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Diversity Of Arbuscular Mycorrhizal Fungi Found In Annona Squamosa L.'s Rhizospheric Soil In Amravati, Maharashtra

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Abstract:
In addition to being an essential component of the ecosystem, arbuscular mycorrhizal fungi are important players among soil bacteria. Nearly 80% of land plants have symbiotic relationships with these fungi. AMF offers an alternate supply of minerals and other nutrients, including phosphorus. In present study, investigation about diversity of arbuscular mycorrhizal spores present in rhizospheric soil of total 15 rhizospheric soil samples of *Annona squamosa* L. in Amravati, Maharashtra, India. Isolation of spore population was done by wet sieving and decanting method. Slides were prepared by using PVL (polyvinyl lactic acid) as a mounting medium and this allows the slides to remain usable and observable. Later on, all such slides observed carefully under binocular stereoscopic microscope. Identification and analysis of rhizospheric soil samples resulted that, total 17 species were found in 15 rhizospheric soil samples. *Glomus geosporum* species was commonly found AM fungi found in *Annona squamosa* L. plant. Also, *Glomus fasciculatum* were also found in moderate amount. Along with these, *Acullosporamellea, Scutellospora pellucida* were also found in moderate number. The Genus *Glomus* was distributed in large number among the 15 rhizospheric soil sample.

Keywords: Arbuscular Mycorrhizal Fungi, *Annona squamosa*, rhizosphere, Amravati, *Glomusgeosporum, Glomus fasciculatum.*

Introduction:

The discoveries and theories made concerning mycorrhizae by A. B. Frank in 1885 were contrary to accepted wisdom at the time. He claimed that what we now refer to as many different species of woody plants had ectomycorrhiza on their root systems, which were found in a wide range of environments and soil types. According to his theory, mycorrhizae are a type of widespread mutualistic symbiosis in which the fungus and host are mutually dependent on one another for nutrition (Trappe, 2005).

Arbuscular mycorrhizal fungi are symbiotically associated with roots of plants. The colonization of fungi with the roots is by intracellular as in arbuscular mycorrhizal fungi (AMF), or by extracellular seen in ectomycorrhizal fungi. Almost 80% of plants are associated with AMF in their root system (Brundrett, 2002; Smith & Read, 2010). AMF plays an important role in enhancing phosphorous uptake from the soil (Daft & Nicolson, 1969), the effect of endogonemycorrhiza on plant growth. AM fungi are obligate mutualists belonging to the phylum Glomeromycota and have a ubiquitous distribution in global ecosystems (Redecker *et al*., 2013). Enhanced uptake of P is generally regarded as the most important benefit that AMF provide to their host plant, and plant P status is often the main controlling factor in the plant–fungal relationship (Ryan & Graham, 2002; Smith & Read, 2010).Mycorrhizal fungi are arguably the most important component of the soil microbiota in developing sustainable agricultural practices because they enhance plant growth and natural uptake while at the same time stabilizing soil aggregate making the soil less susceptible to erosion(Jeffries *et al*., 2003; Schreiner & Bethlenfalvay, 1995).

*Annona squamosa*L. in one of the popular fruit cropplant in Maharashtra state. It is an excellent source of nutrition and is medicinal use since ages. Also,*Annona squamosa*L. contains powerful antioxidations and are thought to contain anti-cancerous compounds (Liaw *et al*., 2010). Amravati in Maharashtra is a well-suited habitat of *Annona squamosa*L.Thus, the study is to investigate the diversity of AM fungi associated with *Annona squamosa*L. in Amravati.

Material and Methods:

Rhizosphere Sample Collection:

15 (fifteen) rhizospheric soil samples of *Annona squamosa* L. were collected from the depth of 1 feet of five different sites of Amravati(Maharashtra) for isolation and identification of AM spores., in sterile polytene bags. The collection was carried out in the month of January 2023 from Amravati. The rhizosphere soil was collected and packed in sterile polytene bags and dried and stored at room temperature. Each bag was labelled with relevant information of sampling site, name of site and sampling date.

Isolation of AM fungi Spores from Soil:

Different methods are used to isolate AM fungi spores from soil sample. In the present investigation, wet sieving and decanting technique was used suggested byGerdemann & Nicolson, (1963),in which,100 gm of soil was taken and mixed in 500 ml of warm water in a 1000 ml beaker until all soil disperse and form a uniform suspension. Heavier particles were allowed to settle down. Sieves were arranged in descending order with respect to size starting from 400µm, 300µm, 200µm, 100µm. The residue retain on the sieve were carefully collected on Whatman's Filter Paper no.1.Permanent slides were prepared by using PVL (polyvinyl lactic acid) as a mounting medium and this allows the slides to remain usable and observable. Later on, all such slides observed carefully under binocular stereoscopic microscope.

Identification of VAM Fungi:

The VAM fungi were identified using manual of Schenck and Perez (1990) and keys of Morton and Benny (1990) and Mehrotra and Baijal (1994).Many criteria i.e. colour, shape, size, number of walls and orientation are considered for identification and classification of AM fungi.

Result and Discussion:

Mycorrhizal study is the most significant to agriculture benefit for the phosphorus uptake from soil and is the example of symbiotic association. The country is endowed with enormous variability in agricultural important microorganism. The microorganism mediated many processes that are essential to the agricultural productivity of the soil. These includes recycling of the plant nutrient, maintenance of soil texture, bioremediation and control of plant and animal pest and disease. The variability in fungi, bacteria, actinomycetes and cyanobacteria, etc. seems to coevolved with their host within environment and form an invaluable gene pool resource. The microbial variability in eroding fast. It is well recognized that once a variant is lost it is lost forever.

Present Colonization and Spore Density:

Good crop productivity of *Annona squamosa*L.(Custard apple):

Out of 15 (fifteen)rhizospheric soil samples i.e., S1 to S15, 9 samples recognized as good crop productivity *Annonasquamosa*L. all of thesesites belongto Amravati region.

Average spore count of the soil was found to be 50-65 spores in 100 gm of soil.

Moderate Crop Productivity of *Annona squamosa*L. (Custard Apple)

Total 4 (four) rhizospheric soil samples out of 15 soil samples found to be of moderate crop productivity. All these samples collected from the belong to Amravati region as well. The texture of soil was found to be sandy and loam to sandy in nature.

Table 1: Sites and crop productivity on *Annona squamosa* L. with sample number

Sr. No.	Location	Crop Condition	Soil Sample Number	Sample Name
1.	Gopal Nagar	Good	Soil Sample 1	S1
2.	Congress Nagar	Good	Soil Sample 2	S2
3.	HVPM	Moderate	Soil Sample 3	S3
4.	Saturna	Moderate	Soil Sample 4	S4
5.	Arjin Nagar	Good	Soil Sample 5	S5
6.	Ravi Nagar	Moderate	Soil Sample 6	S6
7.	Akoli Road	Good	Soil Sample 7	S7
8.	Krishnarpan Colony	Good	Soil Sample 8	S8
9.	Yadav Layout	Good	Soil Sample 9	S9
10.	Shilangan Road	Moderate	Soil Sample 10	S10
11.	Dastur Nagar	Moderate	Soil Sample 11	S11
12.	Akoli	Moderate	Soil Sample 12	S12
13.	Bhatkuli Road	Moderate	Soil Sample 13	S13
14.	Rahatgao	Good	Soil Sample 14	S14
15.	Sipna College	Good	Soil Sample 15	S15

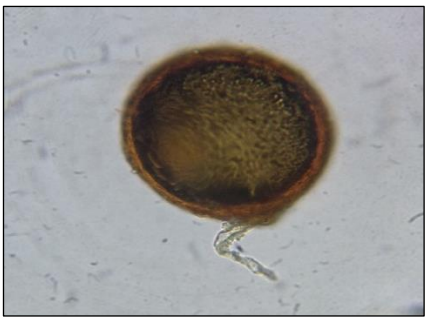
Table 2: Distribution and dominance of AMF Species in different site of Amravati region.

Sr. No.	Soil Sample	AMF Species Distribution	Total no. of Species	Dominant Species
1.	S1	*Glomus geosporum* *Sclerocysttiwanvnsis*	4 1	*Glomus geosporum*

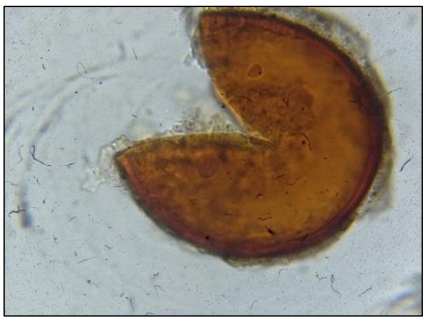
		Scutellispora persica *Glomus intraradix* *Glomus fasciculatum*	2 3 3	
2.	S2	*Glomus callosum* *Glomus fistulosum* *Glomus clarum* *Glomus maculosum* *Glomus citricola*	2 1 1 4 2	*Glomus maculosum*
3.	S3	*Acaulospora appendicula* *Acaulosporagerdemanni* *Glomus geosporum* *Glomus citircola*	1 2 5 2	*Glomus geosporum*
4.	S4	*Acaulosporanigro* *Glomus geosporum* *Glomus fasciculatum*	2 3 2	*Glomus geosporum*
5.	S5	*Glomus intradix* *Glomus fasciculatum* *Glomus citricola* *Glomus maculosum* *Sclerocystisclavispora*	2 3 1 4 1	*Glomus maculosum*
6.	S6	*Glomus geosporum* *Glomus fasciculatim* *Glomus citricola* *Glomus aggregatum*	3 2 1 1	*Glomus geoporum*
7.	S7	*Glomus geosporum* *Glomus citricola* *Glomus fasciculatum* *Glomus maculosum*	4 3 1 2	*Glomus geoporum*
8.	S8	*Acaulospora appendicula* *Glomus citricola* *Glomus maculosum* *Acaulosporagerdemanni*	3 1 2 1	*Acaulospora appendicula*
9.	S9	*Glomus citricola* *Glomus maculosum* *Glomus fasciculatum* *Glomus geosporum*	1 2 2 4	*Glomus geosporum*
10.	S10	*Glomus geosporum* *Glomus fasciculatum* *Glomus citricola* *Glomus aggregatum*	3 2 1 1	*Glomus geosporum*
11.	S11	*Glomus macrocarpum* *Glomus geosporum* *Glomus fasciculatum* *Glomus citricola*	1 4 3 1	*Glomus geosporum*
12.	S12	*Glomus geosporum* *Glomus fasciculatum* *Glomus citricola*	3 2 2	*Glomus geosporum*
13.	S13	*Glomus macrocarpum* *Glomus geosporum* *Glomus fasciculatum*	2 3 1	*Glomus geosporum*
14.	S14	*Glomus fasciculatum* *Glomus citricola* *Acaulosporamellea*	3 1 1	*Glomus fasciculatum*
15.	S15	*Glomus fasciculatum* *Glomus aggregatum* *Glomus maculosum* *Scutellospora pellucida*	3 2 2 1	*Glomus fasciculatum*

Total 17 species were found in 15 rhizospheric soil samples.*Glomusgeosporum* species was commonly found AM fungi found in *Annona squamosa* L. plant.Also, *Glomus fasciculatum* were also found in moderate amount. Along with these, *Acullosporamellea, Scutellospora pellucida* were also found in moderate number. The Genus *Glomus*

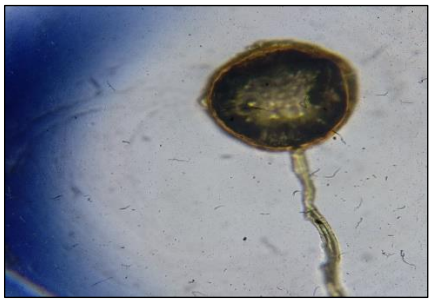
was distributed in large number among the 15 rhizospheric soil sample.



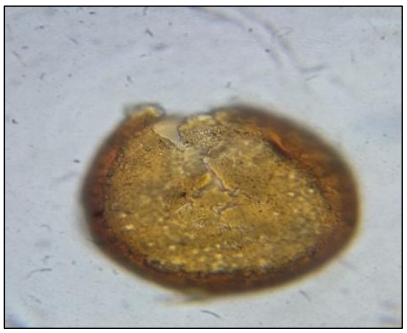
Acaulospora sp.



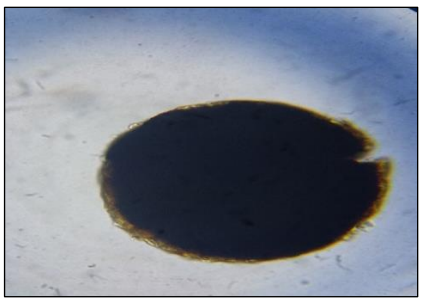
Glomus aggregatum



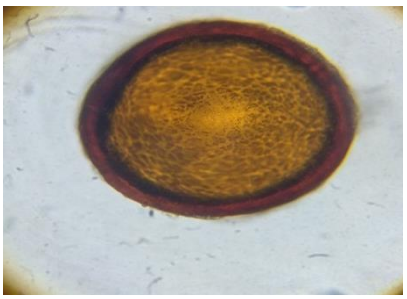
Glomus citricola



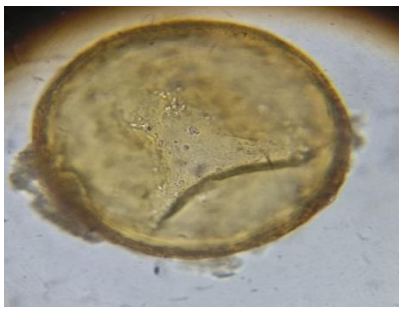
Glomus citricola



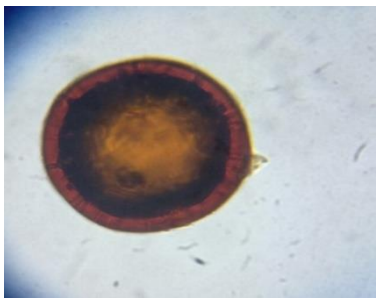
Glomus heterosporum



Glomus heterosporum

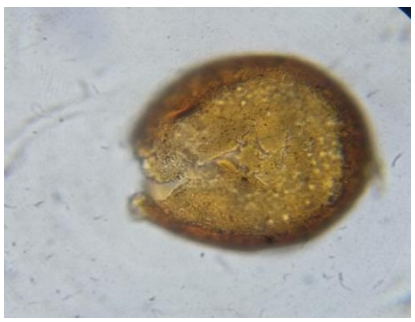


Scutellospora sp.

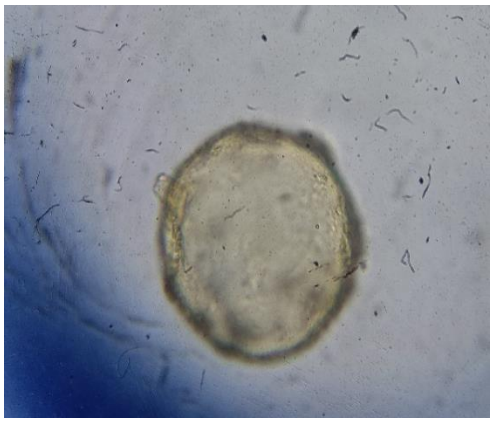


Scutellospora sp.

Acullospora mellea



Glomus fasciculatum



Scutellospora pellucida

Conclusion:

The present study on the mycorrhizal symbionts in the rhizosphere of the fruit plant *Annona squamosa* L. was an important step to assess the diversity and richness of the community of arbuscular mycorrhizal fungi (AMF) was observed at all sites studied.

Arbuscular mycorrhizal fungi on survey in the rhizosphere of *Annona squamosa*L. and its colonization in the soil were conducted in 15 (fifteen) sites located in different areas in Amravati region. The objective of the present study deals the evaluation of mycorrhizal status of soil sample. The present study was undertaken to explore the diversity of AM fungi in the region.

Glomusgeosporum species were dominantly AM fungi found in *Annona squamosa*L. plant also, *Glomus fasciculatum* were also found in moderate amount. Along with these, *Acullosporamellea*, *Scutellospora pellucida* were also found in moderate number. *Glomus* was distributed in large number.

So that on the above observation we recommend that the *Glomus geosporum* is good biofertilizers for the better growth of *Annona squamosa* L. in rhizosphere.

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Deciphering the Morphotaxonomy of Poroid Fungi: A Study on Microporous, Hexagonia, Schezophyllum, and Lenzite

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DOI- 10.5281/zenodo.11259093

Abstract:
Exploring Taxonomy and Morphological Characteristics in Microporous, Hexagonia, Lenzite, and Schezophyllum: A Comprehensive Study of Poroid Fungi"This comprehensive study delves into the taxonomy and morphological intricacies of Microporous, Hexagonia, Lenzite, and Schezophyllum, collectively examining their classification within the fascinating realm of poroid fungi. Employing advanced taxonomic methodologies and detailed morphological analyses, we unravel the intricate characteristics that define these fungi species. Our research aims to contribute to a deeper understanding of their ecological roles, evolutionary relationships, and potential applications. Through meticulous investigation, this study provides a valuable resource for mycologists, ecologists, and researchers interested in the diverse world of poroid fungi.

Introduction:

Fungi play a pivotal role in the forest ecosystem, exhibiting diverse impacts, both positive and negative. Various fungi species thrive in diverse climatic conditions (Bilgrami et al., 1991) and constitute the second-largest group of terrestrial organisms, found in allecosystems worldwide**.**

Classifying biodiversity is crucial as it provides essential insights into the variety of life forms, their interrelationships, and their roles in ecosystems. This knowledge is vital for effective management and conservation of our biological heritage. Autotrophic producers, especially woody plants, foster high diversity across trophic levels and specializations, supporting a myriad of consumers and decomposers.

Decaying wood stands out as a distinctive terrestrial habitat where Animalia, Plantae, Fungi, Protista, and Prokaryota coexist and interact (Schigel, 2009). Wood-decay fungi play a pivotal role in indigenous forests by decomposing fallen wood as well as the heartwood and sapwood of living trees. Fungi, equipped with efficient enzymes for cellulose and lignin degradation, are the primary agents responsible for wood decay. Various fungi utilize different constituents for their metabolism, highlighting the broad spectrum of fungal diversity involved in this process.

Wood, as a food source, is accessible only to fungi capable of breaking down its components. This intricate relationship underscores the significance of fungi, as outlined by Seidl (2009), in the natural decay processes within forests. Understanding and appreciating the role of theseorganisms are paramount for sustainable ecosystem management and the preservation of biodiversity.

Material and method:

Basidiocarps were individually collected and sealed in polythene bags. Thin sections from different parts of each basidiocarp were sliced, stained with cotton blue,congorent red and mounted in lactophenol. Microscopic observations were conducted at 40× magnifications.

Results AndDiscussion:-

***Hexagoniatinius*:**

Basidiocarps solitary, sessile, dimidiate with a narrow base, applanate to flabelliform, slightly concave, measuring 4.0–12.0 × 3.0–8.0 × 0.2–0.3 cm, exhibiting a corky-coriaceous texture. The upper surface varies from pale brown to dark brown, some displaying a greyish-black color at the center. The surface is uneven, showing concentric striations to zonation. The margin is entire and thin, while the hymenial surface appears greyish, with hexagonal pores numbering 10–12 per cm.

Hyphal system: Trimitic. Generative hyphae: Hyaline, thin-walled, branched, clamped, 1.5–3.0 µm wide. Skeletal hyphae: Subhyaline to yellowish-brown, straight or flexuous, thick-walled to solid, occasionally septate towards the apex, 3.0–6.0 µm wide. Binding hyphae: Hyaline to subhyaline, thick-walled to solid, highly branched, mostly short and coralloid, some freely branched but short and flexuous, 1.5–3.2 µm wide. Reddish-brown, thin-walled to slightly thick-walled cuticular cells with irregular projections in the crustose area at the base of the pileus surface. Basidia: Narrow clavate, 4-sterigmate, 15.0–22.0 × 8.0–10.0 µm. Subhyaline to pale-brown cystidioid hyphae formed at apical ends of skeletal hyphae, more common in sterile pore

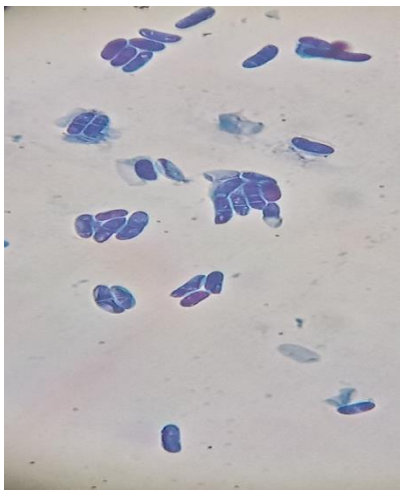
mouths. Basidiospores: Hyaline, thin-walled, cylindrical, 10.0–15.0 × 4.0–6.0 µm.

Hexagonia tinius

(A)Basidiocarp

(B) Upper Surface

(C) Lower Surface,



(D) Basidiospores

Lenzitebetulina:

1. Morphological Characters.

Fruitbody: Annual to perennial, broadly attached, dimidiate with a contracted base, sometimes almost stipitate, semicircular to flabelliform, single or imbricate, brown to gray, hard, woody to corky coriaceous when fresh, flexible when dry; strongly attached, 13-15 cm long x 9-10 cm broad x 1-1.5 cm thick at the base.

Pileus: Semicircular, more or less angulate, dimidiate, flat, upper surface usually whitish, uneven, finely velutinate concentrically zonate, slightly sulcate, distinctly radially wrinkled, dotted warty, fine nodulate, nodules usually scattered near the base, more rough than the margin with asperulate of agglutinated hyphae, zones of cream to brown and grey color alternating with each other first white, cream, pale ochraceous to clay or tan-colored, then leather or dirty brownish colored; Margin sharp, wavy, sometimes folded bent downwards.

Pore Surface: Flat to oblique, orange-buff, yellowish-creamy to brown-colored, mostly with a yellowish tint, this color seems to persist even when the upper surface has become white and dirty grey, pore surface extremely variable; in some specimens poroid 2-4 mm wide, mostly angular mixed with daedaloid to sinuous lamellae up to 3.5 mm wide, in other specimens purely lamellate 3.5 mm wide, 10-11 lamellae per cm, lamellae straight or wavy especially towards the base where they are deeper tubes of lamellae up to 7-9 mm deep.

Context: White cream to yellowish-colored, 3-5 mm thick.Hyphal System: Trimitic; Generative hyphae hyaline, thin-walled, with clamps, 1.5-3.0 µm in diameter; Skeletal hyphae straight, thick-walled to solid, up to 5-7 µm in diameter; Binding hyphae hyaline, thick-walled, solid, highly branched, sword-like, long side branches up to 4.5-5.5 µm in diameter.

Cystidia: Absent, but thick-walled skeletal hyphae project into the hymenium; Hyphal pegs present, conical to cylindrical.

Basidiospores: Hyaline, cylindrical, smooth, thin-walled, and non-amyloid, 6-9 x 2-3 µm.

Lenzite betulina:


(A) Basidiocarp


(B) Pore surface


(C) Basidiospore

***Schezophyllum commune*:**

The fruiting body on finger millet straw was 1-4 cm wide, fan-shaped, and laterally attached to the substratum. Its upper surface was covered with small white hairs, while the under surface consisted of gill-like folds, split down the center, with a shallow groove, giving it the classification of polypores. The fungus, resembling the split gill fungus of the genus Schizophyllum, exhibited longitudinally split gills (lamellae) on the lower side. Close inspection revealed distinctively "split" or "doubled" folds on the under surface, characteristic of the split gill fungus found on decaying wood.

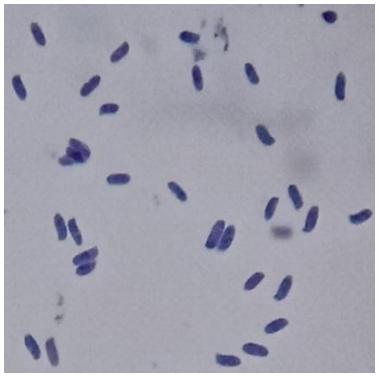
The cap, shell-shaped and often wavy with lobes, resembled a stem, concentrating tissue at the point of attachment. collected from decaying wood, contained generative hyphae with septae and clamp connections. Skeletal hyphae were centrally swollen and broad, while binding hyphae were comparatively thick-walled and branched. Basidiocarps confirmed the presence of skeletal and binding hyphae.

Microscopic examination of the isolate on a slide culture revealed hyaline, septate hyphae with clamp connections, and spicules indicative of a basidiomycete. The elliptical and smooth spores, measuring 4 x 2µ, were observed, and the spore print exhibited a white color. Notably, cystidia was found to be absent in the examined specimen.

Schezophyllum commune:


(A) Basidiocarp


(A) Basidiocarp


(A) Basidiocarp

***Microporous xanthopus*:**

Basidiomata: Annual, centrally to eccentrically stipitate. Pileus circular to dimidiate in young specimens, glabrous and shiny when fresh, hard on dry species, up to 5.4 cm in diameter, 3 mm thick in the center, untomentose; margin acute, slightly wavy; pileus upper surface shiny with numerous distinct to indistinct concentric zones, ranging from yellow to brown to deep reddish-brown.

Pore Surface: White to cream, pores circular, very small, barely visible to the naked eye, 1-2 pores per mm. Pore tube yellowish-brown, up to 1 mm long. Context up to 1 mm thick.

Stipe: Cylindrical, finely velutinate to deep reddish-brown, up to 2.4 cm long, 5 mm in diameter.

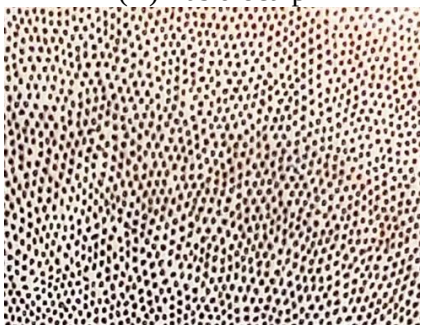
Hyphal System: Trimitic, generative hyphae with clamps, 3-4 µm in diameter, challenging to observe in dried specimens, hyaline and richly branched. Thick-walled clamped hyphae present in aerial specimens. Cystidia or other sterile hymenial elements absent.

Basidiospores: Allantoid to elliptical, smooth, thin-walled, non-amyloid in Melzer's reagent.

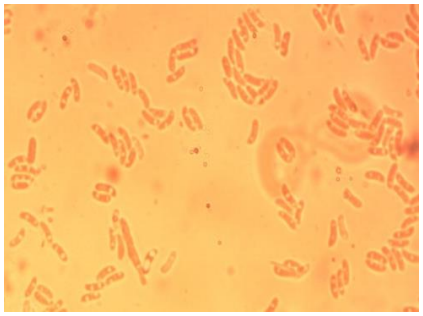
Microporous xanthopus:

(A) Basidiocarp

(B) Stipe



(C) Pore surface



(C) Pore surface

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Performance of PL-Adsorbent for Methyl Orange Adsorption

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Abstract

Water contamination is currently a major environmental hazard for both human health and aquatic ecosystems. There are numerous causes of water pollution, the most common of which being industrialization, with textile companies creating dye- containing water contamination. This work aims to reduce the contamination of dye polluted water.Pigeon leaves, an agricultural waste, is used to create an adsorbent for dye removal.In this investigation, Methyl orange dye was chosen as the target dye contaminants. A kinetics and adsorption investigation was carried out. The produced PL-adsorbent has a significant capacity for adsorption of methyl orange dye and is inexpensive.

Keywords: Pigeon leaves; Methyl orange dye; Adsorption; Adsorbent

Introduction

Water is a renewable resource that is required to sustain all forms of life.Water is also among the most easily manageable natural resources because it can be diverted,transported, stored, and recycled [1]. With the rapid growth of industrial technology, reusing sustainable resources such as water and materials has become a global concern, and water pollution has become a severe global issue. Water contamination has aggravated the water crisis [2].

The massive release of textile waste water is regarded as one of the primary causes of water pollution, and the quality of the water can be severely impacted. This type of pollution can cause a variety of issues, including the destruction of aquatic ecosystems and the spread of water-borne diseases when people drink polluted water [3].Dye-containing wastewaters are extremely difficult to treat since the dyes are recalcitrant molecules. Another challenge is containing dye molecules at low concentration [4]. Dyes have caused great worry about their use due to their harmful consequences. It has been reported to cause mutagenesis, chromosomal instability, cancer, and respiratory toxicity. Therefore, particular methods and technology to remove dyes from various types of water bodies are desired [5].

Textile dyeing wastewater is a major polluter all over the world. Some dyes do not breakdown in water at all. Others that disintegrate emit hazardous compounds as they decompose [6].Textile dyes severely degrade the visual quality of water bodies, hinder photosynthesis, restrict plant growth, infiltrate the food chain, give recalcitrance and bioaccumulation, and may cause toxicity, mutagenicity, and carcinogenicity. Dyes gather in the water to the point where light can no longer enter to the surface, impairing plants' capacity to photosynthesize. This reduces the oxygen content of the water, causing aquatic life and flora to die [7].

A diazonium coupling process produces methyl orange from sulphanilic acid N, N-dimethylaniline. Helianthin, a vivid red form of methyl orange, is the initial byproduct of the coupling. Helianthin is transformed into the sodium salt of methyl orange, an orange color, in the base. When methyl orange comes into touch with water, it transforms from a weak acid into neutral orange molecules. Methyl orange (MO) is a widespread and ongoing acidic anionic mono-azo dye used in textiles, lab studies, and other industrial products. This dye poisons aquatic life. Acute exposure tothis hazardous dye can result in tissue necrosis, an increase in heart rate, vomiting, cyanosis, and jaundice in humans. Therefore, before the wastewater is released into the environment, removing this dye is crucial. This dye is produced by companies associated with MO use and manufacture.[8]

In order to create innovative wastewater treatment methods and meet the demands for clean water, developmental accomplishments are being made gradually. However, using current techniques to thoroughly treat discharged water comprising contaminants has proven difficult. In the literature, a number of methods for wastewater treatment have been published.They typically consist of chemical, physical, and biological procedures that are regarded as sufficient for treating water in a variety of ways. Their selection is influenced by numerous elements, such as dye content, sewage composition, process cost, or other pollutants in wastewater. Each treatment method's unique

characteristics can be advantageous in some ways while being constrained in others. Treatment methods that have high installation and operating costs, lengthy processing times, limited yield, and harmful byproducts are frequently insufficient for industrial use. [8] In terms of starting cost, convenience of design, and simple operation, the adsorption process is regarded as superior to other wastewater treatment methods now in use.[9] It is also a very successful separation technique. There are several biosorbents, including Chlorella vulgaris cells, eggshell powder, biosolids, Daucus sativus residue, Carica papaya wood, animal bones, Sargassum species, Monophylum spicatum, Laminaria japonica, rape straw powders, rice husk ash, Azadirachtaindica leaves, pigeon leaves, turmeric leaves, etc.[10]

Functional groups on surface and pore size distribution affect how well ACs adsorb substances. [12] According to reports, some Zingiberaceae plant species can serve as an adsorbent for the adsorptive elimination of dyes. But there is still a arise desire to research innovative, inexpensive adsorbent materials with excellent adsorption capacities. Studying the sophisticated treatment of Methyl Orange dye by appropriate natural adsorbents is therefore crucial. [2]

In this study a pigeon leaves (PL) ash prepared and used as bio-adsorbent for removal of methyl orange (MO) the adsorption isotherm and kinetics are also studied.

Materials and method2.1Chemicals

Allof the chemicals were bought from LOBA CHEM. Methyl orange dye ($C_{14}H_{14}N_3NaO_3S$), Sodium Hydroxide (NaOH) and Hydrochloric acid (HCl) were usedin this work. There was no further chemical purification done.

Adsorbent Synthesis

Pigeon dried leaves (PL) were gathered from agricultural waste and utilized as a key source for adsorbent making. Before usage, all powdered ingredients were burnedin the oven and graded with a mortar and pestle. The sticky and other undesirable components were removed from the (PL) adsorbent.

The prepared PL-adsorbent was ready to undergo dye adsorption. Methyl Orange dye was used to make an aqueous solution for the adsorption test, and the stock solution was diluted by using distilled water. All tests were conducted under optimal circumstances.

Adsorption experiment

Adsorption studies were performed in a rotary shaker by shaking 150 mg of PL-adsorbent with 20 mL of the required concentration of MO solution at 150 rpm. A colorimeter was used to measure absorbance before and after the experiment.

Equations (1), (2), and (3) were used to compute the percent removal (R%), kinetic adsorption capability (q_t, $mg.g^{-1}$) and equilibrium adsorption capability (q_e, $mg.g^{-1}$) of PL-adsorbent.

$$R\,(\%) = \frac{C_0 - C_e}{C_0} \text{x}100 \qquad (1)$$

$$q_t = \frac{(C_0 - C_t)\,\text{x}V}{m} \qquad (2)$$

$$q_e = \frac{(C_0 - C_e).V}{m} \qquad (3)$$

Where $C0$ ($mg.L^{-1}$) and Ce ($mg.L^{-1}$) are the initial and equilibrium metal ion concentrations, respectively. Ct ($mg.L^{-1}$) represents the concentration of Cu(II) and Cd(II) ions at time *t*, *m* represents the weight of the PL-adsorbent (g), and V represents the volume of the solution (L).

Results and Discussion

The impact of initial parameters

The influence of time improves the equilibrium adsorption of pollutants aswell as the adsorption kinetic performances of the adsorbate and adsorbent. Dye adsorption rises as agitation time increases as observed from figure 1.

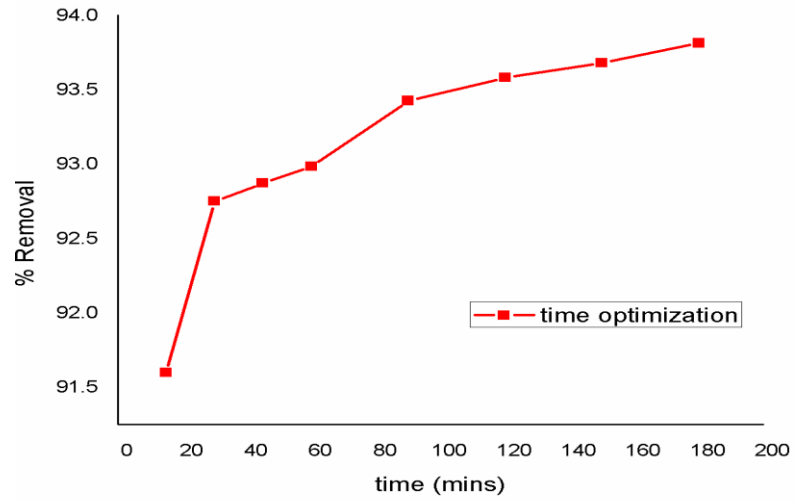

Figure 1. The influence of contact duration on methyl orange dye adsorption on PL adsorbent. By adjusting the starting concentration of methyl orange dye at a set temperature for 90 minutes in stirring time, the effect of concentration on methyl orange dye uptake by the pigeon leaves ash adsorbent was studied.

The adsorption capabilities rose as the original methyl orange dye concentration was raised. Thegraph (figure 2) depicts the influence of dye concentration.

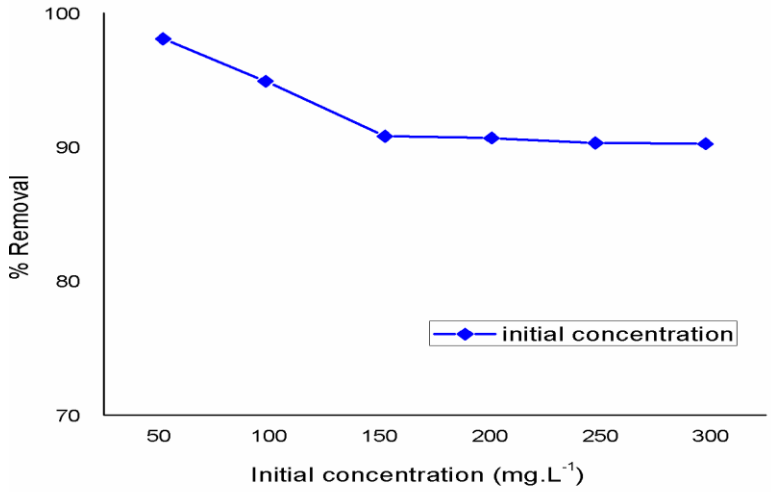

Figure 2. The effect of starting concentration on methyl orange dye adsorptionon PL-adsorbent

Adsorption kinetics

There are several different kinetic models that have been used to represent the order of adsorbate-adsorbent interactions. The well-known pseudo first-order model has traditionally been used in most cases, although second-order kinetics has also been successfully used by many writers to characterize the interactions. The pseudo first order rate equation (4) is typically followed by the kinetics when diffusion through a boundary precedes adsorption. Equation (5) provides pseudo-second-order kinetics. [9].

$$\log (q_e - q_t) = \log q_e - \left(\frac{k_1}{2.303} \right).t \quad (4)$$

$$\frac{t}{q_t} = \frac{t}{q_e} + \frac{1}{k_2 . q_e} \quad (5)$$

Where *k1* is the rate constant of the pseudo-first order adsorption process and $q_t$and $q_e$are the amounts adsorbed at time *t* and equilibrium, respectively. The second- order rate constant is represented by *k2*. Figures (3) and (4), respectively, display the pseudo first order and pseudo second-order kinetics plots. The parameters are listed in Table 1, and psuedo-second order is appropriate for this experiment, with an R^2 value of 0.9997.

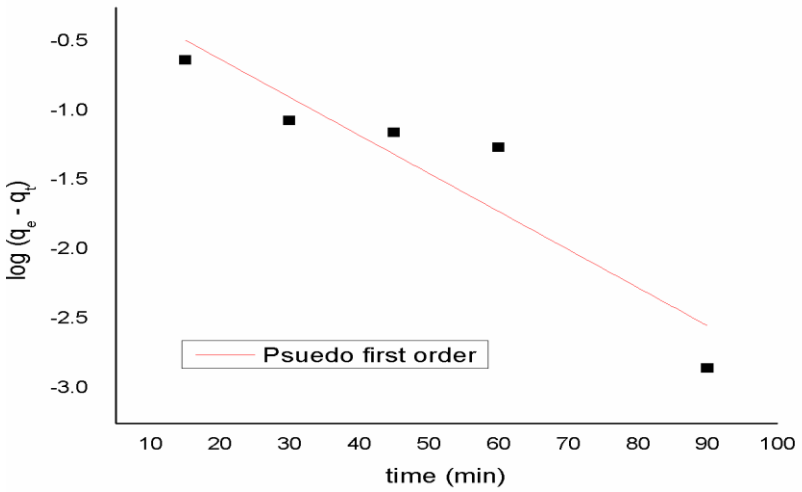

Figure 3. Psuedo first order model for adsorption of congo red dye

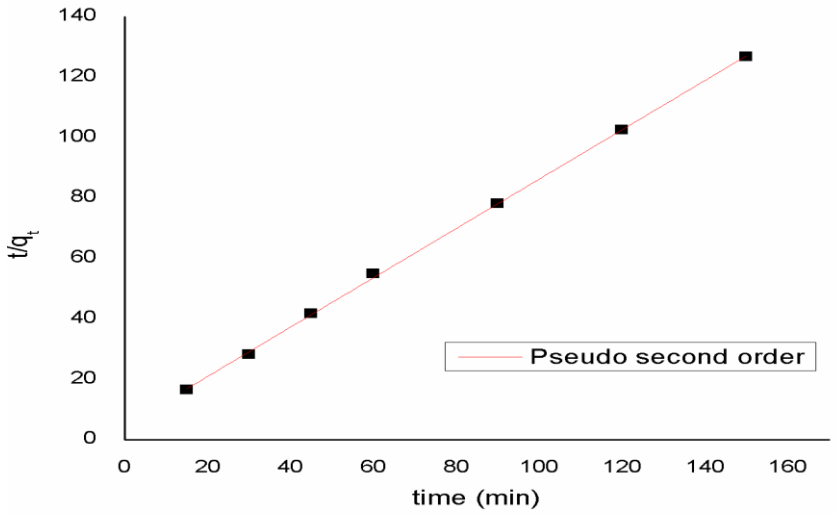

Figure 4. Psuedo second order curve for adsorption of methyl orange dye

Adsorption amounts that vary over time and at various beginning dye concentrations can be

further processed to assess the contribution of diffusion to the adsorption process.

Adsorption is a multi-step process that involves solute molecules beingtransported from the aqueous phase to the surface of solid particles and then diffused into the interiors of pores. Equation (6) provides the intra-particle diffusion rate.

$$q_t = K_{id} \cdot t^{1/2} + C \qquad (6)$$

Where k_{id} is the rate constant for intra-particle diffusion. The slopes of q_t vs. $t1/2$ plots are used to calculate the k_{id} values. Intraparticle diffusion model for adsorption of methyl orange dye is shown in figure 5.

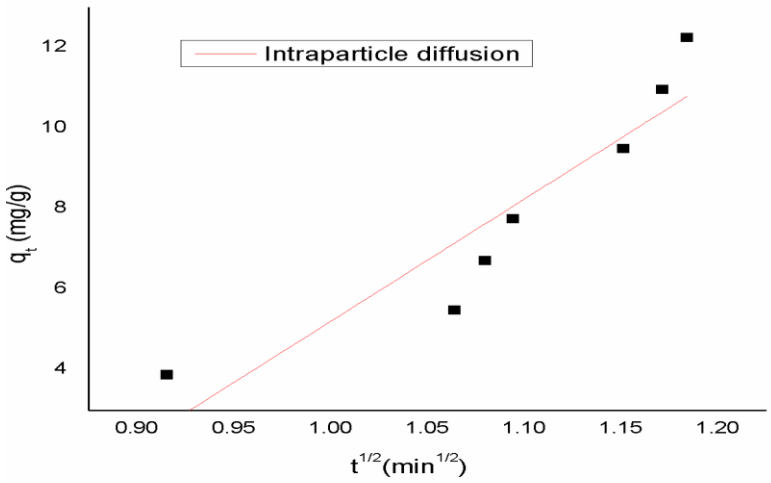

Figure 5. Intraparticle diffusion model for adsorption of methyl orange dye ants

Table 1. Kinetic characteristics of methyl orange dye adsorption on PL-adsorbent

Adsorption Kinetics	Const	Units		Values
Pseudo First Order $\log(q_e - q_t) = \log q_e - \left(\frac{k_1}{2.303}\right).t$	R^2	-		0.8681
	q_e	$mg.g^{-1}$		0.8431
	K_1	min^{-1}		0.0633
Pseudo Second Order $\frac{t}{q_t} = \frac{1}{k_2 . q_e^2} + \frac{t}{q_e}$	R^2	-		0.9997
	q_e	$mg.g^{-1}$		1.2244
	K_2	$g.mg^{-1}min^{-1}$	0.330	
Intraparticle diffusion $q_t = K_{id} \cdot t^{1/2} + C$	R^2	-		0.8562
	C	$mg.g^{-1}$	16.378	
	K_{id}	$mg.g^{-1}min^{-0.5}$		0.491

Adsorption isotherm investigation

To evaluate the probable adsorption mechanism on PL-adsorbent, the most commonlyresearched Langmuir equation (7), which is valid for monolayer chemisorption, was applied. Freundlich model is utilized for multilayer adsorption studies, and the equation (8) is provided below. [11].

$$\frac{C_e}{q_e} = \frac{1}{Q_m K_L} + \frac{C_e}{Q_m} \quad (7)$$

$$\log q_e = \frac{1}{n} \log C_e + \log K_f \quad (8)$$

Kf (L.mg^{-1}) and *n* are Freundlich constants that represent adsorption capacity and intensity, respectively.

Figures (6) and (7) depict the graphs of the Langmuir and Freundlich models, respectively. Table 2 contains the isotherm parameters. The R^2 is higher for the Freundlich isotherm model, implying a multilayer adsorption mechanism. Table 3 displays the comparative adsorption capabilities.

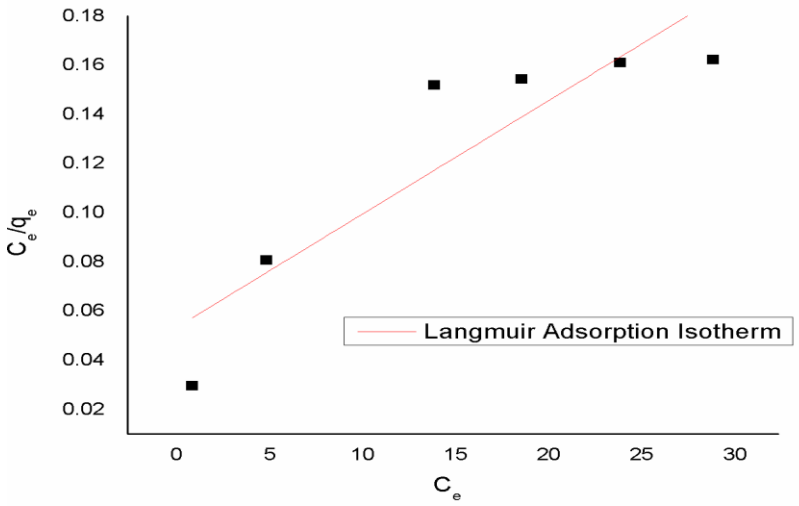

Figure 6. Langmuir model for methyl orange dye adsorption on PL-adsorbent

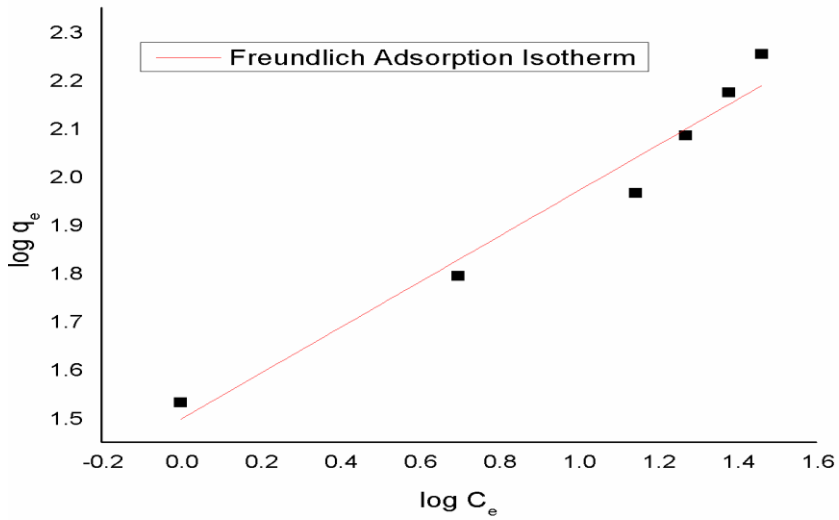

Figure 7. Freundlich model for methyl orange dye adsorption on PL-adsorbent

Table 2. Adsorption isotherm parameters for adsorption of congo red dye on PL-adsorbent

Adsorption Isotherm Constants		Units	Values
Langmuir	R^2	-	0.8156
$\frac{C_e}{q_e} = \frac{1}{Q_m K_L} + \frac{C_e}{Q_m}$	Qm	mg. g^{-1}	217.3913
			0.0874
	kL	$L.mg^{-1}$	
Freundlich	R^2	-	0.9644
$\log q_e = \frac{1}{n} \log C_e + \log K_f$	Kfn	$L.mg^{-1}$	31.4195
			0.4728

Table 3. A comparison of bioadsorbents for methyl orange dye adsorption

MATERIAL	ADSORPTION CAPACITY qmax [$mg.g^{-1}$]	References
Pomelo peel wastes	140.00	[13]
FlyEgg shell 34,	12.50	[14]
CarCorn leaves	13.85	[15]
Chitosan modified by zero valent iron	19.31	[16]
Chrysotile 76	31.46	[17]
PL-Adsorbent (Pigeon leaves ash)	217.3	This experiment

Conclusions

In this study, pigeon pea leaves ash was employed as an efficient and potentially effective adsorbent for the adsorptive elimination of methyl orange dye from aqueous media. To comprehend the dye removal behavior, consider the parameters influencing the methyl orange dye adsorption process, such as contact time and dye concentration. The adsorbent demonstrated reasonably quick kinetic performances based on the effectiveness of pigeon pea husks ash [PL-Adsorbent]. The experimental result was consistent with pseudo-second order kinetics.

The freundlich isotherm model was used to fit the equilibrium data, demonstrating themultilayer coverage of methyl orange dye on the PL-Adsorbent. The adsorbent's capacity for methyl orange dye adsorption was determined to be 217.3 $mg.g^{-1}$ using the Langmuir isotherm model. The results demonstrated that the natural adsorbentwas cost-effective and had considerably higher adsorption ability than other types of adsorbents. The current study revealed the benefits of natural adsorbent with for methyl orange dye adsorption from aqueous media.

As a result, the natural powdered pigeon pea leaves ash adsorbent may be used to efficiently remove dyes from textile effluent and clean up the contaminated water.

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Comparative study of fish markets of Ghuggus and Bhadravati in Chandrapur District of Maharashtra, India

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DOI- 10.5281/zenodo.11259274

Abstract:

The markets of the most aquaculture products are influenced by the supply and demand condition. The standard economics analysis of purely competitive market is relevant. India is the Second largest producer of fish in the world. Fish market significantly contributes to food security and also in generating employments. It supports livelihood of lakhs of people. The price of fishes either fixed by government or by the fisheries cooperative societies. A large number of commission agents are operated in Ghuggus fish market. The study site of fish market of Ghuggus in Chandrapur district is near Nagar Parishad, Ward No.3, Aathawadi bazaar, Ghuggus. This is the main fish market. Ghuggus has coal industry 'WCL' and ACC Cement factory. On every Sunday weekly Bazaar (market) is organized to meet the needs of the people. The fish market located at Bhadravati in Chandrapur District. It lies 26 km away from Chandrapur city. It is near Anganwadi Centre No.6, Santaji Nagar, Bhadravati. The data was collected from 20th March to 27th March 2023. During the study period of Bhadravati and Ghuggus fish market, 12 species of fishes and 1 species of prawn were found. Fish were Mangur, Catla, Rohu, Channa, Common carp and Tilapia. These sold in large quantity because they have good demand. Low price fishes are also sold in market. The condition of Bhadravati and Ghuggus fish market is poor in facilities. It needs development.

Keywords: Fish markets study, Ghuggus, Bhadravati.

Introduction:

The markets are important for selling and purchasing goods. The markets of most aquaculture products are influenced by the supply and demand condition. The standard economics analysis of purely competitive market is relevant. The production and use of product by sale is called as fish marketing. Fishes spend almost their life in freshwater such as rivers and lakes, having a salinity of less than 0.5 ppt. Around 40% of all known species are found in freshwater. India is the Second largest producer of fish in the world. Fish market significantly contributes to food security and also in generating employments. It supports livelihood of lakhs of people. The price of fishes either fixed by government or by the fisheries co-operative societies. A large number of commission agents are operated in Ghuggus and Bhadravati fish markets**.** The prawn and fish production plays important role in the socio-economic development of India. The growth of fish production and development is highly dependent on an efficient fish marketing system. The supply of prawns and fishes to the consumer in the form of fresh, freezed, dried, salted and pieces of prawn and fishes in the fish market. According to the government of Maharashtra, only the registered societies are empowered for prawn and fishes catching and marketing from this water bodies. Prawn and fishing done by nets. Gill nets are suspended at intermediate depth for overnight. Mostly fisherman catches fishes and prawn all the days of the year except months of July to September (Sheikh, 2014). Humans and animals have been utilizing fish as a major food component. Fishes are known to be enriching by high nutritional component and concentrated source of energy. Dominant varieties of fishes such as *Clarious sp., Rohu sp., freshwater Prawn* like *Macrobrachium rosenbergii* are routinely catches from nearby water bodies and sold in local market. A variety of fishes consume regularly are prone to pathogenic spoilage especially by *Vibrio species, Salmonella species, Streptococci species, Staphylococci, Coliforms species, Listeria species, Clostridium spp.* which may get entry in to the fish transportation. A number of report suggest that the consumption of the microbiologically spoiled food might be responsible for food born disease like Diarrhoea, Salmonellosis, Shigelosis, Cholera and even some neurological diseases, an array of viruses, bacteria, fungi and parasites. Therefore, it is crucial to estimate the rate of microbial spoilage and to establish the preventive strategy to ensure the general food safety. The antibiotic resistance pattern of the isolated pathogens was also determined (Kamdi, 2016).

The main source of fishes in Ghuggus and Bhadravati fish market are Pandharkawada, Mukutban, Soit, Madheli and Wardha river. This

supplies varieties of fishes. Domestic markets and distribution of fish are dominated by a large number of intermediaries. All fish traded internally and for export pass through private channels. Markets located in villages, district headquarters or at a crossroads are considered primary markets. They are usually near areas where fish are caught. Fishermen bring a variety of fishes (dominated by small fish from both open-water capture and from ponds) to the primary markets. 52% of such primary rural markets are held twice a week, 28% three times a week and 20% are held daily. Of all these markets, 80% are open during morning hours, particularly for trading milk, vegetables and fish and are attended by a relatively small number of sellers and buyers compared to the usual afternoon markets. The marketing channel for cultured fishes starts with the fish farmer passes through a number of intermediaries and ends with the ultimate consumer. Major intermediaries who enter the fish marketing chain are Nikaries, Beparies, Adtedars and retailers. Fish farmers do not sell fish directly to consumers in the market. Free market where demand lie and supply forces operate and interact freely without any restriction on price setting mechanism and as a result perfect competition prevails in the market. A market managed by a selected committee or local authorities is known as a regulated market. City Corporation administered market. In India, most of the fish production and capture sold in local market. Most of the markets are still in development stage and only few having facilities. Major hindrance in fish marketing include perish ability and large quantities, storage, transportation, quality and quantity of commodity, low demand elasticity and high price spread (Vala *et al.*, 2020).

