, Species - 4)							
27	*Zizula hylax(Fabricicus,1775)*	5	2	8	2	Re	17
28	*Cigaritis lohita(Pallas 1771)*	7	8	5	7	Re	27
29	*Castalius rosimon(Fabricius,1775)*	3	7	6	3	Re	19
30	*Luthrodes pandava(Horsfield, 1829)*	5	4	9	5	Re	23
Family - Hesperiidae (Genus -3, Species - 3)							
31	*Panoquina ocola (W.h. Edward,1863)*	2	1	4	0	Ra	7
32	*Giant skippers(Comstock,1895)*	1	2	0	1	Ra	4
33	*Eudamini clarus(Cramer,1775)*	2	5	3	2	Re	12
Family - Erebidae (Genus -3, Species - 3)							
34	*Creatonotos gangis(Linnaeus,1763)*	2	0	0	0	Ra	2
35	*Spirama sp.*	0	0	1	0	UE	1

36	*Asota caricae (Fabricius,1775)*	0	1	0	0	UE	1
Family - Saturniidae (Genus - 1, Species - 1)							
37	*Antheraea pernyi(Linnaeus,1777)*	0	0	1	0	UE	1
Family - Sphingidae (Genus -1, Species - 1)							
38	*Daphnis nerii(Linnaeus,1758)*	0	1	0	0	UE	1
	Total	462	479	479	458		1878
	Margalef Index(Dmg)	5.378	5.509	5.346	5.059		
	Shannon-Weiner Diversity Index (H')	3.22	3.26	3.25	3.26		
	Eveness(J')	0.91	0.92	0.92	0.94		

VR - Very Regular (> 50 Views), Re - Regular (11- 50 Views), Ra - Rare (2-10 Views), UE - Unexpected (< 2 Views)

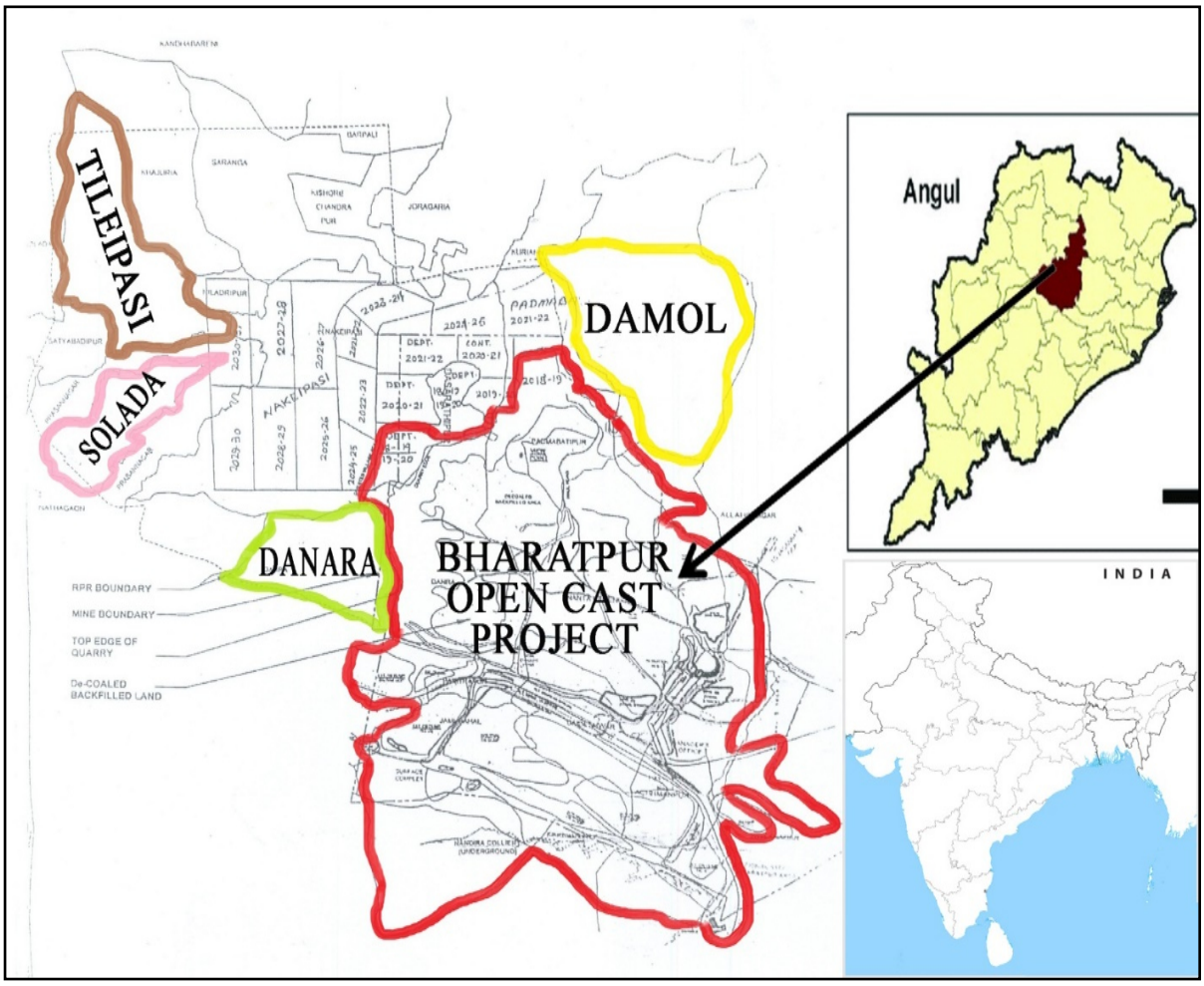

Fig. 1. Study areas of Bharatpur Open Cast Project, Talcher, Angul, Odisha, India.

Plate 1: Observed butterflies in the field