The fisheries sector is recognized as a powerful income generator. On one hand and it stimulates growth of a number of subsidiary industries and on other hand, it provides cheap and nutritious food. It plays an important role in the socio-economic life of thousands of people directly or indirectly involved in it, as it provides source of employment and income to millions of rural farmers, particularly to women. The growth of fish production as well as development of fishery sector in terms of economy and infra-structure is highly dependent on an efficient fish marketing system (Chourey *et al.*, 2014).

The main objective of this study was to study the fish market of the Ghuggus and Bhadravati in relation to fishes and prawns variety availability.

Review of literature:

The review of literature in relation to fish markets study is as follows: Kumar *et al.,* (2008) had studied domestic marketing system in India - Changing structure, conduct, performance and policies. This study has been conducted in all the major coastal states and some selected inland states to understand the domestic marketing of fish in India. The total marketing costs of auctioneer, wholesaler, retailer, vendor, marine fishermen co-operative societies and contractor. The marketing efficiencies for Indian major carps (IMC), Sardine and Seer fish have been found vary from 34 to 74 %, depending on the length of market channel. Chourey *et al.,* (2014) was studied fish marketing system in Bhopal, M. P. The this study was based on a survey of Bhopal fish market with help of direct observation, interview technique and a standard format of questionnaire which are filling up by fish sellers. The study revealed the problem of fish sellers during marketing times, which are briefly discussed in the paper. Ghorai *et al.* (2014) was studied the status of the largest dry fish market of East India: A study on Egra regulated dry fish market, Egra, Purba Medinipur, West Bengal. The study area was purposely selected and the trading system was analysed. The market operated actively once in week. Several species of coastal and marine dried fishes like Patia, Lahara, Vola, Chanda, Ruli, etc. were commonly available in the market. Different lives of businessman are involved in the trading system like fish processor, Beparis, Adtedars, wholesaler and retailers, etc. Shillewar and Totawar (2019) had worked on study of fish market in Nanded city and find the status of wholesale and local fish market in Nanded city. They found fish live *Catla, Labeo, Channa, Common carp, Tilapia* were sold in large quantity. Kewat *et al.* (2020) was studied on fish traders and fish market of Ulhasnagar and its surrounding cities: A qualitative approach. Fishery sector is an important sector and provide livelihood to millions of people of the country. Post harvest fish management is very poor and fish trader, the important stakeholder in this regard are deprived of technology knowledge and are quite unaware about post harvest fish loss in the country. Keeping in view, present study is conduct to explore the knowledge of the fish traders on post-harvest fish management procedure and infra-structure available in existing fish market. So that, these can be streamline in order to develop an ideal fish market in the region and to reduce post-harvest fish loss in the country. Total three fish markets, one from each Ulhasnagar, Ambernath and Kalyan were selected on the basis of fish market easy accessibility and are close to local railway stations. Vala *et al.* (2020) worked on a study of fish marketing system in Himmat Nagar, Sabarkantha, Gujarat. They observed fish market activities and economic features. The main source of fishes in Himmat Nagar fish market is Dharoi dam, lake, small rivers and reservoirs which supply varities of fishes. Major available fishes species in Himmat Nagar market are Indian major carps, exotic carp, cat fishes, hilsa, pomfret and shrimps.

Gaidhane *et al.* (2020) worked on a study of Bhiwapur fish market in Chandrapur, Maharashtra. They observed 23 species of fishes and prawns. They found that wholesalers sold 1 to 1.5 tonnes fishes daily and retailers sales 25-50 kg fishes per day. Gomra *et al.* (2020) made a survey on fish population availability in different seasons in Northern India. The present study conducted on the availability of different fish species during the summer, spring and winter months at the Gummat fish market, Jammu Division, Bilaspur fish market, Chhattisgarh, Himachal Pradesh and Amritsar fish market, Punjab. The survey result shows that, in all the fish markets, the price of the fish was higher in the winter season than in the summer season, mainly *Labeo rohita, Tor mosal, Catla catla, Wallago attu, Bramidae, Anabas testudineus, Carassiusauratus, Ctenophoryngodon idella, Lethrinus bohar, Nandus nandus, Pampus chinensis, Pangasius buchanani, Platycephalus fuscus, Rita rita, Solea solea, Sperata seenghala, Tilapia nilotica, Tenualosa ilisha,* etc. were found in these markets throughout the season. Chanda and Jana (2021) had made a comparative review on freshwater fishes between West Bengal and Odisha to middle East Indian States. The objective of the present study is the comparative revision of inland freshwater fish faunal diversity between West Bengal and Odisha, two states of middle-east India. Work is mainly based on the available published literature on the freshwater fish faunal diversity, checklist for fish, monograph of the area under study. Result reveals the existence of 345 species of fish belonging to 50 families under 14 orders. Sit *et al.* (2021) was studied on fish diversity, marketing and economics of fish markets at Kharagpur, West Bengal, India. During the study period, it has been observed that 28 freshwater inland fish species, 6 freshwater exotic fish species, 19 marine fish species and 4 crustacean species were available in the Kharagpur town. Some marine molluscs like Loligo species and Sepia species was also sold here. There are different peoples, those belong from different districts of West Bengal and involved in fish marketing activities. Therefore, a marketing chain is being established which is inter-dependent to each other with a socio-economic framework. Some measures have been highlighted towards improvement of infrastructure, hygienic conditions. Kumar *et al.* (2010) observed the marketing system and efficiency of Indian major carps in India. The study has revealed that the marketing system is highly efficient in sharing the benefits to aqua farmers while providing quality fish to consumers at reasonable prices. The main reason for the success of fish farming is the prevalence of an efficient marketing system which enables the producers to fix pond site price, as they have access to information on the prices at wholesale market of various fish consuming cities across the country.

Material and methods:

The present study was carried out to analysis the condition of fish market, major species sold and price structure. The present study is based on primary source of data. The primary data was collected by the survey of fish market with help of direct observation and interview techniques. The data collected through visit in the fish market at Ghuggus and Bhadravati. The study site of Ghuggus fish market is near Nagar Parishad, Ward No.3, Aathawadi bazaar. This is main fish market. Ghuggus has coal industries 'WCL' and 'ACC Cement factory'. There is a steel plant and many coal washeries. Due to this reason, Ghuggus is the most polluted town in Maharashtra. Ghuggus main market area is in the middle of the town known for basti. On every Sunday weekly bazaar (market) is organized to meet the needs of the people. Ghuggus fish market is located at Longitude 79.11^0 and Latitude is 19.93^0. The fish market located at Bhadravati in district Chandrapur. It lies 26 km from Chandrapur city. Fish market near Anganwadi Centre No.6, Santaji Nagar, Bhadravati. The data was collected from 20th March to 27th March 2023. The photographs of both Ghuggus and Bhadravati fish markets are as follow (Figures 1 and 2):

Figure 1: A view of fish market of Bhadravati.

Figure 2: View of Ghuggus fish market.

Results:

During the study period of Bhadravati and Ghuggus fish market, following 13 species of fishes and 1 species of prawn was found. These are given in Table 1.

Table 1: Fishes and Prawns collected from Bhadravati and Ghuggus fish markets.

Sr. No.	Local names	Scientific names
1	Catla	*Catla catla*
2	Rohu	*Labeo rohita*
3	Vaur	*Channa striata*
4	Common carp	*Cyprinus carpio*
5	Daku	*Wallago attu*
6	Mangur	*Clarias batrachus*
7	Grass carp	*Cteropharyngodon idella*
8	Kolshya	*Puntius sarana*
9	Zaran	*Pangasius bocourti*
10	Chambhari	*Notopterus notopterus*
11	Tilapia	*Tilapia mossambica*
12	Silver carp	*Hypophthalmichthys molitrix*
13	Zinga	*Macrobrachium rosenbergii*

Fishes like Mangur, Catla, Rohu, Channa, Common carp, Tilapia are sold in large quantity because they have good demand. Low price fishes are also sold in the market. The seller mainly used knives for cutting the fishes with scrappers to remove scale and wooden platform for cutting and filleting. None of the seller in market of Bhadravati and Ghuggus town found using cold chamber at the market place. The hygienic condition of fish markets of Bhadravati and Ghuggus was found to be poor. Fish sellers are set under temporary roofs.

Discussion:

It shows that development of this application would be a great benefit for the set of stakeholders like harbour trader, market trader, mini-trader and other who need the left over fish. Also, it would help in building a more improved fish marketing system in our country is one among the leading producer of fish in the world. On developing the next stage, the application may get completed and will be beneficial for the specific group of population who are our study group. Most of the fishermen were found working in individually for fishing as well as selling. The marketing system of fish market in Ghuggus and Bhadravati was found to be simple one. Mostly fishes caught in morning time and were brought to the market by evening time. Establishment of more ice-plants, cold storage and preservation facilities, improvement of existing fish market structure. Improvement of sanitation,

hygiene condition, washing facilities and sufficient auction place. Introduction of mechanical weighing equipment is necessary.

Conclusion:

From this study it may be concluded that:

1. The condition of Bhadravati and Ghuggus fish market is very poor. Market need to have some development. Local government may take action to develop some basic facilities and infrastructure of fish market. Fishermen should be aware and trained in hygienic fish handling and fish processing.
2. The finding of present work will help the people in general and fish traders in particular to expand their knowledge and understanding about the fishes and requirement of fish market in term of infrastructure and easy accessibility to customers.

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Profitability Analysis of Aquaculture With Special Reference to Cage Farming

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Abstract:

The profitability of aquaculture is assessed, with a focus on cage farming in the coastal area of Sindhudurg, India. Employing a mixed-methods approach, primary data is gathered through surveys and interviews, supplemented by secondary data from government reports and academic literature. The economic analysis takes into account investment costs, operational expenses, and market trends. Cage farming specifics, such as stocking density and water quality management, are examined, along with socio-economic factors like community involvement and government policies.

Insights are provided for stakeholders, aiding decision-making for beneficiaries and policymakers. By understanding profitability dynamics in Sindhudurg, this research aims to foster sustainable growth in aquaculture, with implications for other coastal regions. The broader discourse on responsible aquaculture practices is informed by the findings, guiding industry stakeholders toward economically viable and environmentally sustainable strategies.

Keywords: Traditional Accounting, AI in accounting, Cloud Accounting, Outsourcing of Accounting, Real Time Integration of Accounting, 21st Century Technological Advancement in Accounting

Introduction:

Aquaculture, the controlled cultivation of aquatic organisms, stands as a pivotal chapter in the annals of human food production, addressing the escalating demand for seafood while mitigating pressures on natural fisheries. Its roots trace back thousands of years, with evidence suggesting early forms of fish farming in ancient China, Egypt, and Rome. However, the modern trajectory of aquaculture began to crystallize in the mid-20th century, fueled by technological advancements and a growing global population. The 1950s witnessed the development of intensive aquaculture systems, with notable strides in fish and shrimp farming.

Innovations in breeding, nutrition, and disease management soon followed, fostering the rapid expansion of aquaculture across continents. As a result, aquaculture now contributes significantly to the world's seafood supply, offering diverse species ranging from fish and mollusks to crustaceans.

Over the past few decades, the aquaculture sector in India has undergone a transformative journey marked by advancements in technology, improved management practices, and increased awareness of sustainable approaches. The cultivation of diverse aquatic species, including fish, shrimp, and mollusks, has expanded both along the extensive coastline and inland water bodies. Government initiatives, research and development efforts, and the adoption of best practices have facilitated the sector's expansion, enhancing productivity and fostering employment opportunities in rural areas.

The growth of aquaculture in India underscores its significance as a vital component of the nation's food security strategy and economic development. In Sindhudurg District, located along the picturesque Konkan coast of Maharashtra, aquaculture practices have gained prominence as a sustainable source of livelihood and a key contributor to the local economy. With an extensive coastline and favorable environmental conditions, the region has witnessed the cultivation of various marine species through aquaculture methods. Traditional shrimp farming, particularly the cultivation of tiger shrimp (Penaeus monodon) and other indigenous varieties, has been a significant focus. Additionally, inland aquaculture in ponds and reservoirs has gained traction, encompassing the cultivation of freshwater fish like tilapia and carp species. Local aquaculturists often employ integrated farming systems, combining aquaculture with agriculture to optimize resource utilization. Government initiatives and community-driven efforts have supported the adoption of best practices, emphasizing sustainable and environmentally conscious aquaculture. The aquaculture practices in Sindhudurg District not only contribute to the region's seafood production but also play a vital role in enhancing rural livelihoods and fostering economic resilience.

Cage aquaculture, a prominent method in modern aquaculture practices, involves the

cultivation of aquatic organisms within floating cages anchored in natural water bodies such as lakes, rivers, or coastal areas.

This method offers several advantages, including efficient space utilization, reduced environmental impact, and the ability to rear various species. The cages typically consist of nets suspended at various depths, providing a controlled environment for fish or shellfish farming. Cage aquaculture allows for better management of feeding, water quality, and disease control. This approach is particularly advantageous for regions with limited available land for traditional aquaculture ponds. While offering increased production potential, cage aquaculture also requires careful consideration of environmental sustainability and community engagement to mitigate potential impacts on local ecosystems and ensure the long-term viability of this aquaculture method.

This research paper places a significant emphasis on evaluating the profitability of cage aquaculture, specifically within the context of Sindhudurg District. By delving into the economic aspects of this aquaculture method, the study aims to provide insights into its financial viability and potential contributions to the local economy.The analysis considers factors such as production costs, market dynamics, and the socio-economic impact on local communities ensuring a harmonious balance between profitability and sustainability in the dynamic aquaculture landscape of Sindhudurg District.

1. Objectives of the Study

- To assess the economic viability of Cage Aquaculture Practices in Sindhudurg.
- To explore various stages of Cage Aquaculture Scheme of Mangroves Department.
- To understand the issues regarding the Cage Aquaculture in Sindhudurg District.

2. Hypothesis

Cage Aquaculture is a profitable enterprise for the coastal community in Sindhudurg District.

3. Methodology

This study is based on primary data collected through interview schedule created for the Cage Aquaculture Beneficiaries. The secondary data used for this paper is government reports, various books, journals, online research articles, eBooksand websites, etc.

For Cage Farming Projects are selected for this study from four different villages in Sindhudurg District viz. Hadi, Revandi, Devali and Talashil. Hadi and Talashil projects are associated with Sea Bass and Pearlspot farming while Revandi and Devali projects are associated with Green Mussels farming.

4. Review of Literature

The paper "Environmental Impact Assessment of Cage Aquaculture in Coastal Ecosystems" by Chen and Wang (2017) examines the ecological consequences of cage aquaculture in coastal areas, providing insights into the environmental implications and potential challenges associated with this farming practice.

"Sustainable Aquaculture: A Global Review" by Smith and Johnson (2018) offers a comprehensive examination of sustainable practices in aquaculture on a global scale, providing valuable insights into strategies, challenges, and advancements aimed at promoting environmentally responsible and economically viable aquaculture systems.

The paper "Economic Analysis of Fish Cage Farming in Coastal Communities" by Patel and Gupta (2019) presents a detailed economic assessment of fish cage farming within coastal communities, analyzing financial aspects and management strategies to understand the economic viability and potential challenges associated with this aquaculture practice.

"Community-Based Cage Aquaculture in Developing Regions: Lessons from Sindhudurg District" by Khan and Sharma (2020) explores the experiences and lessons learned from implementing community-based cage aquaculture in Sindhudurg District, providing valuable insights into the social and economic dynamics of such initiatives in developing regions.

"Socio-Economic Benefits of Cage Aquaculture for Coastal Livelihoods" by Das and Dutta (2021) investigates the socio-economic advantages stemming from cage aquaculture, shedding light on its impact on coastal communities' livelihoods, emphasizing the potential positive contributions to the economic well-being of the local population.

Despite the existing literature on various aspects of fish aquaculture, there is a research gap in specifically addressing the profitability analysis of aquaculture projects in Sindhudurg district. The identified papers do not directly focus on the financial viability and economic implications of aquaculture ventures in this specific geographical context.

5. Discussion:

5.1 Mangrove Conservation and Livelihood Generation

On September 20, 2017, the Government of Maharashtra launched a program focused on 'Mangrove Conservation and Livelihood Generation' in the coastal districts of the state. The implementation of this initiative is overseen by the Mangrove Foundation, facilitated through village-based Mangrove Co-Management Committees (MCMCs). Under this scheme, group activities are eligible for a 90% subsidy, while individuals (specifically landowners with over 1 acre of private mangroves) can avail themselves of a 75% subsidy for livelihood-related endeavors. The scheme,

initially set to expire, has been extended until 2025. A total of 122 villages in Palghar, Thane, Raigad, Ratnagiri, and Sindhudurg have been selected for the execution of scheme activities.Following activities are being implemented across various villages along the coastline of Maharashtra:

- Mud Crab Farming
- Oyster Farming
- Fish Cage Culture
- Green Mussels Farming
- Marine and Freshwater Ornamental Fish rearing
- Mangrove Ecotourism

Out of above activities under the scheme, two livelihood generating activities are selected for this study namely Fish Cage Culture of Asian Sea Bass and Pearlspot and Green Mussels Farming.

5.2Steps involved in Cage Aquaculture Projects under Mangrove Conservation and Livelihood Generation Scheme

1. **Registration:** The people in coastal communities in selected villages by Mangrove Foundation, should form a group of 7 to 10 persons for applying the Cage Aquaculture Project under the scheme. Such group is established as the Mangrove Co-Management Committee after compliance of necessary documentation. After site selection and feasibility study the Mangroves Foundation approves the project for further execution.
2. **Training:** The selected groupsare trained at training centers in Gujrat and Chennai.
3. **Cage Construction and Installation:**The cages are constructed by the Mangroves Foundation at the selected sites as per the prescribed parameters of the foundation.
4. **Seedstock Acquisition and Stocking:**The seedstock of Asian Sea Bass, Pearlspot and the Green Mussels are supplied from the Hatcheries in Chennai to the selected sites of projects.
5. **Feeding:** Asian Sea Bass seeds, Pearlspot seeds, need to be fed twice daily until the day of harvesting. In contrast, Green Mussels do not require supplemental feeding; they grow naturally by obtaining nutrients from the water's natural flow.
6. **Maintenance:** The group members look after the maintenance of the cages and the nets in the project. Daily cleaning is required to maintain the health of the fishes and mussels.
7. **Separation:**Periodic separation based on size or growth is necessary for Asian Sea Bass and Pearlspot fishes. Such separation is not required for the green mussels.
8. **Harvesting:** In 6 to 7 months the fishes and mussels are ready to harvest. They are harvested right before the buyer's carriers arrive to the site.
9. **Sales:** After harvesting the fish and mussels they are sold in Goa Market, Raigad Market. A very few times, those are sold in local markets.

5.3Costs involved for Fish Cage Farming

1. Costs Involved: For fish cage farming the costs involved are Cage Installation Cost, Seed Cost, Feed Cost, and Labour Cost for feeding, cleaning, separation of fish and harvesting.
2. Subsidy: The beneficiaries receive subsidy upto the 90% of the project cost sanctioned. They have to incur 10% cost only.
3. Notional Labour Cost: The group members work for the tasks of feeding, cleaning, separation of fish and harvesting. However, they do not charge or calculate their labour cost. For the purpose of profitability analysis, here, the notional labour cost is considered.

5.4 Profitability Analysis

- The following table explains the details of notional labour cost and profitability percentage of the selected cage farming projects.

The cumulative notional labor cost for each Asian Sea Bass & Pearlspot project amounts to Rs. 30,660, whereas the total notional labor cost for each Green Mussels Project is only Rs. 4,500. This difference is attributed to the fact that Green Mussels projects do not involve tasks such as feeding and separation. The labor cost for activities like feeding, cleaning, separation, and harvesting is computed based on the prevailing Labor Rate per hour of Rs. 60 in the specified villages. The necessary labor hours for each task are determined and multiplied by the labor rate to arrive at the labor cost.

Table 1

FISH CAGE FARMING COST BENEFIT ANALYSIS

PARTICULARS	P1	P2	P3	P4
	HADI	REVANDI	DEVALI	TALASHIL
Notional Labour Cost				
Total Cleaning Labour Cost Rs.	1800	1800	1800	1800
Feeding Labour Cost Rs.	13500	0	0	13500
Separation Labour cost Rs.	14400	0	0	14400
Harvesting Labour Cost Rs.	960	2700	2700	960
Total Notional Labour Cost Rs.	30660	4500	4500	30660
Sales				
Asian Sea Bass Kgs	325			410
Pearlspot Kgs	225			150
Green Mussels Kgs		1500	1500	
Total Sales Rs.	197500	562500	525000	253750
Contribution of Beneficiaries	29800	10030	10030	29800
Profit Rs.	137040	547970	510470	193290
Percentage of Profit %	69.39	97.42	97.23	76.17

Source: Primary Data

Observations:

- Notional Labour Cost:P2 (REVANDI) and P3 (DEVALI) Green Mussels projects have significantly lower notional labor costs compared to the Asian Sea Bass projects (P1 and P4).P2 (REVANDI) and P3 (DEVALI) do not incur feeding and separation labor costs for Green Mussels, contributing to their lower total notional labor costs.
- Sales:P2 (REVANDI) has the highest total sales at Rs. 562,500, primarily driven by substantial sales of Green Mussels (1,500 Kgs).
- Contribution of Beneficiaries:P4 (TALASHIL) and P1 (HADI) projects have the highest and lowest contribution of beneficiaries, respectively influenced by the total project sanctioned amount.
- P3 (DEVALI) has the second-highest total sales at Rs. 525,000, with significant contributions from Asian Sea Bass and Pearlspot.
- Profit:P2 (REVANDI) and P3 (DEVALI) projects show higher profits, with P2 achieving the highest profit of Rs. 547,970.P4 (TALASHIL) and P1 (HADI) projects have comparatively lower profits.
- Percentage of Profit:P2 (REVANDI) and P3 (DEVALI) projects exhibit high percentages of profit, exceeding 97%.P1 (HADI) and P4 (TALASHIL) projects have lower percentages of profit, indicating a relatively smaller profit margin.

Overall, the table highlights variations in notional labor costs, sales distribution, beneficiary contributions, and profits among the different fish cage farming projects. The Green Mussels projects (P2 and P3) stand out with lower costs and high-profit percentages, while the Asian Sea Bass and Pearlspot projects (P1 and P4) demonstrate different profit margins.

6.Hypothesis Testing:

Based on the analysis of the Fish Cage Farming Cost-Benefit data, it can be concluded that the hypothesis, "Cage Aquaculture is a profitable enterprise for the coastal community in Sindhudurg District," is generally supported. Here are the key points supporting the hypothesis:

- **Profitability Across Projects:**

The majority of the fish cage farming projects (P2, P3) demonstrate substantial profits, exceeding 97% in terms of percentage of profit.High-profit margins indicate that the cage aquaculture ventures are indeed financially lucrative.

- **Sales Performance:**

The total sales figures across the projects are significant, with P2 (REVANDI) leading with a total sales value of Rs. 562,500.Robust sales contribute to the overall economic viability of the fish cage farming endeavors.

- **Beneficiary Contributions:**

Beneficiaries contribute significantly lower amounts in projects where Green Mussels are involved (P2 and P3), suggesting that the financial burden on the community is relatively low.

- **Notional Labour Cost Analysis:**

The notional labor cost, which includes tasks like cleaning, feeding, separation, and harvesting, is well-managed in projects with Green Mussels, contributing to lower overall costs.

- **Profit Distribution:**

The projects, particularly P2 (REVANDI) and P3 (DEVALI), showcase a balanced distribution of profits among beneficiaries, highlighting the potential socio-economic benefits for the coastal community.

Conclusion:

The data from the fish cage farming cost-benefit analysis supports the hypothesis that cage

aquaculture is a profitable enterprise for the coastal community in Sindhudurg District. The high-profit margins, substantial sales, and manageable labor costs suggest that fish cage farming can contribute positively to the economic well-being of the community.

In conclusion, fish cage farming in Sindhudurg district showcases a sustainable and economically viable model for rural development. Through community involvement, skill development, and livelihood diversification, these projects contribute positively to both the local economy and environmental conservation. The success of fish cage farming underscores its potential as a catalyst for balanced rural development in coastal areas.

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Phytochemical And Biological Evaluation Of Plumeria Pudica Plant

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Abstract:

Present study reports phytochemical screening and the microbial activity of crude extracts of Plumeria pudica plant on some human pathogenic bacteria and fungi.Plumeria pudica(NaagChampa) plant is a very good old plant and about this there are lot of work has been done related to different activities such as anti-inflammatory, laxative, carminative, also possess anti-microbial activity, cytotoxic activity, anti-allergic, ascites, diuretic, anti-ulcer and useful in treating leprosy. Leaf extracts were prepared with different solvents and tested for the presence of primary and secondary metabolites which are pharmacologically active compounds. Ethanol, ethyl acetate and hexane extracts revealed the presence of more constituents including alkaloid, tannins, anthroquinones, glycosides, phenols, flavonoids etc. As many of the active ingredients in chemically manufactured drugs were originally derived from plant compounds, extracts are also used to screen the antimicrobial activity. The zone of inhibition was determined utilizing the well diffusion method. Ethanol was found to be highly sensitive against Gram positive S-aurous and gram-negative E-coli. More recently there have been preclinical and clinical studies looking into the plants supposed liver- protective abilities and effect on hepatitis B.The inhibitory activity of these extract confirmed the potential use of the plant in the treatments of microbial induced ailments.

Keywords: Phytochemical screening, Plumeria pudica, pharmacologically, Antimicrobial activity.

Introduction:

The present Plumeria pudica (NaagChampa) plant is a very good old plant and about this there are lot of work has been done related to different activities such as anti-inflammatory, laxative, carminative, also possess anti-microbial activity, cytotoxic activity, anti-allergic, ascites, diuretic, anti-ulcer and useful in treating leprosy. Plumeria contains so many species, they are mostly for decorative purpose and the plant flowers perineal. It is native to Mexico in India we see them near the temples and empty grounds. Along with the flowers and leaves other parts of plant also have good activities like bark of root is bitter, pungent, heating, laxative, carminative, used in treatment of leprosy.

Evergreen or semi-deciduous plant, it appears as a shrub or as a tree of small or average size, with compact foliage which slightly expands with the shape of a cone, which can reach about the 5 metres of height; it has rather thin stems, grey in the older part, dark green in the younger one, and leaves with the typical “arrow” shape (oblong-spatulate) up to about 30 cm of length, of a glossy dark green colour. Terminal inflorescences with showy flowers, bisexual, funnel-shaped, with a diameter of 7-8 cm, with petals of a candid white colour with yellow fauces, inodorous. The fruits are fusiform, coupled, follicles, 15-25 cm long, containing several flat seeds provided with a membranous wing, which favour their dispersion. It usually and easily reproduces by cutting and by air layering.

The Plumeria pudica plant has been placed in old literacy texts as laxative, anti-allergic, carminative, also possess cytotoxic activity, anti-inflammatory, anti-microbial activity, anti-ulcer, diuretic, and useful in treating leprosy and ascites, . Plumeria species are worn as decorative plant that blossoms perineal. It is indigenous to Mexico and in India normally seen in worship places and burial grounds. The root bark is pungent, bitter, laxative and heating, carminative, used in treatment of leprosy. The literacy texts disclose that the systemic study, includes pharmacognostical evaluation of this plant is till now imaginary. There is a necessity for confirmation of investigation work carried out on new therapy. With this loop point, pharmacognostical evaluation becomes very important to prepare the standards for the medicinal plants. The existing study of the present work is to evaluate pharmacognoistic standards of the leaves of plant Plumeria pudica, which will useful for the correct authentication of this plant.

Plant of great ornamental value, thanks to its copious blooming with a dazzling flowerage, which lasts, in the tropics, for 6-8 months per year and its typical foliage. Rather sensible to low temperatures plant, if outside from the tropical and subtropical zones, it must be cultivated in pot, in

order to be sheltered in winter in a luminous space which temperature which are not to get lower than 12-14°C, and to be replaced in open location in spring, possibly exposed towards the south, as it needs at least 6-8 hours of sun per day in order to give a good blooming.

Phytoconstituents from plants gives diversity of drugs now days. The plants have the plant drugs also constitute a ability for expand few novel semisynthetic curative agents. Over the past 10 years there has been a increasing attentiveness of plants origin and from the familiar plant species, no activity has been done for phytochemicals and pharmacological activities. Wild Plumeria an evergreen species of Plumeria native to Panama, Colombia and Venezuela. It is a shrub which usually has one or two slender trunks that branch close to the ground forming a shaped. Large clusters of bright white 3-inch flowers with small yellow centers cover this tree as a beautiful bouquet, hence the common name. The flowers are not fragrant. The plant looks attractive even when it is not flowering, because of its beautiful leaves. Small tree, leaves in distinct fiddle shape with 2 lobes in the middle. Flowers white with yellow throat, bloom in bunches like a bouquet thus the common name 'Bridal Bouquet'. Blooming occurs all year round and blooming period usually long. Prone to attack by mealy bugs and frangipani caterpillars and affected by rust fungus that speed up leaf loss. When injured, plant secretes white milky sap that is slightly poisonous.

Benefits of plumeria leaf:

It is known to alleviate inflammation, headache, back pain, and tinnitus. While the aphrodisiac nature of this oil relaxes nerves, muscles, and boost libido. Imbued with strong antioxidant and anti-inflammatory traits, the frangipani flower is beneficial in uplifting overall health and well-being.

Traditional use of Plumeria pudica:

In various diseases includes Anti-inflammatory, nociceptive, anti-helminthic, anti-diarrheal activities and neurodegenerative disorders.

Gynecological disorders:

Every woman suffers with a gynecological disorder such as vaginal infection, menstrual problems etc. The infection was more in rural areas because of non-hygienic conditions, life style and their food habits. In India so many medicinal plants are used in Ayurveda which do not have any toxicity or less toxic compared to synthetic drugs. In order to use in a better way, the drugs are to be standardized and validated with established methods. In the present study plumeria pudica and other three herbs play an important role to cure the gynecological disorders in medication conventional system.

Materials and Method:

Plants Collection:

The present work was carried out at Department of Chemistry, J.M.V. Chandrapur, Gondwana University. The plant namedPlumeria pudicacollected from Chandrapur forest region. Their botanical identity of plant was determined and authenticated from literature available in Department of Botany, J.M.V. Chandrapur. The leaves of Phyllanthus amarusplant was thoroughly washed with water and dried under shade for about ten days. The dried plant sample was grinding well into a fine powder in a mixture grinder. The powder was stored in air sealed polyethylene bag at room temperature before extraction.

Preparation of Ethanol extract:

100 g of the dried and powdered Plumeria pudicaleaves were extracted at room temperature with 500 ml absolute ethanol for 72 h. extraction was done using the soxhlet apparatus briefly 100 gm of powder leaf was stored in a air sealed polyethylene bag & placed in Soxhlet & extracted with absolute ethanol The extraction was done until the solvent in the soxhlet turned colourless. The extract was concentrated by recoveringthe solvent using the soxhlet apparatus until the extractbecame just pourable. It was poured into a beaker & this was then used for the analysis.

Phytochemical Analysis:

There are two extract: i) Ethanol

The extracts were analyzed for the presence of Alkaloids, Terpenoids, Tannine , Saponin,

Flavonoid, Anthraquinone, Reducing Sugar, Glycoside and Cardiac glycoside.

1. **Alkaloid:** About 0.2g of the extracts was warmed with 2% H_2SO_4 for two minutes. It was filtered and few drop pf Dragencloffs reagent were added. Orange red precipitated indicated the presence of alkaloids.
2. **Tannine:** Small quantity of extracts was mixed with water and heated on water bath. The mixture was filtered and ferric chloride was added to the filtrate. A dark green solution indicates the presence of tannins.
3. **Anthraquinones:** About 0.5 g of the extracts was boiled with 10% HCl foe few minutes in a water bath. It was filtered and allow to cool. Equal volume of $CHCl_3$ was added to the filtrate. Few drop of 10% NH_3 were added to the mixture and heat. Formation of rose-pink colour indicates the presence of anthraquinones.
4. **Glycoside:** The extract was hydrolyzed with HCl solution and neutralized with NaOH solution. A few drop pf Fehling's solution A and B were added. Red precipitate indicates the presence of glycoside.
5. **Reducing Sugars:** The extracts was shaken with distilled water and filtered. The filtrate was boiled with drop of Fehling's solution for minutes. An orange red precipitate indicates presence of reducing sugar.
6. **Saponins:** About 0.2g of the extract was shaken with 5ml of distilled water and then heated to boil. Frothing (appearance of creamy miss of small bubbles) shows the presence of saponins.
7. **Flavonoids:** Extracts of about 0.2g was dissolved in diluted NaOH and HCl was added. A yellow solution that turns colorless, indicates the presence of flavonoids. Phlobatannins: The extract (0.5g) was dissolved in distilled water and filtered. The filtrate was boiled with 2% HCl solution. Red precipitated show the presence of phlobatannins.
8. **Terpenoids (Salkowski test):** 0.2g of extracts was mixed with 2ml Chloroform ($CHCl_3$) and concentrated H_2SO_4 (3ml) was carefully added to form a layer. A reddish-brown coloration of the interface was formed to indicate positive results for the presence of terpenoids.
9. **Cardiac glycosides:** 5 ml of each extracts was treated with 2ml glacial acetic acid containing one drop of ferric chloride solution. This was underplayed with 1 ml of concentrated H_2SO_4. A brown ring of the interface indicates a deoxysugar characteristic of cardenolides. A violet ring may appear below the brown ring, while in acetic acid layer, a greenish ring may form just gradually throughout thin layer.

Preparation of aqueous extract:

100 g of the dried and powdered Plumeria pudicaleaves were extracted at room temperature with 500 ml aqueous solution for 72 h. extraction was done using the soxhlet apparatus briefly 100gm of powder steam was stored inair sealed polyethylene bag & placed in soxhlet& extracted with absolute ethanol The extraction was done until the solvent in the soxhlet turned colourless. The extract was concentrated by recoveringthe solvent using the soxhlet apparatus until the extractbecame just pourable. It was poured into a beaker & this was then used for the analysis.

Preparation of extracts:

The microorganism used in the study: Gram-negative E-coli, Gram-positive S-aurous and Nizer fungus Aspergillus were obtained from stock culture in the Department of Microbiology, J.M.V. Chandrapur.

Antimicrobial Activity:

Antimicrobial activity of callus, different solvent extracts and zinc nanoparticles (leaves). The antimicrobial activities of plant leaves, callus and zinc nanoparticles synthesized used leaves aqueous extract were evaluated by agar well diffusion assay, In each 50ml of plant extract was poured. DMSO was used as a negative control whereas ciprofloxacin was used as positive control. The anti-microbial activity of extract was determined by inhibition zone diameter. The zones are measured by high media zones scale. The experiment was repeated twice and the average values were recorded for anti-bacterial activity.

Antimicrobial screening of extracts:

Susceptibility test were carried out. The modified agar well diffusion method to test the antimicrobial activity of the extracts. The medium employed was diagnostic sensitivity agar. The culture was prepared in triplicate was incubated at 370^0 C for 24 to 72 hr. 0.2 ml of the broth culture of the test organism was put in the sterile Petri-dish and 18ml of sterile molten diagnostic sensitivity agar, was added. Well were bored into the medium using 0.1ml of the extracts. Streptomycin and Chloramphenicol were used as the standard antimicrobial agents at a concentration of 10 mcg/disk, 30 mcg/disk respectively. The plates were kept in sterilized inoculation chamber for 2hr to facilate diffusion of the antimicrobial agents into the medium. The plates were then incubated at 37^0C for 24 hr. and the diameter of zone of inhibition of microbial growth were measured in the plates in millimeters.

Result:

Phytochemical screening of ethanol extract of *Plumeria pudica* is shown in table 1.

The susceptibility of test microorganism to the crude extracts of *Plumeria pudica* is shown in table. 2

Phytochemical tests of ethanol extract of plants *Plumeria pudica* leaves in ethanol extract
Table No. 1

Chemical composition	Ethanol Extract
Alkaloid	Present
Tannine	Absent
Anthraquinone	Absent
Glycoside	Absent
Reducing sugar	Absent
Saponine	Present
Flavonoid	Absent
Terpenoid	Present
Cardiac glycoside	Present

Table 2 -Antimicrobial activity of leaf in ethanol,

1	Gram +ve s-aureus	Gram -ve E-coli
2	20mm	15mm

Discussion:

The qualitative analysis of extracts from ethanol and leaves of *Plumeria pudica*. Showed the presence of photochemical constituents such as

1.Ethanol extract present in alkaloid, terpenoid, saponine, Cardiac glycoside.

Absent tannine, anthraquinone, glycoside, reducing sugar and flavonid.

2.This result is summarized in table 1. The above result indicates that, the leaves of plant extract in ethanol solvent investigated are rich in alkaloid, terpenoid, saponine, Cardiac glycoside. The Ethanol extract have showed absence of tannine, anthraquinone, glycoside, reducing sugar and flavonid. Extract of leaves were tested against Gram positive S-aurous and Gram-negative E-coli (with zone of inhibition above 20mm for gram +ve and 15mm for gram -ve means highly sensitive). Ethanol extract was showed more antimicrobial activity than standard antibiotics and chloramphenicol. The inhibitory activity of these extract confirmed the potential use of the plant in the treatment of microbial induced ailments. Ethanol extract was showed more antimicrobial activity than standard antibiotics streptomycin and chloramphenicol. The inhibitory activity of these extract confirmed the potential use of the plant in the treatment of microbial induced aliments.

The plant studied here can be seen as a potential source of drugs. Further studies are going on this plant in order to isolate,identify, characteristics and elucidate the structure of bioactive compounds.

Conclusion:

The plant *Plumeria pudica*is rich in alkaloid, flavonoid, saponin, etc. The antimicrobial activity of the extracts can be co-related to their specific contents of alkaloids, flavonoids and terpenoids. The ethanol extract was found to be antimicrobials more effective than the hexane extract. The antimicrobial activity of S-aurous is more effective than E-coli.The plant summarizes information concerning the morphology, ecology and most importantly phytochemical constituents and antimicrobial activity. Plumeria pudica herb is widely used Tropical countries including India. It has significant traditional uses, some of them have been experimentally established and an attempt has been made to isolate potential chemical constituents and their mechanism of action.

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Symbiotic Synergy: Unraveling Arbuscular Mycorrhizal Fungi Associated With Medicinal Flora in Melghat, Amravati (Ms)

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Abstract:

Asian countries are very rich in medicinal plant species and are the major exporters of these plants and their products. These medicinal plants can be popularized and used to improve the economy of low-income countries of Asia and create livelihoods for its people.

The Melghat nestling in the Satpuda hill ranges of Central India with vast tract of inviolate natural forest consisting of unique and representative ecosystems with rich biodiversity. It is also represented as centre of biodiversity of medicinal plant. The current day emphasis is on sustainable agriculture, which uses less of chemical inputs like fertilizers and pesticides having adverse effect on soil health, fertility and environment. Thus, use of microbial inoculants plays an important role in sustainable agriculture. Arbuscular Mycorrhizal fungi (AMF) are known to improve the nutritional status, growth and development of plants.

AMF affects secondary metabolism and active ingredients production of plants and it influences the quality of herbal medicines, thus improving the total yield.Hencethe purpose of this research was to isolate and identify Arbuscular Mycorrhizal Fungi (AMF) associated with the rhizosphere soil samples of some medicinal plants and mass propagate the native dominant species for further studies. The soil samples were collected from various regions of Melghat, Amravati (M.S.). These samples from rhizosphere of medicinal plantswere wet sieved, and AMF spores were isolated and identified morphotaxonomically. In all five species of *Glomus* were observed e.g.,*Glomus leptotichum, Glomus aggregatum, Glomus fasciculatum, Glomus maculosum*. The most dominant were of *Glomus fasciculatum.* This dominant species will be recorded.

Key Words: Melghat, Medicinal Plants AMF, *Glomus*

Introduction:

The Melghat nestling in the Satpuda hill ranges of Central India with vast tract of inviolate natural forest consisting of unique and representative ecosystems with rich biodiversity and varied habitats offered by deep valleys and high hills with rivers and nallahs. It is also represented as centre of biodiversity of medicinal plants. Giri (1994) has listed many medicinal plants from this region. About 80% of the world population use traditional medicine for their primary health care (Patil and Kutemate, 2017). These both surveys had explored medicinal importance of plants.

Medicinal plants are the most important source of therapeutic agents since time immemorial. Tribal and rural community from their parents on folklore medicines acquire incredible knowledge of phytomedicine in non-coded form. The knowledge of these medicinal plants is transferred traditionally from one generation to other without any documentation. Korkus, Bhumka, Vaidus or Bhagats traditionally use plants for the treatment of different types of diseases like diarrhoea, dysentery, stomach-ache, and many other enteric disorders (Tambekar et al., 2009).

Overuse of pesticides and chemical fertilizers mostly generates severe problems and may deteriorate the quality of medicinal plant products. Therefore, adoption of modern technologies and uses of bio-fertilizers for farming of medicinal plants is essential. Arbuscular mycorrhizal fungi (AMF) are an important group of soil microorganisms that form AM symbioses with the roots of 80% of terrestrial plants, playing an important role in soil fertility, plant nutrition and inducing changes in plant physiology and secondary metabolism. Therefore, it is very important to explore the role and diversity of these fungi in the rhizosphere community structure. The relationship between medicinal plants and their rhizosphere fungi for enhancing the quality of medicinal plants. The diversity of AMF communities to improve soil structure and fertility.

About 80–90% of higher plants on earth and in all of the planet's environments have roots that are in mutualistic symbiotic partnerships with arbuscular mycorrhizal fungus(van der Heijden et al., 2015). The plant gives the fungus products of photosynthesis, and the fungus gives the plant

nutrients, particularly immobile nutrients like phosphorus (Cardoso et al., 2017; Ma et al., 2019).

Almost all land plants and AM fungus have symbiotic relationships. They can boost the efficiency with which their host plants utilise nutrients, increase N2-fixation in legumes, decrease the occurrence of plant diseases, raise plant tolerance to stress, and enhance the physico-chemical quality of the soil (Jeffries et al., 2003).

In recent years, due to their enormous potential in both traditional and modern medicine, the cultivation of medicinal and herbal plants has taken on greater significance. In the pharmaceutical, cosmetic, and fragrance industries, they are also employed as raw ingredients. ISM (Indian System of Medicine) employs 25,000 species from more than 1000 genera. Industries employ about 25% of species (Jaleel *et al* 2009). Inoculating VAM fungus at the beginning of the acclimatisation phase has evolved into a different tactic for better establishment by enhancing plant growth. Microorganisms, particularly VAM fungus, have been found on therapeutic plants, as has been previously documented (Karthikeyan et al., 2008). Along with promoting the growth of medicinal plants, the VAM fungal relationship also increased the yield of medicinal chemicals.therefore, the aim of this research was to isolate and identify Arbuscular Mycorrhizal Fungi (AMF) associated with the rhizosphere soil samples of some medicinal plants and record the dominant species for further studies.

Materials And Methods:

Area of study:

Study area is Melghat. Melghat in the South-western Satpura mountain ranges. Melghat means 'meeting of the ghats'. It stretches from south to north between latitudes 21 0 -11’ and 21 0 - 46’ north and from west to east between longitude 78 0 - 38’ and 77 0 -34’ east.

Collection of soil sample:

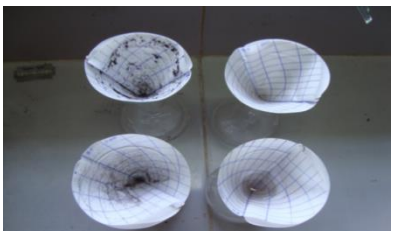
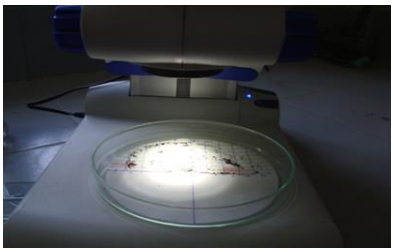
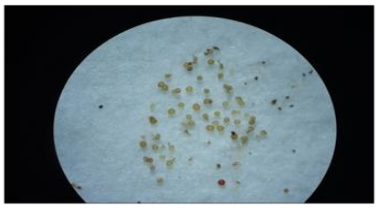
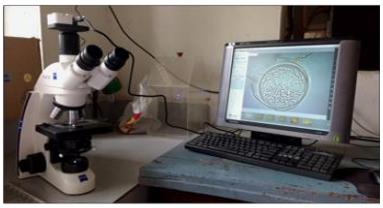
The samples were collected from different villages of melghat. The soil samples of selected medicinal plants were homogenized and deposited in polyethylene bags and labelled. The rhizospheric soils of each sample were collected from the depth of 2 to 20 cm along with roots with the help of soil auger and other instruments.

Selected medicinal plants are:

- Abutilon indicum
- Abrus precatorius
- Achyranthus aspera
- Sida cordata
- Caesalpinia bonduc

Isolation of AMF spores from Rhizospheric Soil:

AMF spores were isolated from the rhizospheric soil by the method given by Gredemann and Nicolson (1963), with some modification.Air dried rhizospheric soil was sieved from sieve having 2mm aperture size to remove large stones and debris from the soil.100gm of that sieved soil was suspended in 1000ml of tap water and mixture was stirred for 10-15 second. Coarse particles were allowingto settle for 15-30 min or more depending on texture of soil.The supernatant then decanted through a series of 4 scientific sieves arranged in descending order of mesh size viz. 150mm, 75mm, 53mm, 37mm.Sievates from each sieve then filtered through Whatman filter paper no. 1 to isolate the spores.

Estimation of AMF Spore

AMF spore number was estimated by the method given by Gaur and Adholeya (1994), with some modification in this method.Filter paper (Whatman No. 1, size 12.5cm diameter was folded into two equal parts followed by a second fold resulting in four equal parts. The filter paper then reopened and two lines were drawn to divide it into four equal quadrates. Then vertical lines were drawn on one half of the filter paper dividing it into approximately 10 columns which are about 1 mm apart and also horizontal lineswere also drawn dividing it into ten rows about 0.5mm apart with each other resulting into rectangles. Each column and row were numbered and direction of counting was marked with arrows.The filter paper was then folded in such a way that during decanting that marked portion will be receiving surface for the spores during filtrations. Thus, the spores were collected only on the marked surface of the filter paper and the remainder was retained without spores. The Sievates of rhizospheric soil (which is described in the method of Gerdemann and Nicolson, 1963) were filtered from filter paper having rectangles formed by vertical and horizontal lines. The filter paper with spore and other debris was spread on a large petri-plate and observed under Carl Zeiss Stereozoom microscope. The spore number was then counted from each rectangle of columns in upward direction by moving the petriplate. Intact spores were picked up using a wet needle and mounted in polyvinyl alcohol lactoglycerol (PVLG) on a glass slide for identification and photography.

Identification of AMF Spores:

Identification of AMF spores was done by using 'Manual for the Identification of VA Mycorrhizal Fungi' – by N. C. Schenck and Yvonne Pérez (1990) and using the link invam.wvu.edu/the-fungi/species-description.

Photography:

Photography of AMF spores isolated from rhizospheric soil was done by using Carl Zeiss inverted compound microscope with Tucsen Camera (0.5 MP).

Results And Discussion:

The present investigation shows the occurrence of AMF species associated with some medicinal plants species from Melghat region of Amravati (MS). Total 125 spores were isolated from soil sample out of which *Glomus* was most dominant.In all four AM fungal species were identified as *Glomus maculosum, Glomus aggregatum, Glomus leptotichum and Glomus fasciculatum*.

Glomus maculosum, Miller and Walker

- Colour :- Pale straw colour
- Shape :- Globose to subglobose
- Size :- (95-)135-178(-220) x (95-)130 -187 (-220) µm
- Composite spore wall :- 4.4- 15µm
- The inner wall in many older spores bearing domed, scalloped ingrowths.

Glomus aggregatum, Schenck and Smith emend. Koske

- Colour :- Pale yellow to yellow brown
- Shape :- Globose to sub- globose
- Size :- (20-) 40-85 (-120)µm
- Composite spore wall :- 2-6 (-10)µm
- Subtending hypha: - Straight, constricted, swollen or irregular and (6.4 -) 14.3(-21.6) µm wide at spore base.
- Spores produced in sporocarp

Glomus leptotichum, Schenck and Smith

- Colour :- Light yellow
- Shape :- Globose
- Size :- (48-)175(-262)µm
- Composite spore wall :- 1.5-7.4(-10.5)µm
- Subtending hypha :- 9-27µm wide at the point of attachment
- Spore wall with adhering debris on the outer surface especially at the hyphal attachment

Glomus fasciculatum, Walker and Koske

- Colour :- Pale yellow to pale yellow brown

- Shape :- Globose
- Size :- 75-149 µm
- Composite spore wall :- (2.3)7-12(-16.1)µm
- Subtending hypha straight

Glomus maculosum

Glomus aggregatum

Glomus leptotichum

Glomus leptotichum

Glomus leptotichum

Glomus leptotichum

Glomus fasciculatum

Glomus maculosum

Conclusion:

The present study revealed that the rhizosphere soil of some medicinal plants shows dominance of *Glomus* species.This study has a future scope to explore the antimicrobial activity of AMF spore and study the effect of dominant species on growth parameters by raising the inoculum and applying nature's own tool as a biofertilizer.

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The Significance of Physical Education in Promoting Holistic Development

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Abstract:
This research paper delves into the crucial role of physical education in fostering holistic development, encompassing the physical, mental, and social dimensions of individuals. By examining historical perspectives, educational impacts, challenges, and innovative trends, this study aims to underscore the multifaceted contributions of physical education to the overall well-being of individuals. The educational impact of physical education on cognitive development is a central focus of this research. By examining empirical studies and educational outcomes, we aim to elucidate the intricate connections between physical activity and mental well-being. The paper also explores challenges faced by physical education programs, including resource constraints, societal attitudes, and potential barriers to inclusivity.Innovative trends in physical education are analyzed to discern their potential in redefining conventional approaches. From the integration of technology to novel teaching methods, these trends offer insights into the future of physical education and its adaptability to the evolving needs of society.

Keywords: Holistic, physical activities, education, exercise, importance, development.

Introduction:

In an era marked by technological advancements, shifting lifestyle patterns, and an ever-increasing emphasis on academic achievement, the role of physical education in shaping well-rounded individuals cannot be overstated. Holistic development, an intricate interplay of physical fitness, mental acuity, and social competence, has emerged as a cornerstone of individual well-being. Physical education stands at the intersection of these dimensions, offering a unique and comprehensive approach to nurturing the multifaceted growth of individuals.Historically, physical education has traversed a diverse landscape, adapting to societal changes, cultural influences, and educational philosophies. From ancient Greek gymnasia to the structured physical education programs of modern schools, its evolution mirrors the evolving understanding of the interconnectedness between physical health and overall well-being. As we navigate the intricate layers of this dynamic field, this research embarks on an exploration of the significance of physical education in promoting holistic development.

The contemporary landscape of education often places a disproportionate emphasis on cognitive development, relegating physical activity to a secondary role. However, an increasing body of evidence suggests that physical education is not merely a supplement but an essential catalyst for fostering holistic growth. This study delves into the historical roots of physical education, establishing a contextual foundation for understanding its transformative potential in shaping well-rounded individuals.

The educational impact of physical education extends beyond the playing field. Physical activity is intricately linked to cognitive development, problem-solving skills, and academic performance. As we scrutinize empirical studies and educational outcomes, we aim to unravel the symbiotic relationship between physical engagement and mental well-being, advocating for an integrated approach to education that encompasses both body and mind.

However, despite its inherent significance, physical education faces a myriad of challenges, from resource constraints to societal attitudes that undervalue its role. This research confronts these challenges head-on, seeking to identify barriers and propose strategies for the effective integration of physical education into educational curricula.

Previous Work:

The roots of physical education extend deep into the annals of human history, weaving a narrative that intertwines cultural practices, societal norms, and evolving educational philosophies. From ancient civilizations to the present day, the historical perspective of physical education reveals a dynamic interplay between the physical, mental, and social aspects of human development.

- **19th Century: The Rise of Formalized Physical Education:**

The 19th century marked a pivotal era with the formalization of physical education within educational institutions. Pioneers like Friedrich Jahn

in Germany and Per Henrik Ling in Sweden introduced structured physical education programs. Jahn's "Turnplatz" (gymnastics field) and Ling's system of gymnastics laid the foundation for the inclusion of physical training in schools.

- **20th Century: Shifting Paradigms and Recognition of Holistic Development:**

The 20th century witnessed a shift in perspectives toward physical education, moving beyond the militaristic and disciplinary focus prevalent in the 19th century. Visionaries like John Dewey advocated for a more child-centered approach, recognizing the importance of play, recreation, and physical activity in the overall development of children.

Ennis[1] argued that physical education needs to provide a transformative learning environment that will motivate students to achieve learning goals. Creating transformation within physical education requires a thorough understanding of motivation sources.Based on summarized findings from classroom research,expectancy beliefs and task values (EBTV) have been identified as strong sources of motivation in physical education.

A comprehensive definition of Physical Education (PE) is proposed, drawing upon abundant scientific evidence. PE stands as a foundational subject entrenched in the educational curricula of numerous countries [2]. Its primary objective is to contribute substantively to the holistic development of children by enhancing their motor, psychic, affective-emotional, and social skills [3,4,5]. This developmental progress is achieved through the deliberate incorporation of prescribed educational content tailored to each school stage.

The effectiveness of PE hinges on the meticulous adaptation of methodological and didactic principles to suit the age group and developmental stage of the students. Functioning as a conduit for knowledge acquisition and practical application, PE utilizes the body and movement as central instruments [6, 7]. Its broader mandate encompasses the promotion of physical exercise adherence, fostering a healthy lifestyle, and instilling values related to body aesthetics, health, and social well-being [8].

Within its practical sessions, PE serves as a facilitator for students to connect with their bodies, fostering feelings of awareness, acceptance, care, development, and love. Simultaneously, these sessions provide a platform for the establishment of interpersonal relationships [9]. The subject further functions as a medium for the cultivation of motor skills, psychomotricity, physical abilities, and technical and tactical proficiency in various sports games and activities [10].

Beyond the physical realm, PE plays a pivotal role in the development of human capital. It influences ethics, morals, values, psychological and psychosocial variables, and critical thinking within the domains of physical exercise, health, and nutrition [11]. Finally, PE emerges as an ideal subject for the integrated exploration of content from diverse areas of knowledge.

Educational Impact of Physical Education: Nurturing Minds and Bodies

Physical education, often perceived as a domain solely dedicated to bodily development, transcends its apparent confines to exert a profound and positive influence on cognitive abilities, academic performance, and the overall educational experience. This section explores the intricate connections between physical education and its educational impact, shedding light on how an active body contributes to a sharper mind.

1. Cognitive Development: Numerous studies suggest a robust correlation between physical activity and enhanced cognitive function. Engaging in physical education promotes neuroplasticity, the brain's ability to adapt and reorganize itself. Regular exercise has been associated with improved memory, attention span, and information processing. The increased blood flow and oxygenation resulting from physical activity create an optimal environment for cognitive growth, benefiting students in their academic pursuits.

2. Academic Performance: Physical education is not a detractor from academic endeavors but, rather, a supportive pillar. Research indicates that students who participate in regular physical activity often exhibit better academic performance. The discipline and time management skills cultivated in physical education programs often spill over into other aspects of a student's life, contributing to improved focus, discipline, and resilience in academic pursuits.

3. Problem-Solving Skills and Creativity: The dynamic and often team-oriented nature of physical education fosters the development of problem-solving skills and creativity. Whether in team sports or individual activities, students are constantly challenged to strategize, adapt to changing circumstances, and think critically. These skills are transferable to academic settings, empowering students to approach challenges with a resourceful and creative mindset.

4. Social Skills and Collaboration: Beyond cognitive benefits, physical education serves as a crucible for social development. Team sports, group exercises, and collaborative activities promote the development of interpersonal skills, teamwork, and leadership qualities. These social competencies are invaluable in academic settings, contributing to a positive learning environment where students can effectively collaborate, communicate, and engage with their peers.

5. Emotional Well-being and Stress Reduction: The positive impact of physical education extends to the emotional well-being of students. Physical activity is a natural stress reliever, promoting the release of endorphins and reducing anxiety. A healthy mind is better equipped to handle the challenges of the academic journey, and physical education plays a role in creating a positive emotional foundation for effective learning.

6. Lifelong Healthy Habits: The educational impact of physical education extends far beyond the classroom. By instilling a love for physical activity and promoting lifelong healthy habits, physical education equips students with the tools to maintain a balanced lifestyle. Healthy individuals are more likely to be present, engaged, and ready to learn, contributing to a positive educational experience.

Navigating Obstacles to Holistic Development:

While physical education plays a crucial role in fostering holistic development, it is not immune to a range of challenges that can impede its effectiveness. Identifying and addressing these challenges is essential to ensure that physical education continues to be a cornerstone in nurturing well-rounded individuals.

1. Resource Constraints: One of the primary challenges faced by physical education programs is resource limitations. Insufficient funding, inadequate sports equipment, and a lack of dedicated facilities can hinder the implementation of robust physical education initiatives. Addressing these resource constraints is essential to provide students with a well-rounded and adequately equipped environment for physical development.

2. Limited Time and Curriculum Squeeze: In the face of rigorous academic demands, physical education often contends with limited time within school schedules. The pressure to cover extensive academic content may result in a reduced emphasis on physical activities. Striking a balance between academic priorities and the need for physical education is crucial to ensure that students receive a comprehensive education that nurtures both mind and body.

3. Societal Attitudes and Misconceptions: Misconceptions about the role and importance of physical education persist in certain societal attitudes. Some individuals may view it as secondary to academic pursuits, undermining its significance in the overall development of students. Overcoming these societal attitudes requires advocacy and education about the holistic benefits of physical education.

4. Lack of Qualified Instructors: Effective physical education requires knowledgeable and skilled instructors who can design and implement developmentally appropriate activities. However, the shortage of qualified physical education teachers poses a significant challenge. Professional development opportunities and efforts to attract and retain qualified instructors are crucial to overcoming this hurdle.

5. Inequality in Access and Opportunities: Disparities in access to physical education and sports opportunities based on socio-economic factors, gender, and geographic location are prevalent challenges. Ensuring equitable access to quality physical education for all students requires addressing systemic inequalities and implementing inclusive policies.

6. Technology Distractions: The pervasive influence of technology and sedentary lifestyles poses challenges to promoting physical activity. Students may be more inclined towards screen-based activities, leading to a decrease in overall physical engagement. Integrating technology in physical education and promoting active, technology-enhanced learning experiences can help mitigate this challenge.

7. Limited Adaptation for Diverse Needs: Physical education programs may face challenges in adapting to the diverse needs and abilities of students. Students with varying levels of physical abilities or disabilities may not receive tailored support. Implementing inclusive practices, adaptive physical education strategies and individualized accommodations are essential for addressing this challenge.

8. Safety Concerns: Ensuring the safety of students during physical activities is a paramount concern. Inadequate supervision, poorly maintained equipment, or insufficient safety protocols can lead to accidents and injuries. Establishing and enforcing rigorous safety standards is crucial to creating a secure environment for physical education.

9. Parental and Cultural Influences: Cultural attitudes and parental perceptions of physical education can impact a student's participation. Some parents may prioritize academic achievements over physical activities. Initiatives that involve parents in understanding the holistic benefits of physical education can help overcome such challenges.

Embracing Innovation and Holistic Well-Being:

As we stand at the intersection of advancing technologies, evolving societal needs, and a deepened understanding of holistic development, the future of physical education holds exciting possibilities. Anticipating and embracing these directions is key to ensuring that physical education remains relevant, engaging, and impactful in fostering the well-rounded individuals of tomorrow.

1. Integration of Technology: The future of physical education will inevitably involve a seamless integration of technology. Virtual reality (VR), augmented reality (AR), wearable devices, and interactive platforms offer avenues to enhance both the learning experience and physical activities. Gamification and digital fitness programs can make

physical education more interactive, appealing, and adaptable to diverse learning styles.

2. Personalized Fitness and Adaptive Programs: Recognizing the diverse needs and abilities of students, the future of physical education will likely witness the rise of personalized fitness programs. Adaptive physical education will become more prevalent, tailoring activities to individual strengths, preferences, and developmental stages. Customized fitness plans, leveraging data and assessments, will ensure inclusivity and engagement for all students.

3. Interdisciplinary Approaches: Breaking down traditional silos, the future of physical education will involve interdisciplinary collaboration. Integrating physical activities with subjects like science, mathematics, and technology can provide holistic learning experiences. This approach not only reinforces the connection between body and mind but also fosters a deeper understanding of real-world applications of physical education concepts.

4. Emphasis on Mental Health and Well-Being: Acknowledging the inseparable link between physical and mental well-being, future physical education programs will prioritize mental health initiatives. Mindfulness, stress reduction techniques, and activities promoting emotional resilience will become integral components of physical education, nurturing students' holistic development.

5. Inclusive and Diverse Curriculum: The future of physical education will place a strong emphasis on inclusivity and diversity. Curriculum design will be more intentional in catering to various cultures, backgrounds, and abilities. Adaptive sports, culturally relevant activities, and recognizing diverse forms of physical expression will be integrated to ensure that all students feel represented and included.

6. Lifelong Health and Physical Literacy: Shifting the focus beyond school years, the future of physical education will aspire to instill lifelong habits and physical literacy. Empowering individuals with the knowledge, skills, and motivation to engage in physical activities throughout their lives will be a central goal. This extends beyond traditional sports to encompass a wide range of recreational and fitness pursuits.

7. Community Engagement and Partnerships: Recognizing that education extends beyond the classroom, the future of physical education will involve strengthened partnerships with communities, sports organizations, and health institutions. Collaborative initiatives will provide students with diverse opportunities for physical activities, mentorship programs, and exposure to a variety of sports and fitness disciplines.

8. Sustainable and Outdoor Education: Fostering a connection with nature and promoting sustainable practices will be integral to the future of physical education. Outdoor education, adventure sports, and activities that emphasize environmental awareness will contribute to both physical and ecological well-being.

9. Professional Development for Educators: To implement these future directions effectively, ongoing professional development for physical education educators is crucial. Training programs will equip educators with the skills to leverage emerging technologies, adopt innovative teaching methods, and stay abreast of the latest research in physical education and holistic development.

Conclusion:

As we aspire to nurture lifelong habits and physical literacy, the significance of physical education becomes not just a chapter in the academic journey but a lifelong companion in the pursuit of health and well-being. Community engagement, sustainability, and a commitment to outdoor education broaden the horizons of physical education, connecting individuals not only with their bodies but with the world around them.

In conclusion, the significance of physical education in promoting holistic development is profound and enduring. It is a symphony of movement, knowledge, and social connection that resonates through the corridors of education, leaving an indelible mark on the individuals it touches. In recognizing and embracing this significance, we pave the way for a future where physical education continues to be a transformative force, shaping resilient, adaptable, and well-rounded individuals poised to thrive in the intricate dance of life.

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Concept of Smart Library in Indian Perspective

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Abstract:

In addition to PC innovation, broadcast communications, virtual stockpiling, and so on, Smart Library in India started with these advances. This paper also expresses that Smart Library will offer better types of help to library clients. Smart library in India is a combination of equipment and products with a wide range of opportunities for smart clients. Inside the library is an inside lab where scientists, understudies, and staff can foster smart advancements and gather information in terms of the review reason. Current administrations can also give the smart library clients furniture, building, lighting, cooling, warming, internet, smart library card, and so on. The goal of making a smart library is to make the use of new supplies in the library more noteworthy through intuitive correspondence.

Keywords: Smart library, technology, India users, Smart card, etc.

Introduction:

We as a society are aware that according to Ranganathan's fifth regulation, a library is a living organism that is constantly adapting to changes in innovation, administration, collections, and customers. With the advent of the PC innovation, traditional library administration is constantly evolving and adapting to the computerized world. In the current era, the role of the libraries, the data administration, and the relationship between the library and the customers is constantly changing.

Smart libraries are a framework that is designed to keep up with modern examination and preparation. In a computerized world, Smart libraries are just a library goal to enhance library and data administration. A library can be worked with Smart innovation that can be accessible to library clients without being a faculty. The innovation works with the controller of the library building and includes all-around equipped furnishings, automated entryways, lighting, self-administration booths, and open PCs for all clients. Creating another development edit and organize is another way for structures to solve the problems of their clients while reducing costs and increasing proficiency.

Smart Library Concept:

Smart library ideas started in the 21st century with the advancement of computer innovations and computer communication. Smart library is also called computer libraries, virtual libraries, and research libraries. The idea of an intelligent library arises from different perspectives, for example, the word cunning means subtle, adaptable, refined, and recognizable. As shown by the requirements and needs, the idea of an Intelligent library isthe composition of hardware and programming with a large number of possibilities to search and provide key information to successful customers. A smart library is a library that offers a wide range of resourceful, intelligent, educational, creative, transformative, and more. An important reason for a smart library is to get customer data through computer innovation. Focusing on the information needs of customers is conceivable throughdata updates.

Review of Literature:

Schopfel (2018) This article is motivated to provide new perspectives on public and academic libraries. The overview shows that smart library management is described by four perspectives such as smart place, smart management and smart people. A smart library does not deal with the task, but the cycle is less simple or less ordered, rather more original and inventive.

Kulkarni and Dhanamjaya (2017) assessed that thepublic library framework isinternationally effective in terms of library space, selection, management, establishment, exercises, etc. The results of the review will help promote the important organization of public libraries according to global standards and ensure that libraries become centers of knowledge.

Hoy (2016) saw in a review that the SmartLibrary building offers its customers advanced offices such as furniture, lighting, cooling, heating, and in addition real security. These offices promote the development of intelligent clients and additionally study its effect on libraries.

Baryshev and Babina's (2016) idea of a paper-aware library at the Siberian Government College characterizes the smart library as a confusing project withequipment and a product that

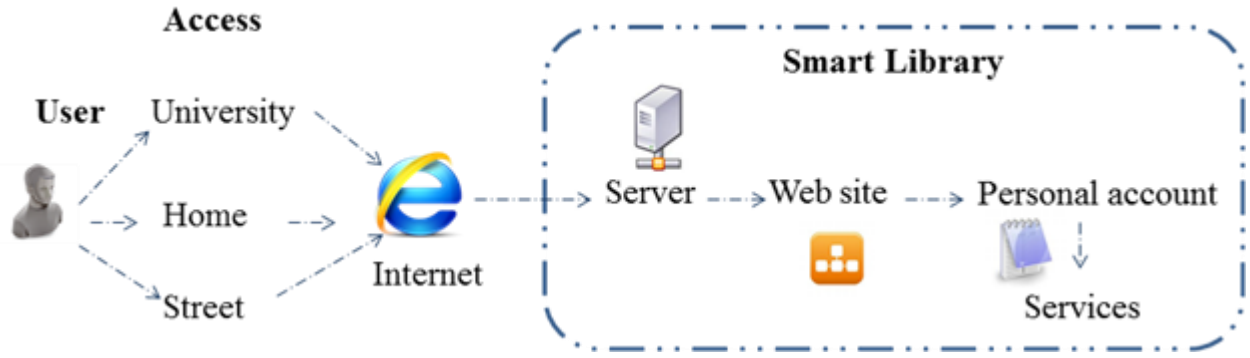
has enormous potential and provides basic information to students and experts.

Baryshev (et.al.) (2015) the main motivation of this work was to look at patterns from the e-library to the smart library. Important issues were discussed in the conditions of the university and public library areas. The results of the article were the construction of a brilliant library, where the assets of the library, space, climate, and personnel were constantly considered.

Kuny and Claveland (n.d.) indicate that the library community must address the issues of the computer-based library.

Working of Smart Library :

Each library customer receives their library card when the library is in smart mode. A short preparation is required before using the card. This preparation gives everyone an overview of the smart library card. Smart libraries have many ways to make the product available, through which a customer can enter the Smart library by checking the card at the entrance and entering the PIN code. Once the card is activated, it can give finesse to each customer. The smart card is used when entering the customer's library and also when handing over/returning books.



(Source: http://WWW.science-sd.com/463-24965)

Elements of a smart library: The elements of smart libraries are as follows.

- The Smart Library empowers the library community with opportunities and resources to manage digital challenges and preserve the positive highlights of online outreach.
- For many libraries, the intelligent library is designed for editing and modification, such as provincial, national, academic, local, metropolitan, remote, and multi-purpose, and it also provides a useful course for libraries.
- A smart library is the development of a modified model for the current situation or current time frame.
- To expand the knowledge and skills of customers and employees, smart innovation helps to reduce the progress gap in the online world.
- The most suitable tools and practical devices for digital security are collected in one place.

Technologies for Smart Library:

- Based on new information and developments in correspondence, an intelligent library organization is imaginable with library innovations. The following are the steps to proceed: Smart library card: Each customer receives their library card when entering the library, to look at the library smart card at the entrance and enter the PIN code, the card will be activated and it will have all the library information. students and experts. In addition, a smart card used to issue and return books.
- Versatile use of applications: Portable applications consist of programming that dramatically increases the demand of the mobile phone and performs certain tasks on behalf of its customer. Versatile applications provide definitive information through cell phones.
- Intelligent update of content data; Based on philosophy, the logical content of computer innovationdepends onsemantic organization. The Consortium of Specialized Intelligent Libraries is a resource for semantic ordering. An ingenious library of content enhanced by semantic associations. Content information is based on well-qualified reviews.
- Smart management: Smart Library offers smart help to smart library owners. Special Information Decentralization (SDI) enables the semantic acquisition of new distribution and archive label information based on long-term as well as one-time requirements formed by customers.
- Intelligent positioning of information: Production of new information using reference data. Enhancing new ontological relationships, developing a new metaphysics.
- Smart Touchpoint: A smart touchpoint that enables correspondence with customers, records customer action surveys, and simulates an effective survey.

Conclusion:

This article shows that the smart library in India focuses on the use of new information innovations in the library and is considered a very

collaborative school environment where patrons are encouraged to provide new knowledge and circulation. it further develops the conventional and non-traditional advantages of the libraryand works onpotential open doors to guide patrons and provide patrons with electronic innovations. The structures in this libraryare attractive but remain as intelligent as the individuals who maintain them. In this article, the library will quickly adopt innovations in a development environment. The main explanation of this article is to make more visible use of new types of devices and smart correspondence andmake a smart library of smart clients.

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To study on the various Encryption techniques used for Information Security in Social Media

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Abstract:
In presently used to internet communication network in our society. While Data or information is transmitted on several networks. So it requires different kind of security used such as confidentiality, integrity & authenticity (CIA). In the network security uses various encryption techniques. Cryptography can be defined as techniques the encrypts the original data into unreadable format and the data can only be transformed back to its original form after decryption by an authorized person. In this paper to study on various encryption techniques provide to secure information in internet communication network.

Keyword: Cryptography, Information Security, Encryption, Decryption, CIA, DES, AES, RSA, TDES, BE, TE, FPE, ECC.

Introduction:

In presently, most of the people use internet for transmission and sharing text, image, audio and video etc. data use different devices such as computer and mobile phone. Encryption is the process of encoding information. This process converts the original representation of the information, known as plaintext, into an alternative form known as ciphertext. Only authorized user can decipher a ciphertext back to plaintext and access the original information. Encryption is the process of plaintext is converted into the encrypted piece of data, also known as cipher text. Instead of sending the plaintext to the receiver, the cipher text is sent through insecure channels of communication. Intruder is an unwanted person reads and changes the information in the transmission occurs. In this activity of intruder is called intrusion attack. To avoid such attack data may be encrypted to some formats that is unreadable by an unauthorized person.

The data that needs to be encrypted is termed plaintext or cleartext. The plaintext needs to be passed via various encryption algorithms, which are basically mathematical calculations to be done on raw information. There are multiple encryption algorithms, each of which differs by application and security index. apart from the algorithms, one also needs an encryption key. Once the cipher text reaches the intended receiver, It can use a decryption key to convert the cipher text back to its original readable format i.e. plaintext. This decryption key must be kept secret at all times, and may or not be similar to the key used for encrypting the message.

1. Purpose of Cryptography

Cryptography provides a number of security goals to ensure the privacy of data, non- alteration of data and so on. Due to the important security of cryptography it is widely used .Following are the main goals of cryptography [4].

1. **Confidentiality:** Information in computer is transmitted and has to be accessed only by the authorized party and not by anyone else.
2. **Authentication:** The information received by any system has to check the identity of the sender that whether the information is arriving from a authorized person or a false identity.
3. **Integrity:** Only the authorized party is allowed to modify the transmitted information. No one in between the sender and receiver are allowed to alter the given message.
4. **Non Repudiation:** Ensures that neither the sender, nor the receiver of message should be able to deny the transmission.
5. **Access Control:** Only the authorized parties are able to access the given information.

2. Need of Encryption and Decryption techniques

If anyone wonders why organizations need to practice encryption, keep these four reasons in mind:

- **Authentication:** Public key encryption proves that a website's origin server owns the private key and thus was legitimately assigned an SSL certificate. In a world where so many fraudulent websites exist, this is an important feature.
- **Privacy:** Encryption guarantees that no one can read messages or access data except the legitimate recipient or data owner. This measure

prevents cybercriminals, hackers, internet service providers, spammers, and even government institutions from accessing and reading personal data.

- **Regulatory Compliance:** Many industries and government departments have rules in place that require organizations that work with users' personal information to keep that data encrypted. A sampling of regulatory and compliance standards that enforce encryption include HIPAA, PCI-DSS, and the GDPR.
- **Security:** Encryption helps protect information from data breaches, whether the data is at rest or in transit. For example, even if a corporate-owned device is misplaced or stolen, the data stored on it will most likely be secure if the hard drive is properly encrypted. Encryption also helps protect data against malicious activities like man-in-the-middle attacks, and lets parties communicate without the fear of data leaks.

3. Work of End-to-End encryption

When you use the Messages app to send end-to-end encrypted messages, all chats, including their text and any files or media, are encrypted as the data travels between devices. Encryption converts data into scrambled text. The unreadable text can only be decoded with a secret key.

The secret key is a number that's:

- Created on your device and the device you message. It exists only on these two devices.
- Not shared with Google, anyone else, or other devices.
- Generated again for each message.
- Deleted from the sender's device when the encrypted message is created, and deleted from the receiver's device when the message is decrypted.

The Messages delivery server, and any person or third-party who might gain access to data for messages and content sent between devices, won't be able to read end-to-end encrypted messages because they don't have the key. Each end-to-end encrypted conversation has a unique verification code. This code must be the same for you and your contact to verify that your messages are end-to-end encrypted.

4. Various Encryption techniques

Today, are available different encryption algorithms techniques provide to secure information in internet communication network:

5.1 DES algorithms

Data encryption standard (DES) was the first algorithm developed for the encryption of images & text. DES is the Symmetric Key Algorithm developed in early 1970s at IBM. DES is the Symmetric block cipher, with the key length of 56 bits & block size of 64 bits[1]. It is the block cipher which creates a fixed-length string of plaintext bits and changes it through a sequence of complicated operations into another cipher text bit string of the similar length. It is a symmetric encryption technique which defines both sender and receiver need a shared key to encrypt and decrypt the information. But DES had a small key size & hence it was officially withdrawn later. In 1999, Electronic Frontier Foundation and distributed.net put a series of challenges on DES algorithm to see how long it takes to decrypt a message & were able to break the DES key in 22hours & 15minutes. Therefore, DES proved to be insecure. 3DES was used later on, & avoids the problem of small key size. 3DES, a way of using DES encryption 3 times, it offers key size options of 168,112 or 56 bits & block size of 64 bits. But, 3DES also proved ineffective against Brute Force Attacks in addition to that it slowed down the process substantially.

There are various Limitations of DES which is as follows[9]:

1. DES has small key size of 56 bits.
2. DES is better in hardware implementation and relatively slow when implemented in software.
3. 3DES has different key size options, but it is very slow in hardware implementation.
4. DES & 3DES, both are not much secure, and proved inadequate against Brute Force Attacks.
5. 16 rounds in DES strengthen the algorithm.
6. Each round has the same function which involves key transformation, expansion permutation, s-box substitution, p-box permutation and XOR and swapping.

5.2 RSA Algorithm

The RSA is an cryptographic algorithm which is use to enrypt and decrypt the data. This algorithm developed in1977 by Ron Rivest, Adi Shamir and Leonard Adleman.RSA cryptosystem is also known as the public-key cryptosystems. RSA is normally used for secure data transmission. The encryption is starting on the RSA algorithm with the selection of two large prime numbers, along with an auxiliary value, as the public key. The prime numbers are keep in secret. The public key is used to encrypt a message, and private key is used to decrypt a message or information.The RSA algorithm is encrypt the original image and decrypts the image by the different keys.

There are various Limitations of DES which is as follows:

1. RSA algorithm is a complex mathematical method that can be difficult for some people to understand and implement.
2. RSA algorithm requires large prime numbers as part of the encryption process. The larger the prime numbers, the more secure the encryption, but it also increases the key size and processing time.
3. RSA algorithm can be slower than other encryption methods, especially when encrypting large amounts of data.

4. RSA algorithm is vulnerable to attacks by quantum computers, which can potentially break the encryption.
5. RSA algorithm requires the secure management of the private key, which can be a challenge in certain scenarios.

5.3 AES algorithm:

Advanced Encryption Standard (AES) algorithm. It was published by the National Institute of Standards and Technology (NIST) in 2001. AES is a subset of the Rijndael block cipher developed by two Belgian cryptographers, Vincent Rijmen and Joan Daemen. AES is a symmetric block cipher intended to replace DES. It uses 128-bit block size and a key size of 128, 192, or 256 bits. . Although extremely efficient in the 128-bit form, AES also uses 192- and 256-bit keys for very demanding encryption purposes.

There are various Limitations of AES which is as follows:

1. It uses too simple algebraic structure.
2. Every block is always encrypted in the same way.
3. Hard to implement with software.
4. AES in counter mode is complex to implement in software taking both performance and security into considerations.

5.4 Triple DES:

3DES or the Triple Data Encryption Algorithm (TDEA) was developed to address the obvious flaws in DES without designing a whole new cryptosystem. Data Encryption Standard (DES) uses a 56-bit key and is not deemed sufficient to encrypt sensitive data. 3-DES simply extends the key size of DES by applying the algorithm three times in succession with three different keys. The combined key size is thus 168 bits (3 times 56). TDEA involves using three 64-bit DEA keys (K1, K2, K3) in Encrypt-Decrypt- Encrypt (EDE) mode, that is, the plain text is encrypted with K1, then decrypted with K2, and then encrypted again with K3. Three-key 3DES has an effective key length of 168 bits and is defined as[22]

$C = \mathrm{E}(K3, \mathrm{D}(K2, \mathrm{E}(K1, P)))$.

There are various Limitations of Triple DES which is as follows:

1. Slow speed: The triple layered encryption process of 3DES makes its slower than other encryption algorithms.

2. Limited key size options: while 3DES supports variables key sizes, the maximum key size is only 192 bits, which may not be enough to meet the security need of some application.

5.5 Blowfish Encryption (BE)

Blowfish is a symmetric encryption algorithm that implies it utilizes a similar secret key to both encrypts

as well as decrypt messages. The block length for Blowfish is 64 bits; messages that aren't a multiple of eight bytes in size must be cushioned. Blowfish comprises two sections[7]:

1. Key-expansion: In the key-expansion phase, the inputted key is changed over into several sub key arrays absolute 4168 bytes. There is the P array, which is eighteen 32- bit boxes, along with the S-boxes, which are four 32-bit arrays with 256 entries each. After the string initialization, the initial 32 bits of the key is XORed with P1 (the first 32-bit box in the P-array). The second 32 bits of the key is XORed with P2, etc

until each of the 448.

2. Data encryption: In this stage, the information is utilized with 64-bit plain text and it is encrypted to 64- bit cipher text. The 64 bit of information data is segmented into two 32-bits as left parts just as right parts . Each 32-bit is XORed with P-cluster and the outcome is conveyed to the function (F). At that point, complete the XOR undertaking for similarly left parts and the accordingly 32 bit right parts effortlessly. This procedure proceeds until the finishing of 16 round.

There are various Limitations of Blowfish Encryption which is as follows:

1. Speed is affected when changing keys.
2. The key schedule takes a long time.
3. The small 64-bit block size makes the algorithm vulnerable to attacks..
4. Each new key requires preprocessing equivalent to 4 KB of text, which affects its speed, making it unusable for some applications.

5.6 Twofish Encryption (TE)

The Block cypher is a finite state algorithm which is operated on ‘blocks’ or combination of bits. The initial bit stream is encrypted by the use of a function which takes another sequence of bits called the key to decrypted by the inverse of the function used to encrypt. The Twofish cypher is a block cypher which makes use of the symmetric encryption process having the input bit size of 128 bits and the key size up to 256 bits[6].

There are various Limitations of Twofish Encryption which is as follows:

1. TwoFish encryption is vulnerable to side-channel attacks, such as timing and power analysis attacks.
2. It can be challenging to implement TwoFish encryption correctly, and errors in implementation can result in vulnerabilities that can be exploited by attackers.

5.7 Format-Preserving Encryption (FPE):

In cryptography, format-preserving

encryption (FPE), refers to encrypting in such a way that the output (the cipher text) is in the same format as the input (the plaintext). The meaning of "format" varies. Typically only finite sets of characters are used; numeric, alphabetic or alphanumeric. For example:

- Encrypting a 16-digit credit card number so that the ciphertext is another 16-digit number.
- Encrypting an English word so that the ciphertext is another English word.
- Encrypting an *n*-bit number so that the ciphertext is another *n*-bit number (this is the definition of an *n*-bit block cipher).

For such finite domains, and for the purposes of the discussion below, the cipher is equivalent to a permutation of *N* integers {0, ..., *N*−1} where *N* is the size of the domain.

Limitation of Format Preserving Encryption is that, it's deterministic: the same plaintext always leads to the same ciphertext. And by an entropy argument, that must be if all plaintexts that fit the format are possible.

5.8 Elliptic Curve Cryptography (ECC):

The ECC encryption algorithm is a relatively new asymmetric encryption method. It uses a curve diagram to represent points that solve a mathematical equation, making it highly complex. The shorter keys make it faster and stronger than RSA encryption. ECC can be used for:

- Web communications security (SSL/TLS protocols)
- One-way email encryption
- Digital signatures in cryptocurrencies like Bitcoin or NFTs

There are various Limitations of Elliptic Curve Cryptography Encryption which is as follows:

1. Large encryption size: ECC increases the size of the encrypted message significantly more than RSA encryption.

2. A more complex: The ECC algorithm is more complete and more difficult to implement than RSA.

Conclusion:

In this internet communication system information transmitted in a digitally uses different networks services. Security of these information against unauthorized access is on high demand. so the various encryption techniques have the important motive of providing reliable, powerful, and robust network and data security. There are different kinds of attacks on the security policies and also growing with the advancement and the growing use of internet. In this research paper to study on various encryption techniques provide to secure information in internet communication network. It will be more helpful to increase the efficiency and security of internet communication. So various encryption techniques has emerged as an essential to safeguard our confidential information.

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Tadoba: The Treasure of Tribal Tourism and Culture

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Abstract:
Scheduled Tribes Constitute 8.6% of India's population and they exhibit enormous diversity Theirprotection and development require attention. Theecological setting in which they live along with their unique cultural alteringwill aid in the preservation and promotionof the tribal culture it is planned holistically owing to the sheer diversity and the sensitivities in the tribal population of India there can't be one size fits all approach to tribal tourism development India rather it has to be a tailor-made approach for tribal regions of tourism potential identified after due diligence monitoring the negative socio-cultural impacts of such from tourism development plans accordingly is very important.

Key Words: Tribes, Ecological,sensitivities, Tourism, attention.

Introduction:

India a myriad land stores wonders in its magical womb from the tranquil seashores and the pre-historic or nomentalcaves to the heritage temples and places.

Tourism is a highly complex phenomenon and several academic, disciplines are involved in its study Tourism is a basic and most desirable human activity deserving the praise and encouragement of all people and all governments it is an industry concerned with attracting people to a destination and transporting them arrange their housing feeding and entertain them upon arrival and returning them to their homes. It deals for the most part with consumer tourists they money they spend and the people and meansthat,Provide them with goods,services products.Tourism is not only an economic activity important medium of cultural exchange among nations of the world.

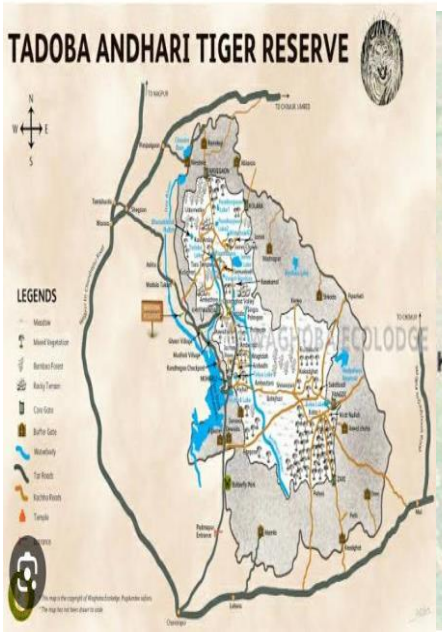
Tourists are a temporary exodus population who normally travel to predetermined destinations for whatever purpose they consume tourism products while traveling and return home after a short period independently of whether their envisaged purpose is achieved tourists are normally divided into two categories namely Domestic and Foreign Tourists.

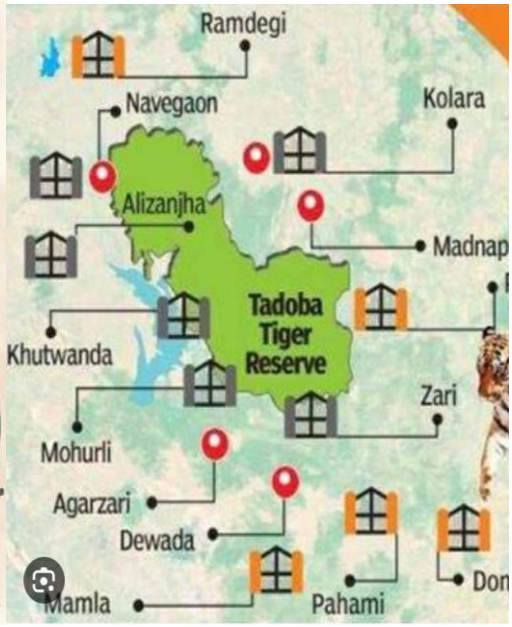
Hypothesis:

Conservation Awareness Cultural tourism can raise awareness about the importance of conserving Tadoba's natural and cultural Heritage visitors engaging in cultural tourism experiences can gain a deeper understanding and appreciation for the local traditions.

Study Area:

The name Tadoba is the name of the God Tadoba or Taru praised by the tribal people who live in the dense forests of the Tadoba and Andhari region while the Andhari River that meanders through the forest gives the Andhari name TadobaAndhari Reserve is the largest national park in Maharashtra total area of the Reserve is 625.4 sq km (241.55 mi) This includes Tadoba National park,Created in 1955 with an area of 116.55 sqkm Andhari wildlife sanctuary created in 19 with an area of 50.5skm This reserve also includes 32.51 kmprotected forest and 20 10 0" N to 79 24' 0" E and coordinates 20 10' 0" N to 79 24' 0" E





Aim's And Objective:

1. To study the tribal population and tourism culture of the village in the Tadoba sanctuary.
2. To Understandthe Tadoba treasure of Tribal Tourism and Culture.
3. To Study the number of tourists to Tadoba sanctuary as per Geographic analysis.

Tadoba Rainfall And Temp:

Climate and Rainfall The climate of Chandrapur district is hot and dry humid in monsoon and hot in summer with rainfall of 140 cm (1578mm) in Tadoba Rang.

Cultural Tourism In Tadoba:

Cultural Tourism is the subset of tourism concerned with a country or region's culture, especially its art It generally focuses on traditional communities that have diverse customs unique forms of art, and distinct social practices,which distinguish it from others.By Promoted the reason is simple enough the members of the tribes despite being in the best position to manage and showcase their culture in anauthentic and undiluted manner do not have the required additional skills and knowledge to do just that.Hence the following sections of the paper start with a clear definition of cultural tourism and capacity building.Then the discussion shifts to the various issues concerning capacity buildings would scan other possible avenues along with cultural tourism and at the same time would depict the possibility of ICT integration for promoting cultural tourism in Tadoba.

1)Destinations:

One of the most important destinations for cultural tourism is the tribal hotspots of Tadoba for indigenous cultures as seen here that have stayed larelyseparated from the surrounding majority tourism can present both advantages and problems on the positive side are the unique cultural practices and arts that attract the curiosity of tourists. and provide opportunities for tourism and economic development The negative side is the issue of how to control tourism so that those same cultural amenities are not destroyed and the people do not feel violated other destinations include historical sites which again the region has in plenty.

Head Of Tribal Village In Tadoba Tourist Place And Total Tribal Population 2022:

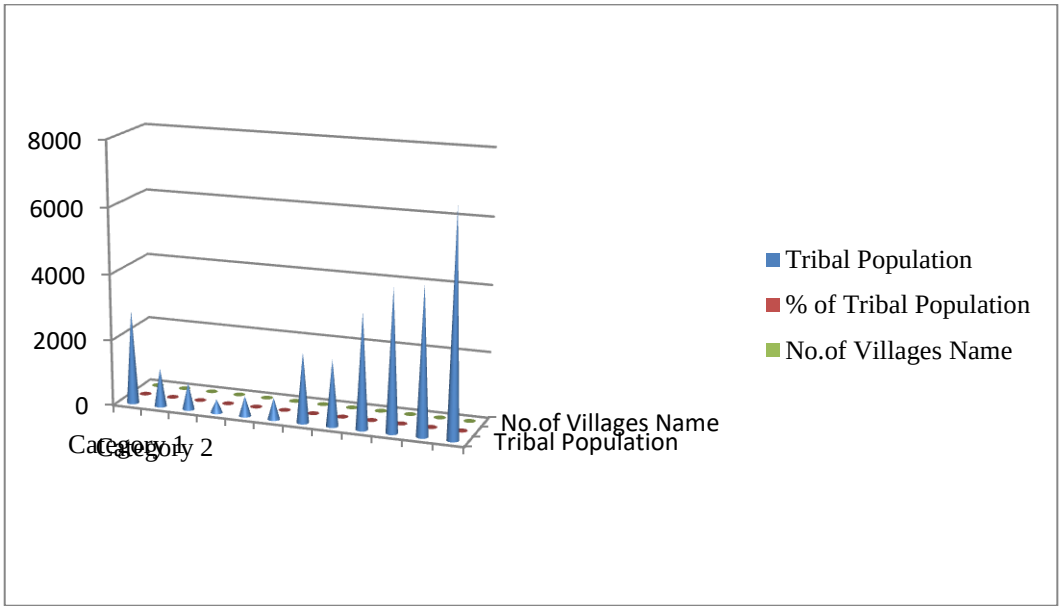
41,644 people are living in and around the reserve in 59 villages of which 5 are inside the core zone this village in the core zone still do farming activity inside the core area. The process of rehabilitation is going on but the Indian bureaucracy has been at its slowest in the forest department.

Table No-1

Head of Tribal village in Tadoba Tourist place and total Tribal Population2022

Sr.no	No.of Villages Name	Tribal Population	Tribal Population%
1	Mohorli	2849	9.58%
2	Aagarzari	1150	3.87%
3	Kunvatha	800	2.69%
4	Zari	400	1.34%

5	Bhamini	600	2.01%
6	Navegao	650	2.18%
7	Karwa	2121	7.13%
8	Dewada	2008	6.75%
9	Shedegao	3518	11.83%
10	Kolari	4310	14.50%
11	Masal	4490	15.11%
12	Kolsa	6819	22.94



Recently the Naveaon village was rehabilitated and a grassland is expected on the place where the village existed.There are 41,800 cattle with the villagers in the core and buffer zone. while cattle grazing is not allowed in the core zone regulated grazing in the buffer zone is allowed for cattle ofthe village inhabitants. However, cattle from peripheral villages sometimes sneak into the reserve and cause additional damage to the habitat.

Forest fires are a constant problem in the dry season, consistently during between 2% and 16% of the park each year. Most of these forest fires are man-made,started by people who venture into the forest in search of the mahua flowers for liquor production. Poaching of prey such as sambar deer, spotted deer,here,nilgai, andwild boar is also a near-permanent problem not fully controlled. The villagers on the periphery of the forest are expected to afford goat meat which costs upwards of INR 400 per kilogram.Whereas they manage their entire household for a meager inr4000(85$) a month as income is extremely low.The forest guards are mostly from local villages and they sometimes are involved in poaching but it is essentially for the meat and not for any. Human Wildlife conflict is common with the killing of domestic livestock by tigers and leopards as a frequent phenomenon in the areas neighboring villages. This hurts the economic condition of the local people and results in antagonism towards the management.In the year 2013 so far there have been up to 4 people and 30-50 cattle heads killed by leopards tigers or sloth bears.

1) Cultural Heritage:

Cultural tourism is a form of tourism that focuses on experiencing the history, customs, traditions, and lifestyle of a particular destination. Tadoba, located in the state of Maharashtra, India, is a popular cultural tourism destination known for its rich cultural heritage and diverse traditions. This paper examines the cultural tourism in Tadoba and explores the various aspects that attract tourists to this enchanting destination.

1.1) Cultural Heritage:

Tadoba is home to numerous tribes, each with its distinct cultural heritage. The Gond, Kolam, and Mana,Andh tribes are prominent indigenous communities in the region. These tribes have preserved their unique traditions and practices, which are highly valued by cultural enthusiasts and tourists. Cultural tourism in Tadoba provides an opportunity to interact with the local communities, witness their traditional dances, music, art forms, and rituals, and gain a deeper understanding of their way of life.

1.2) Historical Sites:

Tadoba also boasts of several historical sites that attract cultural tourists. The Chandrapur Fort, built during the Gond dynasty, is a significant historical landmark. The fort offers a glimpse into the region's history and architectural grandeur. Another popular historical site is the Ballalpur Dargah, a sacred Muslim shrine known for its spiritual significance. These historical sites provide a rich cultural experience, immersing tourists in the history and traditions of the region.

1.3) Traditional Festivals:

One of the major attractions of cultural tourism in Tadoba is the vibrant festivals celebrated by the local communities. Festivals like Gond Gaurav, Pola, and Bhaji Pala are celebrated with great enthusiasm and grandeur, showcasing the cultural diversity of the region. Tourists have the opportunity to witness the colorful processions, traditional dances, music performances, and religious ceremonies associated with these festivals. Participating in these festivals allows tourists to fully experience and appreciate the cultural richness of Tadoba.

1.4)Handicrafts and Artisans:

Tadoba is known for its skilled artisans and traditional handicrafts. The local communities engage in crafts such as bamboo and woodwork, pottery, and handloom weaving. Tourists interested in cultural tourism can visit the artisan villages, interact with the craftsmen, and witness the intricate craftsmanship that goes into producing these traditional artifacts. Additionally, tourists have the opportunity to purchase these unique handicrafts as

souvenirs, supporting local artisans and promoting their traditional skills.

1.5) Cuisine and Local Delicacies:

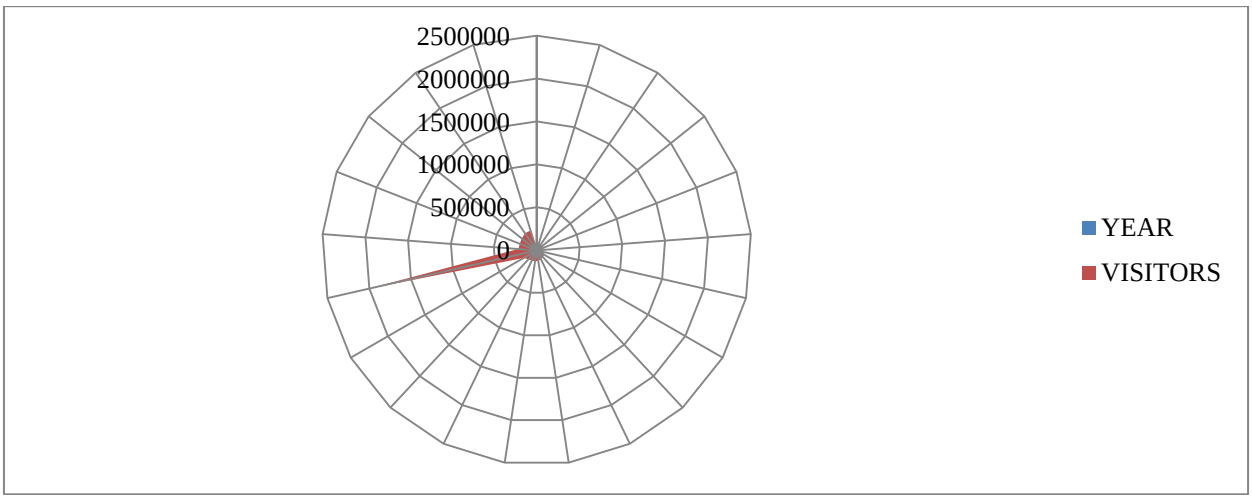
Cultural tourism in Tadoba also includes exploring the region's culinary delights. The cuisine of Tadoba encompasses a blend of traditional Maharashtrian and indigenous tribal dishes. Tourists can savor the flavors of authentic regional dishes like Varhadi (spicy) and Saoji (rich and spicy) cuisine. Food festivals and culinary workshops provide tourists with an opportunity to learn about traditional cooking techniques and try their hand at preparing local delicacies.

1.6) Preservation and Conservation Efforts:

Cultural tourism in Tadoba goes beyond experiencing the local culture and traditions. It also emphasizes the importance of preserving and conserving the rich cultural heritage of the region. Efforts are being made to raise awareness about the cultural significance of Tadoba and promote sustainable tourism practices. The involvement of local communities, government organizations, and NGOs plays a crucial role in preserving the cultural aspects of Tadoba, ensuring that future generations can continue to experience its cultural richness.

Table No.2 Tadoba Andhari Tourists Chart 2002-2022:

YEAR	YEAR WISE TOURISTS VISITORS.	YEAR	YEAR WISE TOURISTS VISITORS
2002-03	30951	2012-13	124080
2003-04	35944	2013-14	130500
2004-05	36325	2014-15	131502
2005-06	35640	2015-16	140602
2006-07	43000	2016-17	180708
2007-08	61790	2017-18	2017711
2008-09	68183	2018-19	Covid Period
2009-10	103696	2019-20	Covid Period
2010-11	104690	2020-21	Covid Period
2011-12	114901	2021-22	240215



Conclusion:

Cultural tourism in Tadoba offers a unique and enriching experience for tourists who wish to explore the rich heritage, customs, and traditions of the region. The indigenous tribes, historical sites, traditional festivals, handicrafts, local cuisine, and conservation efforts all contribute to making Tadoba a fascinating cultural tourism destination. By engaging with the local communities and experiencing the unique cultural aspects of Tadoba, tourists not only gain a deeper understanding of the region but also contribute to the preservation and promotion of its cultural heritage.

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Study on Diversity of Zooplankton in and Around Gadchiroli: A Review

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Abstract:
Gadchiroli is a tribal area & located on the eastern side of Maharashtra and is the central part of India. Various studies on zooplankton have been done from respective lentic & lotic ecosystems present here. According to studies, Zooplankton population size was correlated with biotic and abiotic parameters. Traditional morphology-based methods have been used to investigate the interaction between the biodiversity of zooplankton and aquatic pollution in freshwater ecosystems as some species are denoted as pollution indicator species. In the mentioned checklist, there are a total of 132 species of zooplanktons there are, out of which 66 belong to Rotifer, 35 to Cladocera, 11 to Copepoda, 5 from Ostracoda, and 9 taxa from Protozoan. Many of the studies showed that Rotifers are dominating the zooplanktonic population followed by Cladocera and Copepoda. The objective of the study is to review the distribution and diversity of zooplankton with the help of available literature up till now. The review study is very much helpful to study the diversity, seasonal variation, and dynamics of zooplankton concerning the eutrophication of the lentic and lotic ecosystems.

Keywords: Aquatic Ecosystem, Biotic and Abiotic parameters, Diversity, seasonal variation, zooplankton.

Introduction

The aquatic ecosystem covers a vast area of Land. The global human population growth rate is increasing rapidly and it affect natural resources like Air, Water & Land. Various anthropogenic activities reduce the water quality & aquatic biota are under the influence of its physicochemical properties. The abundance of plankton is an important biological tool for monitoring the ecology of any aquatic system *(Gunwant et al 2014*). Thus, to understand the ecology of any water bodies we must examine the ecology of a plankton. Several studies on zooplankton in the past several decades conclude that the assessment of zooplankton provides valuable information about the management and restoration of aquatic ecosystems. Many scientists have worked on a zooplankton species in India. Pioneers of this, *Baired(1859), Battish(1987), Chatterjee(2013), B.K. Sharma,(2011) S. Sharma(1999), R. G. Michael, Sinev, Smirnov(1971), Van Damme, K. Venkataraman, S. R. Das, A. A. Kotov(2010), S. M. Padhye(2014), H .Segers (1996), Dhanapathi(2000), Dumount, Edmondson (1959), W. Koste, Karuthapandi(2003) etc*.

The objective of the current study is to review, the available taxonomic literature on zooplankton in and around Gadchiroli, to know the importance of zooplankton in ecology as primary consumers in the food web and explore the possibilities of using them as bio indicators of pollution to assess the sustainability of water bodies for conserving the biodiversity. It also aims to review the current status of the zooplanktonic study of the Gadchiroli district and to list the noticed zooplankton species from this region.

Review of Literature:

During the literature survey (Table 1 Showing the Status of zooplankton in and around District Gadchiroli), it was observed that the population of Rotifers was dominant among the total zooplankton population. Rotifers show their dominance during winter and recessivity during the summer season. Family Branchionodae was the dominant among the Rotifer. In recent years, though there is some progress in the study of zooplankton diversity from the Gadchiroli district, still many more ecosystem studies are left behind and there is a need to further study about the cyclometric changes in zooplankton and their diversity correlation with other parameters. A detailed survey can only establish the current status of zooplankton diversity in some areas of the said region. But of course, this information in turn can be used to check the ecological status of the water bodies and historical review for further studies.

Material and Methods:

As this study is only on review, the methodology used for this is, all research papers and reference books regarding this topic.

Study Area:

Gadchiroli is located in Maharashtra state situated in western India. With latitude 19 to 21 degree north and longitude 80 to 81 degrees east region. {Figur1 showing the Satellite Image of Gadchiroli District (Red Border)} Near about 76 % of the geographical area of Gadchiroli is covered by the Forest region.

The lotic ecosystem comprises the Wainganga River which is the main riverine system in this area. Wainganga is a major Sub-basin of the Godavari River. Which runs through Maharashtra and Madhya Pradesh. About the Lentic Ecosystem, many Ponds and Lakes are present in and around Gadchiroli. Some of them are Man-made mainly used for agricultural purposes and some are Natural which are present in the Forest region but now comes under urban/rural area due to the explosion of population and directly in touch with anthropogenic practices.

Observation and Result:

In the mentioned checklist (Table 2: showingChecklist of Commonly observed Zooplankton Species in and around Gadchiroli District), there are a total of **132** species of zooplanktons there are, out of which **66** belong to **Rotifer**, **35** to **Cladocera**, 11 to **Copepoda**, **5** from **Ostracoda** and **9** taxa from **protozoan**. Many of the studies showed that Rotifers are dominating the zooplankton population followed by Cladocera and Copepoda.

Discussion:

According to a review study it was observed that the Composition of the zooplankton community is strongly dependent on the season. The climate of the Gadchiroli district changes seasonally. During summer, there is a hot climate while during winter it becomes cool. Humidity in the district is approximately 62%. The district is blessed with sufficient rainfall during the Monsoon.

The present literature survey reveals that the density of a rotifer was maximum during winter in February and minimum in summer in May. Cladocera density was topmost during winter and least during the pre-monsoon during the month of June. Copepoda shows their maximum density during winter, however, Ostracoda shows their maximum density throughout the summer and minimum density in the course of the winter season. Variation in abundance of Ostracoda was in the order of a summer>> winter >>monsoon. (Chavan AW and Murkute VB., 2020)*(Sawane et al 2012)*

Relationship with Biotic and Abiotic factor

In an aquatic ecosystem, the Physico-chemical environment profoundly influences its biotic components. It controls the diversity, biomass, and spatial distribution of biotic communities in time and space. The physical and chemical parameters show their impact individually as well as collectively, their dealing constructs an abiotic domain that ultimately leads to the origin, development, and succession of biotic communities. Once a water body is established it forms a definite ecosystem with its own physicochemical and biological properties. Both these aspects are significant in monitoring the water quality. (*Murkute VB et.al2007)*

Present literature survey shows Fluctuations in Physicochemical parameters such as ph, temperature, conductivity, DO, Free Co2, Sulphate, Nitrate, Phosphate, BOD, and COD often create worse effects on zooplankton, restrict their production and deplete their ability to compete with other populations within the environment. *(Dahegaonkar, N.R. (2008) Gadekar GP (2014)*, These variations of the water bodies seem to be due to mighty factors like climate change associated with rainfall, evaporation leads to variations in water level which directly affects the shape and size of the actual water body. Various Anthropogenic activities and macrophyte succession in an aquatic system affect the water body. (*Chavhan R. V. et.al 2015). Sawane et.al (2005-2007)* analyzed several Physico-chemical parameters of urban Lake Wani districts Yeotmal, located western side of Gadchiroli districts, emphasizing on the impact of the urban sewage waste, on Physico-chemical characteristics of water which is an indirect expression of nutrients load being put into the water bodies.

Conclusion:

Reported Studies mentioned here, showed their powerful correlations between Biotic and Abiotic factors of freshwater ecosystems. It is also proved that Zooplankton played a crucial role as an indicator component and helps to detect the trophic status of aquatic systems.

Some species combat extreme abiotic conditions and survive well, indicating their high tolerance level, while sensitive ones are eliminated due to low tolerance. Thus, the study of these fascinating organisms can always help in monitoring the status of aquatic systems.

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Recommendations:

The Zooplankton abundance, as well as diversity, shows a direct as well as indirect relation to the above discussed Physico-chemical parameters of water and other abiotic factors. To conserve and help flourish these organisms, certain

cures and preventive measures need to be taken. There is a great need for creating awareness among the villagers along with promotion and capacity building among farmers and fishermen on conservation and good farming practices such as agro-fishery in the river's catchment area. They should be encouraged to carry out practices like rainwater harvesting and tree plantations along the water bodies. Which can help to reduce the load of sediments in the water bodies and soil erosion. Government officials can also involve local villagers by employing them for these practices thus encouraging the conservation of the Water bodies.

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Table 1: Review of Literature and Status of zooplankton in and around District Gadchiroli:

S. N	Name of Author	Year	Topic Name	Obs/Result
I	R.V. Tijare and M.R. Thosar	2005	Rotifer diversity in three Lakesof Gadchiroli, a Tribal Districtof Maharashtra (India)	A total of 25 species of Rotifers were recorded out of which Branchionodae was the dominant family of Rotifer.
II	Bhandarkar W.R., Bhandarkar S.V., MurkuteV.B.	2005	Observation Species Diversity of Brachion us (Rotifera) from Kalikar Pond, Bramhapuri, District Chandrapur	*A total of 9 Brachionus species were identified and B. calyciflorus was* the most dominant sp. followed by *B falcatus*. The occurrence of these species indicates the waterof this pond is grossly polluted.
III	Chavan A.W., Murkute V.B.	2005-2007	Zooplankton diversity concerning the physicochemicalParameter of River Wainganga,near Bramhapuri, District Chandrapur.	A total of 23 zooplankton species out of which 15 species of Rotifera, 03 species of Cladocera, 04 species of Copepoda, and only 01 species of Ostracoda wererecorded
IV	A. P. Sawane, M.C. Kale and A. D. Bobdey	2006-2007	Zooplankton abundance and its correlation with physicochemical parameters from Urban Lake Wani Dist.Yeotmal, Maharashtra	Total of 65 Zooplankton species were recorded Protozoa 7 species, 6 genera, Rotifer 29 species,21 genera, cladocera 12 species, Ostracod, and 05 species were recorded.
V	Tijare Rajendra andShashtrakar Avinash	2010-2012	Diversity of Rotifer in Asolamendha District Chandrapur Maharashtra, India	Total of 25 species of Rotifers were recorded out of which Branchionodae was the dominant family of Rotifer.
VI	Tijare RV, and Gedekar SG	2010-2012	Zooplanktonic Diversity In Kolar River, District Nagpur,(MS) India Rotifer diversity in Wainganga River atthe region of Markandadeo, TahChamorshi, District Gadchiroli,Maharashtra (India)	The Zooplankton community is more diversethan phytoplankton as a total of 31 species were recorded in the river Kolar.16 species in the present study represented Rotifera, the common genera were Brachionus, Keratella, and Trichocera.
VII	Meshram MP, Tijare RV and Patil KG	2011-2012	Species diversity of microscopic crustacean inKarmaveer Kannamwar reservoir, Regadi, Tah. Chamorshi, District Gadchiroli, (MS) India	13 species of crustacean zooplankton were recorded. Study reveals that the significant dominant group was Cladocera followed by Copepoda and Ostracoda in microcrustaceans faunal diversity
VIII	R.K. Agrawal , Sanjay Thiske and Sunil Mondal	2011	Diversity and Seasonalfluctuation of zooplankton in FreshwaterReservoirMongra Bajaj RajnandgaonDistrict CG., India.	Total of 18 zooplankton species out of which 04 species of Rotifera, 09 species of Protozoa, 05species of Copepoda were recorded
IX	S.V. Bhandarkar and G.T.Paliwal	2011-2012	(G.T., 2010)	A total of 21 species were identified. 9 belong to Rotifera, 8 to Cladocera, 3 to Copepoda, and 01 to Ostracoda.

X	M. Karuthapandi, D.V. Rao and Xavier Innocent	2013	Freshwater rotifers of Andhra Pradesh- Checklist	a total of 114 species of freshwater rotifers have been reported from the state, of which 113 species belonging to Monogononta (03 Order, 22 families, 39 genera) and only one species belongingto Bdelloidea.
XI	Shashikant R. Sitre	2011	Zooplankton Fauna of a Freshwater Pond in Bhadrawati Town of Chandrapur District in Maharashtra State (India)	The pond shows 27 different species in its water of which maximum species are represented by Rotifera, while the minimum isrepresented by Protozoa and Ostracoda.
XII	Koushik Roy Sandipani Gupta and Saurav Kumar Nandy	2012 - 2014	Checklist of commonlyoccurring Phytoplankton and Zooplankton Genera of Urbanand Rural Ponds of Raipur,Chattisgarh.	Total of 24 zooplankton species out of which 03 protozoa, 11 Rotifera, 02 Cladocera, 07 Copepoda 01 Ostracoda, 01 were recorded.
XIII	Meshram UG, Dahare RB and Dhamani AA	2013-2014	Zooplankton diversity in Balasamudram lake of Pauni,Dist. Bhandara, Maharashtra, India	Total of 36 Zooplankton species were recorded. The Zooplankton population of Balsamudra Lake reveals the eutrophic condition.
XIV	Gadekar GP	2013	Seasonal Variation in Zooplankton Diversity of Railway Pond, Gondia, District Gondia (MS)	The population Railway pond consisted of 20 genera of zooplankton.
XV	Shashikant R. Sitre	2011	Zooplankton Biodiversity in Ghost Nimbala Reservoir in Bhadrawati Tehsil of Chandrapur District	total 21 zooplankton species out of which 04 protozoa, 08 Rotifera, 04 Cladocera, 03 Copepoda 01 Ostracoda, 01 Nematoda, and 01 Oligocheta were recorded.
XVI	Chavhan R.N.	2014-2015	"Limnological Studies onTalodhi Village Lake of tehsil Chamorshi, District Gadchiroli (M.S.), India, with Special Respect to Plankton Species Diversity"	total 104 zooplankton species out of which 09 protozoa, 49 Rotifera, 35 Cladocera, 06 Copepoda and 05 Ostracoda species were recorded.
XVII	Chapat P.B., Telkhede P.M., Khinchi P.J. and Sontakke D.D.	2015	A Seasonal Survey of Zooplankton Diversity in River Penganga Near Korpana, Dist. Chandrapur, Maharashtra, India.	28 zooplankton species were Recorded. Maximum zooplankton density was observed in winter and minimum density in TheMonsoon season.
XVIII	Shashikant R. Site and Atul K. Pimpalshende	2015	Zooplankton diversity of dham river at pawnar in wardha district of maharashtra state	In all 27 different zooplankton species are found in the river stretch at Pawnar out of which 07 protozoa, 11 Rotifera, 04 Cladocera, 03 Copepoda and 01 Ostracoda species wererecorded.
XIX	A.V. Dorlikar	2016	Correlation study of Zooplankton diversity, speciesrichness and Physicochemical parameters of ghodazari lake (maharashtra)	26 zooplankton species were Recorded out of which 11 Rotifera, 07 Cladocera, 05Copepoda and 03 Ostracoda species wererecorded.
XX	C.J. Khune and B.P. Parwate	2016-2017	Zooplankton Diversity and Their Seasonal Variation inNav-Talav, Amgaon, Gondia District	Total 23 zooplankton genera out of which 02 protozoa, 08 Rotifera, 06 Cladocera, 05 Copepoda and 02 Ostracoda genera were recorded.
XXI	Gaidhane D.M.	2016-2017	Plankton diversity in Wardha River near Rajura in Chandrapur District of Maharashtra, India	Total of 13 species of zooplankton were recorded. The zooplankton analysis shows that the total zooplankton density was more during the period of study due to the winter season as the low temperature is favorable for the growth of plankton
XXII	Dahegaonkar, N. R.	2016	Studies on pollutional status of Lohara Nullah in Chandrapur (Maharashtra), India.	Total 23 species of zooplankton were recorded from the study site. The present investigation showed that Rotifera (11species) dominated the water body

				followed by Cladocera, Copepoda and Ostracoda.
XXIII	S.W. Kuchankar, R.R. Kamdi, and P.R. Patel	2020-2021	An Analysis of zooplankton in a MAMA lake, near Wani Tehsil, District- Yavatmal(M.S.)	Total of 40 zooplankton species out of which 02 protozoa, 27 Rotifera, 05 Cladocera, 03 Copepoda, and 02 Ostracoda were recorded.
XXIV	Paresh Patel ReenaLaharia	2019-2022	Zooplankton Diversity of a Freshwater perennial pond in Wani city of Yavatmal District, In Maharashtra, India	Total 42 spp of zooplankton out of which 03 protozoa, 12 Rotifera, 09 Cladocera, 13Copepoda 05 Ostracoda,were recorded.

Table 2: Checklist of Commonly observed Zooplankton Species in and around Gadchiroli District:

Recorded Zooplankton Species	Recorded Zooplankton Species	Recorded Zooplankton Species
ROTIFERA **Family : BRACHIOPODA** *1. Brachionus Calyciflorus* (Wierzeijski) 2. *Brachionus Falcatus* (Zacharias) *3. Brachionus Caudatus (Boris Dadey)* *4. Brachionus Angularis(Gosse)* *5. Brachionus Forficula (Wierzejski)* *6. Brachionus Diversicornis(Daday)* *7. Brachionusquadridentacus(Her mann)* *8. Brachionus Urceolatus (O.F.Muller)* *9. Brachionus Platupusplatpus (O.F.Muller)* *10. Brachionus Plicatilis* *11. Brachionus Havansis* *12. Brachionus Dimidiatus* *13. Brachionus Plicatilis* *14. Brachionus Rotundiformis* *15. Brachionusbidenta* *16. Brachionus Rubens* *17. Keratella Tropica(Apstein)* 18. *Keratella cochlearis* (Gosse) *19. Keratella Quadrata (Muller)* *20. Keratella Ticinensis* *21. Epiphanes macrourus(Barois Daddy)* *22. Anuraeopsis Fissa*	**CLADOCERA** **Family: Sididae** *1. Diaphanosomasarsi* *2. Diaphanosoma Excisum* *3. Diaphanosoma Senegal* *4. Diaphanosoma Leuchtenbergia Num* *5. Diaphanosoma Brachyurum* **Family: Daphniidae** *1. Ceriodaphnia Cornuta* *2. Ceriodaphnia Rigaudi* *3. Ceriodaphnialacustris* *4. Ceriodaphnia acanthine* *5. CeridaphniaquadrangulaCerio daphnialaticaudata* *6. Ceriodaphnia Pulchella* *7. Daphnia lumholtzi* *8. Daphnia ambigua* *9. Daphnia dubia* *10. Simocephalus Vetulus* *11. Scapholeberiskingi* **Family: Moinidae** *1. Moina Micrura* *2. Moina macrocopa* *3. Moinsarosea* **Family - Bosminidae** 1. *Bosmina longirostris* 2. *Bosminadeitersi* 3. *Bosmina Coregoni* **Family -**	**PROTOZOA** Subphylum: Sarcomastigophora, Superclass: Mastigophora Class: Phytomastigophora, Order Volvocida **Family - Volvocaceae** 1. Volvox **Family – Nebelidae** 2. Euglena acus 3. Euglena sp. Class Rhizopoda, Order - Amoebida 4. Amoeba sp. Order - Arcellinida, Family - Arcellidae 5. ArcelladiscoidaFamily - Difflugia Difflugia sp. **Sub-phylum Ciliophora,** Class Ciliata **Family Paramedic Ae** 7. Paramecium sp. **Family – Peridiniaceae** 8. Peridinium sp. **Family - Frontonida** 9. Phacus Sp
(Gosse) **ROTIFERA** **Family : BRACHIOPODA** 1. *Brachionus Calyciflorus* (Wierzejski) 2. *Brachionus Falcatus* (Zacharias) 3. *Brachionus Caudatus (Boris Dadey)* 4. *Brachionus Angularis(Gosse)* 5. *Brachionus Forficula (Wierzejski)* 6. *Brachionus Diversicornis (Daday)* 7. *Brachionusquadridentacus(Her*	**Macrotpricidae** *1. Macrothrix Rosea* **Family - Chydoridae** 1. *Chydorus Globosus* 2. *Chydorus SphaericusChydorus Ovalis* **Family: Sididae** 6. *Diaphanosomasarsi* 7. *Diaphanosoma Excisum* 8. *Diaphanosoma Senegal* 9. *Diaphanosoma LeuchtenbergiaNum* 10. *Diaphanosoma Brachyurum* **Family: Daphniidae** 12. *Ceriodaphnia Cornuta* 13. *Ceriodaphnia Rigaudi*	Subphylum: Sarcomastigophora, Superclass: Mastigophora Class: Phytomastigophora, Order Volvocida **Family - Volvocaceae** 1. Volvox **Family – Nebelidae** 2. Euglena acus 3. Euglena sp. Class Rhizopoda, Order -Amoebida 4. Amoeba sp. Order - Arcellinida, Family - Arcellidae 5. ArcelladiscoidaFamily - Difflugia 6. Difflugia sp. **Sub-phylum Ciliophora,** Class Ciliata **Family Paramedic Ae** 7. Paramecium sp. **Family – Peridiniaceae** 8. Peridinium sp. **Family - Frontonida**

mann) 8. *Brachionus Urceolatus (O.F.Muller)* 9. *Brachionus Platupusplatpus (O.F.Muller)* 10. *Brachionus Plicatilis* 11. *Brachionus Havansis* 12. *Brachionus Dimidiatus* 13. *Brachionus Plicatilis* 14. *Brachionus Rotundiformis* 15. *Brachionusbidenta* 16. *Brachionus Rubens* 17. *Keratella Tropica(Apstein)* 18. *Keratella Cochlearis*(Gosse) 19. *Keratella Quadrata (Muller)* 20. *Keratella Ticinensis* 21. *Epiphanes macrourus(Barois Daddy)* 22. *Anuraeopsis Fissa(Gosse)* **Family : LECANIDAE** 1. Lecane bulla 2. Lecane Papuana 3. Lecane Eswari	14. *Ceriodaphnialacustris* 15. *Ceriodaphnia acanthine* 16. *CeridaphniaquadrangulaCerio daphnialaticaudata* 17. *Ceriodaphnia Pulchella* 18. *Daphnia lumholtzi* 19. *Daphnia ambigua* 20. *Daphnia dubia* 21. *Simocephalus Vetulus* 22. *Scapholeberiskingi* **Family: Moinidae** *4. Moina Micrura* *5. Moina Macrocopa* *6. Moinsarosea* **Family - Bosminidae** *1. Bosmina* *2. longirostris* *3. Bosminadeitersi* *4. Bosmina Coregoni* **Family - Macrotpricidae** *1. Macrothrix Rosea* **Family - Chydoridae**	9. Phacus Sp **Class: Ostracoda** *1. Heterocypris* *2. Cyclo Cyprus* *3. Stenocypris* *4. Eucypris* *5. Centroypris*
4. Lecanedecipiens 5. Lecane Cornuta 6. Lecane Ohioensis 7. Laecanemonostyla 8. LecaneTesselata 9. Lecane Cervicornis 10. Lecanedecipiens 11. Lecane Cornuta 12. Lecanearculata 13. Lecane Luna 14. Lecane Depressa 15. cephalodella mucronata 16. cephalodella gua 17. cephalodella gibba 18. Monostyla bulla 19. Monostylaclasterocera Monostylaquadridenta **Family : ASPLANCHNIDAE** *1. Asplanchna brightwelli* *2. Asplanchna Berricki* *3. Asplanchna Priodonta* *4. Asplanchna Priodonta* *5. Asplanchna Sphanchopsis* **Family: HEXARTHRIDAE** *Hexarthra MiraPhilodina* **Family: FILINIDAE** 1. Filinia Longiseta(Ehrenberg) 2. Filipiniana Soloensis (Zach) **Family: SYNCHAETIDAE** Polyarthra vulgaris (Carlin) **Family:**	1. *Chydorus Globosus* 2. *Chydorus SphaericusChydorus Ovalis* 3. *Chydorus Falciformis* 4. *Leydigia* **Sub-Family Aloninae** 1. *Alona RectangularRectangular* 2. *Alonarectangularichardi* 3. *Alonadavidi Punctata* 4. *Alona Macrocopa* 5. *Alonakarau* 6. *Alonella nana* 7. *Alonella Dentifera* **Phylum ArthropodaClass- Crustacea Subclass CalanoidaOrder Calanoid - COPEPOD Family - Diaptomidae** 1. Allodiaptomusraoi 2. Heliodiaptomus 3. viddus 4. Phyllodiaptomus. RhineDiaptomus **5.** Neodiaptomus**Order Cyclopoida** **Family - Cyclopidae** 1. Cyclops leuckarti 2. Mesocyclops Hyalinus 3. Paracyclopsaffinis 4. Microcyclops bicolor 5. Mesocyclops leuckarti 6. Eu Cyclop *spp.* *7. Cyclop spp.* *8. Diaptomus spp.* **Family Canthocamptus**9 Nauplii	
TRICHOCERIDAE 1. Trichocerca cylindrica(Imhoff) 2. Trichocerca Cylindrica 3. Trichocerca Longiseta 4. Trichocerca similis	**Class: GASTROPODA** 1. Ascomorpha	

5. Tricocerarattus Platyias Quadricornis **Family: TESTUDINIDAE** 1. Testudinella Patina 2. Filinia Longiseta 3. Filiniaterminalis 4. filiniatetramatrisHorell Mira **Family: TROCHOSPHAERIDAE** 1. Horaellabrehmi 2. Trichocerca Longiseta		

Figure 1: Satellite Image of Gadchiroli District (Red Border) [https://earth.google.com]

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Synthesis, Charecterisation and Kinetic study of Terpolymer Transition Metal Complexes Pthalic acid-Thiosemicarbazide -Formaldehyde (PTSF)

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Abstract

In this studies metal complexes have been synthesized by the buildup of pthalic acid, thiosemicarbazide and formaldehyde and formaldehyde with 2 M acetic acid is required as a catalyst for polymerization in (1:1:2) ratio of monomers. The structure of three coordination polymer were characterized by NMR, FTIR and elemental analysis. Thermogravimetric analysis was used for the investigation of thermal stability of the terpolymer ligand metal complexes. Additionally, Freeman-Carroll method was utilized for the calculation of activation energy with the help of TGA data. The structures of Cu(II) and Ni(II) complexes in the all coordination polymers were found as octahedral geometry. TGA results revealed that among the complexes PTSF-Cu(II) complexe has the highest thermally stable than the Ni.

Keyword: synthesis, characterization, structure, thermal studies.

Introduction

The excessive usage of heavy metals in industries are affecting with toxic effects on life of organism. Therefore it must be removed from environment. Recently copolymer-metal complexes have been more attracting in scientific and technological fields. In many areas have found that coordination polymers have vast applications in wastewater treatment, bioinorganic industry, pollution control , superconducting materials, ultra high strength material, anionic polyelectrolyte hydrogels , cation-exchange resins, etc. Due to its features as high thermal stability and antimicrobial behavior, the synthesis of polymer-metal complexes attracted researchers. The synthesize and characterization of several polymer-metal complexes have been reported in literature survey [1-2]. Khobragade et al. have synthesized metal complexes using Cu (II), Ni (II) and Zn (II) and characterized by different spectral and physical technique. They have studied thermal and antimicrobial properties of the synthesized copolymer-metal complexes [3-4]. Synthesized new terpolymer ligand and metal chelates derived from anthranilic acid, phenyl hydrazine and formaldehyde with Cu (II), Ni(II), Zn(II), Co(II). The complexes were studied for thermal stability and antibacterial screening [5-6]. The results reveals that all the complexes are highly thermally stable and more potent antibacterial agents than their corresponding ligands [7]. Some divalent transition metal complexes of 8-hydroxquinoline were prepared and described for their warm air stability and antibacterial activities [8].

In present research work, synthesis of new terpolymer metal complexes. Further, Structure of the copolymer metal complexes were confirmed by different spectroscopic and physical methods [9].

Materials and Methods:

Materials:

Entire starting materials utilized were of AR grade. The pthalic acid (Fisher India), thiosemicarbazide (S.D. Fine Chemicals) and formaldehyde (Sigma Aldrich) were procured from the market. Synthesized PTSF-Cu, Ni terpolymer ligand in 1:1:2 ratio.

Method of Synthesis of PTSF-Cu, Ni complexes:

Preparation of Polymer-Metal Complexes:

The terpolymer metal complexes have been prepared using the synthesized terpolymers as ligand with few transition metal ions such as Cu2+ and Ni2+ ions. The terpolymer was taken in 2 M and the transition metal ions (Cu2+ and Ni2+) was taken in 1 M for the complex formation reaction. The PTF terpolymer (2 g) was taken in round bottom (RB) flask and immersed in ethanol solution to allow it for swelling in 2 h. The cupric nitrate (1 g) was dissolved in ethanol solution and then poured into round bottom flask with equipped mechanical stirrer and a reflux condenser. The reaction has been carried out with an effective reflux at 60°C for 3 h. The colloidal precipitate was observed in the flask and separated out. The product was filtered off and washed with ether and ethanol to remove the impurities. The purification has been done repeatedly to separate the purified product. The resultant purified sample was air dried, powdered and kept in vacuum desiccator with silica gel.

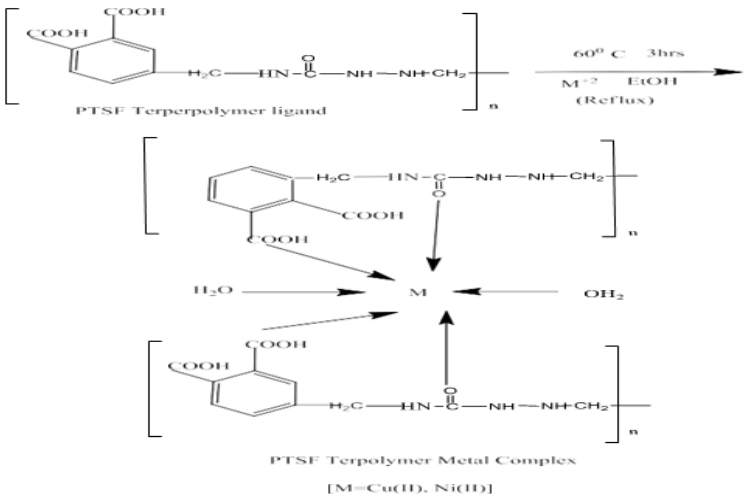

Fig. 1. Reaction of the PTSF-M Terpolymer Metal Complexes.

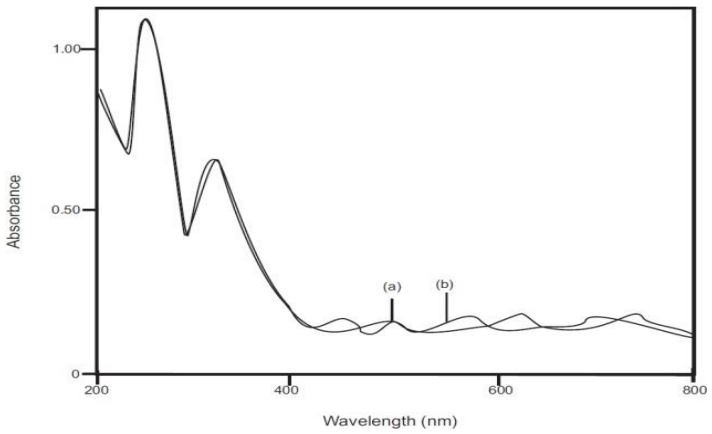

Fig.2. UV-Visible Spectra of (a) PTSF-Cu, (b) PTSF-Ni Metal Complexes

Fourier transform infrared spectra

The FTIR spectra of PTSF terpolymer metal complexes are depicted in Figure 3 and Fig.4. The terpolymer ligand spectrum showed a broad band at 3410.07 cm-1 is assigned to the hydroxyl group of –COOH present in the aromatic ring. A band appeared at 2942.57 cm-1 is assigned to aromatic ring (-CH) stretching modes. The 1,2,3,5 tetra substitution of aromatic benzene ring is confirmed by the bands appeared between 1266 cm-1 and 728.04 cm-1 [14- 15]. The band appeared at 1715.40 cm-1 is assigned to –C=O stretching vibrations of Ar-COOH [16]. The band appeared in the region of 1433.01 cm-1 to 1266 cm-1 is attributed to –CH2 - bending (twisting & wagging) mode of vibrations [17].

In the spectra of PTSF terpolymer metal complexes, the bands are slightly broadened compared to the terpolymer ligand. The shifting of bands appeared in region of 3406 cm-1 to 3408 cm-1 are due to the coordination of the ligand with the metal ions through the lone pair of oxygen present in –C=O of phtalic acid. The band appeared in the region of 1064.2 – 1010.6 cm-1 is assigned to C-O-M stretching mode. The band appeared at 1732.6 cm-1 for –C=O stretching vibrations in the ligand spectrum is shifted to the range of 1714.6 – 1714.8 cm-1 in the complex spectrum clearly indicates the metal coordination takes place through the –C=O of Ar-COOH moiety.

The band appeared at 1648 cm−1 is assigned to –C=O amide (I) stretching vibration. In the spectra of PTSF metal complexes, the bands are slightly broadened compared to the terpolymer ligand. In the spectrum of polymeric ligand, the band at 1648 cm−1 assigned for C=O amide (I) is shifted to the lower frequencies (1630 to 1631 cm−1) in the case of polymer–metal complexes. It is due to the coordination of the metal ions through the lone pair of oxygen in carbonyl group present in the semicarbazide moiety. This is a clear evidence for the involvement of oxygen and –C=O of Ar- COOH in the chelation. It is further supported by the appearance of O_M and O_M stretching vibrations at 613–614 and 559–560 cm−1 respectively.

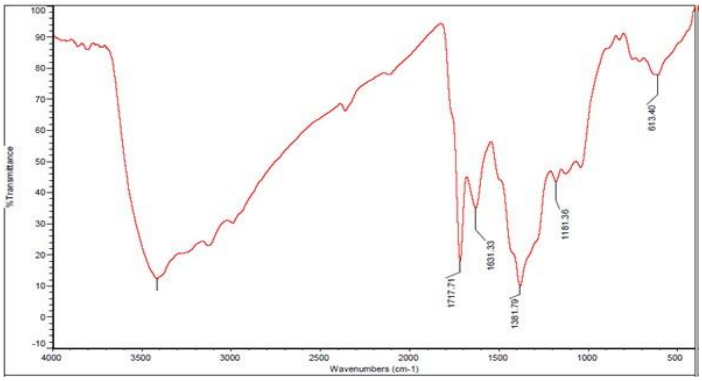

Fig.3. FTIR Spectra of PTSF –Cu

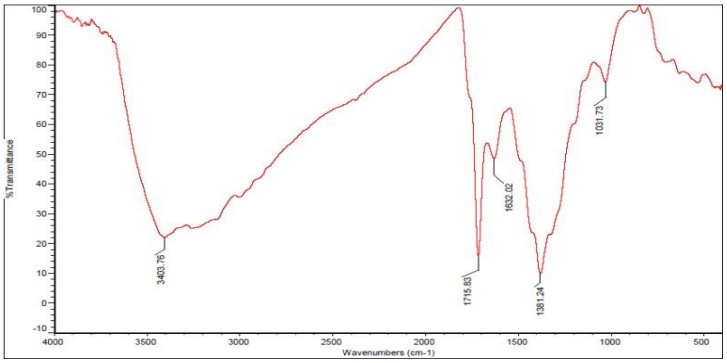

Fig.4. FTIR Spectra of PTSF –Ni

Nuclear Magnetic Resonance

The 1H NMR spectra of PTSF terpolymer ligand and its Cu(II) and Ni(II) metal complexes are shown in Fig. 4 and 5. The signals obtained for the terpolymer and its metal complexes were interpreted on the basis of the literature [18]. The spectrum of terpolymer showed the signals appeared in the region of 7.32 – 8.84 ppm is assigned for all the protons of the aromatic ring. A signal appeared at 5.74 ppm is assigned to the –NH protons of the thiosemicarbazide moiety and the peak appeared at 9.86 ppm is assigned to –OH proton of Ar-COOH. A peak appeared at 2.42 ppm is due to the methylene protons present in the terpolymer ligand.

The 1H NMR spectrum of the metal complex shows multiplet in the range of 7.05 – 8.94 ppm are assigned to the aromatic protons and the methylene protons appeared in the region of 2.40 – 3.10 ppm. The signal for –OH proton is shifted from 9.86 ppm to 10.06 ppm in the complex spectrum which gives a clear evidence for the complexation of the metal ion with the – to –OH proton of Ar-COOH.

On comparision with the ligand spectrum, the line broadening has been observed in the spectrum of metal complex, further confirms the metal ion incorporation with the polymer backbone.

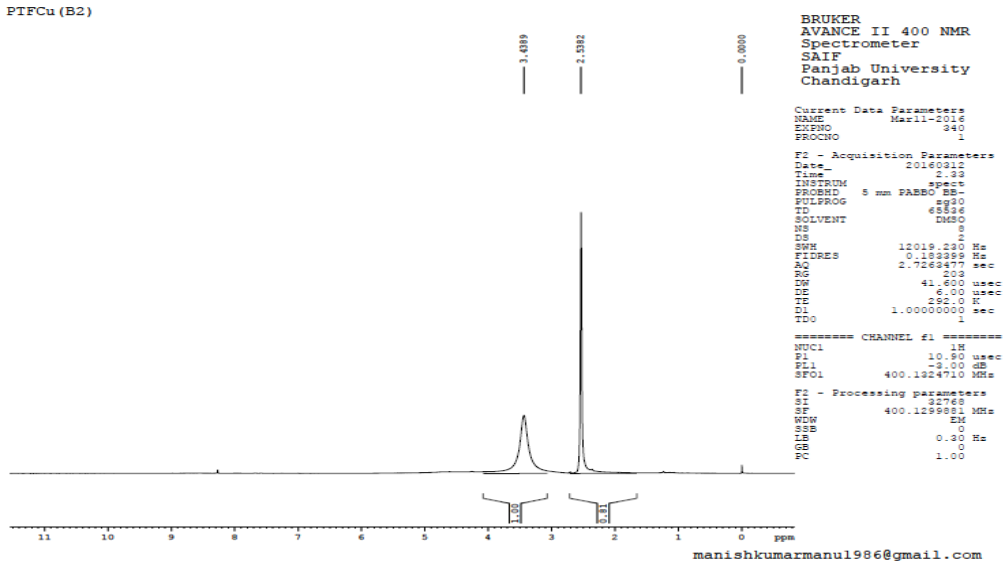

Fig. 5: ^{1}H–NMR Spectra of PTSF-Cu Ligand

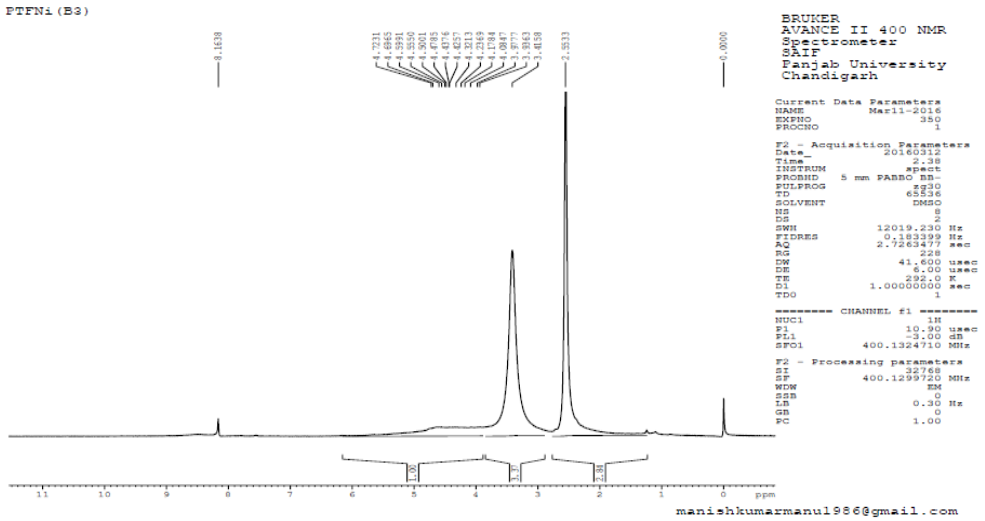

Fig. 6: ^{1}H–NMR Spectra of PTF-Ni Ligand

Thermal Stability

The non-isothermal thermogravimetric analysis was performed in air atmosphere with heating rate of 10 ºC.min-1 from temperature range of 40ºC to 740ºC using Perkin Elmer Diamond TGA analyzer in argon environment. The thermal stability of terpolymer, based on the initial decomposition temperature, has also been used here to define their relative thermal stability, neglecting the degree of decomposition. A brief account of thermal behaviour of these copolymers metal complexes is given in results and discussion. Stability of the PTSF-Cu (Cu=Ni) terpolymer metal complexes has been analyzed by thermogravimetric analysis (TGA). To obtain the relative thermal stability of terpolymer metal complexes, the method described by Sharp-Wentworth adopted [19-21]. Thermoanalytical data and the decomposition temperatures were determined for different stages.

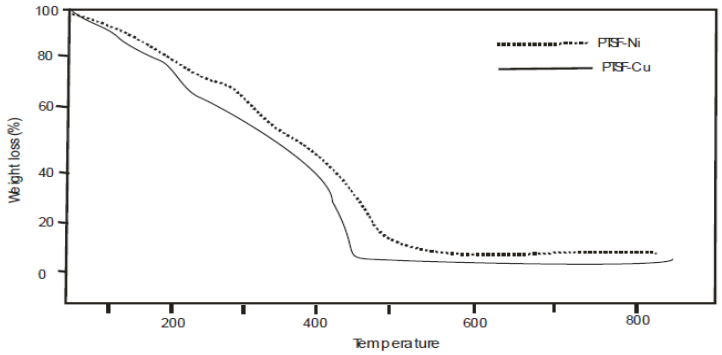

Fig.7. Thermogram of PTSF-Cu and Ni Complex

TGA of PTSF–Cu Complex

From the weight loss curve of the PTSF–Cu complex, the initial weight loss is observed up to 140°C due to the elimination of lattice water molecules and then the weight loss is continued up to 190°C (Weight loss in found–5.25% and calc.–5.14%) represents the release of two coordinated water molecules from the Cu(II) complex. This also confirms the octahedral geometry of the PTSF–Cu complex. Beyond this a gradual weight loss was observed up to 430°C, which may be due to thedegradation of unchelated part of the polymeric ligand. Above 430°C again a rapid weight loss up to 500°C has been observed which is attributed to the loss of chelated part. The TG curve attains a constant after 490°C leading to the formation of CuO as residue (Residue in found–12.60%, and calc.–11.47%).

TGA of PTSF–Ni Complex

The analysis of PTSF–Ni thromogram reveals that, there is a weight loss at 200–230°C (Weight loss found–5.63% and calc.–5.03%) indicates the release of two coordinated water molecules. This also confirms the octahedral geometry for the nickel complex. Beyond 230°C, a gradual weight loss is observed up to 450°C, which may be due to the loss of non-coordinated part of the ligand. The next degradation stage starts at 450°C and ends up at 530°C which involves an elimination of chelated part. After this temperature the NiO is formed as a stable metallic residue (Residue in found–10.60% and calc.–10.44%) [22-26].

In all the thermogram of the metal complexes, the rate of second stage thermal degradation was very fast as compare to the first

stage. This is due to the degradation of unchelated part of the terpolymer ligand. Further the low thermal stability of the metal complexes is also due to the oxidation of terpolymer by the catalytic action of metal ions. The order of thermal stability of the terpolymer metal complexes are in the following order:-

PTSF-Ni > PTSF-Cu

By using an analytical technique suggested by Sharp-Wentworth and Freeman-Carroll [27-30], we developed the TG curves to give further proof about the degradation mechanism of the examined substances.

Table. 1. Results of Thermogravimetric Analysis of PTSF - Metal Complexes.

Copolymer ligand and its metal complex	Half Decomposition Temp. (T)	Activation Energy Ea (KJ)/mol	
		SW	FC
PTSF-I-Cu	653	5.84	5.22
PTSF-I-Ni	673	6.02	6.08

Copolymer Ligands And its metal complex	Entropy change ΔS(J)	Free energy ΔF (KJ)	Frequency Z (S^{-1})	Apparent entropy (S*)	Order reaction
PTMF-I-Cu	150.23	62.39	702.78	-24.98	0.9
PTMF-I-Ni	-144.52	60.82	686.41	-25.14	0.92

Further from the knowledge of activation energy using Freeman-Carroll method, it is possible to calculate the values of various thermodynamic parameters. The kinetic parameters such as order of reaction (n) and activation energy (Ea) and the thermodynamic parameters such as frequency factor (Z), entropy change (ΔS), free energy change (ΔF) and apparent entropy (S*) are presented in Table 1 and 2. The Ea values calculated by SW and FC methods are in good agreement with each other. The order of activation energies for PTSF-Cu(II) and Ni(II) complexes are parallel to the order of their thermal stability. The values of thermodynamic parameters are comparable indicating a common mode of decomposition reaction. The abnormally low value of frequency factor (Z) indicates that the decomposition reaction of PTSF terpolymer and its metal complexes takes place in a slow phase. The order of PTSF−Cu and PTSF−Ni complexes are 0.90, and 0.92 respectively. From the above results, it is quite clear that the decomposition reaction follows approximately a first order kinetics.

Conclusions

The Phthalic acid−Semicarbazide−formaldehyde (PTSF) terpolymers Cu (II) and Ni (II) metal complexes were newly synthesized with good yield. For spectral analysis UV-Visible, IR & H1-NMR test from Kochi research center give the result of the sample show the structural representation. All the terpolymer and their metal complexes have been successfully characterized to propose their possible structures and geometries by various spectral techniques. The Cu2+ and Ni2+ complexes of PTSF ligands follow the octahedral geometry and also Cu (II) and Ni (II). However, Molar conductivity values reveal that all the metal complexes are electrolytes. The thermal stability of the metal complexes is less compared to its terpolymer ligand. In TGA, the kinetic parameters derived using the Freeman-Carroll approach are found to be comparable, and the energy of activation assessed using the Sharp-Wentworth and Freeman-Carroll methods are found to be substantially equivalent, suggesting the same reaction mechanism. It is challenging to get any original conclusions on the breakdown process. According to thermogravimetric research, this copolymer is thermally stable at high temperatures.

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Studies on Foliicolous Microfungi from Amravati University Campus, Amravati, Maharashtra, India

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Abstract:
Foliicolous fungi are an essential part of the ecosystem and should be thoroughly researched sincethey are essential to the emergence and control of plant diseases. To study the foliicolous fungi present study was carried out in regions of Amravati Maharashtra from June 2022 to August 2023.Twenty plant samples with various disease symptoms were collected and brought to the laboratoryand cultured on PDA media and kept one to two weeks for incubation. We found 8 genera and 10species of foliicolous fungi prominently *Alternaria, Bipolaris, Cercospora, Curvularia, Dreschlaria, Fusarium* etc. The fungal samples were identified with the help of standard monographs and online databases.

Keywords: foliicolous fungi, Amravati, University campus, identification

Introduction:

Sant Gadge Baba Amravati University, formerly Amravati University, located at Amravati in the Vidarbha region of the state of Maharashtra, India with 480 acres campus. This campus is with diverse vegetation and habitats having huge potential for the growth and explorations of fungal diversity. Since foliicolous fungi are crucial to the appearance and management of plant diseases, they should be thoroughly studied as an integral element of the ecosystem. It is possible for facultative or obligatory parasitic fungus to exist in both favorable and adverse environments. These produce diseases by infecting leaves of various plants from both sides and exhibiting symptoms including leaf spots, hypertrophy, canker, die-back, etc. Shade and decorative trees are most commonly affected by leaf spots, a disease that not only damages the tree but also lowersits value. Though the surface of leaf provide a hostile environment for fungal growth, where interesting interactions occur betweenleaf and fungi (Andrews & Harris 2000). Kinkel (1997) reported that a thin nutrient film deposited from the atmosphere on the leaf surface further facilitates the microbial colonization for growing plants make new surfaces available for fungi. The richness of fungi varry according to biotic and abiotic limitations (Iara F. Santiago *et.al.*, 2018). Over 95% of the diversity of fungi is still unknown, andthose that have been identified lack scientificnames. Hibbett (2016). Keeping this view in mind, present study has been conducted in Amravati University campus during from June 2022 to August 2023.

Material and Methods:

Plant leaves with various disease symptoms were collected in the separate paper bags. The herbarium of samples were made by pressing and dried in blotting paper and the papers were changed after short interval of time till the specimens were completely pressed and dried. The infected samples were further processed by microscopic investigations, which involved hand sections and preparation of the slides has been done in a drop of Lacto phenol, Cotton blue and glycerine (Dubey *et.al.*, 2019). In the laboratory,nail polish techniques were used to study the structural and morphological characters of fungi (Hosagouder and Kapoor, 1984). The infected part of leaves were also cultured on PDA media and kept one to two weeks for incubation or sporulation. The fungal samples were observed under compound microscope and identified with the help of standard monographs and online databases.

Results and Discussion:

The extensive survey of foliicolous fungi was carried out from June 2022 to august 2023 in Sant Gadge Baba Amravati University, Amravati campus. The foliicolous fungus with respective hosts and family is enumerated in Table 1. Table 1 reveals that there are twenty angiospermic host plants representing nine families infected by ten fungal species representing eight fungal genera. Several hosts are being reported to be infected with same fungi. Few fungi have been found infects to two or three different host (Kumar A and Mall, TP., 2013). All the fungal genera can be divided into some categories viz. *Alternaria* represented by two fungal species where as *Fusarium* by two species, *Bipolaris, Cercospora, Cladosporium, Colletotrichum Curvularia, Drechslera* by one

species each. The nine families of angiospermic hosts can also be categorized into some groups. Members of Fabaceae (*Bauhinia variegata* (L.), *Cassia fistula* (L.), *Bauhinia variegata* (L.), *Saraca asoca* (Roxb), *Acacia arabica* (L.) Willd. *Acacia arabica* (L.) Willd. *Dalbergia sissoo* Roxb. And *Casia tora* (L.) Roxb.) are most susceptible to be infected by five fungal species followed by Apocynaceae (*Alstonia scholaris* (L.), *Plumeria alba* (L.), and *Catharanthus roseus* (L) G.Don) by three species; Moraceae (*Ficus benghalensis* (L.) and Ficus religiosa (L.)) and Myrtaceae (*Syzygium cumini* (L.) Skeels., and *Eucalyptus globules* Labill.) by two; Bignoniaceae (*Tecoma stans* (L.) Juss. ex Kunth.), Meliaceae (*Azadirachta indica* A.Juss.), Poaceae (*Bambusa vulgaris* Schrad), Sapotaceae (*Mimusops elengi* (L.)) and Verbenaceae (*Lantena camera* (L.)) are being infected by single fungal species each.

Conclusion:

Fungal species infecting to the host plants severely which is a situation of challenge for humans so for as the health of the host plant like decreasing rate of photosynthesis, other metabolic activities and quality of their products.

Acknowledgement: The authors are thankful to Head, Department of Botany, Sant Gadge Baba Amravati University, Amravati for providing necessary facilities for the completion of thiswork.

Table 1: List of Foliicolous Fungi and their Host with family collected from Amravati University campus

Sr. No.	Fungus	Host	Host family
1	*Alternaria alternata*	*Tecoma stans* (L.) Juss. ex Kunth.	Bignoniaceae
2	*Alternaria alternata*	*Mimusops elengi* (L.)	Sapotaceae
3	*Alternaria* spp.	*Bauhinia variegata* (L.)	Fabaceae
4	*Alternaria* spp.	*Ficus benghalensis* (L.)	Moraceae
5	*Bipolaris* spp.	*Cassia fistula* (L.)	Fabaceae
6	*Bipolaris* spp.	*Bauhinia variegata* (L.)	Fabaceae
7	*Bipolaris* spp.	*Saraca asoca* (Roxb)	Fabaceae
8	*Cercospora* spp.	*Acacia arabica* (L.) Willd.	Fabaceae
9	*Cercospora* spp.	*Azadirachta indica* A.Juss.	Meliaceae
10	*Cladosporium* spp.	*Bambusa vulgaris* Schrad.	Poaceae
11	*Cladosporium* spp.	*Cynodon dactylon* (L.) Pers.	Poaceae
12	*Colletotrichum* spp.	*Syzygium cumini* (L.) Skeels.	Myrtaceae
13	*Curvularia* spp.	*Alstonia scholaris* (L.)	Apocynaceae
14	*Curvularia* spp.	*Ficus religiosa* (L.)	Moraceae
15	*Drechslera* spp.	*Plumeria alba* (L.)	Apocynaceae
16	*Drechslera* spp.	*Dalbergia sissoo* Roxb.	Fabaceae
17	*Drechslera* spp.	*Eucalyptus globules* Labill.	Myrtaceae
18	*Drechslera* spp.	*Lantena camera* (L.)	Verbenaceae
19	*Fusarium* spp.	*Casia tora* (L.) Roxb.	Fabaceae
20	*Fusarium oxysporium*	*Catharanthus roseus* (L) G.Don	Apocynaceae

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Vidarbha' sparadise, Ecotourism of nagzira wild life sanctuary

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Abstract:
The present paper in tends to analyze the eco-tourism and biodiversity of Nagzira Wildlife Sanctuary. Ecotourism is ecologically sustainable tourism with a primary focus on experiencing natural areas that foster environmental and cultural understanding, appreciation, and conservation. Tourism, bird watching, and jungle safariare all concepts that brings joy and are based on biodiversity in Nagzira Wildlife Sanctuary. Biodiversity makes it possible to study the evolution of all living things. Their future and the existence of man are closely related to each other.

Introduction: -

Navegaon-Nagzira Tiger Reserve (NNTR) was notified as to 44th tiger reserve of India on the 12thof December 2013.It's the 5th Tiger Reserve of Maharashtra. It is situated in Gondia and Bhandara Districts in the North – Eastern corner of Maharashtra. Gondia district share common boundaries with the states of Madhya Pradesh & Chhattisgarh on the North and Eastern side respectively. Strategically, The Tiger Reserve is located in the heart of the central Indian Tiger landscape which contributes almost 1/6 of the Total tiger population of the country. This area is an excellent abode for almost all major floral and faunal species found in central India.

"Nagzira" name derived from two words i.e. 'Nag' and 'Zira'.'Nag' is a Sanskrit word that means Elephantand 'Zira' means Spring. This area indicates the historic habitat of elephants denoted by the name 'Nagzira' There is a temple of 'Naag'(Snake)which is exactly in the middle of the Nagzira temple of Mahadev.

There was also a village inside the forest called 'Nagthana' denoted the name of the forest Nagziragot its name from this temple and 'Zira' (Zara) in Marathi means the source of water that comes out from a hillin'Pongezara'.Nagzira mostly tribal people who lived in the area were under Gond Kings in the old days.

Objectives of the study:

1. To know the impact of natural and cultural factors on ecotourism due to Nagzira Wild life Sanctuary.
2. To search the potential of eco-tourism development in the NNTR area
3. To give suggestions to the government of Maharashtra and the tourism board for development.

Study area: -

The core zone is situated administratively in the Gondia and Bhandara districts of Vidarbha region in Maharashtra state. It is in the North–East corner of the state, near the boundaries of Chhattisgarh in the east and Madhya Pradesh in the north, and geographically forms part of central Indian highlands in the sub-ranges of Satpuda Hill Rangei.e. Nagzira block in the Gaikhuri Range.
The geographical coordinates of the Core Zone is as under

Conservation Unit	Block	Geographical coordinates	
Core Zone	Nagzira	latitude	$N21^0 06^{|}$ to $21^0 21^{|}$
		longitudes	$E79^0 42^{|}$ to $80^0 10^{|}$

Data base & Methodology:

This study of research is mainly based on secondary data. It is collected from TCP, Forest Department of Maharashtra in Gondia and Bhandara District and various sources of secondary data have been utilized, such as journals, books, and the internet.

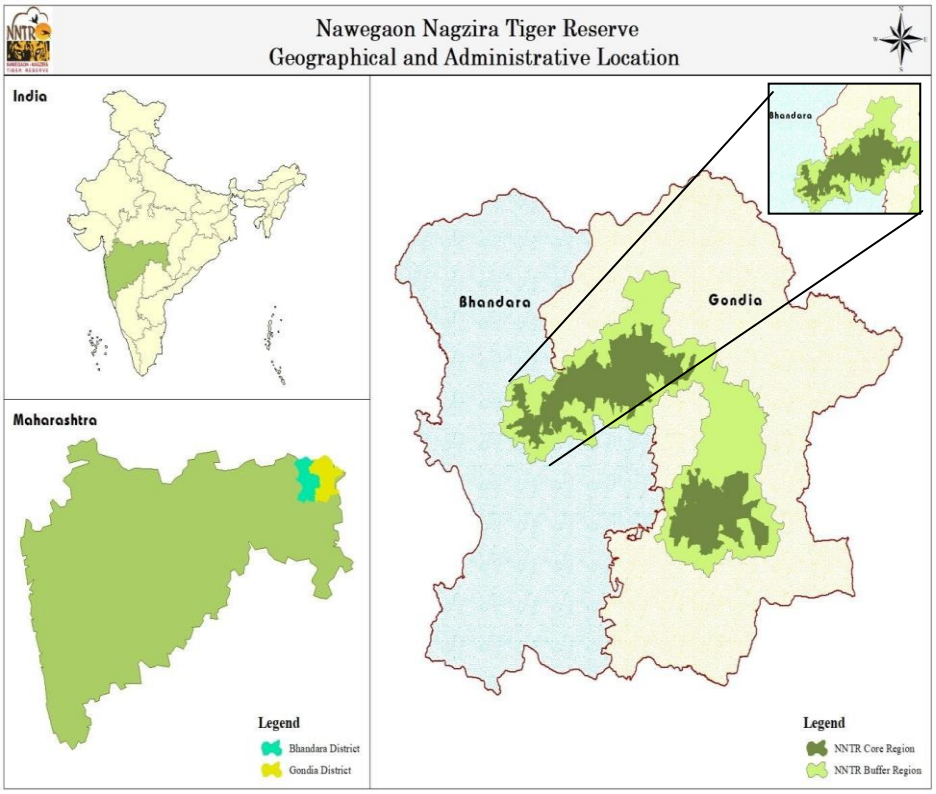
The habitat & Biodiversity scenario:

Nagzira Wildlife Sanctuary has rich floristic diversity. The major forest type is "Southern Tropical Dry Deciduous Forest "5A/C3" as per the Champion and Seth Classification. Till now 274 and 364 plant species has identified from Nagzira Wild life Sanctuary. It grows as the middle story in teak as well as mixed forest.

Nagzira Wildlife Sanctuary is home to many endangered species with 72 species of mammals, more than250 species of birds including migratory land and water birds, about 48 species of reptiles, and many species of amphibians.

The large carnivores like Tiger and leopard and smaller carnivores like wild-dog, wolves,

jackals, and jungle cats, and also the good population of sloth bears are reported from Nagzira Wildlife Sanctuary. The important her bivores include Cheetal, Sambar, Nilgai, Chousingha, Barking deer, wild pig, and Gaur, Mouse deer has also been recorded from the area. The other animals include common Langur, Rhesus Macaque, Badger, Flying Squirrels, Civet sand Mongoose species, Giant squirrel, etc. The area is surrounded by good patches of forest from 3 sides mostly under the Territorial Forest division. Beside sits floral and faunal values.



Sr. No.	Wildlife Species	Nagzira Wildlife Sanctuary
1	Mammals	38
2	Birds	202
3	Reptiles	36
4	Butterfly	49
5	Germs	09
6	Fish	52

Types of plants	Species of Vegetation's
Tree Class	124
Grass	38
Climber	28
FlowerClass	02
Medicinal	91
Bamboo	02

Eco-Tourism: -

Eco-Tourism in contest of Tiger Reserve is ecologically sustainable nature tourism, which is emerging as an important component of the tourism industry. Eco-tourism is proposed to be fostered with financial support to the host community through soft loans from Eco-development communities, by site-specific Eco-Tourism plan and carrying capacity of Tiger Reserve.

In recent times, vast changes in the Eco-Tourism Policy of the state and Central Government have taken place. The Supreme Court of India in its order dated 16th October 2012 in Civil Appeal no. 21339/2011 directed that the state to prepare an Eco-Tourism plan for each Tiger Reserve as per National Tiger Conservation Authority's Eco-Tourism guidelines circulated. The eco-tourism plan of Nagzira Tiger Reserve (NNTR) is a project that aims to promote sustainable and responsible tourism in the area, while conserving the rich biodiversity and cultural heritage of the region. Some of the features of the plan are:

- The Forest Development Corporation of Maharashtra Limited (FDCM) operates various resorts and facilities for tourists inside and outside the core jungle of NNTR
- The Maharashtra Eco Tourism Portal provides online booking facilities for accommodation and safari in NNTR
- The eco-tourism activities are subject to the guidelines of the National Tiger Conservation Authority (NTCA) and the district collectors concerned
- The eco-tourism plan also involves the participation of local communities and stakeholders in the management and development of the region

- The eco-tourism plan is expected to generate revenue and employment opportunities for the local people, as well as enhance the awareness and appreciation of the natural and cultural values of NNTR

Objectives of eco-Tourism: -

1. Highlight the heritage valves of Nagzira Wild life Sanctuary.
2. Build environment and cultural awareness, nature education, and respect.
3. Providelivelihoodopportunitiestolocalcommunit iesandbenefitsharing.
4. Wild ernes conservation in ecologically sensitive landscapes.
5. Capacity building of local communities in planning, providing, and managing ecotourism facilities.

Conclusion:

The development of ecotourism to improve the respect of the environment can be a unique resource for wild animals and the local economy. Choosing to live an ecotourism experience means not only experiencing an un for gettable adventure, being in contact with the most pristine nature, and admiring beautiful wild life but also supporting local communities and organizations committed to the protection of local fauna. The strength of the tourists in NNTR is increasing day-by-day. The socio-cultural factors are responsible for the development of Eco-Tourism in NNTR and other tiger reserves too. The tourism potential of NNTR is also vast as compared to the present tourist status.

Suggestions:

The government has to develop the Tourist facility in NNTR. The accommodation facilities as well as the number of vehicles are very low in Nagira Tiger Reserve which must be further developed. There is a need to increase the tourist routes in NNTR. Villages inside the NNTR May be relocated to other areas to make more geographical space for the wildlife. The Wildlife Corridors must be protected for the smooth movement of wildlife with the other protected areas especially Satpura Tiger Reserve and Karna Tiger Reserve in Madhya Pradesh as well as Tadoba Andari Tiger Reserve in Maharashtra.

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Thermogravimetric Analysis of Tercopolymer Resins Derived From O-Aminophenol, Dithiooxamide and Formaldehyde

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Abstract

Tercopolymers were prepared by the condensation of o-Aminophenol(o-A)-,dithiooxamide (D) and formaldehyde (F) in the presence of of hydrochloric acid (2M) as catalyst with varying molar ratio of reacting monomers. Tercopolymers were characterized by their electronic absorption spectra, NMR spectra, IR spectra, elemental analysis and TGA. Molecular weight of the copolymer were determined by non-aqueous conductometric titration. The kinetic and thermodynamics parameters such as order of reaction, energy of activation, frequency factor,entropy charge, free energy change and apparent entropy change have been determined. Freeman Carrolland Sharp Wentworth method have been applied for the calculation of kinetic parameters while the data from the Freeman- Carrollmethod have been used up to determine various thermo dynamics parameters. The static (isothermal) TGdata were analysed by use of Sharp-Wentworth method were calculated and it was observed that the o-APDF-IV was more stable than those fo-APDF-I,o-APDF-IIando-APDF-III.This prediction on the basis of static TGdataisan agreement with the prediction based on the activation energies and initial decomposition temperatures calculated from the dynamic TG curves.

Keywords-Tercopolymers, Synthesis, Resin, Thermal degradation

Introduction

Many research is being directed towards the preparation of polymeric chains which are propagated because of the formation of metallic chelates, so that also synthetic resins derived from hydroxyl and amino compounds have attracted the attention of many research workers because of their versatile use as ion exchangers, photographic binders, thermal stabilizers, etc.

As the term implies, macromolecular science deals with compounds whose characteristic properties depend mainly on the extraordinary large size of the molecules and synthetic polymeric or macromolecular compounds lies between 104 and 107 polymeric materials received attention and importance only in the recent years. Condensation of phenol or hydroxybenzoic acid with formaldehyde in presence of acid afforded a polymer, while condensation of hydroxybenzoic acid and urea/thiourea with form aldehyde/trioxane in presence of acid yieldsater polymer. These terpolymers are reported to have better acid resistance, better thermal stability and electrical properties than those of phenol-formaldehyde type copolymers.

Tercopolymer are macromolecular entities which form an integral part of the backbone.Tercopolymers are found to be amorphous powder or crystalline resinous in nature and form special class of polymers which are widely known for their uses. Condensation of phenol or hydrobenzoic acid with formaldehyde in presence of acid afforded a polymer, while condensation of hydrobenzoic acid and biuret with formaldehyde or trioxane in presence of acid as catalystyieldsa Tercopolymer. These Tercopolymer have better thermal stability and electrical properties than those of phenol - formaldehyde type copolymers. The tercopolymers can be used as ion-exchangers, semi-conductors, antioxidants, hardening agents, molding materials, rectifiers, dyes, fungicides in plants and living tissues.

In this paper we describe the study of Freeman-Carroll (1) and Sharp-Wentworth (2) methods to evaluate activation energy and thermal stability of newly synthesized tercopolymer resin. The o-APDF terpolymer resins have been synthesized by the condensation process and purified. These are yellow color and are soluble in DMF, DMSO, aqueous KOH, and NaOH and insoluble in almost all organic and inorganic solvents.

Experimental

Chemicals: All the chemicals used were of Analytical R.grade.

Instruments used: The apparatus required for a thermo gravimetric analysis consists of the components.

1) Asensitive analytical balance.
2) A furnace.
3) A furnace temperature controller program
4) Arecorder which provide a ploto sample.The

plot is known as the program.

This is the entire experimental set-up for the thermogravimetric analysis, known as thermobalence. A wide range of commercial instruments are available and all of these have many common features. The thermograms of the terpolymer resins under present investigation were carried out at Sophisticated Instrumentation Centre for Applied Research and Testing (SICART), Vallabh Vidyanagar, Anand, Gujarat.

Synthesisofo-Aminophenol (o-A)-Dithiooxamide (D) -Formaldehyde (F) TerpolymerResin.

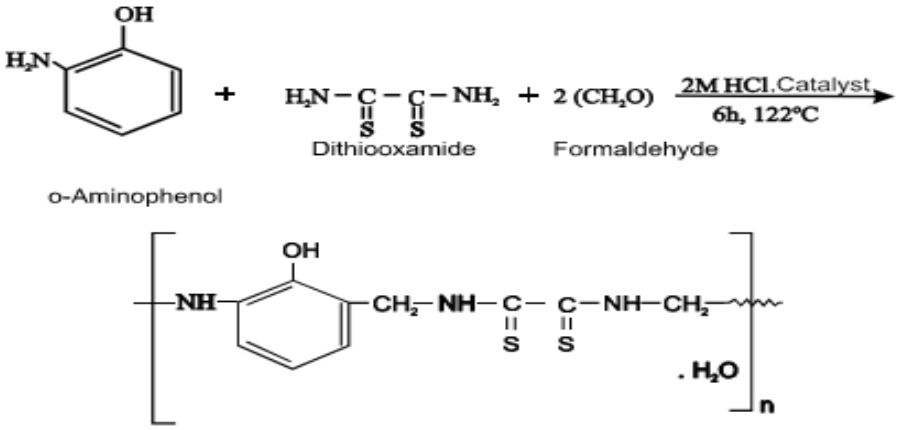
The four different types of o-APDF terpolymer resins have been successfully synthesized and abbreviated as given in Table 1.

Synthesisofo-APDF-Iterpolymer resin

A mixture of ortho amino phenol(1.09gm, 0.1 mol), and dithiooxamide (1.20 gm, 0.1 mol) and formaldehyde (7.50 ml, 0.2 mol) in molar ratio of 1:1:2 in the presence of 2M (200 ml) HCl as a catalyst has been prepared in round bottom flask. The resultant mixture was refluxedover an oil bath for heating at122ºC± 2ºCfor5 hrs with occasion alshaking to ensure thorough mixing. The temperature of oil bath was controlled electrically with the help of dimmer stat. The resinous sticky brown solid mass obtained was immediately removed from the flash as soon as the reaction period was over and then it's purified. Excellent yieldo after polymerresincan be obtained by this reaction the reaction is shown as follows in Fig. 1.

Purification of Resins:

The solid product was repeatedly washed with cold distilled water, dried in air and powdered with the help of agate mortar and pestle. The powder was washed many times with hot water followed by methanol to remove the un reacted starting materials, if any. The properly washed powder was dried in vacuum desicator over unhydrous calcium chloride. The resin was further purified by reprecipitation technique. The terpolymer was dissolved in 8% NaOH, filtered and reprecipitated by drop wise addition of ice cold 1:1 (v/v) concentrated hydrochloric acid /distilled water with rapid stirring to avoid the lump formation. The process of reprecipitation was repeated twice. The terpolymer resin o-APDF-I so obtained was filtered, washed several times with hot water, dried in air,powdered and kept in vacuum desicator over unhydrous calcium chloride.



o-APDF Terpolymer

Fig.1.ReactionandSuggestedStructureofRepresentative o-APDF-I Terpolymer Resin

Table 1

Synthesis and Physical Data of o-APDF Terpolymer Resins

		Reactants							
Terpolymer Resin Abbreviation	Ortho amino phenol o-AP (mol)	Dithiooxamide D (mol)	Formal dehyde F (mol)	Molar ratio	Catalyst 2M/HCl (ml)	Reflux Temp. (K)	Time (hr)	Yield (%)	Melting point (K)
o-APDF-I	0.1	0.1	0.2	1:1:2	200	393	5	80	386
o-APDF-II	0.2	.1	0.3	2:1:3	200	393	5	82	393
o-APDF-III	0.3	0.1	0.4	3:1:4	200	393	5	84	390
o-APDF-IV	0.4	0.1	0.5	4:1:5	200	393	5	85	389

Similarly other terpolymer resins o-APDF-II, o-APDF -III and o-APDF -IV were synthesized by varying molar properties of starting materials such as (2:1:3), (3:1:4) and (4:1:5) respectively by varying little experimental condition during polycondensation reaction of reacting materials.

Results and Discussion

Thermogravimetry Ofo-APDFTerpolymer Resin:

The thermo gra vimetric analysis of o-APDF terpolymer resins has been carried out in the temperature range of 40ºC to 800ºC. The thermograms of o-APDF terpolymer resins are shown in Fig. 2, 3, 4 and 5. The thermogram of o-APDF terpolymer shows three steps in the decomposition reaction after initial loss of water molecular.

Thermogravimetryofo-APDF-Iterpolymerresin

Thermogramofo-APDF-Iterpolymer resinisgivenin Fig. 2, depicts three steps in decomposition reaction, after loss of one crystalline water molecule entrapped in thepolymer molecule (5.94% found and 6.64% calculated). The first step of decomposition starts from 110ºC to 150ºC, corresponding the gradual mass loss of 17.82% found and 18.18% calculated, which may be due to the gradual loss of one hydroxyl group and one Amino (-NH-) group attached to aromatic benzene ring. The second step of degradation starts from 150ºC to 530ºC corresponding the rapid mass loss of 89.10% found and 88.40% calculated which may be due to the degradation of one aromatic benzene ring. The third step of decomposition starts from 530ºC to 800ºC, corresponding to slow loss of 94.26% found and 100.00% calculated, due to the degradation of side chain and Dithiooxamide moiety consequently the residue is left behind. Which is of carbon moiety The thermal degradation by increasing temperature may be due to the increasing strain and unstability and cross linking of molecule by increasing thermal vibration. To decrease the strain and to maintain stability the resin undergoes degradation.

Thermogravimetryofo-APDF-IIterpolymer resin

Thermogramofo-APDF-IIisshownin Fig.3, showing three stage decomposition, in the temperature range of 40ºC-800ºC after initial mass loss of crystalline water molecule (3.96% found and 4.59% calculated). The first step of decomposition starts from 140ºC to 250ºC corresponding the mass loss of 16.50% found and 16.84% calculated, which may be due to loss of the hydroxyl groups and two Amino (-NH-) groups attached to aromatic benzene ring, may be due to increasing strain by thermal vibrations. The second step starts from 250ºC to 560ºC, corresponding the mass loss of 92.40% found and 92.28% calculated which may be due to degradation of two aromatic benzene nuclei, may be due to unzipping strain and unstability in the molecule. The third step of degradation starts from 560ºC to 800ºC, corresponding to the mass loss equal to 95.73% found and 100.00% calculated,which may be due to the degradation of side chain and dithiooxamide moiety and consequently the residue left over is carbon moiety.

Thermogravimetryofo-APDF-IIIterpolymer resin

Thermogramofo-APDF-III terpolymer resinisshown in Fig.4,inthetemperaturerangeof 40ºCto800ºC, showing three stage decomposition reaction with initial loss of one water molecule corresponding the loss of 3.30% found and 3.50% calculated. The first step of decomposition starts from 145ºC to 280ºC, corresponding to the lossof mass equal to 16.50% found and 16.16% calculated, which may be due to the degradation of two hydroxyl and twoAmino(-NH-) groups attached to two aromatic benzene rings,may be due to increasing crosslinking,strainand unstability by thermal vibrations.The second step decomposition starts from 280ºC to 590ºC, when the molecule loss it's fine structures, cross linking, strain and unstability may increased, which result of showing the mass loss equal to 94.38% found and 94.2147% calculated which may be due to the degradation of three aromatic benzene rings. The third step starts from 590ºC to 800ºC, when the strained molecule suffer unzipping of cross linking, leading to the mass loss of 97.50% found and 100.00% calculated, may be due to degradation of side chain and Dithiooxamide moiety consequently the residue left behind.

Thermogravimetryofo-APDF-IVterpolymerresin

Thermogram ofo-APDF-IVterpolymer resin is shown in Fig.5, in the temperature angeof40ºCto 800ºC, showing three stages in the decomposition reaction with initial loss of water molecule corresponding the mass loss of 2.64% found and 2.83% calculated. The first stage of decomposition starts from 150ºC to 290ºC, which is corresponding to the mass loss (15.84% found and 15.74% calculated) of four hydroxyl and four (-NH-) groups attached to four aromatic benzene nucleus, may be due to increasing cross linking, strain and unstability in the molecule by increasing thermal vibration due to increasing temperature in the molecule. The second step of decomposition starts from 290ºC to 600ºC, when strain increases high, leading to the mass loss equal to 95.70% found and 95.37% calculated, which may be due to the degradation of four aromatic benzene rings. The third and last step decomposition may be due to the loss of side chain and dithiooxamide moiety, when the strained molecule suffer unzipping of cross linking, leading to the mass loss equal to 98.62% found and 100.00% calculated and consequently the residue left behind is carbon moiety.

The results of thermogravimetric analysis of o-APDF terpolymer resins and species degraded with their corresponding percentage mass loss are given in Table 3.62. By using thermal decomposition data the graphs were plotted by applying Sharp-Wentworth method (Fig. 6) and activation energy was calculated, found to be in good agreement with the activation energy calculated by Freeman-Carroll method . The thermal activation energy plotand Freeman-Carroll plots for

o-APDF terpolymer resin have depicted in Fig. 7 to 8 respectively. The thermogravimetric parameters have been calculated on the basis of thermal activation energy of using Freeman- Carroll method. The various kinetic parameters such as change in energy (ΔS) free energy change (ΔF) frequency factor (Z) and apparent entropy (S*) are given in Table 3.

Discussion

By using thermal decomposition data and then applying the Sharp-Wentworth method (a representative Sharp- Wentworth plot of o-APDF - (1) polymer is shown in Fig.6) activation energy is calculated which is in agreement with the activation energy calculated by Freeman-Carroll method (Table2). A representative thermal activation energy plot(Fig.7) and Freeman-Carroll plot(Fig.8) for the polymer has been shown. Thermodynamic parameters have been calculated on the basis of thermal activation energy. These values are given in Table2.

By using the data of the Freeman-Carroll method various thermodynamic parameters have been calculated (Table2).The values of thes ethermo dynamic parameters for all the tercopolymers are out the same. The similarity of the values in dicatesa common reaction mode. From the abnormally low values of frequency factor, it may be concluded that the decomposition reaction of o-APDF polymers can be classed as a 'slow' reaction. There is no other obvious reason.

Table 2

Thermogravimetric Data and Decomposition Temperature Range of o-APDF Terpolymer Resins:

	onstep,temperaturerange(°C),massloss(%)and species degraded								
Terpolymer Resins	**Loss of crystalline water molecule**		**First Step (loss of methyl& hydroxyl group)**		**Second Step (lossofaromatic phenyl nucleus)**		**Third Step (lossofside chain** ofoxamide**)**		**Mass of residue leftover (%)**
	Temp. range (°C)	Mass loss (%)	Temp. range (°C)	Mass loss (%)	Temp. range (°C)	Mass loss (%)	Temp. range (°C)	Mass loss (%)	
o-APDF-I	40-110	5.94(F) 6.64C)	110-150	17.82(F) 18.18(C)	150-530	89.10(F) 88.40(C)	530-800	94.26(F) 100.00(C)	5.74(F) 0.0(C)
o-APDF-II	40-140	3.96(F) 4.59(C)	110-250	16.50(F) 16.84(C)	250-560	92.40(F) 92.28(C)	560-800	95.73(F) 100.00 (C)	4.27F) 0.0(C)
o-APDF-III	40-145	3.30(F) 3.50(C)	145-280	16.50(F) 16.16(C)	280-590	94.38(F) 94.21(C)	590-800	97.30F) 100.00 (C)	2.70(F) 0.0(C)
o-APDF-IV	40-150	2.64(F) 2.83(C)	150-290	15.84(F) 15.74(C)	290-600	95.70(F) 95.37(C)	600-800	98.62F) 100.00 (C)	1.38(F) 0.0(C)

F=found, C= calculated

Table 3

Results of Thermogravimetric Analysis of o-APDFTerpolymer Reins

Terpolymer	**Half decompositi**	**Activationenergy Ea (KJ)/mol**		**Entropy change □S (J)**	**Free energy □F (KJ)**	**Frequency factor**	**Apparent entropy**	**Order reaction (n)**
resins	on Temp. (K)	FC	SW			(Z) ($Sec.^{-1}$)	(S*) (KJ)	
o-APDF-I	633	23.41	23.74	-163.956	97.314	659	-19.149	0.98
o-APDF-II	673	25.64	24.41	-164.521	00.375	705	-19.11	0.97
o-APDF-III	683	26.72	26.61	-165.092	102.548	785	-19.03	0.95
o-APDF-IV	688	27.25	27.51	-165.662	104.721	812	-19.02	0.94

SW–Sharp-WentworthMethod **FC–Freeman–CarrollMethod**

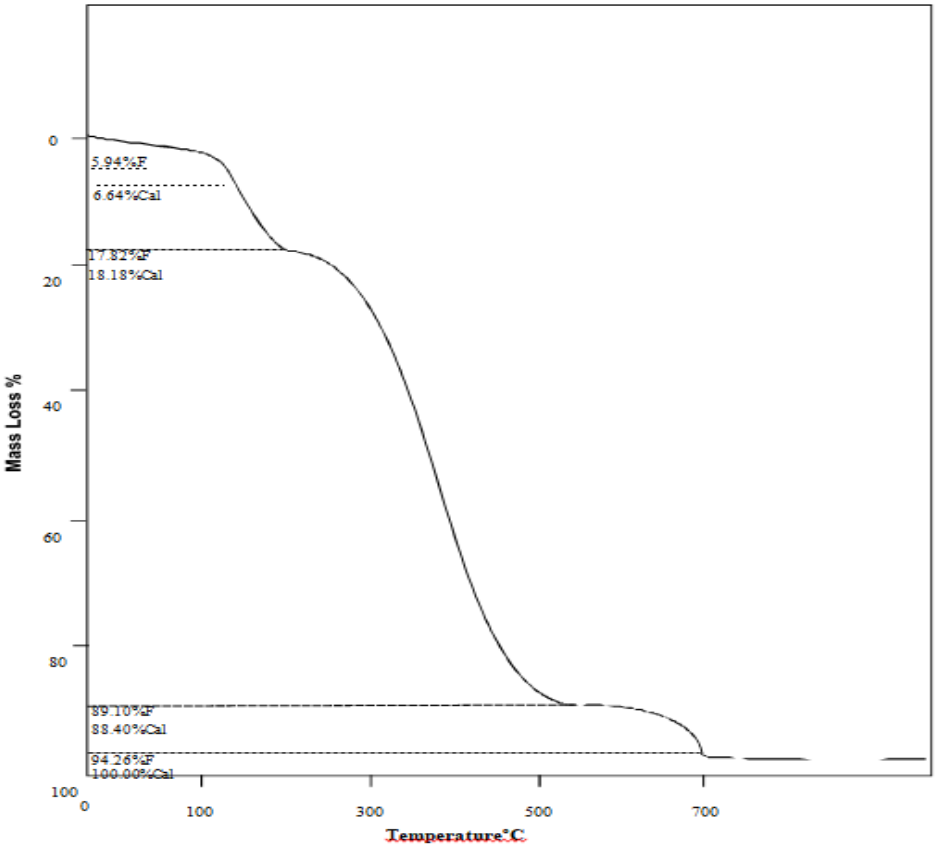


Fig.2.Decomposition Patternofo-APDF-IIterpolymer Resin

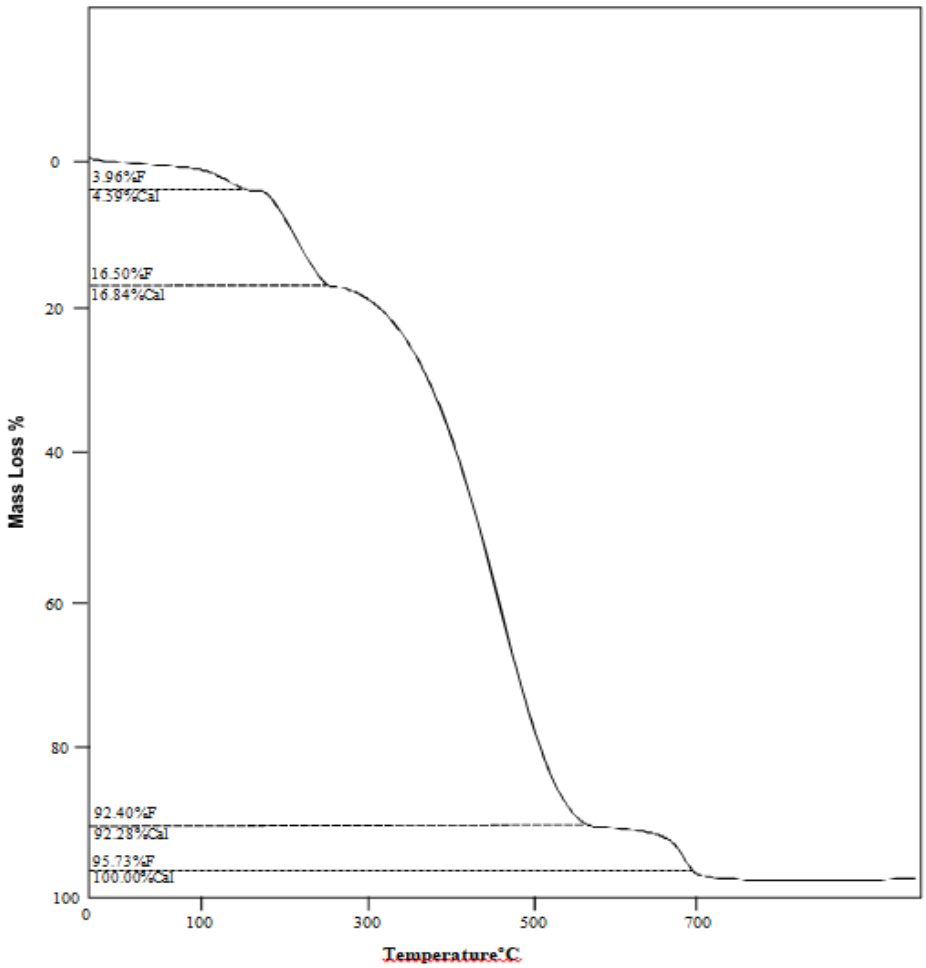


Fig.3.Decomposition Pattern of o-APDF-IIterpolymer Resin

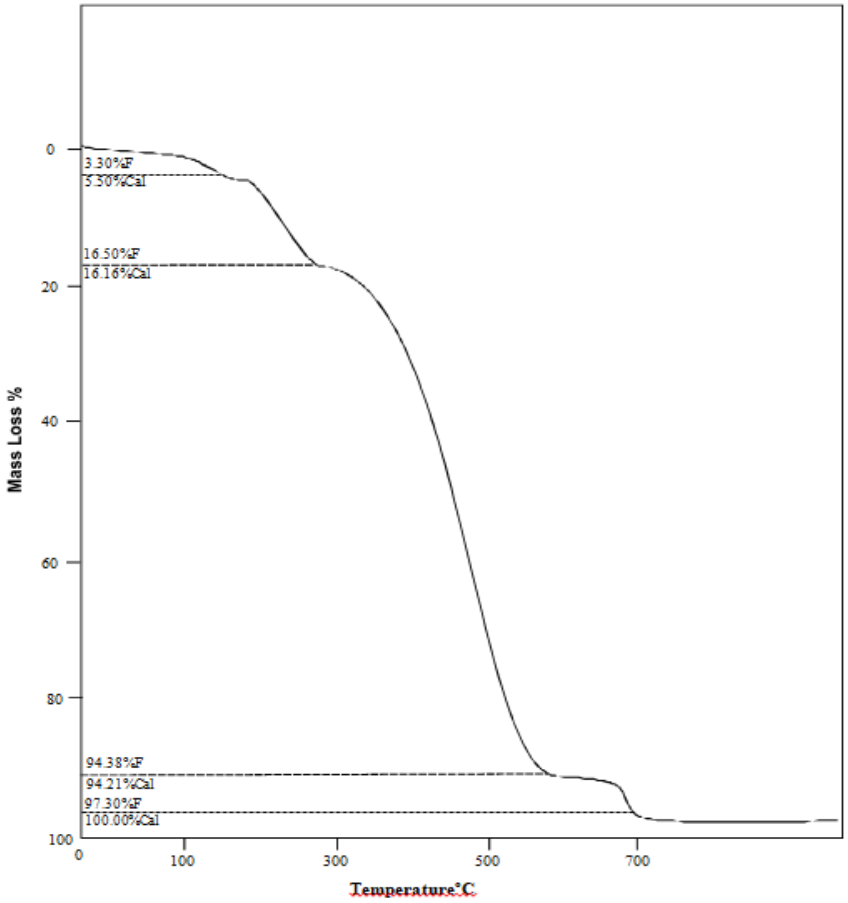


Fig.4.Decomposition Pattern of o-APDF-IIITerpolymer Resin

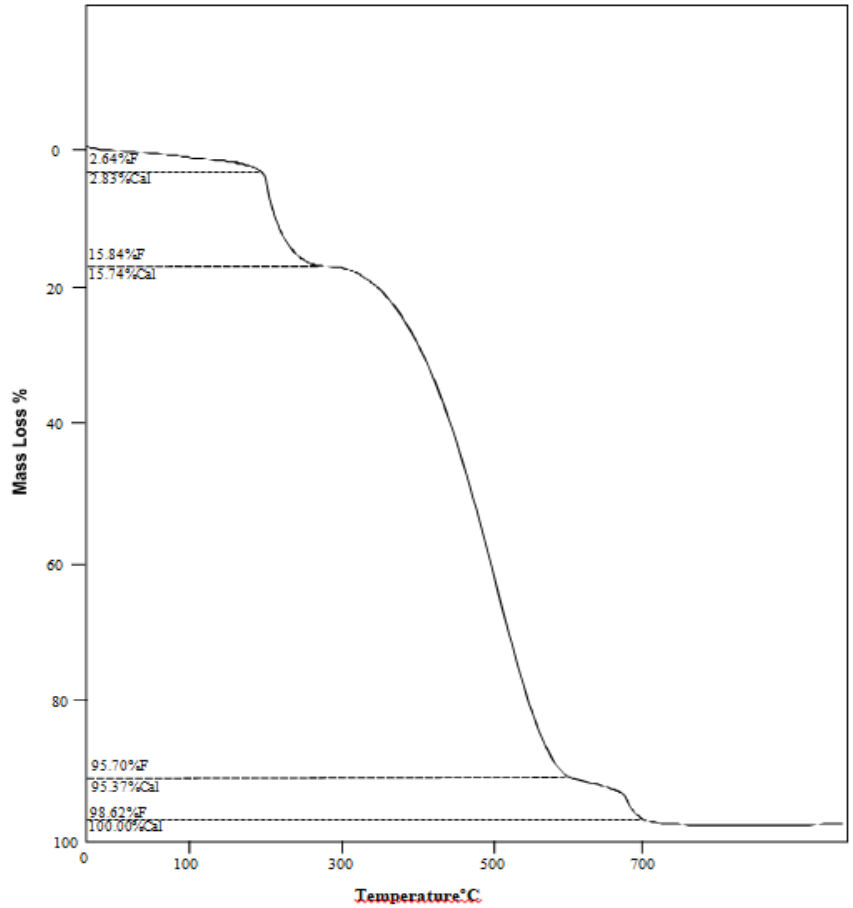


Fig.5.Decomposition Pattern of o-APDF-IV Terpolymer Resin

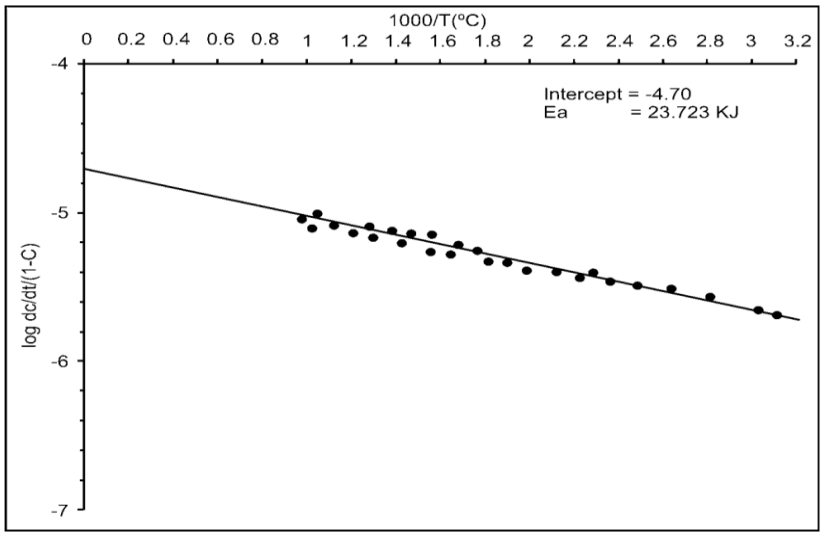


Fig.6.Sharp-Wentworth Plot of o-APDF-ITerpolymer Resin

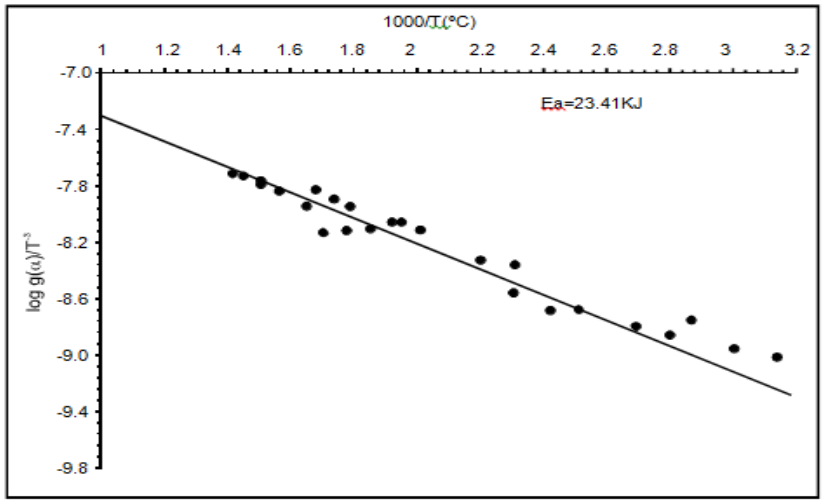


Fig.7. Thermalactivation energy plot (Freeman-Carroll plot) of o-APDF-I terpolymer resin

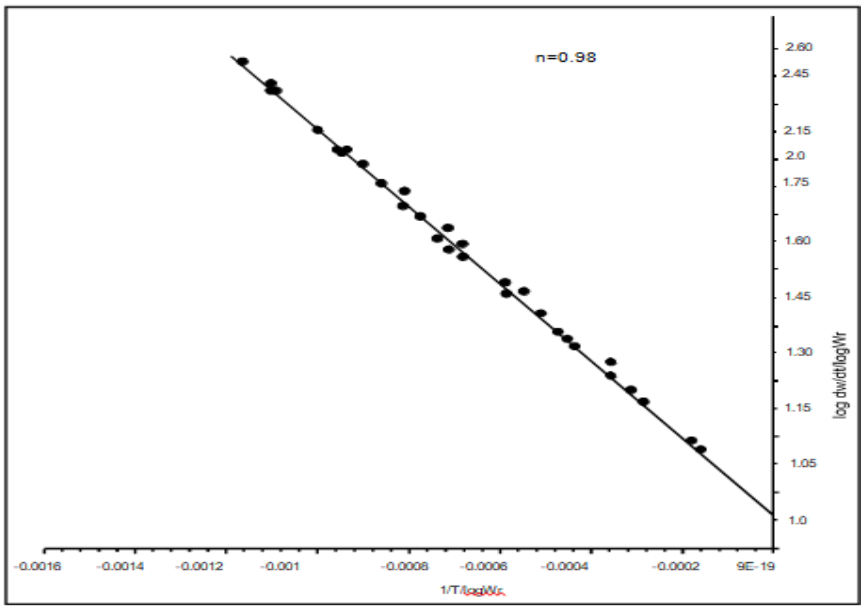


Fig.8.Freeman-Carroll Plots ofo-APDF-I Terpolymer Resin

The activation energy calculated by Sharp-Wentworth method and Freeman-Carroll method are in good agreement. The sequence of thermal stability is found to the o-APDF-I < o-APDF-II < o-APDF-III < o-APDF-IV. The sequence of thermal stability is predicted on the basis of increasing initial

and half decomposition temperatureas well as on the increasing melting points. The removal of water molecule is the initial slow mass loss, which may due to the water entrapped in terpolymer resin, hence the water is probably considered as a crystal water. Finally residue remained ascribed as oxamide moiety. The various kinetic parameters calculated by Freeman-Carrollmethod are about same, indicating common mode of decomposition reaction. Abnormally the low values of frequency factor may be indicated that the decomposition reaction can be classed as slow reaction. The slow reaction is also predicted by negative values of entropy change. The negative values means the disorder is less and the reaction in carried by more order manner, making it slower. The graphs obtained by Sharp-Wentworth and Freeman-Carroll methods are fairly good straight liners or linear by ignoring some abnormal points, indicating that the decomposition does not obey first order kinetics perfectly [3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]. However no unique conclusion can be drawn from the TGA study as the decomposition reaction perhaps is very complicated. On the basis of all the physico-chemical and spectral evidences and fore going results and discussion the most probable structures have been proposed for o-APDF terpolymer resins under investigations as shown in Fig. 9.

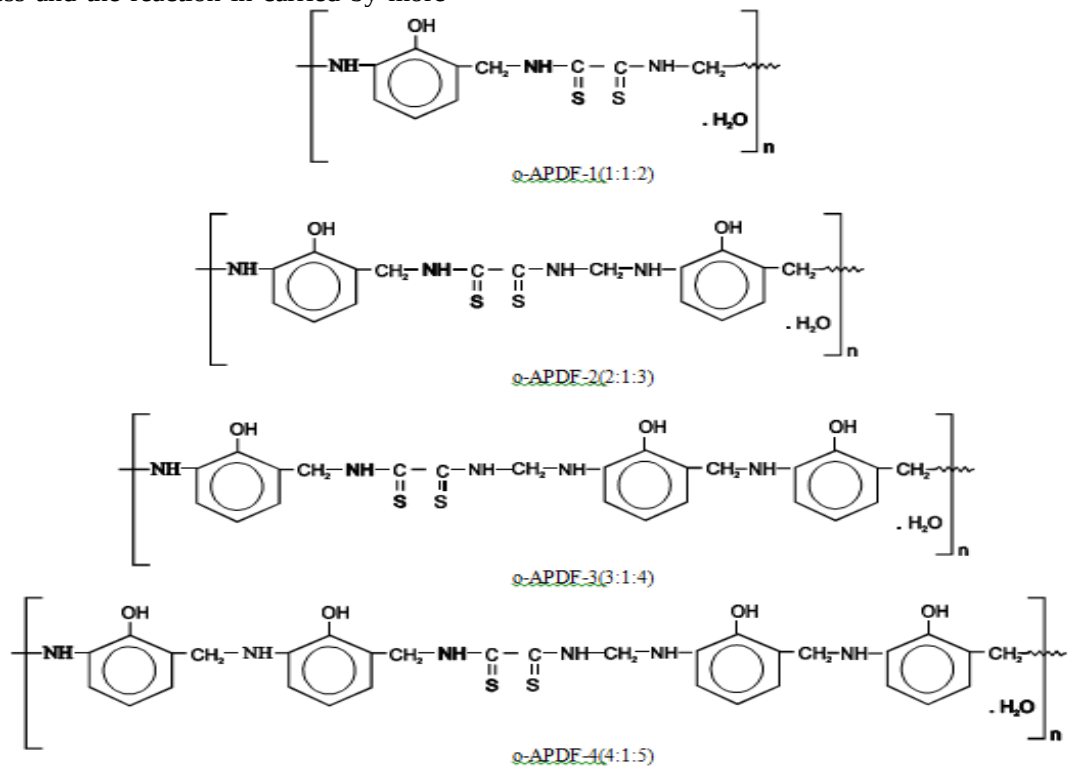


Fig.9.Structures of o-APDFTerpolymer Resins

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Ichthyofaunal diversity of Junona Lake, Chandrapur, Maharashtra, in relation to physicochemicalstatus.

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Abstract

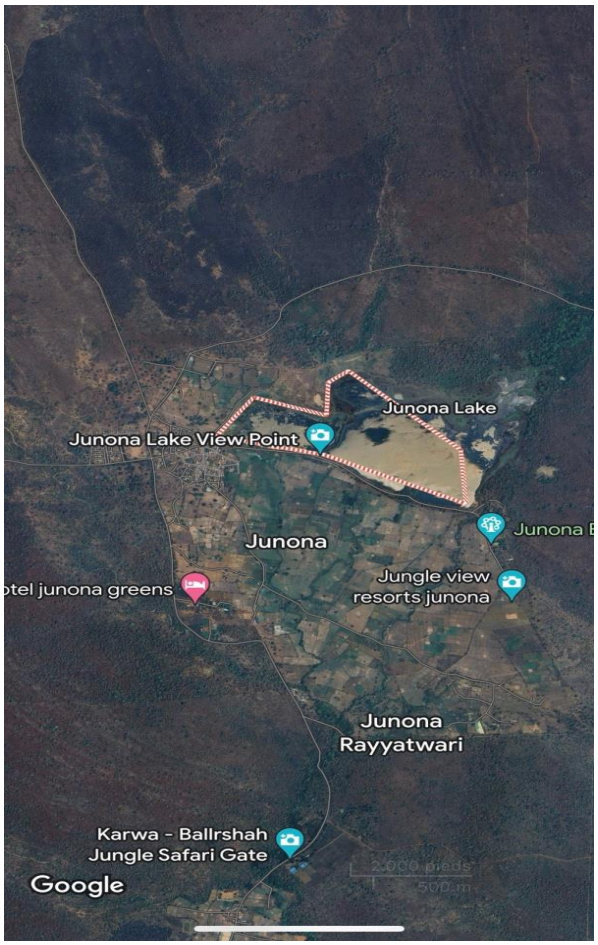
Lakes and reservoirs contribute immensely to inland fishery resources in terms of size as well as productivity, which in turn is affected by physicochemical status of waterbody. Present study deals with the diversity and abundance of fish fauna of Junona lake in relationto the physicochemical parameters.

The investigation of present study confirmed the occurrence of 22 species of fishes belonging to five different orders . The order Cypriniformes was found to be dominant. The study was carried out from June 2018 to March 2019 . Economical value as well asabundance of fishes were also studied. General conclusions showing the impact of physicochemical factors on Ichthyofaunal diversity are also stated.

Key Words: Ichthyofauna, fish diversity, physicochemical

Introduction

The lakes and reservoir constitutes habitat for variety of Flora, fauna and aquatic life.These act as important life support system for aquatic biota. It is necessary to analyse physicochemical and biological parameters of water body because these have direct impact on aquatic environment. Lakes and reservoirs are the ecological and cultural landmark on the map of any city or forest. Industrial development, population explosion as well as advanced agricultural practices have become threat to these aquatic ecosystem. Fresh water perennial water bodiessuch as reservoirs and lakes located especially in rural areas are mainly used as a source of drinking water, irrigation and for fish production by the local fisherman communities. Fishes are most valuable bio-product of fresh, marine and brackish water ecosystem.



Reservoir fishery in India is also important from socio-economic point of view as it has a potential to provide employment to several people. The fish catching is a major source of livelihood of many fishermen and tribals of that area. Ichthyofauna of a lake basically represents the fish faunal diversity and their abundance. Lake preserves a rich variety of fish species which support commercial fisheries. Fish fauna in Maharashtra has been studied by many researchers (Sakhare 2001, Pawar et al 2006, Buttle et al 2007) in different waterbodies. From Vidarbha region of Maharashtra, yadav (2006) reported 4 species from Tadoba National Park, Dist. Chandrapur. Heda (2009) reported 32 species from Kathani river of Gadchiroli Dist. Gadchiroli. Khan (2012) reported 40 fish species from Chulbandh reservoir, Dist. Gondia. Shelke (2016) studied the Ichthyofaunal biodiversity of Girna Dam, Dist. Nashik. Maharashtra, India and reported 24 species. The present investigation has been undertaken with the aim to study the fish fauna of Junona lake along with the physiochemical status of the lake.

Study area

Junona is a beautiful perennial freshwater lake situated 13 kms away from Chandrapur city, Maharashtra, India. It is spread over near about 300 acres, situated about 677 meters above the sea level and is at 79° 23’ 3597’’ E

longitude and 19° 55'29.92" E latitude. It harbours several aquatic weeds and organisms like crustaceans, molluscs, insects and it is a beautiful site for bird watching.

Material and methods

Fishes were collected from Junona lake during the study period June 2018 to March 2019 with the help of fishermen. These were examined directly and also preserved in 10% formaldehyde. Fishes were identified following the key of Talwar and Jhingran (1991), Day (1994) and Jayram (1999). The physicochemical parameters of the water were analysed by methods described by APHA (1998).

Result and discussions

Junona lake is adequate in its ecological importance because it provides a suitable habitat for large number of floral and faunal species.The main purpose of this investigation was to determine the current status of fish fauna in Junona lake. The present study reveals the occurrence of 22 species belonging to 16 genera under 10 families and 5 orders. The order Cypriniformes was found to be dominant with eight species followed by order Siluriformes having six species. The order Channiformes and order Perciformes were represented by three species each whereas two species were found from the order Clupeiformes. (Table 1) Most of the fishes collected and studied were found economically important. The collected fish fauna include major carps, catfishes, perches, snake-head fishes as well as feather back. Most of these are used as food fishes and commercially cultured .Some have their importance as ornamental fishes.

Sharma et al (2007) published Ichthyofauna of Kishanpura lake, Indore. Ahirrao and Mane (2000), in earlier studies recorded 32 fish species belonging to 25 genera, from fresh waters of Parbhani district of Maharashtra. Sakhare, V.B. (2001) recorded 23 species belonging to 7 orders in Jawalgaon reservoir in Solapur district. Hiware and Pawar (2006) recorded 43 fish species from Nath Sagar Dam, Paithan. Vyas et.al (2012) recently studied the aquatic biodiversity of ponds and rivers of Madhya Pradesh and reported 86 fish species in different rivers. Physicochemical parameters play a very important role in the composition of aquatic biota of any water body. The fresh water lake generally have warmer water temperature, slightly alkaline pH, optimum values of dissolved oxygen and moderate or minimum free CO2 level. Important physicochemical parameters related to productivity were evaluated from the water samples of Junona lake are represented in table 2. Jaya Raju et al (1994) have studied fish diversity in collaboration with physicochemical parameters from the river Munneru, a tributary of Krishna river. According to this study dissolved oxygen and temperature were observed to be major controlling factors in the distribution of fishes.

Conclusion

Fish fauna is an important aspect in determination of ecological status and productivity of any water body. It shows wide range of diversity according to geographical condition and limnological status of aquatic ecosystem. The changes in the composition of fish assemblage indicate a variation in physicochemical parameters of water such as pH, temperature, DO, free CO2 etc.

The Junona lake which is slightly away from the crowded area of Chandrapur city and surrounded by a dense forest on one side, reveals a good Ichthyofaunal diversity. It is observed that physicochemical parameters, specially dissolved oxygen and temperature support the diversity and commercial production of fishes. It is necessary to implement proper conservation strategies to maintain the beauty and ecological status of the lake as well as to increase fish productivity in future.

Table 1 Lchthyofaunal Diversity of Junona Lake during the Study Period July 2018to March 2019

Order	Family	Scientific Name	Vernacular	Economic status
Cypriniformes (Carps)	Cyprinidae	Labeo rohita	Rohu	Culturable food
		Labeo calabasu	Karaunt	Culturable food
		Catla Catla	Catla	Culturable food
		Cirrhina mrigala	Mrigal	Culturable food
		Gyprinous carpio	Common Carp	Culturable food
		Ctenopharyngodon	Idella Carp	Culturable food
		Puntius sarana	Olive barb	Ornamental /weed
		Puntius sophore	Khavli	Ornamental /weed
Siluriformes (Catfishes)	Hyteropneustidae	Heteropneustus	Singhi	Food fish
	Bagridae	Mystus seenghala	Shingala	Ornamental /weed
		Mystus tengara	Tengra	Ornamental /weed
	Claridae	Clarias batracus	Magur	Food fish
	Siluridae	Wallago attu	Padan	Food fish/Live fish
	Siluridae	Ompak pabda	Butter catfish	Food fish
Channiformes (Snakehead)	Channidae	Channa marulius	Murrel	Food fish
		Channa puntatus	Girau/Sauri	Food fish
		Channa striala	Dokrya/Morrul	Food fish

Perciformes (Perches)	Cichlidae	Tilapia	Talaphi	Food fish
	Anabantidae	Anabas testudinus	Koi	Food fish
	Aborssidae	Ambasis ranga	Glass fish	Ornamental fish
Clupeiformes (Featherback)	Notopteridae	Notopterus	Patola	Food fish
		Notopterus chitala	Chital	Food fish

Table 2: Physicochemical Status of Junona Lake during July 2018 to March 2019

Sr No	Parameters	Range	
		Minimum	Maximum
1	Water temperature	21°	29°
2	pH	7.1	7.8
3	Dissolved Oxygen	5.2	11.07
4	Free carbon dioxide	4.2	5.7
5	Total alkalinity	138.22	189.9
6	Total hardness	102.13	218.7
7	Total dissolved solids	122.4	172.8
8	Phosphate	0.62	1.08
9	Nitrate	0.23	0.74
10	Chloride	19.88	26.32

Note: All the values expect temperature (°C) and pH are in mg/lit.

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Observations of *Eutectona machaeralis* attack on *Tectona grandis* L.f.(Teak)

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Abstract:
The ***Tectona grandis* L. f** (Family: Lamiaceae) an economically important tree species planted and natural teak forests in India. This scientific review investigates leaf Skeletonizer affecting teak (***Tectona grandis* L. f)** forests. Utilizing observational methods, we identify prevalent insect pests, analyze their impact on teak trees, and assess the overall health of the forest ecosystem. Our findings shed light on key challenges posed by this pest and propose potential management strategies. This review contributes valuable insights to the understanding of insect-induced diseases in teak forests, aiding in the development of sustainable forest management practices. This scientific review investigates insect pest diseases affecting teak forests. Examining prevalent species, we assess their impact on teak health, growth, and overall ecosystem dynamics.

Key Words: Observations, *Eutectona machaeralis* and *Tectona grandis.*

Introduction:

Teak *Tectona grandis* (Linnaeus) is one of the important hardwood trees of Indian forest which has commercial utilization in making furniture and other domestic usages. Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh and Uttar Pradesh etc. are major teak growing states of India. In India, it grows naturally in about 9 million hectares. The teak plant is attacked by about 174 species of insect pests all over the world **(Sen Sharma, 1983).** In past, insect pests of teak have been studied by **Stebbing (1914), Sen-Sharma and Thakur (1985), Browne (1986), Jha and Sen Sharma (1994), Sathe and Padharbale (2008), Sathe (2009,2014 a), Sathe and Kadam (2015),** etc.

Natural teak forests in India is distributed in an area of 6.8 M ha and teak plantations in an area of 1.68 M ha (FAO, 2015). Teak plantations are found in the state of Madhya Pradesh, Maharashtra, Tamil Nadu, Karnataka, Kerala, Gujarat, Orissa, Andhra Pradesh, Rajasthan and Manipur **(Awasthi H.2021).** Teak grows well in regions having rainfall range of 900-2500 mm and temperature regime of 17 °C to 43 °C **(Die *et.al.*2012).**The present study is an observation of diseases on plants of teak in forest of surrounding areas.

Kinwat taluka is located at latitude 190 25` to 190 55` North and longitude 770 51` to 78019` East. The total land area of Kinwat Taluka is 201235 square kilometers. Out of that, 57256 square kilometers are covered by forests (Dnyaneshwar and Sharad, (2012) and [8, 9].

Methodology:

Methodologically, we employ field surveys and literature analysis. Findings reveal significant threats posed by specific pests, influencing teak sustainability. Insect pest of teak *T. grandis* have been studied from Kinwat-Mahur forest region, Nanded, Maharashtra by visiting various study spots and observing pest insects in the month of July-August. The observed insect have been identified by consulting appropriate literature search was performed using the both offline and online databases like Google Scholar, Research Gate, Springer Link, Bio Med Central, Science Direct, Web of Science, PubMed and Elsevier etc. scientific databases were chosen based on the topic covered.

Life cycle in pest was studied by observing different immature stages of pests in natural conditions. Incubation, larval period, pupil period and adult formation period were taken to the consideration for the record. Bio control agents have been observed during the development of immature stages of pests and identified by consulting appropriate literature.

Result & Conclusion:

The results recorded indicate that, species of insect pest have been recorded on teak from Kinwat-Mahur forest region, Nanded, Maharashtra. From order Lepidoptera i.e. Pyralid teak moth (*Eutectona machaeralis)* is the dominant cause for

the devastation of teak forest is of very common abundance in this particular region. *Eutectona machaeralis* (Walker) completed their life cycle within 1 month and attacked by 5 parasitoids namely, *Cedria paradoxa* (Braconidae: Hymenoptera), *Trichogramma minutum* (Trichogrammatidae: Hymenoptera), *T. pickle*, *T. brasilensis* and *T. evansence* were the potential biocontrol agent for the pest species.

Life cycle of *E. machaeralis*

The moth of *Eutectona machaeralis* are small, bright yellow, having pink or reddish markings of zig-zag line on the forewings and reddish marginal band in the hind wings. The female moth lays an average of 250-550 greenish white eggs on the ventral side of the leaf. The newly hatched larvae are dirty white, which changes to pale green in due course of time. There are five larval instars, the growth and development differs in respect to instars and a distinct pre-pupal stage. The larvae consume the whole fleshy tissues of the leaf leaving the vein network intact thereby skeleton zing the leaf. Larval period varies from 10-14 days or more depending on the climatic factors. Pupation occurs in small loose cocoon on green or fallen dry teak leaves.

The present result & conclusion will add great relevance as a base for approaching ecofriendly preventive biological control measures for the *E. machaeralis* in the form of encouragement for the intercrop farming practices with *Azadirachta indica* in forest area, it will help to control the insect pest remarkably in near future.

Photo Plate: Tectona *grandis* L. f in forest field and life cycle of *Eutectona machaeralis*

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A Systematic Review on *Cajanus cajan (L.) Mills* (Pigeon Pea)

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Abstract
This study aimed to summarize the available data on the *Cajanus cajan* (L) Millsp.(family: Fabaceae) is the most important grain legume crop of rain- fed agriculture in semi-arid tropics. It is both a food and a forage crop with high levels of proteins and important amino acids like methionine, lysine and tryptophan. The comprehensive account of the plant uses are presented in this review such that the potential of this plant in various zones can be systematically evaluated.

Key Words: A Review, *Cajanus cajan* (Pigeon Pea)

Introduction:

Agriculture is the mother of all cultures. It has played a key role in the development of human civilization. Agricultural practices such as irrigation, crop rotation, fertilizers, and pesticides were developed long ago, but have made great progress in the past century. By the early 19th century, agricultural techniques had so improved that yield per land unit was many times that seen in the middle ages **(Arivazhagan *et.al.*2013).** Man is directly dependent upon plants for his survival because plants are his prime source of food, fiber and drugs, the crop production is one of the basic human activity for continued existence of human life, the total production depends on healthy crops, whether it may be cereals, pulses, oil seeds, fruit plants or vegetables. A number of plant pathogens (Viruses, mycoplasma, bacteria, fungi and nematodes) attack on the crop plants and decrease the quality, quantity and productivity of crop **(Ayyappan *et.al.*2007).**

The world's population will increase from the present level of about 7.25 billion to 15 billion by the year 2050. Providing food for such a large number of people will be a formidable task. So, there would always be a compulsion to increase agricultural production in spite of the fact that cultivable land would be decreasing due to its requirement for non-agricultural uses such as expanding urbanization, and rail and road network, etc. According to recent estimates, agricultural production would need to be increased by 70 per cent (100% in developing countries) by 2050 to cope up with the increasing world population **(Saini, 2014).**

Food plants of the world are damaged by 100,000 diseases (caused by fungi, viruses, bacteria, and other microorganisms), 10,000 species of insects, 1000 species of nematodes, and 30,000 species of weeds. It is essential for humans to take action to limit the destruction of food crops by pests. Crop pests must be controlled to protect the security of the world food supply. **Pimentel and Levitan (1986)** estimated that "total worldwide food losses from pests amount to about 45% (of total food production). Pre-harvest losses from insects, plant pathogens, and weeds amount to about 30 per cent. Additional post harvest losses from microorganisms, insects, and rodents range from 10 to 15 percent. The role of plant pathology is important for alleviating losses to the agricultural products, plants are also important to man because they utilize Co^2 in photosynthesis and release O^2 **(Mehrotra,2000).**The present study is an observation on plant diseases on *Cajanus cajan* (L.) Mills in standing fields found in surrounding areas.

Pulses have special significance in the dietary of the predominantly vegetarian population of India as they contain two to three times more protein than that in cereals. Among the pulses, pigeon pea is the 2nd major pulse crop grown in India. It is an important grain legume crop of rain filed agriculture. Pigeon pea (*Cajanus cajan*) originated in India which developed to have secondary diversity in East Africa. Currently it is grown all over the tropics. In the Philippines, pigeon pea is grown primarily as a fresh vegetable on a limited scale in the Ilocos Region, Cagayan Valley Region and Batangas. This crop has a great potential for the cropping systems in the country and is a good crop in battling malnutrition as it is a good source of protein **(Rona *et. al.* 2022).**

It has been cultivated in ancient Egypt, Africa and Asia since prehistoric times, and was later introduced to America. Now it acclimatizes in several tropical countries. The major producer is India contributing about 90% of world production. Its altitude range is 1250 m in Hawaii, 0-3000 m in India and Columbia. It is essentially a plant of the semi-dry lowlands but has wide adaptability **(Duke J. A. 2004).**

Historical perspectives of pigeon pea genetic diversity

The centre of origin of pigeonpea has been a subject of discussions in the past. For instance, some studies **(Leslie 1976, Purseglove 1976, Singh et al. 2001)** favoured the origin of pigeonpea in Africa. Many other studies **(Van der Maesen 1990, Fuller and Harvey 2006, Saxena et al. 2014)** suggest India as the origin of the crop. The presence of several wild relatives, the diverse genepool of the crop in the Indian subcontinent and some recent molecular studies provide a stronger evidence of the latter group. Africa harbours only two wild species of pigeonpea: C. kerstingii Harms and C. scarabaeiodes (L.) Thouars. It is most likely that pigeonpea was introduced by immigrants in the 19th century who moved to Africa to become railway workers and storekeepers (see Odeny 2007). From eastern Africa, pigeonpea spread over the African continent, albeit without acquiring a prominent position. In Africa and the Far East, pigeonpea has been grown for at least 4000 years **(Van der Maesen 1980)** and therefore considerable agro-ecological adaptation has been obtained locally. The traditional African pigeonpea genotypes are long-duration, cream- and large-seeded **(Remanandan 1990).** In Uganda, medium- duration, cream to mottle small-medium seeded type **(Manyasa et al. 2009)** have been part of the traditional cropping system (**Silim et al. 1991, Kimani 2001).** Uganda was the first country in ESA to implement a pigeonpea breeding programme in 1968 at Makerere University **(Saxena 2008).** However, there is a scope to expand further under sustainable intensification of cropping systems with pigeonpea as one of the component crops.

Photo Plate 01. Pigeon pea (*Cajanus cajan*) in cultivated field.

Classification

Kingdom: Plantae
Family: Fabaceae
Subfamily: Faboideae
Order: Fabales
Genus: Cajanus
Species: *cajan*

Biological activities and medicinal properties:

Being a rich source of protein and a most important forage crop, *C. cajan* is the most widely used and cultivated crop. It has also been used traditionally in many parts of the world for its innumerable medicinal properties but still its identity as a medicinal plant is not established. To date, several flavonoids, isoflavonoids, tannins and protein fractions have been isolated from its different parts and their medicinal uses **(Pal, *et al.* 2011).**

Pharmacological actions:

Different parts of *C. cajan* have been utilized for their biological activities since time immemorial and some of them have experimental grounds for their acceptance. Apart from their uses in folkloric medicines, there are several reports on the biological activities and pharmacological actions of *C. cajan* based on modern scientific investigations. Antibacterial Activity, Hypocholesterolemic Effects, Antidiabetic Effects, Neuroactive Properties, Antioxidant Activities, Anticancer Activity, Hepatoprotective Effects, Anthelmintic Activity and Glycemic Activity**, (Dilipkumar Pal, 2011).**

Conclusion:

Being a rich source of protein and a most important forage crop, *C. cajan* is the most widely used and cultivated crop. It has also been used traditionally in many parts of the world for its innumerable medicinal properties but still its identity as a medicinal plant is not established. To date, several flavonoids, isoflavonoids, tannins and protein fractions have been isolated from its different parts and their medicinal uses have been established, but many bioactive constituents and pure compounds have so far been neglected by phytochemists and pharmacologists and a large amount of work has been done only on extracts and not the isolated fractions which shows scope for further study in this direction. The present review article aims at focusing the attention of research

scholars on the unexplored and untouched areas related with *C. cajan* and may act as an important step towards the establishment of *C. cajan* (L) Millsp. as a medicinal drug.

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Diversity of Some Angiospermic Climbers in Digras Tehsil of Yavatmal District, Maharashtra

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Abstract

The work in question deals with an extensive study on the diversity of flowering climbing plants in Digras tehsil of Yavatmal district. The investigation is carried out to survey, identify the climbing species, and determine to what extent their biodiversity has declined in the region in terms of population as well as community level. We identified about 98 species of angiospermic climbers belonging to 35 families. Fabaceae, Cucurbitaceae, Ascelpiadaceae, and Convolvulaceae were found to be the most dominant. Habitat fragmentation, anthropogenic activities, declined pollinator diversity, changing agricultural practices, and less public awareness about the importance of these species influenced the diversity of climbing plants in the area.

Key words: Climbers, Diversity, Abundance, Conservation Status

Introduction-

Climbers play diverse roles in the ecology of forests. Climber species due to its fragile nature are suitable to any change in the forests. Knowledge about climber species in the forests is relatively inadequate and this is the first effort to report the climber plant species in Digras Tehsil of Yavatmal District. Angiospermic climbers are flowering plants that have adapted to grow vertically by using other plants or structures as support. They are commonly found in various ecosystems, including forests, grasslands, and urban areas. These climbers can belong to a wide range of families and genera, showcasing a diverse array of characteristics and adaptations.

A plant species which cannot withstand on itself due to weak stem and takes support of other plants or objects to continue its growth and ascending up to trap the solar energy is by and large considered as a climber. Climber is defined as plant species that require mechanical support for its growth (Putz & Windsor1987). It includes herbaceous and woody lianas (Gentry1991). According to an estimate, climbers are one half of vascular plant species. A liana is a woody climber that generally has roots in woodland or forest floor but its leaves often in full sun, blanketing canopies of trees, often many meters from the ground. All these climbing elements having various morphological forms including climbers, twiners and lianas are components of vegetation and play a crucial role to maintain the diversity of the particular area. A climber floristically plays an important role in tropical forest and considered to be a structural component that affects the physiognomy of the forest (Gentry 1991). A climber plant species plays a vital role in forest ecosystem as it provides habitat and food for animals (Hladik 1978; Emmons & Gentry1983; Gentry1991; Gelatti & Padroni 1994). Climbers are almost neglected in all floristic studies but this group represents one of the major part of plant collections (Gentry 1991). A climber starts its life on the forest floor and spends almost one-fourth of its life on forest surface. After this phase the adhering, anchoring, and leaning starts on other plants to achieve immense stature (Jongkind & Hawthorne 2005). Families such as Cucurbitaceae, Convolvulaceae, and Dioscoreaceae are considered to be climber rich. Amongst the climber-rich families, Apocynaceae, Rubiaceae, Celastraceae, andLeguminosae have more than 50 species (Gentry 1991; Schnitzer & Bongers 2002). Diversity is also found in the climbing mechanism in the form of branch twiners, stem twiners, tendril climbers, root adhesive climbers, hook climbers, and scramblers (Bongers et al. 2005; Jongking& Hawthorne 2005). The liana life-form is dependent on host tree species for mechanical support and further on animals for dispersal, underlines the intersystem coupling of forest functional ecology in maintenance of biodiversity (C. Muthumperumal et al. 2012). Study on the diversity and distribution of climbing plants is still scanty in the Indian scenario when compared to their study worldwide. (Kashung et. al. 2021).

Materials and Methods

Study Area:

Digras is the tehsil located in district Yavatmal of Maharashtra state in India. There are 80 villages and 1 town in Digras Taluka, surrounded by lush green forests and farmlands. There is a rich

diversity of angiosperms in the area, consisting of various floras like herbs, shrubs, trees, and climbers in wild habitat as well as in cultivated gardens and farmlands. The climbers are one of the most important canopy structures in deciduous forests. Many tribes in the area depend on the angisopermic climbers for ethnomedicine and as wild vegetables in their day-to-day lives.

Methodology

The present work was conducted from June 2021 to May 2022 in all seasons. Angiospermic climbers were collected from different localities, like wild habitats in forests, farmlands, gardens, and roadsides. Photographs were taken on site of climber species in the flowering stage for proper identification. Some important identifying characters were noted in field notes. Collected species were identified from regional floras like the Flora of Yavatmal district (Karthikeyan and Anand Kumar, 1993), the Flora of Maharashtra Dicotyledons Vol. I (Singh and Karthikeyan, 2000), and the Flora of Maharashtra Monocotyledons (Sharma et al., 1996), with the help of expertise. Herbarium of climbers was prepared and stored at the Department of Botany, Bapuraoji Butle Arts, Narayanrao Bhat Commerce, and Bapusaheb Patil Science College Digras.

Results and Discussion-

Table. 1. Enumeration of various angiospermic climber species.

Sr. No	Name of the Species	Name of the Families	Common Name
1	*Artabotrys hexapetalus (L.f.) Bhandari.*	Annonaceae	Hirwa Chafa, Madan masta
2	*Cocculus hirsutus (L.) Diels.*	Menispermaceae	Vasanvel
3	*Tinospora cordifolia (Willd.) Miers.*	Menispermaceae	Gulvel
4	*Capparis zeylanica L.*	Capparaceae:	Waghati.
5	*Maerua arenaria (DC.)Hook. f. &Thoms.*	Capparaceae:	Kaba, Kalwari
6	*Celastrus paniculata Willd.*	Celastraceae	Dhimarbel
7	*Ventilago denticulata Willd.*	Rhamnaceae	Lokhandi.
8	*Ampelocissus latifolia (Roxb.) Planch.*	Vitaceae	Dokela
9	*Cissus quadrangularis L.*	Vitaceae	Kandvel.
10	*Cissus repanda Vahl.*	Vitaceae	Gendal
11	*Cissus vitiginea L.*	Vitaceae	Jangli angur
12	*Cardiospermum helicacabum L.*	Sapindaceae	Ghanphodi.
13	*Bauhinia vahlii Wight & Arn.*	Caesalpiniaceae	veli aapta
14	*Caesalpinia bonduc (L.)Roxb.*	Caesalpiniaceae	Sagargota
15	*Abrus precatorius L.*	Fabaceae	Gunj.
16	*Butea superba Roxb.*	Fabaceae	Palasvel
17	*Cajanus platycarpus (Bth.) van der Maes*	Fabaceae	Gophanvel
18	*Clitoria ternatea L.*	Fabaceae	Gokarni
19	*Clitoria ternatea var. pilosula L.*	Fabaceae	Gokarni
20	*Derris scandens Benth.*	Fabaceae	Tupbel.
21	*Lablab purpureus (L.) Sweet.*	Fabaceae	Popat.
22	*Lablab purpureusvar. lignosus (L.), King.*	Fabaceae	Waal.
23	*Lathyrus aphaca L.*	Fabaceae	Ran watana.
24	*Mucuna pruriens (L.)DC.*	Fabaceae	Khajkuiri.
25	*Phaseolus radiatus*	Fabaceae	Jangli moong.
26	*Phaseolus vulgaris L.*	Fabaceae	Vilayati sem.
27	*Pisum sativum L.*	Fabaceae	Vatana.
28	*Rhynchosia bracteata Benth.*	Fabaceae	Turvel
29	*Rhynchosia minima (L.)DC.*	Fabaceae	Turvel
30	*Vigna unguiculata (L.)Walp.*	Fabaceae	Barbati.
31	*Calycopteris floribunda (Roxb.)Poir.*	Combretaceae	Ukshi.
32	*Combretum ovalifolium Roxb.*	Combretaceae	Madbel,
33	*Quisqualis indica L.*	Combretaceae	Lalchameli.
34	*Passiflora foetida L.*	Passifloraceae	Gangurli
35	*Passiflora incarnata L.*	Passifloraceae	Krishnkamal.
36	*Citrullus colocynthis (L.) Schrad.*	Cucurbitaceae	Indrayan
37	*Citrullus fistulosus Stock*	Cucurbitaceae	Dhemse.
38	*Citrullus lantus Matsumura et Nakai.*	Cucurbitaceae	Tarbooz,
39	*Coccinia grandis (L.)Voigt.*	Cucurbitaceae	Tondli.
40	*Cucumis callosus (Rottl.)Cogn.*	Cucurbitaceae	Pangogri kadu.
41	*Cucumis melovar agrestis Naud.*	Cucurbitaceae	Shendada.

42	*Cucumis sativus L.*	Cucurbitaceae	Kakadi.
43	*Cucurbita maxima Duch.*	Cucurbitaceae	Bhopala, Kaddu.
44	*Cucurbita moschata (Duch.) Poir.*	Cucurbitaceae	Kala bhopala
45	*Cucurbita pepo L.*	Cucurbitaceae	Kashibhopala.
46	*Diplocyclos palmatus (L.) Jeffrey*	Cucurbitaceae	Shankar-vel
47	*Lagenaria siceraria (Molina) Standley.*	Cucurbitaceae	Dudhi bhopala.
48	*Luffa acutangula (L.)Roxb.*	Cucurbitaceae	Dodka.
49	*Luffa cylindrica (L.)Roem.*	Cucurbitaceae	Chopda Dodka.
50	*Momordica charantia L.*	Cucurbitaceae	Karle.
51	*Momordica dioica Roxb.*	Cucurbitaceae	Kartoli.
52	*Trichosanthes anguina L.*	Cucurbitaceae	Padval.
53	*Trichosanthes cucumerina L.*	Cucurbitaceae	Jangli Padval.
54	*Mikania micrantha Kunth.*	Asteraceae	
55	*Jasminum officinale L. var. officinale.*	Oleaceae	
56	*Jasminum officinale L var. grandiflorum*	Oleaceae	Chameli, jai
57	*Jasminum sambac Ait.*	Oleaceae	Batmogra.
58	*Allamanda cathartica L.*	Apocynaceae	-
59	*Quirivelia frutescens (L) M.R. & S.M. Almeida.*	Apocynaceae	Shamlata, Kadhidudhi,.
60	*Leptadenia reticulata (Retz.)Wt. & Arn.*	Asclepiadaceae	Hirandodi
61	*Pergularia daemia (Forsk.)Chiov.*	Asclepiadaceae	Utaranvel, Utarni.
62	*Telosma pallida (Roxb.)Craib.*	Asclepiadaceae	Jiwati
63	*Tylophora indica (Burm.f.)Merr.*	Asclepiadaceae	Potmari.
64	*Wattakaka volubilis (L.f.) Stapf.*	Asclepiadaceae	Ambri
65	*Cryptolepis buchananii Roem.& Sch.*	Periplocaceae	Dudhivel
66	*Hemidesmus indicus var.indicus.(L.)*	Periplocaceae	Anantmul,
67	*Hemidesmus indicus var. pubescens (Wight & Arn.)Hook.f.*	Periplocaceae	-
68	*Argyreia nervosa (Burm.f.)Boj.*	Convolvulaceae	Samudrashoth.
69	*Convolvulus arvensis L.*	Convolvulaceae	Chandvel.
70	*Ipomoea cairica (L.)Sweet.*	Convolvulaceae	Garwel.
71	*Ipomoea hederifolia L.*	Convolvulaceae	-
72	*Ipomoea muricata (L.)Jacq.*	Convolvulaceae	-
73	*Ipomoea nil (L.) Roth.*	Convolvulaceae	Kaladana.
74	*Ipomoea obscura (L.)Ker-Gawl.*	Convolvulaceae	Pungali.
75	*Ipomoea pes-tigridis L.*	Convolvulaceae	Belukeja.
76	*Ipomoea quamoclit L.*	Convolvulaceae	Ganesh pushpa.
77	*Ipomoea sinensis (Desv.) Choisy.*	Convolvulaceae	-
78	*Jacquemontia paniculata (Burm.f.) Hallier*	Convolvulaceae	-
79	*Operculina turpethum (L.) S. Manso.*	Convolvulaceae	Dudhkalmi, Nishottar.
80	*Cuscuta reflexa Roxb.*	Cuscutaceae	Amarwel
81	*Bignonia unquis-cati L.*	Bignoniaceae	-
82	*Asystasia gangetica (L.) T. Ander.*	Acanthaceae	-
83	*Thunbergia fragrans Roxb.*	Thunbergiaceae	-
85	*Clerodendrum splendens G. Don*	Verbenaceae	-
86	*Petrea volubilis L.*	Verbenaceae	
87	*Bougainvillea glabra Choisy.*	Nyctaginaceae	-
88	*Bougainvillea spectabilis Willd.*	Nyctaginaceae	
89	*Basella rubra L.*	Basellaceae	Velbondi.
90	*Antigonon leptopus Hook, &Arn.*	Polygonaceae	-
91	*Aristolochia indica L.*	Aristolochiaceae	Badakvel
92	*Piper betle L.*	Piperaceae	Pan, Nagwel.
93	*Cassytha filiformis L.*	Cassythaceae	Adharvel, Amarbel.
94	*Tragia plukenetii L.*	Euphorbiaceae	Khajvel
95	*Dioscorea bulbifera L.*	Dioscoreaceae	Akashvel, Kadu-karanda.
96	*Asparagus racemosus Wiild.var. javanica Baker*	Liliaceae	Shatawari.
97	*Gloriosa superba L.*	Liliaceae	Kallavi
98	*Smilax perfoliata Lour.*	Smilacaceae	-
99	*Pothos scandens L.*	Araceae	-

The present study reveals 98 species of climbers belonging to 35 families of climbing species of angiosperms in the area which marked the rich diversity of climbers in the given region but the population of some species is declining. Climbers associated with diverse habitats such as forests, grasslands, and wetlands. Deforestation, urbanization, and agricultural expansion can lead to the destruction of these habitats, affecting the climbers that rely on them for support and resources. The diversity of climber species like *Artabotrys hexapetalus (L.f.) Bhandari. ,Cardiospermum helicacabum L, Telosma pallida (Roxb.)Craib., Hemidesmus indicus var.indicus.(L.) Aristolochia indica L., Dioscorea bulbifera L., Gloriosa superba L* were rare among all climbers. Invasive plant species are outcompeting native climbers, leading to a decline in their populations. Invasive species disrupting the natural ecological balance and threatening the survival of native plants. In some cases, climbers are harvested for various purposes, such as medicinal or ornamental use. Unsustainable harvesting have negatively impact on the populations. Climate change also altering the distribution and timing of plant species, including climbers. Shifts in temperature and precipitation patterns affecting their growth and reproductive cycles. We have took conservation efforts with classical approach by collecting seeds of rare and medicinal climbers for seed banks.

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Bird's Nest Fungi, Cyathusstriatus: A checklist in India and a record from Chikhaldara, Melghat, Maharashtra

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Abstract

Twenty-four bird's nest fungal species, grouped into four genera (*Crucibulum*, *Cyathus*, *Nidula*, and *Sphaerobolus*), have been documented from India; the majority of these reports came from the Northeastern states situated in the Eastern Himalaya region, which is widely acknowledged for its abundant biodiversity. With 61 species currently known to exist worldwide, including 17 species from India, *Cyathus* is the largest genus among these. Only *Cyathuspoeppigii* has been identified thus far, and it comes from the state of Arunachal Pradesh in the Eastern Himalayas. This study reports on a new species, *Cyathusstriatus*, that was discovered in Melghat, Amravati District, Maharashtra. It includes detailed taxonomic details. Compared to the previously described, it generates relatively fewer basidiocarps. Additionally, the basidiospores have thin walls but are larger than usual.

Key Word – *Crucibulum, Cyathus*, *Nidula, Sphaerobolus*, Basidiocarps, Basidiospores

Introduction –

The fungal diversity in tropical and subtropical forests is very high, and many new taxa have been described through the use of an integrated taxonomic method[1]. In the Fungal kingdom, the second-largest phylum after Ascomycota, Basidiomycota, has undergone a recent revision in comprehensive notes and outline[2,3]. The Bird's Nest Fungi are one of the most exquisite groups of Basdiomycota. They belong to six genera: *Crucibulum, Cyathus, Mycocalia, Nidula, Nidularia, and Sphaerobolus*[4,5,6,7,8,9,2]. These fungi do not exhibit anamorphic states[10].

They were previously classified as members of the Nidulariaceae family, however these fungi have moved to Agaricaceae family[11]. With the exception of *Sphaerobolus*, other genera in this group that generate numerous peridioles have been assigned to the order Agaricales, Agaricomycetes, under theincertaesedis[2]. Taxonomic key for bird's nest fungus have released[11]. White peridioles, a simple funiculus, and an interior smooth and tawny golden cup are characteristics of*Crucibulum*. The world is home to seven species of *Crucibulum*: *C. albosaccum, C. crucibuliforme, C. cyathiforme, C. laeve, C. parvulum*, *C. simile*, and *C. vulgare*. There are just two species from India: *C. laeve* and *C. vulgare*. The genus *Cyathus*is saprobic; it grows on fertile soil and decaying wood[12]. It forms gregarious basidiomata, which can be up to 3 cm tall and have a cone, funnel, or inverted bell shape. Multiple gray to black peridioles are connected to a three-layered peridium via a funicular cord[13]. 61 species have been documented for this genus of bird's nest fungi [1,2,14], with the highest number of records coming from Brazil. The global edition of Cyathus has released[15]. The Queensland Mycological Society's key to bird's nest fungi states that whereas *Mycocalia*, *Nidula*, and Nidularia lack funicular cords, *Crucibulum* and *Cyathus* do. A unique genus of bird's nest fungi known as Mycocalia is characterized by globose to subglobosebasidiomata, hyaline to brown peridium, peridioles in a hyaline gelatinous matrix, and cylindrical to ellipsoid, hyaline basidiospores[16]. As of right now, seven species of Mycocalia—*M. aquaphila*, *M. arundinacea*, *M. denudate*, *M. duriaeana*, *M. minutissima*, *M. reticulata*, and *M. sphagneti*—have been identified [17].

The morphological characteristics of the seven species that make up *Nidula*are as follows: urn- to vase-shaped basidiomata containing lenticular brown peridioles; peridium six-layered; mouth covered by a lid; tunica layer surrounding the peridioles; and basidiospores that are broadly ellipsoid to elongate, hyaline, and smooth walled. This genus has three species that have been identified as coming from India*: Nidula candida*, *N. emodensis*, and *N. shingbaensis*. The type genus for the family Nidulariaceae is Nidularia Fr. (1817). Its pulverulent, soft, early-deliquescent basidiomata surface and spinose hyphae-composed peridium are its distinguishing features [18]. Nidularia lacks epiphragm, just like Mycocalia does. There are currently three species known to exist: *N. confluens*, *N. farcta*, and *N. pulvinata*; however, none of these

have been found in India. S*phaerobolus*, a distinct genus with small basidiomata that hold a single brown peridiole has described [19]. Because it has a unique spore-dispersal technique, it is also known as artillery fungus. Four species—*S. iowensis*, *S. ingoldii*, *S. stellatus*, and *S. jaysukhianus*—are recognized under this genus (which is currently classified under Geastraceae, Geastrales, Agaricomycetes[2]. Later, two species were identified from India [20]. 17 species of bird's nest fungi from India, which are divided into three genera: 1 species of Crucibulum, 14 species of Cyathus, and 2 species of Nidula[11]. Following that, numerous species were introduced to these three genera (Table 1) and two additional species—*Sphaerobolusjaysukhianus* and *S.stellatus*—to Sphaerobolus[11,20].

Table 1 Checklist of Bird's nest fungi found in India

Name of the species	Substratum	Site	Reference
*Crucibulum laeve** (Huds.) Kambly 1936.	Unknown	Unknown	Das & Zhao (2012)
C. vulgare Tul. & C. Tul. 1844.	Unknown	Nilgiris (Tamila Nadu)	Butler & Bisby (1931)
*Cyathus. Colensoi** Berk. 1855.	Dead twigs and soil	Shimla hills (Himachal Pradesh), Siliguri (West Bengal), Phey village (Leh, Ladakh)	Yangdol et al. (2018)
C. ellipsoideus H.J. Brodie 1974.	Unknown	Chikmaglur (Karnataka)	Sharma (2016)
C. ***gracilis**** H.J. Brodie 1973.	Twigs	Sevoke (Siliguri, West Bengal)	Sharma (2016)
C. griseocarpus* Brodie & B.M. Sharma 1980.	Dead twigs and soil	Ukhrul (Manipur)	Brodie & Sharma (1980)
C. hookeri* Berk. 1854.	Unknown	Kollong rock (Khashia hills, Meghalaya)	Sharma (2016)
*C. intermedius** Tul. & C. Tul. 1844.	Unknown	Sibpur (near Calcutta, West Bengal), Manali (Himachal Pradesh)	Sharma (2016)
*C. limbatus** Tul. & C. Tul. 1844.	Dead wood	Nongpoh (Khasi hills, Meghalaya)	Góis et al. (2020)
C. microsporus Tul. & C. Tul. 1844.	Unknown	Khasi hills (Meghalaya)	Sharma (2016)
C. novae-zelandiae Tul. & C. Tul. 1844.	Dead wooden log	Jatinga (Haflong, N.C. Hills, Assam)	Sharma (2016)
*C. olla** (Batsch) Pers. 1801.	Unknown	Ladakh	Dorjey et al. (2013)
*C. poeppigii** Tul. & C. Tul. 1844.	Soil and twigs	Bomdila & Nichifu (West Kameng, Arunachal Pradesh)	Das & Zhao (2012)
*C. renweii** T.X. Zhou & R.L. Zhao 2004.	Unknown	Basgo (Leh, Ladakh)	Yangdol et al. (2018)
*C. stercoreus** (Schwein.) De Toni 1888.	Soil and wild animal dung	Khasi hills (Meghalaya), Shoolpaneshwar Wildlife Sanctuary (Sagai, Gujarat)	Patel et al. (2018)
*C. striatus** (Huds.) Willd. 1787.	Soil and twigs	Darjeelin, (West Bengal) Emchi (Papum Pare, Arunachal Pradesh)	This study
C. thindii K. Das, Hembrom, A. Parihar & R.L. Zhao 2015.	Unknown	A.J.C Bose College (Howrah, West Bengal)	Cruz (2017)
*C. triplex** Lloyd 1906.	Soil and twigs	Baramulah (Agartala, Tripura)	Sharma (2016)
*C. montagnei** Tul. & C. Tul. 1844.	Unknown	Dehradun (Uttarakhand)	Sharma (2016)
*Nidula candida** Peck 1893.	Dead twigs of *Abies densa*	Between Hilley and Barsey (Sikkim)	Das & Zhao (2012)
N. emodensis (Berk.) Lloyd 1906.	Dead wood	Lachen (Sikkim)	Butler & Bisby (1931)
N. shingbaensis* K. Das & R.L. Zhao 2013.	Dead twigs of *Abies densa*	Shingba Rhododendron Sanctuary, (North District, Sikkim)	Das & Zhao (2013)
Sphaerobolus jaysukhianus* AM Vasava, RS Patel & KS Rajput 2020.	Cow dung	Ajwa Road (Vadodara, Gujarat)	Vasava et al. (2020)
*S. stellatus** Tode 1790.	Dead moss	Botanic garden (Saharanpur, Uttar Pradesh)	Butler & Bisby (1931)

Note: **Bold** letters indicate new species, * Indicates molecular data available, Name of the province (State) of India has been put within bracket.

Reference:

Cyathusstriatus: a new record from Arunachal Pradesh and a checklist of Bird's nest fungi in India

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Niranjan M, Singh RK 2021 – *Cyathusstriatus*: a new record from Arunachal Pradesh and a checklist of Bird's nest fungi in India. Studies in Fungi 6(1), 168–174, Doi 10.5943/sif/6/1/10

Material and Method –

In the Amravati district, Maharashtra (MS), fresh basidiomata growing on dead and decaying wood were gathered, and the macro-morphological characteristics were recorded. Its surface was prepared for microscopic inspection by cleaning it with 70% ethyl alcohol. In order to identify the structures, the samples were inspected using a stereo zoom microscope (Zeiss Stemi 508, Germany), and an AxiocamERc 5s digital camera was added for taking pictures. Basidiomata slices were cut free-hand and mounted in a lactophenol-cotton blue solution.

Under the Zeiss Axio Lab, fungus structures were examined under a microscope in great detail, and microphotography was conducted. Digital camera AxiocamErc 5s attached to A1 microscope. ZEN-2012 imaging software version 8.0.0 was used to measure sizes. Adobe Photoshop version 7.0 was used to prepare photographic plates. The outline and comments for Basidiomycota were consulted in order to undertake morphological identification[2,3]. Samples from the herbarium were placed in the department's fungal herbaria. Per the description, the Facesoffungi number was registered[22].

Taxonomy –

Scientific Name :*Cyathusstriatus*Willd., (1787)

Basionym :*Pezizastriata*Huds. 1778 7.

Synonyms :*Pezizastriata*Huds., (1778)

Nidulariastriata (Willd.) With., (1792)

Cyathellastriata (Willd.) Brot., (1804)

Nidulariastriata var. pusillaBerk., (1839)

Classification :,

Eumycota

Basidiomycota

Agaricomycotina,

Agaricomycetes,

Agaricomycetidae

Agaricales,

Occurrence on Wood Substrate :

Saprobic; clustered on wood chips, bark, fallen branches. saprobic on rotting timber. Teleomorph: Infundibuliform, hyaline puffy, basal brown to dark brown apical ends, **basidiomata** 6-8 × 5-6 mm in diameter at the mouth, thinning towards the base, short stalk, scattered to gregarious. Hyaline and rupturing at maturity is the epiphragm. A wood-attached strip with three layers visible in cross section, the outer layer having structures resembling pale brown hair.

A wooly trimitic hyphae-based exoperidium with generative hyphae that are hyaline, often septate and branched, and binding hyphae that are 2.6–3.3 µm wide, hyaline to pale brown, and distantly septate with clamp connections. Skeletal hyphae are 2.5–3.2 µm in diameter, thick-walled, brown, and rarely branched.

The **peridium** is composed of three distinct layers, with a thickness of >164.5 µm and >153.8 µm in the middle. The middle wall is hyaline to pale brown, tightly packed texturaintricata hyphae, 2.6–2.8 µm, highly branched, and the inner wall is gray to brown textura, epidermoid tissue. The outer wall is conspicuously plicate, tomentose, arranged in regular flexible tufts or fibrose hyaline to pale brown hyphae, 4.7–5.8 µm wide, rarely branched, and the apical cells are ovoid with apiculate ends. **Peridioles**are round to elliptical, 1-3 × 0.2-0.3 mm, with 10–12 per basidioma, smooth to wrinkled surfaces, sticky by nature, and when wet, coated in a thin layer of mucilaginous gel.

There are **funiculi**, which range in size from 3.8 to 5.1 µm and have a pale yellowish color. They are made up of branching mycelial cords without septa. The peridiole has three layers with a thin tunica covering it that is more than 15.5 µm thick. The **exocortex** is 7.8–12.0 µm broad, brown to black, while the endocortex is 40–142 µm wide and hyaline. The **hymenium** is 81–86 µm wide and is made up of branched hyphae that are 1.1–2.5 µm wide.

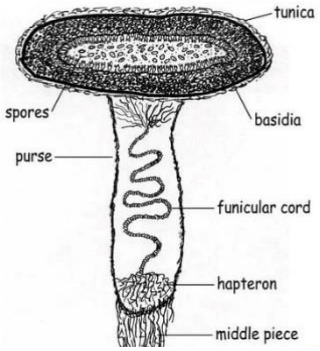
Discussion:

There are currently twenty-four species of bird's nest fungi known to exist in India, divided into four genera: two species each of Cribicum, Cyathus, Nidula, and Sphaerobolus. While Sphaerobolus has been recorded from Gujarat and Uttar Pradesh, Crucibulum has been reported from Tamil Nadu. India is home to the greatest number of known species of Cyathus, with many species found in the Northeastern part of the nation, which is located inside the Eastern Himalayas.

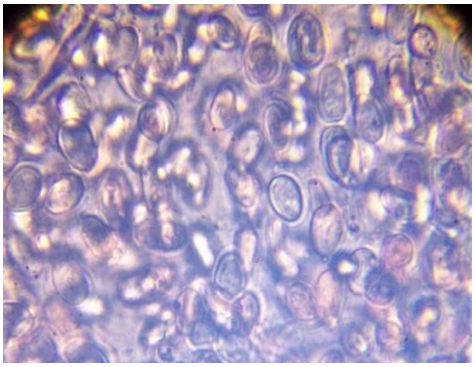
The species C. striatus was first identified in the Northeastern region from Darjeeling, West Bengal, and was rediscovered in theChikhaldara area of Melghat forest in the state of Mharashtra for this study. Nonetheless, in contrast to the aforementioned prior record, the specimens in our collection have relatively smaller Basidioma with somewhat larger but thin-walled basidiospores. The limited geographic range of Nidula in India is reflected in the three species that have been identified, all of which are from the state of Sikkim in the Eastern Himalayas.

a

b

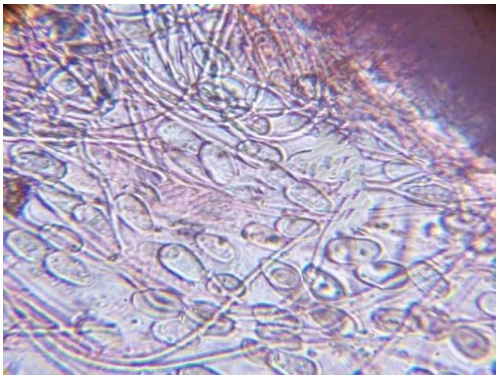


c



d

e



f

Microscopy and Photography by - (Zeiss Stemi 508, Germany), and an AxiocamERc 5s digital camera **.**

Fig 1 - a – b *Cyathusstriatus*on dead and decaying wood,
c. Aperidiole and attached funiculus in cross section (Tunica, Spores, Basidia, Purse, Funicular Cord, Hapteron, Middle Piece),
d.Basidiospores,
e-f Hyphae with Basidiospores.

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Comparative Study of Thermo-Acoustic Properties of Ethanol-Cyclohexane and 1-Propanol-Cyclohexanebinary Mixturesat 298.15 K

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Abstract

The density, ultrasonic velocity and viscosity were measured using Anton Paar DSA 5000 M in the binary mixtures of ethanol-cyclohexane and 1-propanol-cyclohexane systems at various mole fractions from 0.1 to 0.9 at T = 298.15K. The isentropic compressibility, acoustic impedance, free length, free volume and internal pressure were calculated using the values of experimental density, sound velocity and viscosity. The values obtained from experimental parameters and derived parameters have been compared and discussed in the vicinity of non-covalent interactions taking place in the liquid mixtures.

Key words: Isentropic compressibility, acoustic impedance, free length, free volume, internal pressure, intermolecular non-covalent interactions.

Introduction

From fundamental as well as engineering point of view, the knowledge of structure and molecular interactions of liquid mixtures is very important. For better understanding of the non-ideal behavior of complex systems, fundamental thermodynamic and thermo-acoustic properties are essential and necessary sources of information because of physical and chemical effects, caused by intermolecular forces (dipole-dipole, Van der Waal's, hydrogen bonding, *etc*.) of unlike molecules. These properties are necessary from practical point of view, for development of thermodynamic models required in adequate and optimized processes of the chemical, food, drugs, petrochemical, pharmaceutical, paintindustries,etc. [1,2].

Ultrasonic velocities of liquid mixtures consisting of polar as well as non-polar components are of considerable importance in understanding intermolecular interaction between components molecules and are applicable in several industrial and technological processes [3-5]. Acoustical and thermodynamical study of liquid mixtures provide enough knowledge about the association of molecular packing, molecular motion and strength of intermolecular interactions. Ethanol is an important industrial solvent. It has widespread use as a precursor for other organic compounds such as ethyl halides, ethyl esters, diethyl ether, acetic acid and ethyl amines [6,7]. Ethanol is considered a universal solvent, as its molecular structure allows for the dissolving of both polar, hydrophilic and nonpolar, hydrophobic compounds [8]. Propanol is used as a solvent in the pharmaceutical industry, mainly for resins and cellulose esters and sometimes as a disinfecting agent [9-11]. Cyclohexane is a non-polar liquid, frequently used as a recrystallization solvent, as many organic compounds exhibit good solubility in hot cyclohexane and poor solubility at low temperatures [12-13].

In the present investigation, we are interested to study molecular interactions occurring in mixture of polar and non-polar solvents with the variation in parent carbon chain. As the possibility of formation of hydrogen bonds between components in the mixture containing cyclohexane as a common solute is negative.Density (ρ), viscosity (η) and ultrasonic velocity (U) for the binary systems of ethanol-cyclohexane and 1-propanol-cyclohexane was studied at T = 298.15 K over the concentration range of 0.1 to 0.9 mole fraction to observe the possible sources of variations. Using the measured values of sound velocity (u) and density (ρ), the thermodynamic parameters such as isentropic compressibility, acoustic impedance, internal pressure, free length and free volume have been computedand discussed in terms of molecular interactions[14,15].

Material and methods

The objective of the present investigation was to find out the density (ρ), viscosity (η) and ultrasonic velocity (U) for the binary system constituted by these components at T = 298.15 K over the concentration range of 0.1 to 0.9 mole fraction. The experimental values were used to calculate isentropic compressibility (βa), acoustic impedance, free length,free volume (V_f) andinternal

pressure (πi)over the entire concentration range for the binary mixtures. The results are discussed in terms of the molecular interactions.

The chemicals Ethanol(CAS 64-17-5), 1-Propanol (CAS 71-23-8) and Cyclohexane (CAS 110-82-7) used in present work were procured from Merck KGaA, Darmstadt, Germany with minimum assay of 99.8%. These chemicals were ofHPLC grade and used without further purification. The glassware was cleaned using standard methods and dried to absolute dryness which was further checked with anhydrous $CuSO_4$.

The equipment used for measurements of density, viscosity and ultrasonic velocity was Anton Paar DSA 5000 M having range, up to 3g/cc with 0.000007 g/cc accuracy for density, 1000 to 2000 m/s with 0.01 m/s accuracy for ultrasonic velocity, 0.2 to 30,000 mm^2/s range for viscosity with 0.1% accuracy and temperature range from 0^0C to 100^0C with repeatability of 0.001^0C. This equipment works based on oscillation periods of quarts U tube with air, solvent and solutions [16].

For each experimental measurement, the tube was cleaned with acetone first and then dried by passing dried air through the tube using air pump. This process of drying the tube was continued till a constant oscillation period was obtained as was done during the initial instrument calibration.

Result and discussion

The literature and experimental density, speed of sound and viscosity values of pure ethanol, 1-propanol and cyclohexane with standard deviations at T = 298.15 K, are given in table 4.1 which shows accuracy and calibration of instruments.The values of density (ρ), viscosity (η) and ultrasonic velocity (U) along with isentropic compressibility (βa), acoustic impedance,free length,free volume (V_f) andinternal pressure (πi) for ethanol-cyclohexane and 1-propanol-cyclohexane at 298.15 K are reported in Tables 4.2 and 4.3 respectively. The results are discussed in terms of the molecular interactions.

Table 3.1

298.15 K	Lit	ρ/(g cm^{-3})	б	Lit	u/ (m s^{-1})	б	Lit	η (mPa.s)	б
Ethanol	0.78950[17]	0.790173	6.73 x 10^{-4}	1161.78 [18]	1161.82	0.04	1.1870[19]	1.18635	6.5 x 10^{-4}
1-Propanol	0.79960[20]	0.799601	1.00 x 10^{-6}	1205.93 [21]	1205.85	0.08	2.1178[20]	2.11800	2.0 x 10^{-4}
Cyclohexane	0.77392[22]	0.77385	3.50 x 10^{-5}	1254.00 [23]	1254.03	0.03	0.9040[24]	0.89901	4.5 x 10^{-4}

Table 3.2Ethanol-Cyclohexane System

C (M.F.)	ρ (kg m^{-3})	u (m s^{-1})	η (mPa.s)	$\beta_{a\ x\ 10^{-10}}$ (cm^2/dyne)	Z (g/cm^2sec)	$L_{f\ x\ 10^{-11}}$ (cm^2/dyne)	$V_{f\ x\ 10^{-8}}$ (cm^3/mol)	$\pi_{i\ x\ 10^{8}}$ (dyne/cm^2)
0.1	783.867	1141.21	0.9759	9.7821	895168.3	6.1516	5.0360	8.4188
0.2	780.476	1142.78	0.9295	9.7836	893161.1	6.1521	6.0694	7.5104
0.3	778.082	1149.39	0.9003	9.6882	896171.5	6.1220	7.1243	6.7878
0.4	776.087	1155.83	0.8813	9.5930	899453.8	6.0918	8.1761	6.2012
0.5	774.991	1166.75	0.8663	9.4104	907320.7	6.0336	9.3225	5.6967
0.6	774.692	1179.56	0.8569	9.2028	917498.7	5.9666	1.0501	5.2700
0.7	774.194	1191.41	0.8511	9.0160	926656.0	5.9058	1.1683	4.9047
0.8	773.894	1207.03	0.8528	8.7774	938981.1	5.8271	1.2835	4.5931
0.9	773.695	1227.44	0.8660	8.4809	955134.2	5.7279	1.3845	4.3351

Table 3.3 1-Propanol-Cyclohexane System

C (M.F.)	ρ (kg m^{-3})	u (m s^{-1})	η (mPa.s)	$\beta_{ax\ 10^{-10}}$ (cm^2/dyne)	Z (g/cm^2sec)	$L_{fx\ 10^{-11}}$ (cm^2/dyne)	$V_{f\ x\ 10^{-8}}$ (cm^3/mol)	$\pi_{ix\ 10^{8}}$ (dyne/cm^2)
0.1	793.425	1208.87	1.8060	8.6245	959147.7	5.7762	3.0562	8.6245
0.2	788.365	1209.53	1.5598	8.6704	953551.1	5.7915	4.0329	7.6348
0.3	784.164	1210.87	1.3784	8.6976	949520.7	5.8006	5.1356	6.8504
0.4	780.823	1213.03	1.2330	8.7041	947138.3	5.8028	6.4152	6.1959

0.5	778.139	1216.11	1.1186	8.6911	946217.0	5.7984	7.8413	5.6523
0.6	775.953	1220.21	1.0299	8.6585	946662.7	5.7875	9.3703	5.2014
0.7	774.177	1225.20	0.9678	8.6049	948521.7	5.7696	1.0857	4.8410
0.8	772.754	1232.09	0.9248	8.5258	952032.9	5.7430	1.2273	4.5471
0.9	771.656	1241.21	0.9004	8.4119	957779.4	5.7045	1.3513	4.3127

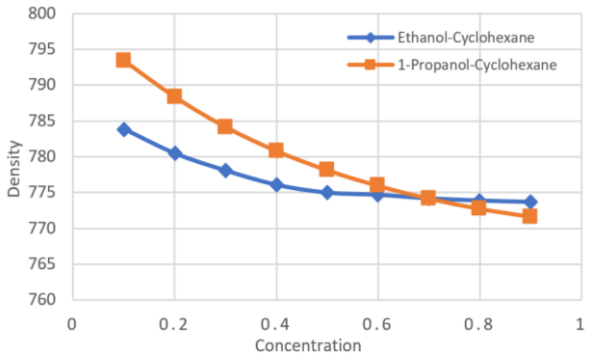

Fig. 4.1 Variation of Density vs. Concentration of cyclohexane in ethanol and 1-propanol at 298.15 K

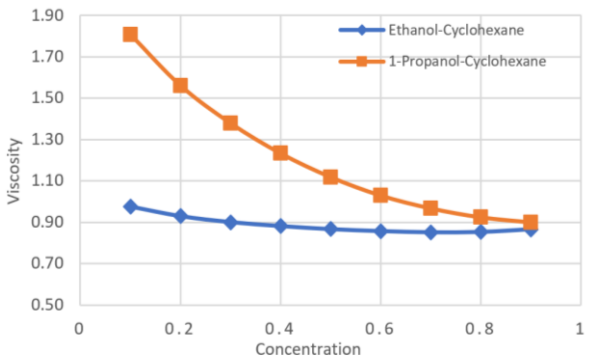

Fig. 4.2 - Variation of Viscosity vs. Concentration of cyclohexane in ethanol and 1-propanol at 298.15 K

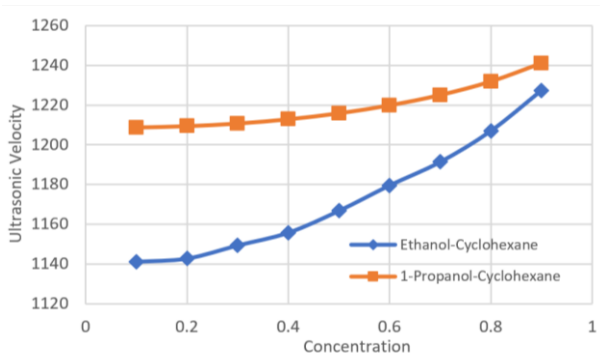

Fig. 4.3 - Variation of Ultrasonic Velocity vs. Concentration of cyclohexane in ethanol and 1-propanol at 298.15 K

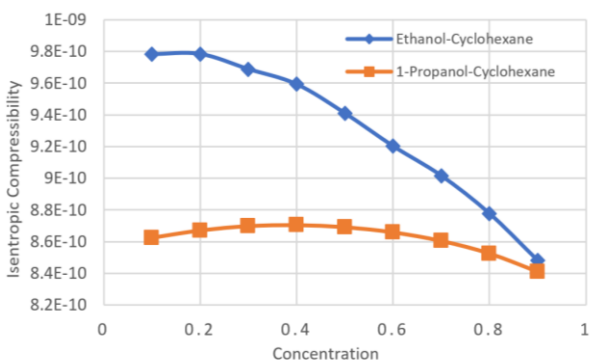

Fig. 4.4 - Variation of Isentropic Compressibility vs. Concentration of cyclohexane in ethanol and 1-propanol at 298.15 K

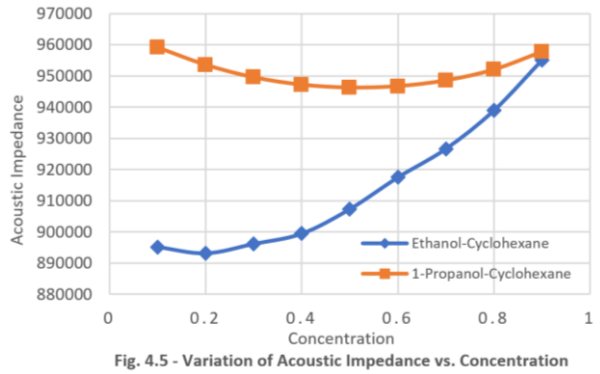

Fig. 4.5 - Variation of Acoustic Impedance vs. Concentration of cyclohexane in ethanol and 1-propanol at 298.15 K

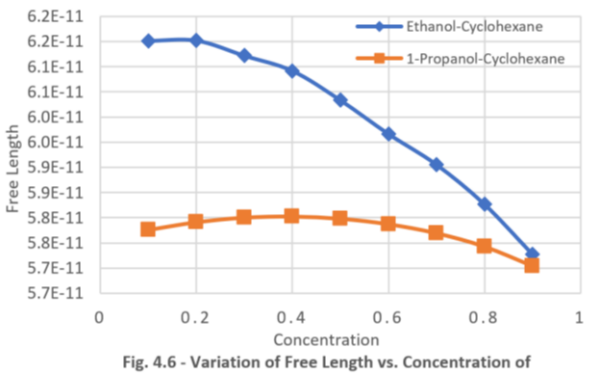

Fig. 4.6 - Variation of Free Length vs. Concentration of cyclohexane in ethanol and 1-propanol at 298.15 K

It is observed from the Fig. 4.1 that, density of ethanol-cyclohexane system is lower compared to 1-propanol-cyclohexane system. It is general observation that, as the length of carbon chain increases, solubility of organic molecule increases in organic solvent. 1-propanol has greater length compared to ethanol, which may favor solubility of cyclohexane, thereby increasing the density. Increase in density of 1-propanol-cyclohexane system may be attributed due to extra -CH_2 group present in 1-propanol, which causes proper orientation and packing become strong compared to ethanol-cyclohexane system, thereby increasing the density in 1-propanol-cyclohexane system. Another factor which must be contributing to this increase in density of 1-propanol-cyclohexane system may be the density of 1-propanol itself, which is greater

than ethanol hence the density of its solution [25, 26].

It can be observed from the Fig. 4.2 that, viscosity of1-propanol-cyclohexanesystem is greater compared to ethanol-cyclohexanesystem. Viscosity depends upon the structure of a molecule. In this case 1-propanol is having one extra -CH_2 group than ethanol, thereby causing more friction compared to ethanol. Due to presence of extra -CH_2 group in 1-propanol, 1-propanol-cyclohexane may have greater viscosity compared to ethanol-cyclohexane [27-29].

It can be observed from the Fig. 4.3 that, ultrasonic velocity of 1-propanol-cyclohexane system is greater compared to ethanol-cyclohexanesystem. Ultrasonic velocity depends on density. So, the higher ultrasonic velocity in 1-propanol-cyclohexane system compared to ethanol-cyclohexane system may be suggested due to higher density of 1-propanol-cyclohenxane system [30-32]. From the Fig. 4.4 it is observed that, isentropic compressibility of 1-propanol-cyclohexane system is lower compared to ethanol-cyclohexane system. As isentropic compressibility depends upon closed packing of the medium, its lower value in 1-propanol-cyclohexane system may be suggested due to closed packing of molecules, which is slightly less in ethanol-cyclohexane system. This may due to the fact that, solubility of cyclohexane may be higher in 1-propanol than in ethanol as discussed before, thereby increasing closed packing in 1-propanol-cyclohexane system, and decreasing its compressibility.

It can also be observed from the Fig. 4.5 that acoustic impedance shows exactly opposite trend as that of isentropic compressibility and From the Fig. 4.6, it is found that free length variation in comparative study between ethanol-cyclohexane and 1-propanol-cyclohexane systems follows the same trend as that is observed for isentropic compressibility. All the above parameters depend on closed packing of the medium. So, it is clear from the above observations that, close packing in 1-propanol-cyclohexane system is more compared to ethanol-cyclohexane system. This closed packing may be due to more solubility of cyclohexane in 1-propanol than in ethanol, thereby increasing number of available molecules in unit volume in 1-propanol-n-hexane system [33-40].

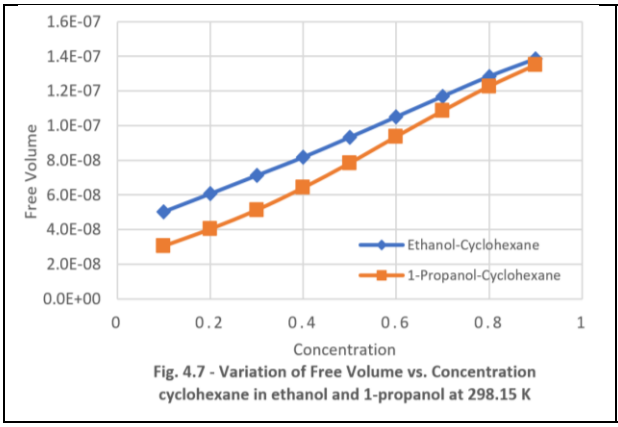

Fig. 4.7 - Variation of Free Volume vs. Concentration cyclohexane in ethanol and 1-propanol at 298.15 K

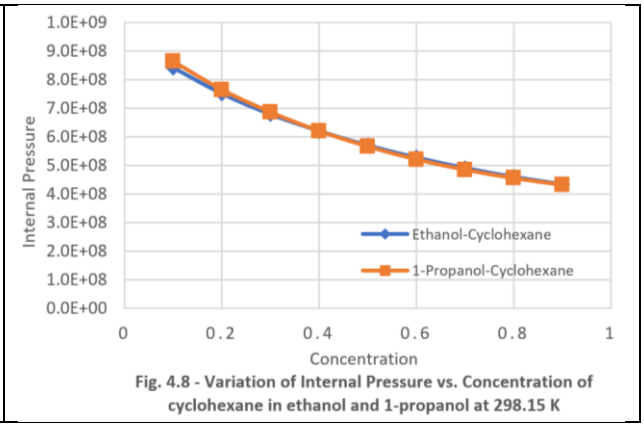

Fig. 4.8 - Variation of Internal Pressure vs. Concentration of cyclohexane in ethanol and 1-propanol at 298.15 K

From Fig. 4.7, it can be seen that, free volume of ethanol-cyclohexane system is greater than 1-propanol-cyclohexane. This may be suggested due to smaller size of cyclohexane and more polarizability of 1-propanol, 1-propanol-cyclohexane system may have greater number of molecules in given volume, thereby decreasing its free volume [41, 42]. From Fig. 4.8, it can be seen that, internal pressure shows almost no change in comparison between 1-propanol-cyclohexane and ethanol-cyclohexane systems. Internal pressure in such kind of solutions is observed due to strong solute-solvent interactions. So, it can be concluded that, due to same nature of solvents in both systems, interactions observed in both the systems may be almost same causing almost no change in internal pressure [43, 44].

Conclusion

Comparative study between ethanol-cyclohexane and 1-propanol-cyclohexane systems suggests that, greater length of 1-propanol favors solubility of cyclohexane thereby increasing density of 1-propanol-cyclohexane compared to ethanol-cyclohexane. Due to greater polarizability of 1-propanol, its solution with cyclohexane might show greater viscosity. At higher concentrations, due to dominancy of amount of cyclohexane, almost no difference in viscosities is observed. Due to higher density, sound velocity of 1-propanol-cyclohexane is found to be greater. From the acoustic parameters like isentropic compressibility, acoustic impedance and free length, it is suggested that close packing in 1-propanol-cyclohexane system is more. This closed packing may be due to more solubility of cyclohexane in 1-propanol than in ethanol. Lower value of free volume in ethanol-cyclohexane is suggested by smaller size of ethanol compared to 1-propanol, which requires less space hence free volume. Almost no difference in the value of internal pressure may be suggested due to same nature of solvents in both systems, interactions

observed in both the systems may be almost same causing almost no change in internal pressure.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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GC-MS Analysis & Conservation of Ethonomedicinal Aromatic Plant *Anisomelis indica* (L)

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Abstract

Anisomeles indica (L) is a wild plant of family Lamiaceae. Commonly known as "**Gopoli"**,.The plant is used traditionally as an analgesic, antiinflammatory and in skin problems such as snak ebites. Medicinally it has beenproven to possess various pharmacological activities like antioxidant, antimicrobial, our knowledge of the intimate relationship between early man and plants has come to us mainly through tradition. Today, the field of ethnobotany requires variety of skills, because it is the study of relationship between plants and people. To search novel active compounds from plant origin and to access the valuable thereupatic properties with minimum side effects, application of advanced method like GC-MS computational techniques plays an important role in the development of drug of interest. 2 compounds were identified in aerial parts of Anisomeles indica these are**Tetracosapentaene,2,6,10,15,19,23-hexamethyl-**,**22-Stigmasten-3-one** .the coming generation should not miss the flora and fauna of our country. It is observed that *Anisomeles indica* is becoming rare, day by day in some region of Nagpur. The efforts of awareness in the society regarding its conservation should be made. Plantation of this species should be increased.

Keyword: Conservation, GC-MS, Ethnobotany, compounds. *Anisomeles indica*

Introduction:

The plant Anisomeles indica, commonly known as "Gopoli" belongs to the family Lamiaceae and is an ethonobotanically important medicinal plant. Almost all parts of this plant are being used in traditional medicines to treat various diseases.Medicinally it has been proven to possess various pharmacological activities like antioxidant, antimicrobial, our knowledge of the intimate relationship between early man and plants has come to us mainly through tradition. (Chatterjee A and Pakrashi SC, 1997) Interest and support for the conservation and development of ethnomedicinal plant is increasing in all parts of the world. As per world Health organization (WHO) estimates almost 80% of the population of developing countries relies on traditional medicine mostly plant drugs for their primary health care needs. The plant isused in folk medicine as a cure in gastric catarrh and intermittent fever and essential oil present in herb isused in uterine affection. (Kirtikar et.al. 1999, Anonymous, 2003) A. indica Linn. is reported to have antipyretic, analgesic, antiinflammatory activity and it also acts as natural herbicide in wheat fields(Dharmasiri et.al.2000 and2003).

Figure 1 : View of *Anisomeles indica* Plant

Methodology:

The present work based on various sits survey made in Nagpur region. This plant was collected and their identification was authenticated at research laboratory of Institute of Science, Nagpur. Ethnomedicinal uses medicinal properties of the plants was collected during field trips. GC-MS analysis done by the help of shade dried powder of leaves.

GC-MS Analysis –

The test plant extracts were subjected to GC-MS analysis at laboratory's (IIT Bombay) Sophisticated Analytical Instrument Facility (formerly RSIC), Indian Institute of Technology, Powai, Mumbai – 400076, India.

Results and Observation:

Ethno medicinal uses of *Anisomelis indica:*

1) The plant isused in folk medicine as a cure in gastric-dysfunction
2) Essential oil present in herb isused in uterine affection. (Kirtikar et. al. 1999, Anonymous, 2003). A indica Linn.
3) The plant is used traditionally as an analgesic, antiinflammatory and in skin problems such as snakebites.
4) In 100 gm of leaves after prosesing the dried leaves powder founf 6.33 % aromatic oil .
5) Aromatic oil use in various joints pain.

There is need to develop alternative antibiotic drugs from plants.

One approach is to screen local medicinal plant s,which represent rich source of novel antimicrobial agent s. The dried or fresh material is used as a wash for external afflictions, eczema, pruritis and skin problem. The plant is to act as a mosquito-repellent.

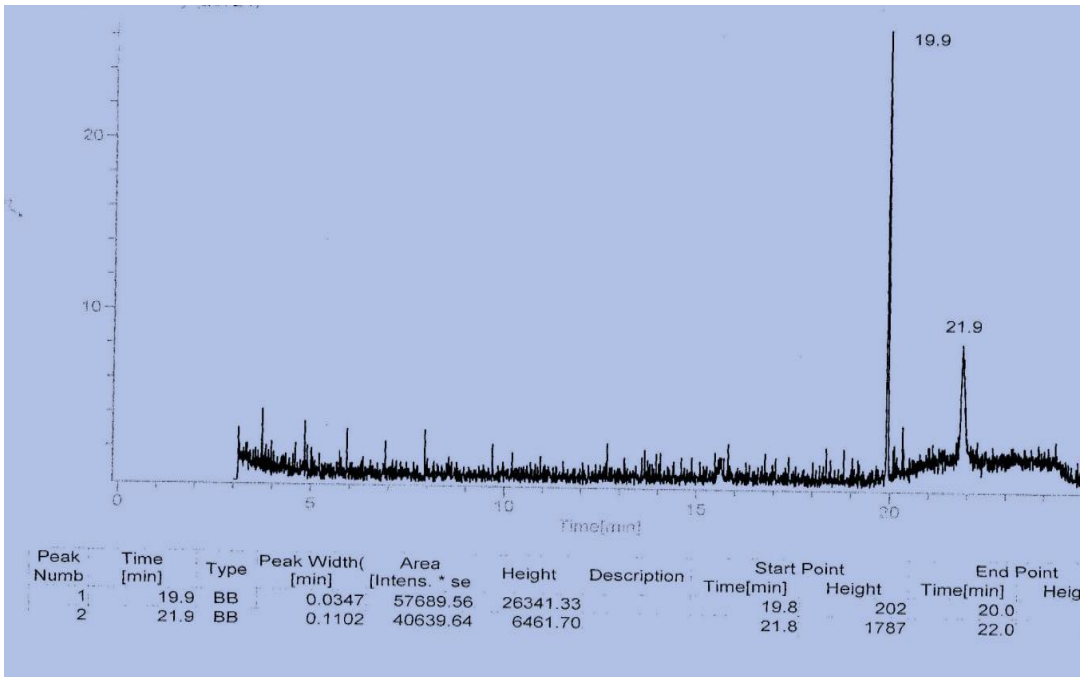
Table No. 1:
The Chemical Composition *Anisomelis indica* (wild) Linn.

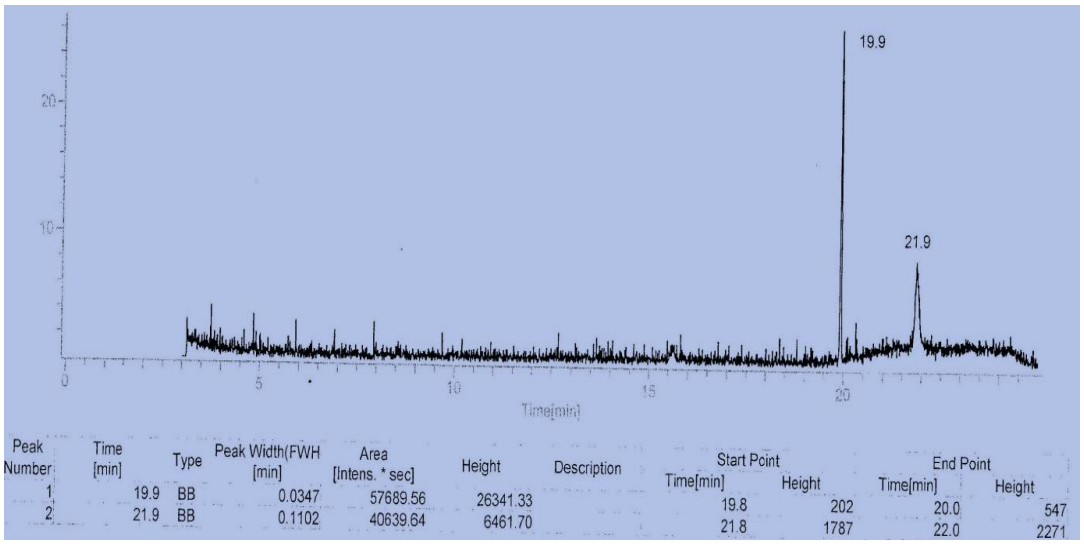
S. N.	R.T	Name of compound	Molecular formula	Mol. Weight	Peak Area
1	19.9	Tetracosapentaene,2,6,10,15,19,23-hexamethyl-	$C_{30}H_{52}$	412	57689
2	19.9	22-Stigmasten-3-one	$C_{29}H_{48}O$	412	57689

Table No. 2 – Analysis of oil percentage in Leaves of studied plants

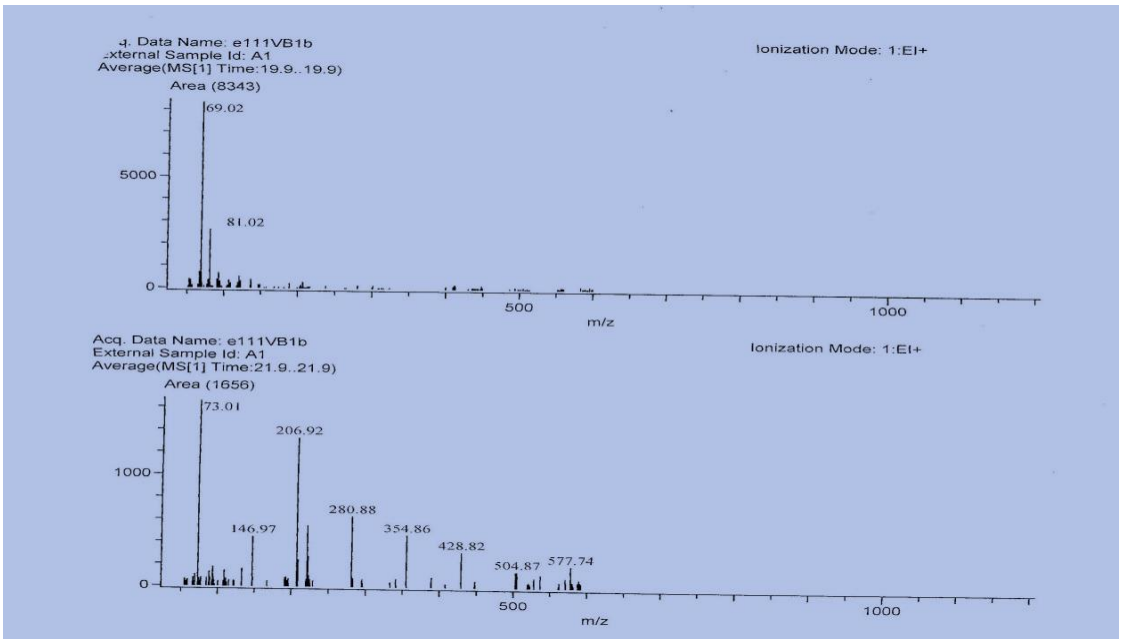
No. Plant	Plant Sample Name	Empty flask weight	Empty flask oil weight	Oil percentage of leaf
1	***Anisomeles indica***	138.680 gm	138.870 gm	6.33 %

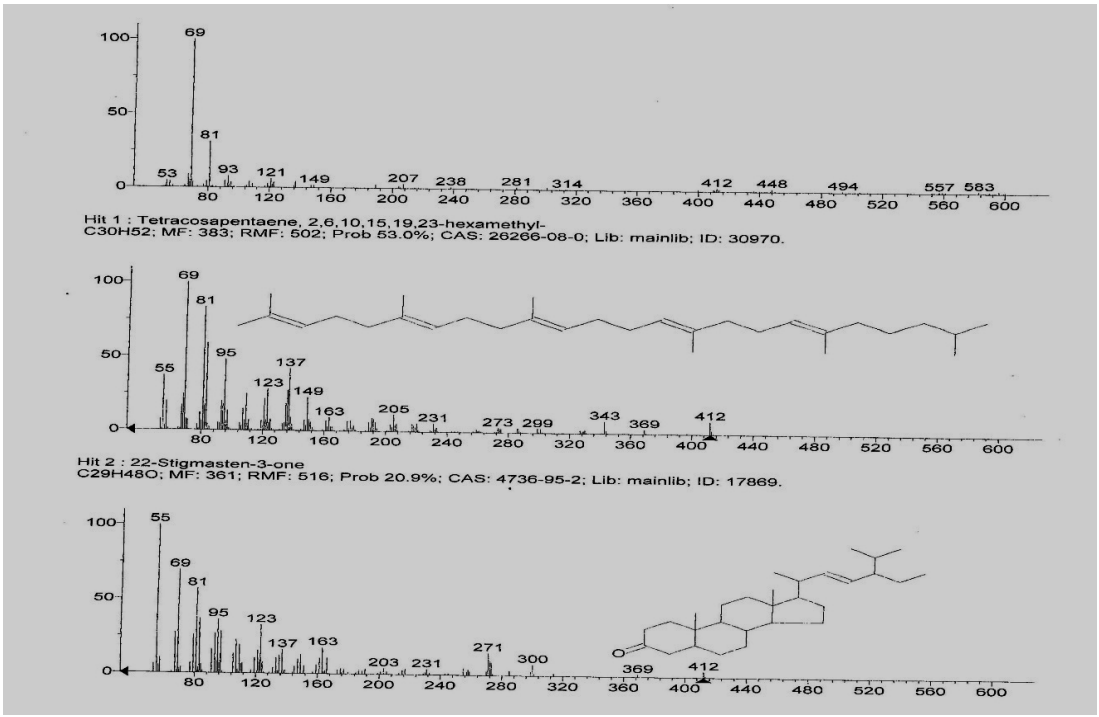
Table. No. - 3: GC-MS Chromatogram of *Anisomelis indica* Plant





Peak Number	Time [min]	Type	Peak Width(FWH [min]	Area [Intens. * sec]	Height	Description	Start Point Time[min]	Start Point Height	End Point Time[min]	End Point Height
1	19.9	BB	0.0347	57689.56	26341.33		19.8	202	20.0	547
2	21.9	BB	0.1102	40639.64	6461.70		21.8	1787	22.0	2271





Conclusion:

The present investigation was carried out on *Anisomelis indica* plant of Lamiaceae family to study the presence of medicinally active phytochemicals in the leaves. The chemical composition of the essential compounds from the leaves *Anisomelis indica* of collected from Gorewada forest and PDKV forest which experienced different climatic and geographic circumstances, were determined by GC-MS. The present investigations concluded that the leaf *Anisomelis indica* of contains chemical compounds. These chemicals are widely used in Ayurvedic traditional medicines. This study concludes and recommends further advanced study of these plants, so that it will help in preserving our traditional knowledge. The present GC-MS screening may serve as pavements for the researcher to select a group of plants having similar chemical constituents of particular class to isolate biologically active principles and future studies on family Lamiaceae.

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Antibacterial Activities of Crude Extracts of Endophytic Fungus *Myrothecium roridum*(Tode)Isolated from *Tridax procumbense*

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Abstract:
Endophytes are microorganisms that reside inside plants and are thought to be non-pathogenic symbionts because they do not manifest any indications of illness in their host plant. Among other things, topography and soil conditions affect the kind of endophytes that are isolated from plants. In the current study, fresh, healthy leaves of the medicinal plant *Tridax procumbense* (L.) were used to isolate the endophytic fungi. Healthy leaves of *Tridax procumbense*(L.)were gathered, cleaned, and surface sterilized to isolate the endophytic fungi. A sterile scalpel was used to cut the leaf segments uniformly (6mm).After surface sterilizing, the cut segments were inoculated into the Potato Dextrose Agar plates, they were incubated at 20–25°C for 3 to 8 days. *Myrothecium roridum* was isolated and then cultured in Potato Dextrose Broth in an orbital shaking incubator for 7 to 21 days.*Staphylococcus aureus*, *Streptococcus pneumoniae*, *Klebsiella pneumoniae*, *Salmonella typhimurium*, and *Escherichia coli* were the five human pathogenic bacteria against which the antibacterial activity of a concentrated crude extract derived from *Myrothecium roridum*(Tode) was evaluated. An endophytic fungus *Myrothecium roridum*(Tode) showed an inhibitory effect against all five pathogenic bacteria. Maximum inhibitory activity was shown against *Staphylococcus aureus* (33mm) and minimum against *Salmonella typhimurium* (22mm).

Keywords: Endophytic Fungi, Medicinal Plant,*Tridax procumbense*(L.), Antibacterial Activity,

Introduction

Endophytes are microorganisms living in the tissues of plants without causing any harm, both the endophytes and the plants experience symbiotic relationships. Endophytes are microorganisms that reside asymptomatically in the tissues of higher plants and are promising sources of novel organic natural metabolites exhibiting a variety of biological activities. Many studies have suggested that bioactive compounds produced by endophytes could be an alternative to discovering new antimicrobial compounds. Fungal endophytes may biosynthesize the same or similar compounds as their host plant and other diverse bioactive compounds, which provide various pharmacological activities. Plant endophytic fungi, microorganisms that reside in the tissues of living plants without causing any apparent disease symptoms, are relatively unstudied as potential sources of novel natural products for exploitation in medicine, agriculture, and industry.

The term "endophyte" refers to all microorganisms that colonize internal plant tissues for all or part of their lifetime (Hu, Y., et al., 2017). Endophytes are an under-investigated group of microorganisms that represent a plentiful and renewable source of bioactive and chemically new compounds with the potential for exploitation in various medical, agricultural, and industrial realms (Mbilu, M., 2018). The association between fungal endophytes and their host plant is due to the result of unique adaptations that enable the endophytes to harmonize their growth with that of their host (Rajagopal, K., et al 2012). They are a taxonomically and ecologically heterogeneous group of organisms; mainly belonging to Ascomycota, coelomycetes, and hyphomycetes (Strobel, G., et al., 2004; Sultan, S., et al ., 2022).*Tridax procumbens*(L.) is a very promising species that produces secondary metabolites reported to have a variety of medicinal uses including among others, anti-anemic, anti-inflammatory, anti-diabetic, and anesthetic properties. This species has a long history of traditional use by different communities. This study aimed to review the scientific literature regarding the medicinal properties, biological activity, and phytochemical components of *Tridax procumbens*(L.), a member of the Asteraceae family that originated in Central and South America.(Beck S., et al.,2018).

Methods and Material

1. Plant Material

Tridax procumbense (L.) fresh leaves were gathered from selected areas of Amravati, and the plant materials were verified by a taxonomist of the department.

2. Test Organisms

A total of fivehuman pathogenic bacterialstrains: - *Staphylococcus aureus, Klebsiella pneumoniae*,*Streptococcus pneumoniae*, *Escherichia coli*, and*Salmonella typhi*muriumwere used to evaluate the antibacterial activity of the isolated fungal endophyte extracts.

3. Isolation and purification of endophytic fungi

The collected plant materials were subjected to surface sterilization and isolation procedures following the method of Arnold et al. including some modifications. The plant materials were first washed several times under running tap water, followed by washing in distilled water. Surface sterilization was then done by sequentially rinsing the plant materials with 70% alcohol for 1 min; 2% sodium hypochlorite (NaOCl) for 1 min then rinsed in another 70% alcohol for 2 min and finally washed with sterile distilled water for 2–3 times. The plant materials were then dried insterile filter papers under aseptic conditions. After sterilization, the leaves were further cut aseptically to expose the interior surface and inoculated in the Potato Dextrose Agar plates amended with streptomycin150mg/mL to suppress bacterial growth.

The petri-plates were sealed with parafilm wax tapes and incubated at 25 ±1 ℃ for 3-7 days. Within the days of incubation, the hyphal tips of fungi growing out from the samples were subsequently transferred onto fresh Potato Dextrose Agar plates. The procedure of transferring to freshPotato Dextrose Agar plates was carried out several times in order to obtain a pure culture of fungi. The isolated endophytic fungus was subjected to liquid-state fermentation in an Erlenmeyer flask containing sterilized Potato Dextrose Broth (prepared by autoclaving a mixture of 200 g of potato, 20 g of dextrose, and 1000 ml of distilled water). The flask was inoculated with agar blocks containing the fungus and incubated at 25-27℃ for 7-21 days. After fermentation, the fungal secondary metabolites were filtered with Whatman filter paper and crude aqueous extract used for antibacterial activity against five human pathogenic bacterial strains.

4. Identification of the isolated endophytic fungi

Macroscopic study

A morphological study was done by plating the fungus on Potato Dextrose Agar plates and incubating it for 3-7 days. The growth appearance was then noted by observing both the back and front views of the plates.

Microscopic study

Unknown endophytic fungus was identified by studying their cultural characteristics, spore formations, and mycelium. Slides were prepared by tease mount method using Lactophenol Cotton Blue reagent and observed at ×10, ×40 and ×100 magnifications, at Agharkar Research Institute, Pune, under the supervision of senior scientist Dr. P. N. Singh.

Large-scale synthesis of antimicrobial metabolites

250 ml flasks containing 150 ml of Potato Dextrose Broth were filled and autoclaved for 20 minutes at 15 pounds per square inch. After inoculating the medium with an isolated fungus culture and incubating it for 25 ±1 for 21 days, the crude culture broth was filtered and subjected to antibacterialactivity against the six pathogenic bacteria by using agar welldiffusion methods.

Antibacterial activity

The fungus's ability to inhibit bacteria was evaluated using the agar well diffusion assay technique. This procedure involved creating aseptic wells in the seeded Muller and Hinton (MH) media using a sterile cork borer, dropping the required amount of the bioactive metabolite into the wells, and then incubating the wells for 24 hours at 37ºC in a bacteriological incubator. Lastly, zones of inhibition were found on the plates, and their diameter was calculated using the Hi-Antibiotic zone scale from Hi-Media Laboratories in Bombay. To assess the antibacterial activity of fungi, five strains of human pathogenic bacteria, including *Salmonella typhimurium*(ATCC-14028), *Escherichia coli*(ATCC-8739), *Klebsiella pneumoniae*(ATCC-4352),*Streptococcus pneumoniae*(ATCC-6303),and *Staphylococcus aureus*(ATCC-6538), were utilized. The American Type Culture Collection (ATCC) is where these bacterial strains were obtained.

Results and Discussion

Since ancient times *Tridax procumbense* (L.)has been used as a medicinal plant in Ayurveda. *Tridax procumbens*(L.) has a long history of traditional use but the isolation and evaluation of each phytochemical have not been properly related to its pharmacological properties and could show difficulty in reproducibility after isolation and evaluation (Beck S., et al ., 2018). Different substances such as oils, teas, and skin poultices, among others,have been manufactured using this species. An array of natural products have been characterized from endophytes, including anti-cancer, anti-fungal, anti-bacterial, anti-viral, anti-oxidant,anti-insecticidal, and immunosuppressant. In the present investigation, an endophytic fungus *Myrothecium roridum*(Tode)was isolated from plant parts of *Tridax procumbens* (L.). Fiveendophytic fungi from *Tridax procumbens (L.)-Aspergillus*

japonicus,*Fusarium sp*., *Aspergillus niger*, *Alternaria sp*., and *Penicillium sp.* And assessed *Aspergillus japonicus* for antibacterial activities were also reported (Aharwal P., et al., 2018).The aqueous extract (25µl) of endophytic fungus *Myrothecium roridum*(Tode)was assessed for antibacterial activity against fiveisolates of pathogenic bacteria-*Staphylococcus aureus*(ATCC-6538), *Klebsiella pneumonia* (ATCC-4352), *Escherichia coli*(ATCC-8739), *Streptococcuspneumoniae* (ATCC-6303) and*Salmonella typhimurium* (ATCC-14028) showed broad-spectrum activity against all five pathogenic bacteria. Theaqueous extract of *Myrothecium roridum* (Tode)showed a zone ofinhibition of 33 mm against *Staphylococcus aureus*, 32 mm against*Klebsiella pneumoniae*, 30 mm against *Escherichia coli*, 25 mmagainst *Streptococcus pneumoniae*, 22 mm against *Salmonella typhimurium*.

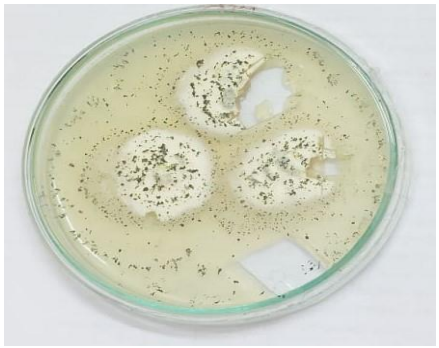
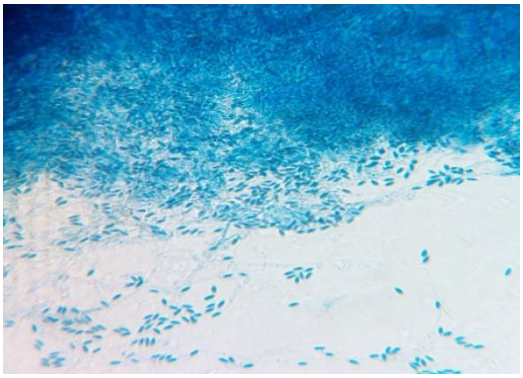
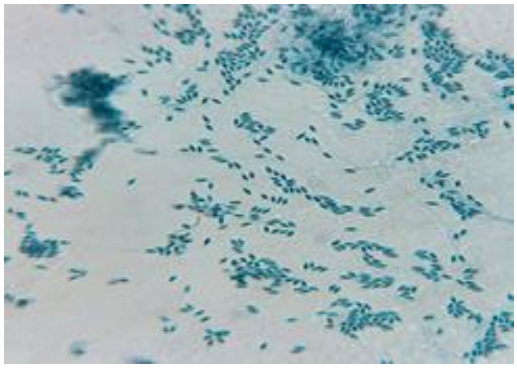


Figure: A. *Myrothecium roridum*(Tode)colony on PDA Media





Figures: B and C; Microscopic images of endophytic fungus*Myrothecium roridum* (Tode)

Table: Antimicrobial activity of the endophytic fungus *Myrothecium roridum*(Tode)

S.N	Bacterial Strain	Zone of Inhibition (mm)
1	*Staphylococcus aureus*	33
2	*Klebsiella pneumoniae*	25
3	*Escherichia coli*	32
4	*Streptococcus pneumoniae*	22
5	*Salmonella typhimurium*	30

Conclusion

According to the study, *Salmonella typhimurium*, *Escherichia coli*, *Klebsiella pneumoniae*, *Streptococcus pneumoniae*, and *Staphylococcus aureus* are among the microorganisms that *Myrothecium roridum*(Tode) exhibit antibacterial activity against. Maximum activity against *Staphylococcus aureus*(33 mm) and minimum activity against *Salmonella typhimurium*(22 mm). Subsequent analysis could reveal biochemicals in the form of secondary metabolites that are in charge of this antibacterial action.

Acknowledgement

We are happy to extend our gratitude to Dr. P. N. Singh, Senior Scientist at the Agharkar Research Institute in Pune. Thank you also to the funding organization CSIR-UGC.

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Synthesis, Characterization of 2- substituted Benzimidazoles via Green Catalyst

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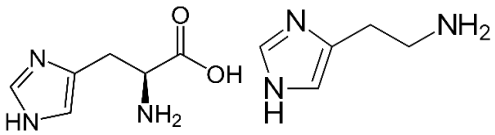
Abstract
2-Substituted aryl benzimidazoles have been synthesized in excellent yields by cyclocondensation of *o*-phenylenediamine and substituted aldehydes in the presence of a sulphurorgano catalyst such as sulphanilic acid and sulphosalysilic acid and comparatively studied in search of efficient catalyst by classical heating method.

Keywords: Imidazole's, Benzimidazole, Green Catalyst,2- substituted Benzimidazoles.

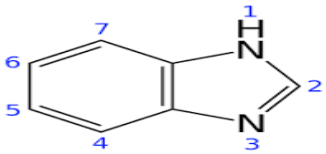
Introduction

Imidazole is an organic compound with the formula $C_3H_4N_2$ This Aromatic heterocycle is 1-3 diazoles and classified as alkaloids. Imidazole refers as a parent compound in diazole family and a class of heterocycles with similar ring structure. But varying substituents to ring system is serving as an important biological building block such as Histidine and relative hormone Histamine[1].



L-HISTIDINEHISTAMINE

Imidazole was first synthesized by Henrich Debus in 1858 and various imidazole derivative have been discovered as early as 1840, many derivatives among those have biologicaland pharmacological importance, present work is devoted to synthesis of the one of the important derivative of imidazole's that is Benzimidazole.it contains phenylring fused to an imidazole as shown in structure



Benzimidazole

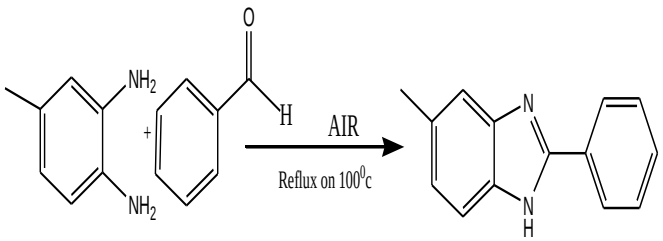
Benzimidazole is predominantly basic compound having ability to form salt with acid benzimidazole(pka 5.5) is basic considerably weaker than imidazole(pka 7) this difference in stain is a reflection of a conjugation between the imidazole and benzene ring.

Conjugation increases the number of contributing states in the resonance sense thus enhancing the stability to the molecules[2]benzimidazole derivative shows such biological and pharmacological activity suchas neuropeptideYY-1receptor antagonist, Factor X-A inhibitor and ,Smooth Musclecell proliferation Inhibitor[20-23],benzimidazole nucleus has structural similarities with various biological compounds such as purine base of DNA, it present in vitaminB12[3],this similarities believed to help in easy recognition for various biological systems, as a result of this it has been termed as privileged for drug designing, benzimidazole derivative shows significant activity against viruses such as HIV, Herpes(HVS-1),RNA,Human cytomegalo virus(HCMV),and also against Anti-Influenza[24-28],according to recent study benzimidazole derivative shows Anti-Tumoractivity[29], benzimidazole derivative such as 1-{[Dimethyl (phenyl) silyl] methyl}-3-(2-phenylethyl)-1H-benzimidazol-3-ium bromide monohydrate. Shows Anti-ulser properties [30-31], benzimidazole derivative shows Anti-Hypertensive, Anti-fungal,Anti-

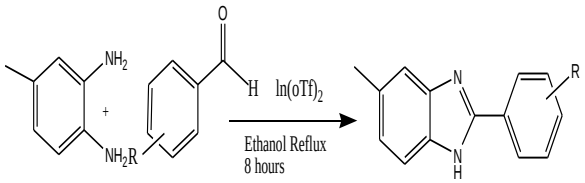
Histaminic properties reported in literature[32-36], in addition of above it is a important precursor in organic synthesis. a number of methods have been reported for the synthesis of benzimidazole, reaction between o-Phenylene diamine and carboxylic acid and their derivatives (Nitriles, amides and ortho esters) required high temperature and more time but reaction speed up in presence of strong acid such as polyphosphoric acid[3]or mineral acid[4].

another method is cyclocondensation of o-phenylene diamine with aldehyde under oxidative condition, the use of oxidising agent as a catalyst improves reaction speed as well as yield of the product various catalytic agents for the synthesis of benzimidazole derivative have been reported such as sulphuric acid,I-26,DDQ,AIR(Scheme-1),OXANE,$Fecl_3 6H_2O$[6-10],an efficient solvent free method for synthesis of benzimidazole derivatives using In (oTf)(Scheme-2), Yb(oTf) ,Sc(oTf)as a catalyst also reported [11-13],Benzimidazole derivative synthesis in presence of $KHSo_4$and, Nitrobenzenealso reported[14-15](scheme-4),Oxidative synthesis of benzimidazoles,quinoxalines, and benzoxazoles from primary amines by ortho-quinone as a catalysist also reported[16]A"MnO2 nanoparticles as efficient oxidant for ultrasound-assisted synthesis of 2-substituted benzimidazoles under mild Conditions Reported in literature[17], An efficient NaHSO3-promoted protocol for chemoselective synthesis of 2-substituted benzimidazoles in water reported by Naeimi, Hossein, and Zahra Babaei.[18], microwave assisted synthesis benzimidazole using $Na_2S_2O_5$as a catalyst (Scheme-3),have been employed[19]. most of these methods are although efficient but many of these methods also have some limitations such as drastic reaction condition, expensive reagent and catalyst low yield, prolong reaction time and high energy consumption as well as co-occurrence of side product, for the isolation of the pure product.

Though the rare earth metal catalyst gives better yields, the prohibitive cost of the catalysts makes them inappropriate for industrial purpose. Due to these limitations more efforts should be required in search of, the environmentally-benign, cost effective and higher yields giving chemical process which is superior to the existing methods.keeping the importance of such highly beneficial pharmacophore in mind here we synthesized 2-Substituted-aryl benzimidazoleby cyclocondensation of O-Phenylene diamine and Aryl Aldehyde in presence of sulphanilic acid and sulphosalycilic acid as catalyst for comparative study purposeby conventional heating method final product wash with water and recrystallised in ethanol molecule was confirmed by IR spectroscopy and melting point.

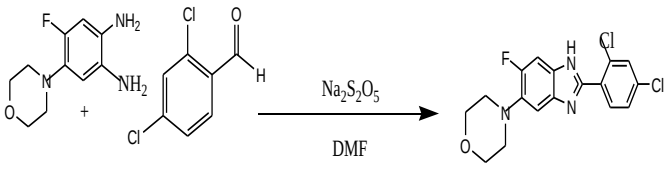


2SCHEME 1

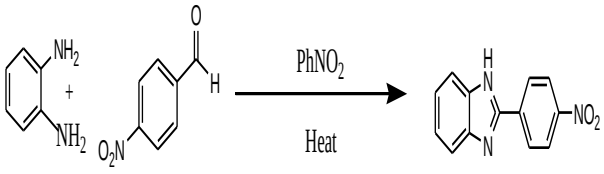


SCHEME-2

Scheme 3

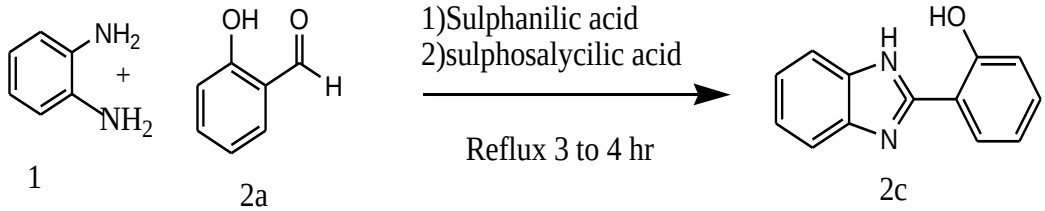


Scheme 4



Present Work

In present work O-phenylene diamine (1) and 2 Hydroxy-Benzaldehyde (2a) is reflux on water bath for 2-3 hour in presence of sulphur catalyst such as sulphanilic acid, sulphosalysilic acid, the o-phenylene diamine undergo cyclisation to yield Crude product, which washed with water and recrystalised in ethanol and identified as 2-(2-Hydroxy-phenyl)-benzimidazole(3a) having melting point 176⁰c



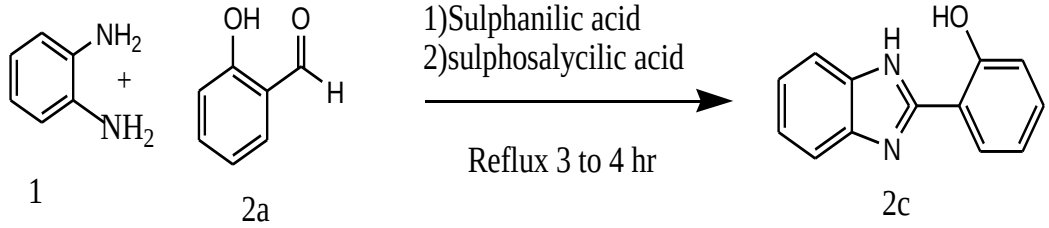
1 2a 2c

Experimental

The o-phenylene diamine used as a starting material which undergo cyclisation with substituted aryl aldehyde using different sulphur catalyst such as sulphaanilic acid,sulphosalycilic acid to form respective compounds.

All compounds are synthesised by using A, R grades (S.D Fine chem) and melting point is recorded on digital melting point apparatus (Veego DMP) Reaction is monitored by TLC till compound show single drop of iodine vapours on silica gel Glass plates. IR spectra were recorded on perkins Elmerspectrophotometer in the range 4000-400 cm in Nujol mull as KBR palate

A 1:1 molar mixture of O-phenylene diamine (1) and 2 Hydroxy-Benzaldehyde (2a) is reflux on water bath for 2-3 hour in presence of sulphur catalyst such as sulphanilic acid,sulphosalysilic acid, the o-phenylene diamine undergo cyclisation to yield Crudeproduct, which washed with water and recrystalised in ethanol and identified as 2- (2-Hydroxy-phenyl)-benzimidazole (3a) having melting point176^{0}c



Result and Discussion

Analytical data of 2-(2-hydroxy-phenyl)-benzimidazole (3c)

Sulphur Catalyst	Time	Yield (%)	Melting Point (^{0}C)	Molecular Formula
Sulphanilic Acid	1-2 hr	78	176	$C_{13}H_{11}N_2O$
Sulphosalycilic Acid	1-2 hr	73	176	$C_{13}H_{11}N_2O$

2-(2-Hydroxy-phenyl)-benzimidazole IR spectroscopic data shows absorption signals at : 3363 (cm^{-1}) For NH stretching, 1454 (cm^{-1}) aromatic C=C Stretching and at 3053 (cm^{-1}) which is for aromatic C-H bond stretching, and melting point 176^0**C** which confirms the formation of the 2-(2-hydroxy-phenyl)-benzimidazole .

Summery and Conclusion

In present work 2-(2-Hydroxy-pheny l)-benzimidazole have been synthesized in presence of sulphur organocatalysti.esulphanilic acid, sulphosalycilic acid structure of compound were established on basis of chemical transformation, IR spectroscopic data and melting point. the compound obtained were of good quality and purity maximum yield was obtained in presence of sulphanilic acid (78%) hensesulphanilic acid is more efficient catalyst as compare to sulphosalycilic acid.

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Exploring Arbuscular Mycorrhizal Fungi Diversity In The Rhizosphere Of Andrographis Paniculata Nees Through Soil Trap Cultures

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Abstract:

Sustainable agriculture emphasizes reduced reliance on chemical inputs like fertilizers and pesticides to mitigate adverse effects on soil health, fertility, and the environment. Microbial inoculants, particularly Arbuscular Mycorrhizal Fungi (AMF), play a vital role in enhancing plant nutrition, growth, and development. In the diverse landscape of India, with its rich array of medicinal plant species, there is potential for popularizing and harnessing these plants to uplift the economies of low-income countries in Asia, providing livelihood opportunities.This research focuses on the wonder plant Kalmegh (*Andrographis paniculata* Nees.), renowned for its numerous medicinal properties. The primary aim is to isolate and identify AMF associated with the rhizosphere soils of *Andrographis paniculata*. The study employs soil trap culture, utilizing a composite soil sample from the rhizospheric area of *Andrographis paniculata*.

Coleus is grown in a composite soil sample using a soil: sand medium. After 45 days, AMF spores are isolated and identified morphotaxonomically. The analysis reveals the presence of five species of Glomus, including *Glomus leptotichum*, *Glomus aggregatum*, *Glomus fasciculatum*, and *Glomus maculosum*. Notably, *Glomus aggregatum* emerges as the dominant species. Further studies will involve mass multiplication of *Glomus aggregatum*, with subsequent application to evaluate its inoculation effect on the growth parameters of Kalmegh. The simplicity of this technology is believed to be easily adaptable by laypeople involved in growing Kalmegh, thereby maximizing its medicinal benefits. This abstract outline the research's ecological and economic significance, emphasizing the potential of AMF in sustainable agriculture and the promotion of medicinal plants for socio-economic development.

Key Words: *Andrographis paniculata*, Soil trap culture, AMF, *Glomus*

Introduction

Plants and fungus that live in symbiotic relationships are referred to as mycorrhiza. Because symbiotic organisms may obtain nutrients that non-mycorrhizal individuals cannot, these connections are thought to be vital in the colonization of land by plants. Through the development of what are known as mycorrhiza, the roots of numerous plant species coexist in symbiosis with specific soil fungus. For agricultural ecosystems to be managed sustainably, mycorrhiza symbioses are necessary. The term "arbuscular" refers to two distinct structures: arbuscules, which are found inside the cortical cells of many plant roots and in certain mycothalli that have been infested by AM fungus. These structures, along with storage vesicles inside or between the cells, have been thought to be diagnostic for AM symbioses (Shitole, 2018).

Plant products have therapeutic potential that dates back more than 5,000 years, as evidenced by their use in Indian, Egyptian, Chinese, Greek, and Roman civilizations for the treatment of illnesses and the revitalization of bodily systems. In India, people of all walks of life make extensive use of medicinal plants, whether as processed pharmaceutical industry products or as traditional remedies in various indigenous medical systems such as Siddha, Ayurveda, and Unani. Of the estimated 4.5 million plant species in India, only between 250,000 and 500,000 have undergone phytochemical research to determine their biological or pharmacological activities. (Bamola et al., 2017).

In Asian countries, *Andrographis paniculata*, also known as Kalmegh, is widely used in traditional medicine to treat a variety of conditions, including fever, herpes, sore throats, upper respiratory infections, and other chronic illnesses (Bhatnagar,2023)

Andrographolide is a labdane diterpenoid delivered by Andrographis paniculate a prevalent constituent of something like 26 Ayurvedic definitions used to treat liver infirmities. The plant creates a scope of bioactive parts like andrographolides and polyphenols Among these, andrographolides are pharmacologically the most dynamic mixtures; However, only 2% to 3% of andrographolide is thought to be present in wild or conventionally propagated plants. The traditional vegetative proliferation of AP is excessively delayed to fulfill the need of drug ventures which is expanding every year at a pace of 3.1%. The plant is ranked 17th out of 32 prioritized Indian medicinal

plants with a demand of 2197.3 tons due to its multiple medicinal uses (Pandey and Rao, 2018).

Isolation of spores directly from field soil is frequently observed to have drawbacks. a) Spores may appear intact but might not be viable, as they can persist in the soil as spore cases for years or even decades. b) Their structural characteristics can change in response to root pigments, soil chemistry, temperature, moisture, and microbial activity. c) They may only represent the AM fungal species colonizing with enough activity and biomass to trigger sporulation. Therefore, the preparation of trap culture emerges as the only viable technique to increase spore numbers and recover intact, fresh, and healthy spores. These spores can then be used as authentic material for identification and initiation of monospecific cultures (Rodrigues and Muthukumar, 2009)

Present examination addresses the *Andrographis paniculata* -mycorrhiza beneficial interaction regardingspore count, AMF spores and soil trap culture.

Materials and Methods

Area of Study

Amravati is a city in the Indian state of Maharashtra, it is the seventh most populous metropolitan area. In Maharashtra. Amravati is located at 20.93°N latitude 77.75°W. Its average height is 343 meters (1125 feet). Amravati is tropical wet and dry climate with hot, dry summers and mild or cool winters. The research sites are located in the city of Amravati (Tapowan).Three different locations in Tapowan were selected for sample collection

Collection of soil sample

The samples were collected from different areas of Tapowan (Amravati). For collection of rhizosphere soil samples, a steel pipe (2 diameter., 50cm long) was inclined at an angle of about 15^0 and driven using a hammer into the soil about 20-25cm at root zone. This method enables the collection of soil samples from different depth, thereby precisely accounting for AM fungal diversity. The rhizosphere soil samples collected were subsequently placed in zip-loc polythene bags.

Preparation of Arbuscular Mycorrhizal (AM) fungal culture by soil trap culture method

The trap culture method described here is modified from Morton *et al.,* (1993). Rhizosphere soil collected from a host plant in the field was mixed with sterilized sand in 1:1 ratio. This mixture was then added to 15cm diameter pots which are thoroughly pre-wiped with cotton dipped in absolute alcohol. Coleus cuttings (5cm tall) washed in sterile water were planted in the pots. Hoagland's solution (without P) is added bi-weekly and the plants were watered twice a week. After 45 days of growth, AM fungal root colonization is checked by staining a sample with 0.05% trypan blue. The plants were maintained for a period of 90 days to established colonization and sporulation. Two or four cultures are required to obtain the maximum number of AM fungal spores. Once good colonization is established, watering was stopped, allowing the plants to dry, after which the shoot portion is cut off at the soil soil surface. The mixture was then placed in a zip-loc polythene bags, labelled and stored at 4^0 C. This was used for isolation of AM fungal spores and preparation of monospecific cultures.

Soil Analysis

Soil physiocochemicals parameters such as soil texture, pH, EC, Org C, N, P, K and Zn from the composite soil samples of three sites were analyzed at Parikshit Biotech, Amravati.

Isolation of AMF spores from Rhizospheric Soil

AMF spores were isolated from the rhizospheric soil by the method given by Gredemann and Nicolson (1963), with some modification. Air dried rhizospheric soil was sieved from sieve having 2mm aparature size to remove large stones and debris from the soil.100 gm of that sieved soil was suspended in 1000ml of tap water and mixrure was stireed for 10-15 second. Coarse particles were allowes to settle for 15-30 min or more depending on tezture of soil. The supernatant then decanted through a series of 4 scientific sieves arranged in descending order of mesh size viz. 150mm, 75mm, 53mm, 37mm. Sievates from each sieve then filtered through whatman filter paper no. 1 to isolate the spores.

Estimation of AMF Spore Count

AMF spore number was estimated by the method given by Gaur and Adholeya (1994), with some modification in this method. Filter paper (whatman No. 1, size 12.5cm diameter was folded into two equal parts followed by a second fold resulting in four equal parts. The filter paper then reopened and two lines were drawn to divide it into four equal quadrates. Then vertical lines were drawn on one half of the filter paper dividing it into approximately 10 columns which are about 1 mm apart and also horizontal lines were also drawn dividing it into ten rows about 0.5mm apart with each other resulting into rectangles.

Each column and row was numbered and direction of counting was marked with arrows. The filter paper was then folded in such a way that during decanting that marked portion will be receiving surface for the spores during filtrations. Thus, the spores were collected only on the marked surface of the filter paper and the remainder was retained without spores. The sievates of rhizospheric soil (which is described in the method of Gerdemann and Nicolson, 1963) were filtered from filter paper having rectangles formed by vertical and horizontal lines. The filter paper with spore and other debris was spread on a large petri-plate and observed under Carl Zeiss Stereo zoom microscope.

The spore number was then counted from each rectangle of columns in upward direction by moving the petriplate. Intact spores were picked up using a wet needle and mounted in polyvinyl alcohol lactoglycerol (PVLG) on a glass slide for identification and photography

Identification of AMF Spores: -

Identification of AMF spores was done by using 'Manual for the Identification of VA Mycorrhizal Fungi' – by N. C. Schenck and Yvonne Pérez (1990) and using the link invam.wvu.edu/the-fungi/species-description.

Photography: -

Photography of AMF spores isolated from rhizospheric soil was done by using Carl Zeiss inverted compound microscope with Tucsen Camera (0.5 MP).

Results and Discussion: -

Although Arbuscular mycorrhizal fungi (AMF) are well studied for their ability to improve plant growth, the propagation and maintenance of AMF culture are critical due to their obligate biotrophic nature. The trap culture method of AMF spore development, widely used to obtain a mixed inoculum, is comparable to other methods; however, the culture from this method is not pure. To minimize the loss or viability of AMF spores, freshly collected soil samples can be maintained in this method.

In the exploration of *Andrographis paniculata* Nees species from Tapowan in Amravati (MS), this investigation unveils the presence of arbuscular mycorrhizal fungi (AMF) species. The study involves the documentation of the morphology and AMF characterization of Andrographis plant species. A total of 120 spores were isolated from the soil sample, with Glomus emerging as the most dominant species. Among the identified AM fungal species were *Glomus maculosum, Glomus aggregatum, Glomus leptotichum*, and *Glomus fasciculatum*, making a total of four distinct species.

Physico – chemical analysis of rhizosphere soil.

Sr. No	Sample	pH	Org C %	P Kg/Ha	K Kg/Ha	Cu ppm	Zn ppm
1	Composite	7.10	0.30	18.64	142.58	2.35	0.45

Glomus maculosum, Miller and Walker

- Colour :- Pale straw colour
- Shape :- Globose to subglobose
- Size :- (95-)135-178(-220) x (95-)130 -187(-220) µm
- Composite spore wall :- 4.4- 15µm
- The inner wall in many older spores bearing domed, scalloped in growths.

Glomus aggregatum, Schenck and Smith emend. Koske

- Colour :- Pale yellow to yellow brown
- Shape :- Globose to sub- globose
- Size :- (20-) 40-85 (-120)µm
- Composite spore wall :- 2-6 (-10)µm
- Subtending hypha: - Straight, constricted, swollen or irregular and (6.4 -) 14.3(-21.6) µm wide at spore base.
- Spores produced in sporocarp

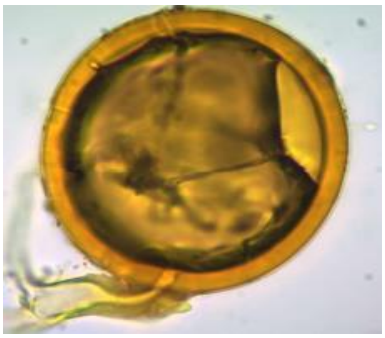
Glomus leptotichum, Schenck and Smith

- Colour :- Light yellow
- Shape :- Globose
- Size :- (48-)175(-262)µm
- Composite spore wall :- 1.5-7.4(-10.5)µm
- Subtending hypha :- 9-27µm wide at the point of attachment
- Spore wall with adhering debris on the outer surface especially at the hyphal attachment

Glomus fasciculatum, Walker and Koske

- Colour :- Pale yellow to pale yellow brown
- Shape :- Globose
- Size :- 75-149 µm
- Composite spore wall :- (2.3)7-12(-16.1) µm
- Subtending hypha straight

Glomus maculosumGlomus aggregatum



Glomus leptothicum ***Glomus fasciculatum***

Soil Trap Culture

Conclusion

Choosing effective AM fungi is a crucial first step in creating a mycorrhizal inoculation program.The investigation into the rhizosphere soil of *Andrographis paniculata* Nees has uncovered the prevalence of Glomus species, emphasizing the significance of arbuscular mycorrhizal (AM) fungi in the plant's ecosystem. The research aims to delve deeper into this association, with a specific focus on understanding the implications of dominant Glomus species on the growth parameters of *Andrographis paniculata* Nees. In the future scope of the study, a key avenue of exploration involves the establishment and cultivation of an AM fungi inoculum.

This inoculum, derived from the naturally occurring Glomus species, is intended to be applied as a biofertilizer. By harnessing nature's own tools, the research seeks to assess the potential of these beneficial fungi in enhancing the growth and nutrient uptake of *Andrographis paniculata* Nees. To complement these efforts, the study could incorporate innovative soil trap culture techniques. Implementing soil trap culture involves strategically placing traps or substrates in the soil to selectively capture and analyze mycorrhizal fungi. This methodology would provide a nuanced understanding of the diversity and dynamics of AM fungi in the rhizosphere, offering insights into their role in sustaining the health and vitality of *Andrographis paniculata* Nees. The combined approach of studying dominant Glomus species, utilizing an AM fungi inoculum as a biofertilizer, and employing soil trap culture techniques positions this research to contribute not only to the specific understanding of Andrographis paniculata Nees but also to broader insights into sustainable agricultural practices and biofertilization strategies.

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Ichthyofaunal Diversity in Some wetlands from Warora region, Chandrapur District, India.

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Abstract:
Biodiversity is one of the important cornerstone of sustainable development and represent the biological wealth of particular nation.The present study was undertaken for the period of two years February 2014 to January 2016 for Ichthyofaunal exploration, identification and classification of fish fauna in some wetland from Warora region, District Chandrapur (M.S.) India. Fishes were collected from fishermen on local landing center from four water bodies of Warora region. The present investigation reveals the occurrence of total 49 different varieties of fishes. All the fishes are belongs to six major order. Most dominant order found Cypriniformes about 57%, Followed by the order Siluriformes 21%, Order Perciformes12%, Order Osteoglossiformes and Synbranchiformes 4%and Antheriniformes 2%.The aim of present investigation is to know fish biodiversity and its conservation status.

Keywords:-Warora, Wardha river, Ichthiofaunal, Water.

Introduction:-

Water is the most important potion of life. Water is responsible for evolution and activity of universe on the earth hence water is mother of all living world (Chaurasia and Pande, 2007).India has rich biological heritage that qualifies it as one of the mega biodiversity nation of the world (Saha and Patra, 2013). India has ninth place in terms of megabiodiversity (Chaudhari and Kumar, 2017). Right from the time immemorial, It can be said that possibly the first source of man's food was fish, which he derived from inland water (Kamdi, 2000). Fishes are the important indicator of aquatic ecosystem and occupy a remarkable position from a socioeconomic point of view (Bera*et al*., 2014).

Exploration of Ichthyofaunal diversity need for planning method for their production and effective exploitation. Fishery plays vital role in socioeconomic development of country. Fishery provides valuable resource of livelihood for huge section of economically backward class (Saha and Patra, 2013). Fish is a good source of high quality protein, vitamins, and minerals. It is also good source of omega-3 fatty acid which has great importance for good health (Khekare and Sawane 2019, Borkar and Joshi, 2023). Fish constitutes more than a half of the total number of all other vertebrates in the world. There are total 32,900 species of fishes and 64,000 total numbers of vertebrate species (Froese and Pauly, 2014 and Wani and Gupta, 2015).Total 35,588 fish species half of the all vertebrates (Singh *et al*., 2021). Kar*et al*., (2003) described that about 2500 species of fishes are found in India. About 21,730 species of fishes have been recorded in the world, of which 11.7% are found in Indian waters (Tripathi and Singh, 2023). Out of the 2546 species so far Listed, 73 belongs to cold water regime, 544 to the warm fresh water domain. 143 to the brackish water, and 1,440 to the marine water ecosystem.

Worldwide about 450 families of freshwater fishes are found. In that near about 40 families are present in India. Merely 25 families contain fish species which has commercial value. (Thirumala*et al*., 2011). As per the report of 16 global conservation organizations "Word forgotten Fishes" about one in three species is now threatened with extinction.In comparison with oceans and Forest. Global Freshwater Biodiversity declining at twice rate (IUCN, 2021, Rao and Rao 2023). There were no work on the Ichthyofaunaldivercity of WaroraTaluka. Since study of Ichthyofauna and their present status is important for sustainable development of fishes (Singh *et al*., (2021).The purpose behind the present research to explore fish diversity in WaroraTaluka. Some valuable instructions also included in research paper which is need forproper conservation and management strategy.

Material and Method:-

Table no. 1: Details of Study site.

Sr. No.	Name of the sampling station	Latitude and longitude of sampling station
1	Wardha River	$20^0$23'N latitude $78^0$94'E longitude
2	Chargaon Dam	20º23′19″N to 20º26′25"N latitude and 79º9′25"E to 79º11′39"E longitude
3	Anandwan Lake	20º15′31"N to 20º15′38"N latitude and 79º1′20"E to 79º1′27"E longitude.
4	Gandhisagar Lake	20º13′50"N to 20º14′8"N latitude and 79º0′10"E to 79º0′32"E longitude

The fishes are observed for three years, fishes were collected by using various nets (Gill net, Hand net, Drag net etc.) with the help of local fisherman. Sometime fish samples purchased from fisherman on local landing centers, from four water bodies. Fishes were brought to the laboratory and preserved in 10% formalin solution in separate specimen jar according to size of the specimen. Fishes were identified by using standard keys and books (Day, 1967; Jhingran, 1991; Misra, 2004; Gupta and Gupta, 2006). Sometime fish base website also referred for identification of fishes and to find out various aspects of fish fauna (www.fishbase.org).

Threat status of each fish species was made according to the report of (Lakra*et al*., NBGFR, 2010) threatened freshwater fishes of India and 'Red List' of threatened species by (IUCN). The relative abundance of the fish was classified into three categories: Abundant (+++) constitutes 71-100 % of total catch, Moderate (++) constitute 36-70 % of the total catch and Rare (+) constitute 1-35 % of total catch, assuming the fishing efforts constant for each catch (Wani and Gupta, 2015).

Result and Discussion:-

Fishes represents one of the best indicator of quality of any aquatic ecosystem. Fishes occupies a remarkable position from socioeconomic point of view (Ingale, 2016). During the study period February 2014 to January 2016, total 49 different varieties of fishes were found in the four water bodies (Wardha river, Chargaon dam, Anandwanlake, Gandhisagar lake) in Warora region indicating that, the area is rich in fish fauna.The list of all these fishes with their classification, local names, fin formulae and biodiversity status is given in the table no. 2, 3, 4 and figure1 respectively.

Six major orders of fishes found in WaroraTaluka are as follows: Cypriniformes, Siluriformes, Perciformes, Osteoglossiformes, Synbranchiformes and Antheriniformes.In the present investigation, 12 fish families represented by 49 fish species. Family Cyprinidae was dominant group with 27 species, followed by 7 species from Bagridae, 3 species of Channidae, 2 species each from Notopteridae, Claridae, Mastacembalidae and single species from family Nemacheilidae, Heteropneustidae, Belonidae, Cichlidae, Anabantidae and Gobidae.

In Vidarbh region many researchers worked on Ichthyofaunal Diversity. Sawane*et al*., (2012) investigated total 41 different fishes from Kollar Dam, District Nagpur. These fishes belongs to 26 genera, 14 families, and 7 orders and reported dominance of cyprinidae. Bobdey (2014) had reported fish diversity and its conservation aspects in the lake and river ecosystem of Bhandara District. There is abundance of common carps.

Table No. 2:- Ichthyofaunal diversity in Warora region during February 2014 – January 2016.

Sr. No.	Genus	Common Name	Local Name	Order	Family
1	***Notopterusnotopterus***(Pallas, 1769)	Feather back	Bharad	Osteoglossiformes	Notopteridae
2	***Notopteruschitala***(Hamilton, 1822)	Moy	Chital	Osteoglossiformes	Notopteridae
3	***Barliusbendelisis***(Hamilton, 1807)	—	Zora	Cypriniformes	Cyprinidae
4	***Catlacatla***(Hamilton, 1822)	Katla	Catla	Cypriniformes	Cyprinidae
5	***Garramullya***(Sykes,1839)	Stone sucker	Mahir	Cypriniformes	Cyprinidae
6	***Garragotyla***(Gray,1830)	Sucker head	Mahirum	Cypriniformes	Cyprinidae
7	***Labeocalbasu***(Hamilton, 1822)	Calbasu	Tab	Cypriniformes	Cyprinidae
8	***Labeorohita***(Hamilton, 1822)	Rohu	Rohu	Cypriniformes	Cyprinidae
9	***Labeoboggut***(Sykes,1839)	Khunus	Bogat	Cypriniformes	Cyprinidae
10	***Labeodeplostomus*** (Day,1889)	—	Rohu	Cypriniformes	Cyprinidae
11	***Labeogonius*** (Hamilton, 1822)	Kurialabeo	Nawari	Cypriniformes	Cyprinidae
12	***Rasboradaniconius***(Hamilton, 1822)	Black line rasbora	Ganya	Cypriniformes	Cyprinidae
13	***Rasborarasbora***(Hamilton, 1822)	—	Ganya	Cypriniformes	Cyprinidae
14	***Salmophasiabalookee***(Sykes,1 839)	Razorbelly minnow	Chal	Cypriniformes	Cyprinidae

15	***Danioaequipinnatus***(McClelland, 1839)	Giant Danio	Chebli	Cypriniformes	Cyprinidae
16	***Puntiuschola***(Hamilton, 1822)	Swamp barb	Chola	Cypriniformes	Cyprinidae
17	***PuntiusChonchonius***(Hamilton, 1822)	Rosy barb	Gharuti	Cypriniformes	Cyprinidae
18	***Puntiusdorsalis***(Jerdon,1849)	Long snouted barb	Kodsi	Cypriniformes	Cyprinidae
19	***Puntiussophore***(Hamilton, 1822)	Spot fin barb	Tepri	Cypriniformes	Cyprinidae
20	***Puntius stigma*** (Valenciennes, 1844)	—	Tepri	Cypriniformes	Cyprinidae
21	***Puntiusticto*** (Hamilton, 1822)	Two spot barb	Khawali	Cypriniformes	Cyprinidae
22	***Puntiussarana***(Hamilton, 1822)	Olive Barb	Polashi	Cypriniformes	Cyprinidae
23	***Hypothalmichthysnobilis***(Richardson,1845)	Big head	Birked	Cypriniformes	Cyprinidae
24	***Hypothalmichthysmolitrix***(Howes,1981)	Silver carp	Silver	Cypriniformes	Cyprinidae
25	***Cirrhinamrigla***(Hamilton, 1822)	Mrigal	Mrigal	Cypriniformes	Cyprinidae
26	**Crossocheiluslatius** (Hamilton, 1822)	Gangeticlatia	Alagar	Cypriniformes	Cyprinidae
27	***Osteobramavigrosii*** (Sykes,1839)	Rohteevigrosii	Mrigal	Cypriniformes	Cyprinidae
28	***Cyprinuscarpiocommunis*** (Linnaeus,1758)	Common carp	Shipner	Cypriniformes	Cyprinidae
29	***Oxygastergora*** (Hamilton, 1822)	Gora chela	Bhat-masri	Cypriniformes	Cyprinidae
30	***Nemacheilusbotia***(Hamilton, 1822)	Zipper loach	Mahirum	Cypriniformes	Nemacheilidae
31	***Mystusseenghala*** (Sykes,1839)	Giant River catfish	Shiwada	Siluriformes	Bagridae
32	***Mystuscavasius*** *(Hamilton, 1822)*	Gangeticmystus	Singhara	Siluriformes	Bagridae
33	***Mystusbleekeri*** (Day,1857)	Day's Mystus	Katwa	Siluriformes	Bagridae
34	***Mystusvittatus***(Bloch, 1794)	Striped dwarf catfish	Katwa	Siluriformes	Bagridae
35	***Rita rita***(Hamilton, 1822)	Rita	Katwa	Siluriformes	Bagridae
36	***Ompokpabda*** (Hamilton, 1822)	Pabdah catfish	Baraj	Siluriformes	Bagridae
37	***Wallagoattu***(Bloch and Schneider, 1801)	Wallago	Sawada	Siluriformes	Bagridae
38	***Clariusbatracus***(Linnaeus,1758)	Walking catfish	Mangur	Siluriformes	Claridae
39	***Clariusgariepinus***(Burchell, 1822)	African sharptooth catfish	Thai mangur	Siluriformes	Claridae
40	***Heteropneustesfossilis***(Bloch, 1794)	Stinging catfish	Singhi	Siluriformes	Heteropneustidae
41	***Xenentedoncancilla***(Hamilton, 1822)	Needle fish	Chocha	Antheriniformes	Belonidae
42	***Mastacembalusarmatus***(Lacepede, 1800)	Spiny eel	Waur/Bam	Synbranchiformes	Mastacembalidae
43	***Mastacembaluspuncalus***(Day, 1857)	Srriped spiny eel	Mallar	Synbranchiformes	Mastacembalidae
44	***Oreochromismossambicus***(Peter, 1852)	Mozambique tilapia	Telapi	Perciformes	Cichlidae
45	***Anabustestudineus***(Bloch, 1792)	Climbing perch	Koi	Perciformes	Anabantidae
46	***Channastriatus***(Bloch, 1793)	Snake head murrel	Botaru	Perciformes	Channidae
47	***Channapunctatus***(Bloch,	spotted snake	Dalad	Perciformes	Channidae

	1793)	head			
48	***Channamarulius***(Hamilton, 1822)	Great snake head	Maral	Perciformes	Channidae
49	***Glassogobiusgiurus***(Hamilton, 1822)	Tank goby	Kaddu	Perciformes	Gobidae

Table 3: Fin formulae of fishes in Warora area

Sr. no.	Scientific Name	Fin formula
1	***Notopterusnotopterus***	B. 8, D. 7-8, P. 15-17, V. 5-6, A. 100-110, C. 19, L.l. 225.
2	***Notopteruschitala***	B, 8-9, D. 9-10, P. 16, V. 6, A. 110-125, C. 12-14, L.l. 180.
3	***Barliusbendelisis***	B. 3, D. 2/7, P. 15, V. 9, A. 2-3/7-8, C. 18, L.l. 40-43, L.tr.7-8/5.
4	***Catlacatla***	B. 3, D. 3-4/14-16, P. 21, V. 9, A. 3/5, C.19, L.l. 40-43, L.tr. 7.5/9.
5	***Garramullya***	B. 3, D. 2-3/8-9, P. 15, V. 9, A. 2/5, C. 17, L.l. 32-36, L.tr. 4-4.5.
6	***Garragotyla***	B. 3, D. 2/9, P. 16, V. 9, A. 2/5, C. 17, L.l. 34, L.tr.4-4.5.
7	***Labeocalbasu***	B. 3, D. 16-18, P. 19, V. 9, A. 7(2/5), C. 19. L.l. 40-44, L.tr. 7.5-8.
8	***Labeorohita***	B. 3, D. 15-16, P. 17, V. 9, A. 7(2/5), C. 19, L.l. 40-42, L.tr. 6.5/9.
9	***Labeoboggut***	B. 3, D. 11-12, P. 17, V. 9, A. 7(2/5), C. 19, L.l. 60-65, L.tr. 11-12/14
10	***Labeodeplostomus***	B. 3, D. 12-13, P. 17, V. 9, A. 7(2/5), C. 19, L.l. 41-44, L.tr. 8/9.
11	***Labeogonius***	B. 3, D. 16-18, P. 17, V. 9, A. 7(2/5), C. 19, L.l. 74-84, L.tr. 16/17.
12	***Rasboradaniconius***	B. 3, D. 9(2/7), P. 15, V. 9, A. 7(2/5), C. 19, L.l. 31-34, L.tr. 4.5/5.
13	***Rasborarasbora***	B. 3, D. 9(2/7), P. 15, V. 9, A. (2/5-6). C. 19. L.l. 26-29, L.tr. 4.5/3.
14	***Puntiuschola***	B. 3, D. 11, P. 15, V. 9, A. 7(2/5), C. 19. L.l. 26-28, L.tr. 5.5/5.
15	***Puntiuschonchonius***	B. 3, D. 11, P. 11, V. 9, A. 7(2/5), C. 19. L.l. 24-26, L.tr.5.5/6.5.
16	***Puntiusdorsalis***	B. 3, D. 11-12, P. 15, V. 9, A. 8(3/5), C. 19. L.l. 24-25, L.tr. 4.5/4.
17	***Puntiussophore***	B. 3, D. 12, P. 15, V. 9, A. 7(2/5), C. 19, L.l. 25, L.tr. 3.5/ 4.5.
18	***Puntius stigma***	B. 3, D. 11-12, P. 17, V. 9, A. 7, C. 19, L.l 23-26, L.tr. 4.5-5/5.
19	***Puntiusticto***	B. 3, D. 11, P. 15, V. 9, A. 7, C. 19, L.l. 23-26, L.tr. 5-6/6
20	***Puntiussarana***	B. 3, D. 11, P.15, V. 9, A. 8(3/5), C. 19, L.l.32-34, L.tr. 5.5-6/6.
21	***Hypophthalamichthysnobilis***	D. 3/7, A 1-3/12-14
22	***Hypophthalamichthysmolitrix***	D. 3/7, P. 1/17, V. 1/7, A. 2-3/12-14
23	***Danioaequipinnatus***	B. 3, D. 12-14, A. 14-16, C.19, L.l. 32-34, L.tr. 6-7/3.5.
24	***Salmophasiabalookee***	B. 3, D. 9(2/7), P. 13, V. 9, A. 13-15(2/11-13), C. 19, L.l. 80-93, L.tr. 12-15/6.
25	***Cirrhinusmrigla***	B. 3, D. 15-16(3/12-13), P. 15, V. 9, A. 8(3/5), C. 15, L.l. 40-45, L.tr. 6.5-7/8.5.
26	***Crossocheiluslatius***	B. 3, D. 10-11(3/7-8), P.15, V. 9, A. 7(2/5), C. 19, L.l. 38-40, L.tr. 6/6.
27	***Osteobramavigrosii***	B. 3, D. 11, P. 19, V. 10, A. 25-28. C. 19, L.l. 75-80, L.tr. 16-18/21
28	***Cyprinuscarpiocommunis***	D. 20(3-4/14-19), P. 1/16-18, V. 1/7-8, A. 2-3/5
29	***Oxygastergora***	B. 3, D. 9(2/7), P. 13-15, V. 8, A. 15-18, C. 19, L.l. 140-160, L.tr18-20/18.
30	***Nemacheilusbotia***	B. 3, D. 12-14(2/10-12), P. 11, V. 8, A. 7(2/5), C 17.
31	***Mystusseenghala***	B 12, D. 1/7, P. 1/9, V. 6, A. 3/8-9, C. 19-21
32	***Mystuscavasius***	B. 6, D. 1/7, P. 1/8, V. 6, A. 4/7-9, C. 16.
33	***Mystusvittatus***	B.10, D. 1/7, P. 1/9, V. 6, A. 2-3/7-9, C.17
34	***Mystusbleekeri***	B 10, D. 1/7, P. 1/9, V. 6, A. 2-3/7-9, C. 17.
35	***Rita rita***	B. 8, D. 1/6, P. 1/10, V.8, A. 4-5/10, C. 19.
36	***Ompokpabda***	B. 12-15, D. 4-5, P. 1/11-15, V. 8-10, A. 54-60, C. 18.
37	***Wallagoattu***	B.12, D. 5, P. 1/13-15, V. 8-10, A. 4/82-89, C. 17.

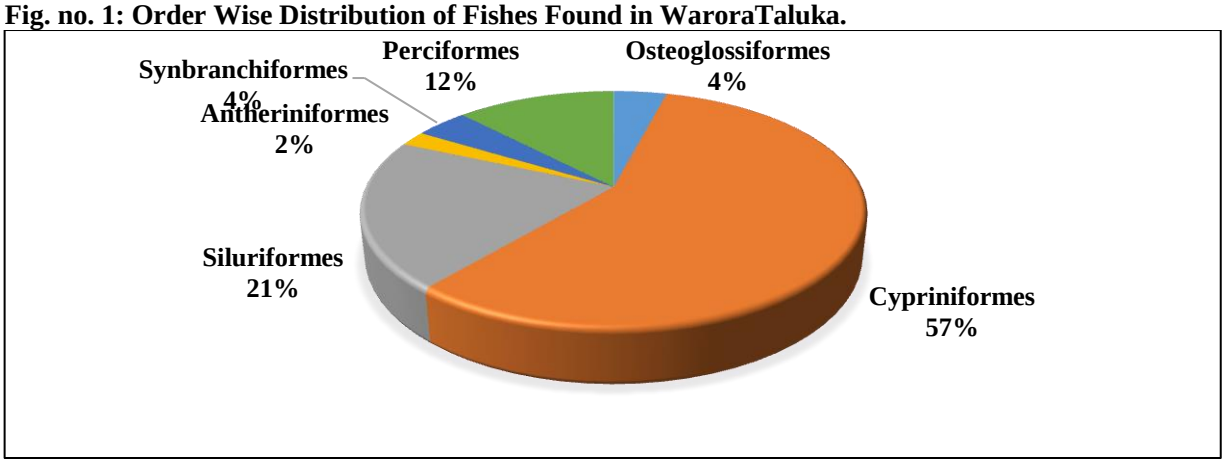
38	***Clariusbatracus***	B. 9, D. 62-76, P. 1/8-11, V. 6, A. 45-58, C. 15
39	***Clariusgariepinus***	B. 9, D. 61-80, P. 10, V. 5, A. 45-65, C. 19
40	***Heteropneustesfossilis***	B. 7, D. 6-7, P. 1/7, V.6, A. 60-79, C. 19.
41	***Xenentedoncancilla***	B. 10, D. 15-18, P. 11, V. 6, A. 16-18, C. 15.
42	***Mastacembalusarmatus***	B. 6, D. 32-39/74-90, P. 23, A. 3/75-88
43	***Mastacembaluspuncalus***	B. 6, D. 24-26/ 32-42, P. 19, A. 3/31-46. C.12.
44	***Oreocromismossambicus***	D. 15/ 12, P.14(1/13), V. 6,(1/5), A. 13
45	***Anabustestudineus***	B. 6, D. 17-18/8-10, P. 15, V. 1/5, A. 9-10/9-11, C. 17, L.l. 28-32, L.tr. 3-4/9-10.
46	***Channastriata***	B. 5, D. 37-45, P.17, V. 6, A. 23-26, C. 13, L.l. 50-57, L.tr. 4.5-8/7-10.
47	***Channapunctatus***	B. 5, D. 29-32, P. 17, V. 6, A. 21-23, C. 12, L.l. 37-40, L.tr. 4/5-9.
48	***Channamarulius***	B. 5, D. 45-55, P. 18, V. 6, A. 28-36, C.14, L.l. 60-70, L.tr. 4.5-8.5/11-13.
49	***Glassogobiusgiuris***	B. 5, D. 6/1/8-9, P. 20, V. 1/5, A. 1/8-9, C. 17. L.l. 30-34, L.tr. 8-9.

Table no. 4. Biodiversity status, abundance of fishes in WaroraTaluka.

Sr. No.	Genus	Biodiversity status (IUCN)	Biodiversity status (NBGFR)	Abundance	Habitat
1	***Notopterusnotopterus***	LC		M	Lo/Le
2	***Notopteruschitala***	LC		R	Le
3	***Barliusbendelisis***	NE		R	Lo
4	***Catlacatla***	LC		A	Lo/Le
5	***Garramullya***	LC		A	Lo
6	***Garragotyla***	LC	VU	R	Lo
7	***Labeocalbasu***	LC		M	Lo/Le
8	***Labeorohita***	LC		A	Lo/Le
9	***Labeoboggut***	NE		R	Lo
10	***Labeodeplostomus***	LC		R	Lo/Le
11	***Labeogonius***	LC		M	Lo/Le
12	***Rasboradaniconius***	LC		A	Lo/Le
13	***Rasborarasbora***	LC		A	Lo/Le
14	***Puntiuschola***	NE	VU	A	Lo
15	***Puntiuschonchonius***	LC		M	Lo
16	***Puntiusdorsalis***	LC		M	Lo
17	***Puntiussophore***	LC		A	Lo
18	***Puntius stigma***	NE		R	Lo
19	***Puntiusticto***	NE		A	Lo
20	***Puntiussarana***	LC		R	Lo
21	***Hypophthalamichthysnobilis***	DD		M	Lo/Le
22	***Hypophthalamichthysmolitrix***	NT	VU	R	Lo/Le
23	***Danioaequipinnatus***	LC		M	Lo
24	***Salmophasiabalookee***	NT		A	Lo
25	***Cirrhinusmrigla***	LC		A	Lo/Le
26	***Crossocheiluslatius***	LC		M	Lo/Le
27	***Osteobramavigrosii***	LC		R	Lo
28	***Cyprinuscarpiocommunis***	VU		M	Lo
29	***Oxygastergora***	LC		M	Lo
30	***Nemacheilusbotia***	LC		A	Lo
31	***Mystusseenghala***	LC		M	Lo/Le
32	***Mystuscavasius***	LC		A	Lo/Le
33	***Mystusvittatus***	LC		M	Lo
34	***Mystusbleekeri***	LC		A	Lo/Le
35	***Rita rita***	LC		A	Lo
36	***Ompokpabda***	NT	VU	R	Lo
37	***Wallagoattu***	NT		M	Lo/Le

38	***Clariusbatracus***	LC		M	Lo
39	***Clariusgariepinus***	LC		A	Lo/Le
40	***Heteropneustesfossilis***	LC	VU	M	Lo
41	***Xenentedoncancilla***	LC		M	Lo/Le
42	***Mastacembalusarmatus***	LC		A	Lo
43	***Mastacembaluspuncalus***	LC		R	Lo
44	***Oreocromismossambicus***	NT		M	Lo/Le
45	***Anabustestudineus***	DD		R	Lo/Le
46	***Channastriata***	LC		A	Lo/Le
47	***Channapunctatus***	LC		M	Lo/Le
48	***Channamarulius***	LC		R	Lo/Le
49	***Glassogobiusgiuris***	LC		A	Lo

Fig. no. 1: Order Wise Distribution of Fishes Found in WaroraTaluka.



Conclusion:-

There are total 49 fish species were found from all the four water bodies of WaroraTaluka. In that majority of species belongs to order Cypriniformes. Twenty eight species of Cypriniformes, ten species of catfishes (Siluriformes), six species of Perciformes, two species of Synbranchiformes and Osteoglossiformes, lastly single species of Antheriniformes were identified.

According to IUCN red data book *Cyprinuscarpiocommunis* species worldwide in vulnerable condition which is moderately abundant in the water bodies of WaroraTaluka during the present investigation. *Hypothalmichthysmolitrix*, *Ompocpabda*, *Wallagoattu* and *Oreochromismossambicus* are near to threatened species. *Hypothalmichthsmolitrix* and *Ompocpabda* are found rarely but *Wallagoattu*and *Oreochromismossambicus* are moderately abundant. For the survival of endangered fish species, attention has to be given towards development of captive breeding and development of breeding fishes. Strict management measures along with large scale public awareness would be essential to save the fish fauna. Awareness among the people has to be spread about illegal fishing. Killing of brood and undeveloped fishes must be prohibited.

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Studies on survey of seasonal flowering plants growing at Amravati (M.S.) for analysis of Mycorrhizal Fungi

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Abstract

My corrhizal fungi live in **symbiosis with the roots** of a large variety of plants, including trees, shrubs, annuals and perennials. The present study is planned to observe Arbuscular Mycorrhizal Fungi (AMF) associated with Seasonal Flowering Plants from Amravati (M.S.)In the present investigation, seasonal trips were made to collect the plants from different sites in Amravati such as nurseries, gardens and educational institution. There were three seasons selected for this investigation such as summer, winter and rainy season. The seasonal trips was done during 13th Dec.2021 to 30th Sept 2022 this period. The ornamental flowering plants were observed and some of the seasonal plants were selected. Proper field note of each specimen was recorded and their identification was done by giving botanical and local names, family, habitat and general morphology etc. There were 40 ornamentally important plants recorded from these sites. The soil samples will be investigated to know AMF species associated with ornamental plants. The purpose of study is to explore and document the important plant species as they play vital role in decorative purpose, aesthetic values, perfume industries and as well as in the field of floriculture. Some most frequently observed ornamental plants in Amravati area which are *Portulaca grandifolia, Pentas, Ixora, Hibiscus, Geranium, Gazania, Gardenia, Thunbergia grandiflora, Viola(Pensy),Bougainvillea, Tradescantia pallida.*

Key Words: Flowering Plants, AM Fungi.

Introduction

In essence, the symbiotic relationship between humans and plants, cultivated over eons, encompasses not only the fulfilment of basic needs but also the enrichment of our lives through cultural practices, aesthetic appreciation, and the stewardship of our shared environment.The plants are grown for the display of their flowers but in many cases ornamental features include leaves, fruits, stem and bark. The estimated area under the flowers crop in the country is about 1.06 hectare(Jain,*et.al*.,2003) Flowering plants have found a thriving market as potted beauties, enhancing indoor spaces with their vibrant blooms. Among the most sought-after varieties for indoor cultivation are poinsettias, orchids, florist chrysanthemums, and finished florist azaleas.Cut flowers are usually sold in bunches or as bouquets with cut foliage. The scent of flowers in particular awakens our senses. We associate relaxing, calmness, delicacy, harmony, heart opening, love and sensuality with it. Traditionally flowers are grown for aesthetic, social function and extraction of essential oils and manufacturing of perfumes. (Byczynski, L. 1997). This concerted effort to elevate growth and flower production is not only a response to market demands but also reflects a commitment to sustainability and quality in the ornamental plant industry. As the cultivation landscape evolves, the pursuit of innovative methods and technologies plays a pivotal role in ensuring the consistent availability of vibrant and robust ornamental plants, meeting the expectations of a discerning and growing clientele.The flora of a region is considered an essential part of the environment that determines the wealth of the ecosystem and human health (Sandifer et al. 2015)

Material and Method

Meeting the escalating societal demand for ornamental plants necessitates a strategic intensification of biomass production and an enhancement of their overall quality. In response to this imperative, there is a compelling need to formulate meticulous plans geared towards optimizing the cultivation and output of these plants.

Study site: -

The study was undertaken at different sites located in Amravati. Amravati, also called Ambanagari is a city of immense cultural and religious importance in Maharashtra. It is also called the cultural capital of the Vidarbha region situated in Maharashtra. Amravati is 340 m above from the sea level located in the East Maharashtra on the altitude of $25_o56'$ north and $77_o47'$ east. It is the main center of west Vidarbha.

Survey: -

Different sites and localities of Amravati or Different nurseries, local garden and institutional garden which is located in Amravati were visited during the course of investigation. There were 40 ornamental plants of economic importance were surveyed from different sites. The purpose of the survey was to collect information of some ornamental flowering plants with proper field notes, identification of the plants by giving botanical name, common name, and general morphology. The photography of all flowering plants was done.

Result and Discussion:-

The field expedition of the study area showed interesting results concerning floristic diversity. A total of 40 plant species belonging to 20 families and 34 genera were recorded from the study site. Out of 40 plants, 40 were angiosperms (Table 1). Asteraceae was the most dominant family with (6 genera and 6 species) and other contributing families are Plumbaginaceae, Acanthaceae, Bignoniaceae, Euphorbiaceae, Verbenaceae, Oleaceae, Lythraceae, Rubiaceae, Portulacaceae, Nyctaginaceae, Oleaceae, Crassulaceae, Rosaceae, Apocynaceae, Malvaceae, Caryophyllaceae, Lytharceae, Lamiaceae and Solanaceae.

India is blessed by nature with one of the richest floras on the earth and is considered the centre of origin of a number of the wild as well as cultivated plants (Vardhana 2008).Floriculture or flower farming, is a discipline of horticulture concerned with the cultivation of flowering and ornamental plants for gardens and for floristry, comprising the floral industry. Floriculture has emerged as an important agribusiness, providing employment opportunities and entrepreneurship in both urban and rural areas. Floriculture also offers careers in production, marketing, export and research. The demand for floriculture products has increasing significantly. As a result there has been an increasing demand.

Fig:-1 some of the common Ornamental plants

***Adenium obesum*(Forssk.)Roem. & Sch.*Catharanthus roseus*(L.)**

***Ixora coccinea*(L.)*Petunia hybrida* (Film.)**

Thunbergia erecta(Benth)

***Plumbagoauriculata*(L.).)**

Table :- 1 Sheet for survey of ornamental flowering plants at Amravati, Maharashtra						
S.N.	Available plant material			Growth form	Annual /	Blooming Period
	Botanical name	Common name	Family	Herb/ Shrub/ Climber	Perennial	
1	*Plumbago auriculata* (L.)	Cape leadwort	Plumbaginaceae	Shrub	Perennial	November - April
2	*Thunbergia erecta (Benth.)*	Bush clockvine	Acanthaceae	Shrub	Perennial	August - January
3	*Euphorbia lophogona (L.)*	Spurge	Euphorbiaceae	Shrub	Perennial	Throughout the year
4	*Euphorbia milii* (Des Moul.)	Christ plant	Euphorbiaceae	Shrub	Perennial	Throughout the year
5	*Lantana involucrata* (L.)	Buttonsage	Verbenaceae	Shrub	Perennial	Throughout the year
6	*Jasminum auriculatum* (Vahl.)	Jasmine	Oleaceae	Climber	Perennial	December - February
7	*Cuphea hyssopifolia* (Kunth.)	Mexican Heather	Lythraceae	Shrub	Annual	Throughout the year
8	*Ruellia humilis*(Nutt.)	Fingerleaf wild petunia	Acanthaceae	Herb	Perennial	Summer
9	*Hamelia patens* (Jacq.)	Firebush	Rubiaceae	Shrub	Perennial	June - September
10	*Portulacae oleracea* (L.)	Pigweed	Portulacaceae	Herb	Perennial	December - April
11	*Bougainvillea glabra*(Choisy.)	Paper flower	Nyctaginaceae	Shrub	Perennial	Late summer
12	*Jasminum grandiflorum*(L.)	Royal jasmine	Oleaceae	Shrub	Perennial	Summer - Autumn
13	*Ixora chinensis*(Lam.)	Chinese ixora	Rubiaceae	Shrub	Annual &Perennial	Summer
14	*Kalanchoe blossfeldiana*(Poelln.)	Widow's- trill	Crassulaceae	Herb	Perennial	late winter - late spring
15	*Ixora coccinea*(L.)	Jungle flame or pendkuli	Rubiaceae	Shrub	Perennial	Summer
16	*Rosa alba*(L.)	Japanese rose	Rosaceae	Shrub	Perennial	November- December
17	*Rosa rubiginosa*	Rose	Rosaceae	Trailing shrub	Annual	May – June
18	*Gazania rigens*(L.)	African daisy	Asteraceae	Herb	Perennial	June – November
19	*Chrysanthemum morifolium*(L.)	Shevanti	Asteraceae	Herb	Perennial	October – December
20	*Catharanthus roseus*(L.)	Periwinkle	Apocynaceae	Herb	Perennial/Annual	Year round flowering
21	*Hibiscus rosasinensis*	China rose	Malvaceae	Shrub	Perennial	May – June
22	*Bougainvillea spectabilis*(Wild.)	Paper flower	Rosaceae	Shrub	Perennial	Late summer
23	*Jasminum polyanthum* (Franch.)	white jasmine	Asteraceae	Shrub	Perennial	Summer - Autumn
24	*Bignonia*(L.)	Garlic vine	Bignoniaceae	Shrub	Perennial	January - February
25	*Dianthus* (L.)	Carnation	Caryophyllaceae	Herb	Perennial	April – May
26	*Salvia* (L.)	Sage	Lamiaceae	Herb	Perennial	October – January
27	*Adenium obesum*(Forssk.)Roem	Desert rose	Apocynaceae	Shrub	Perennial	January - May

	. & Sch.					
28	*Viola tricolor* (L.)	Pansy	Oleaceae	Herb	Perennial	March - May
29	*Dahlia (*Cav.)	Georgina	Rubiaceae	Shrub	Perennial	April – early December
30	*Gerbera jamesonii* (L.)	Barberton daisy	Crassulaceae	Herb	Perennial/Annual	March - May
31	*Tagetes* (L.)	Marigold	Rubiaceae	Herb	Annual	September-December
32	*Petunia hybrida (*Film.)	Garden petunia	Solanaceae	Herb	Annual	February – May
33	*Zinnia* (L.)	Elegent zinnia	Asteraceae	Herb	Annual	July - October
34	*Portulaca grandiflora* (Hook.)	Moss rose	Portulacaceae	Herb	Annual	January-February
35	*Allionia* (L.)	Windmills	Nyctaginaceae	Herb	Perennial	April - September
36	*Chrysanthemum morifolium* (Ramat.)	Garden mum	Asteraceae	Herb	Perennial	December - February
37	*Plumeria pudica* (Jacq.)	Lei flowers or wild Plumeria	Apocynaceae	Shrub	Perennial	March - June
38	*Calendula* (L.)	Desert marigold	Asteraceae	Herb	Annual &Perennial	December - March
39	Mussaenda (L.)	Red flag bush	Rubiaceae	Shrub	Perennial	November - January
40	*Cestrum nocturnum* (L.)	Ratrani,poisonberry	Solanaceae	Shrub	Perennial	August - October

Conclusion: -

Ornamental plants are primarily cultivated for their visual appeal, making the enhancement of aesthetic qualities a central focus in their production. Quality attributes such as leaf types, flower color, fragrance, longevity, and overall form, shape, and architecture are critical aspects that drive economic goals within the ornamental industries. Creating novel variations through propagation and improvement is essential to meet the ever-evolving demands of the market.

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Thermo-Acoustic Investigation of Molecular Interactions in Aqueous Solutions of Arginine at Different Temperatures

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Abstract

The ultrasonic velocity (μ), density *(ρ)*, and viscosity *(η)* have been measured for aqueous solutions of L-Arginine at various concentrations from 0.01 to 0.1M at different temperatures (293.15, 298.15, 303.15, 308.15, 313.15 and 318.15) K. The constancy of temperature was maintained by the use of a refrigerated bath with water as a circulating medium. From experimental data, acoustic parameters such as isentropic compressibility (βa), isothermal compressibility (βi), apparent molar volume(Φ_v), partial molar volume(Φ_v^0), Viscosity coefficients B and A, and hydration number (n_h) have been calculated using standard relations. These parameters have been further used to interpret the type of molecular interactions such as van der Waals forces, dipole-dipole interactions, hydrogen bonding, solute-solvent, solute-solute interactions, etc.present in the system investigated.

Keywords: Ultrasonic velocity (u), apparent molar volume (Φ_v), partial molar volume (Φ_v^0), Viscosity coefficients, hydration number (n_h), L-Arginine.

Introduction:

Amino acids are fundamental structural units of proteins, also they are necessary chemicals in life processes[1,2]. L-Arginine is a non-essential amino acid with a guanidino group appended to the amino acid framework[3]. It is needed to keep the liver, joints, muscles, and skin healthy. It also helps to strengthen the immune system, regulates blood sugar, and promotes male fertility. It is involved in various metabolic pathways. It plays important role in cardiovascular disorders, and also behaves as a good oxidant.[4-6]L-Arginine gets converted to nitric oxide (a powerful neurotransmitter) that helps blood vessels to relax and improves blood circulation in the body.[7] Thermodynamic properties of amino acids in an aqueous medium provide information about intermolecular interactions that help us understand several biochemical processes viz. denaturation, protein hydration, aggregation, etc.[8-10]

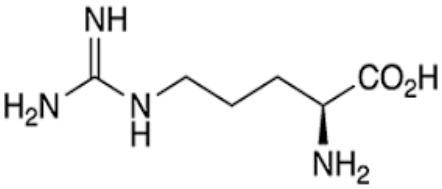

Fig 1. Chemical structure of L-Arginine

Thermodynamic properties of amino acids in aqueous solution provide valuable information about the secondary forces i.e. solute-solute interactions, solute-solvent interactions, hydrogen bonding, Van der Waals forces, etc.

It was found that work on acoustical studies of L-Arginine is rare. Hence, the objective of the present investigation was to find out the behavior of aqueous solutions of L-Arginine at different temperatures. In the present work, an attempt has been made to determine isentropic compressibility (βa), isothermal compressibility (βi), apparent molar volume (Φ_v), partial molar volume (Φ_v^0), Viscosity coefficients B and A, and hydration number (n_h) of aqueous solutions of L-Arginine and studied molecular interactions and variations of above parameters with different concentration at different temperatures.

Materials and Method

The analytical grade of L-Arginine (CAS No. 74-79-3) was obtained from Merck. It was used without further purification. The Milli-Q water (Millipore SAS 67/20 Mosheim) of 10^7 S cm^{-1} conductance was used for experimental purposes. The glassware was cleaned using standard methods and dried to absolute dryness which was further checked with anhydrous $CuSO_4$.

The aqueous solutions of L-Arginine in different concentrations were prepared at molal concentration by using a digital balance (Model-AJO20, aiwa) with an accuracy of± 0.001g. The density (ρ) of solutions was measured by a specific gravity bottle with accuracy ± 0.001 g/cm^3. The viscosity (η) was measured by Oswald's viscometer. The ultrasonic velocity was measured by an ultrasonic interferometer (Mittal Type: Model: M-83) functioning at a frequency of 2MHz with accuracy ±0.1 m/s accuracy. The interferometer was filled with the test solution and water was circulated around the cell. The temperature of the system was maintained by a thermostat. All the measurements were carried out at 293.15, 298.15, 303.15, 308.15, 313.15, and 318.15K temperatures.

Results and discussion

The measured and other derived parameters namelyultrasonic velocity (μ), density *(ρ)*, viscosity *(η),* isentropic compressibility (βa), isothermal compressibility (βi), and hydration number (n_h) are given in Table 3.1. Apparent molar volume *(Φ_v)*, partial molar volume *(Φ_v^0)*, and Viscosity coefficients B and A are reported in Table 3.2. The plots of ultrasonic velocity, isentropic compressibility, isothermal compressibility, and apparent molar volume are shown in Fig3.1, 3.2, 3.3&3.4.

Table 1. Density (ρ), viscosity (η), ultrasonic velocity (u), adiabatic compressibility (βa), isothermal compressibility (βi), hydration number (n_h) values for aqueous L-Arginine solutions at different temperatures.

T K	m Mol Kg^{-1}	$\rho \times 10^3$ kg m^{-3}	$\eta \times 10^{-3}$ N s m^{-2}	U m s^{-1}	Ba × 10^{-7} Kg m^2S^1	βi× 10^{-7} N^{-1} m^2	n_h
293.15	0	0.9982	1.1369	1482.6	4.557	5.469	0
	0.01	0.9990	1.1518	1486.8	4.53	5.43	36.51
	0.02	0.9998	1.1625	1489.5	4.51	5.41	29.38
	0.03	1.0005	1.1727	1492.3	4.49	5.39	28.15
	0.04	1.0010	1.1779	1494.0	4.48	5.37	24.69
	0.05	1.0015	1.1848	1495.2	4.47	5.36	21.49
	0.06	1.0019	1.1911	1496.4	4.46	5.35	19.89
	0.07	1.0024	1.1988	1498.0	4.45	5.33	19.22
	0.08	1.0029	1.2064	1500.2	4.43	5.32	18.76
	0.09	1.0033	1.2099	1502.2	4.42	5.3	18.44
	0.1	1.0037	1.2131	1504.0	4.4	5.28	17.97
298.15	0	0.9971	1.0022	1497.2	4.47	5.37	0
	0.01	0.9979	1.0169	1500.1	4.45	5.34	26.75
	0.02	0.9988	1.0269	1503.4	4.43	5.32	27.06
	0.03	0.9995	1.0342	1505.8	4.41	5.29	25.54
	0.04	1.0001	1.0437	1507.8	4.4	5.28	23.41
	0.05	1.0007	1.0525	1508.4	4.39	5.27	19.74
	0.06	1.0012	1.0617	1509.8	4.38	5.26	18.74
	0.07	1.0017	1.0718	1511.6	4.37	5.24	18.41
	0.08	1.0022	1.0800	1513.4	4.36	5.23	17.70
	0.09	1.0026	1.0868	1514.8	4.35	5.22	17.03
	0.1	1.0030	1.0893	1515.2	4.34	5.21	15.74
303.15	0	0.9957	0.8923	1509.6	4.41	5.29	0
	0.01	0.9967	0.9138	1512.0	4.39	5.27	23.93
	0.02	0.9976	0.9276	1514.0	4.37	5.25	21.01
	0.03	0.9987	0.9380	1516.1	4.36	5.23	20.86
	0.04	0.9990	0.9475	1517.8	4.34	5.21	19.38
	0.05	0.9996	0.9592	1518.0	4.34	5.21	16.04
	0.06	1.0002	0.9677	1519.2	4.33	5.2	15.46
	0.07	1.0008	0.9767	1520.8	4.32	5.18	15.45
	0.08	1.0014	0.9824	1522.8	4.31	5.17	15.40
	0.09	1.0019	0.9874	1523.8	4.3	5.16	14.74
	0.1	1.0024	0.9936	1524.6	4.29	5.15	14.01
308.15	0	0.9941	0.8011	1520.2	4.35	5.22	0
	0.01	0.9951	0.8172	1521.0	4.34	5.21	11.99
	0.02	0.9961	0.8299	1522.4	4.33	5.2	13.42
	0.03	0.9969	0.8374	1524.0	4.32	5.18	14.48

	0.04	0.9976	0.8430	1525.8	4.31	5.17	14.94
	0.05	0.9983	0.8496	1527.2	4.29	5.15	14.35
	0.06	0.9990	0.8572	1528.6	4.28	5.14	14.36
	0.07	0.9997	0.8619	1529.4	4.28	5.13	13.76
	0.08	1.0003	0.8676	1530.8	4.27	5.12	13.43
	0.09	1.0008	0.8733	1531.6	4.26	5.11	12.83
	0.1	1.0013	0.8768	1532.0	4.25	5.11	12.03
313.15	0	0.9923	0.7259	1529.4	4.31	5.17	0
	0.01	0.9934	0.7493	1529.6	4.3	5.16	8.15
	0.02	0.9944	0.7615	1530.8	4.29	5.15	10.87
	0.03	0.9953	0.7666	1532.0	4.28	5.14	11.95
	0.04	0.9961	0.7723	1534.6	4.26	5.12	14.61
	0.05	0.9968	0.7764	1535.8	4.25	5.1	13.81
	0.06	0.9975	0.7817	1536.8	4.24	5.09	13.43
	0.07	0.9982	0.7879	1537.4	4.24	5.09	12.76
	0.08	0.9988	0.7947	1537.6	4.23	5.08	11.53
	0.09	0.9993	0.7983	1539.2	4.22	5.07	11.75
	0.1	0.9997	0.8032	1540.4	4.22	5.06	11.56
318.15	0	0.9903	0.6638	1537.2	4.27	5.13	0
	0.01	0.9913	0.6942	1537.6	4.27	5.12	9.06
	0.02	0.9923	0.7156	1538.2	4.26	5.11	9.14
	0.03	0.9931	0.7260	1539.2	4.25	5.1	10.16
	0.04	0.9938	0.7320	1541.0	4.24	5.08	11.68
	0.05	0.9946	0.7357	1542.2	4.23	5.07	11.63
	0.06	0.9955	0.7370	1543.2	4.22	5.06	11.77
	0.07	0.9963	0.7412	1544.0	4.21	5.05	11.60
	0.08	0.9969	0.7451	1544.8	4.2	5.04	11.05
	0.09	0.9975	0.7501	1547.2	4.19	5.02	11.99
	0.1	0.9981	0.7572	1548.6	4.18	5.01	12.01

Table 3.2. Apparent molar volume, Partial molar volume, and the experimental slope of Eq. 2 and Values of parameters of the Jone-Dole equation for different aqueous L-Arginine solutions.

m mol Kg^{-1}	$\sqrt{C}$	Φv (m^3 mol^{-1})					
		293.15K	298.15K	303.15K	308.15K	313.15K	318.15K
0.01	0.1000	94.175	88.592	69.169	68.045	56.758	66.887
0.02	0.1414	94.075	86.260	76.545	70.919	65.252	70.287
0.03	0.1732	97.338	92.140	82.314	78.570	71.416	78.165
0.04	0.2000	103.958	97.560	90.206	84.888	76.998	84.615
0.05	0.2236	107.906	100.785	94.913	88.649	82.347	86.416
0.06	0.2449	112.194	104.593	98.029	91.133	85.889	85.892
0.07	0.2645	113.803	107.294	100.235	92.886	88.398	86.953
0.08	0.2828	114.994	109.306	101.873	95.449	91.532	90.280
0.09	0.3000	117.028	111.979	104.255	98.555	95.085	92.853
0.1	0.3162	118.644	114.107	106.149	101.026	98.933	94.898
Φ_v^o	(m^3 mol^{-1})	78.0213	70.6782	52.9969	51.4479	38.3218	55.158
S_v^*	(m^3 Kg$^{1/2}$ mol$^{-3/2}$)	130.8077	136.1171	175.2331	158.2857	191.1102	127.1417
$(\eta / \eta_o - 1)/\sqrt{c}$ *versus* $\sqrt{c}$	B (dm^3 mol$^{-1)}$	*B* = 0.3670	*B* = 0.0095	*B* = 0.5552	*B* = 0.3934	*B* = 0.0113	*B* = -0.4167
	A (dm$^{3/2}$ mol$^{-1/2)}$	*A* = 0.106	*A* = 0.0078	*A* = 0.199	*A* = 0.183	*A* = 0.324	*A* = 0.569

3.1. Ultrasonic velocity

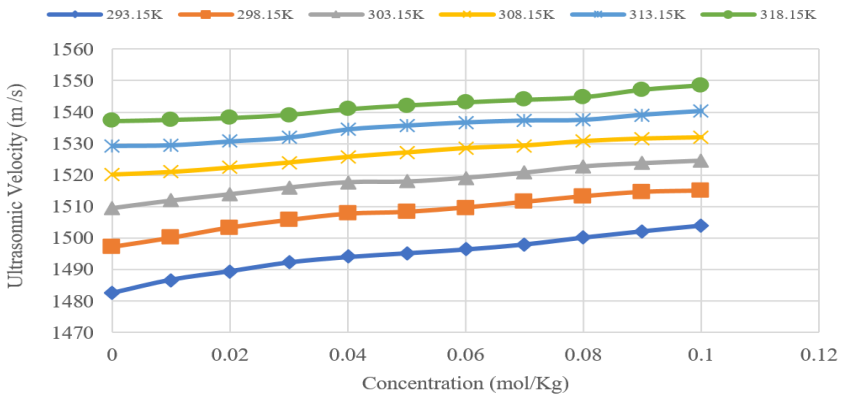

Fig 3.1 - Variation of Ultrasonic Velocity vs Concentration of L-Arginine at different temperatures

From Fig. 3.1, it is observed that the ultrasonic velocity is found to increase with the increase in the concentration of L-Arginine. The increase in ultrasonic velocity in any solution indicates the greater association among the molecules of the solution. The greater association is due to intermolecular hydrogen bonding between the side chain of L-Arginine and water molecules.[11]The steady increase in ultrasonic velocity with an increase in L-Arginine concentration is due to a greater association between solute-solvent molecules in aqueous L-Arginine solution because of the presence of large guanidinium moiety that has the capacity for up to six hydrogen bonds.

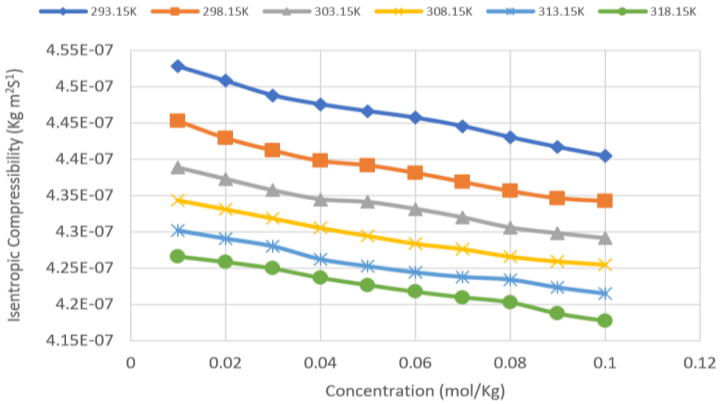

Fig 3.2. Variation of Isentropic Compressibility Vs Concentration of L-Arginine at different temperatures

The ultrasonic velocity is found to increase with the increase in temperature. This behavior is similar to that of pure water, where the ultrasonic velocity increases with the increase in temperature. As the temperature increases, the hydrogen bonds among water molecules break and more monomeric water molecules are formed. These broken water molecules enter the vacant spaces in the cage-like structure of water and gets “trapped”. As a result, the number of closed-packedwater structures increases with the increase in temperature. This increase in closed-packed water structures forms the material medium for the propagation of ultrasonic waves. As a result, ultrasonic velocity increases with the increase in temperature.[12]

3.2. Isentropic Compressibility

[13] The increase in velocity and decrease in isentropic compressibility with an increase in concentration indicates that the molecules are forming a more tightly bonded system. The closer packing of molecules caused by the hydrogen bonds between the solute and solvent molecules has an even greater influence on the overall compressibility of the system.[14] As the temperature increases, due to decreased thermal motion of components in the given mixture, strengthenedinteractive forces enhance the compactness of the structure of the medium. Hence, the isentropic compressibility of the system decreases with an increase in temperature.[15]

3.3. Isothermal Compressibility

In aqueous L-Arginine solutions, it is observed from (Fig 3.3) that the isothermalcompressibility decreases with an increase in concentrations and temperature. This confirms the presence of strong solute-solvent interactions through Amino, Carboxylic, and guanidino head groups of L-Arginine with the surrounding water molecules.[16,17]

3.4. Apparent Molar Volume

When a solute is dissolved in the solvent, the volume of the solution may change due to solute-solvent interactions, this changed volume is called apparent molar volume. The determination of apparent molar volume (Φ_v) was calculated using solution densities using the following eqation:[18]

$$\Phi_v = \frac{M}{\rho} - \frac{1000\times(\rho-\rho_0)}{m\rho\rho_0} \quad (1)$$

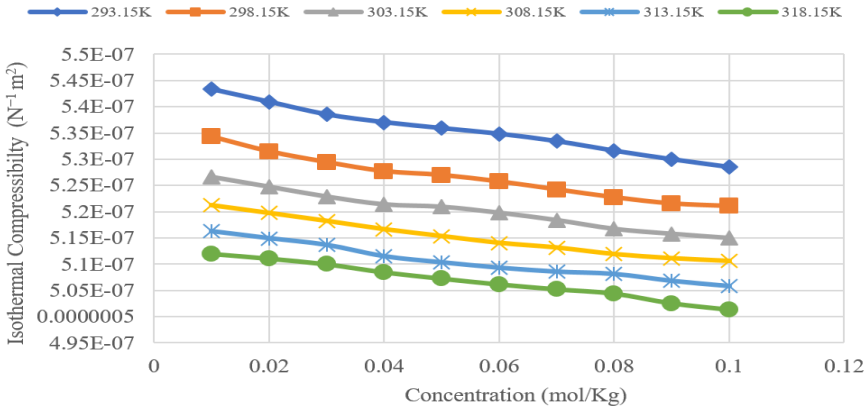

Fig 3.3. Variation of Isothermal Compressibility Vs Concentration of L-Arginine at different temperatures

Where M is the molar mass of the solute, m is the molality of L-Arginine + water mixtures, ρ_0 and ρ are the densities of the solvent and solution respectively.

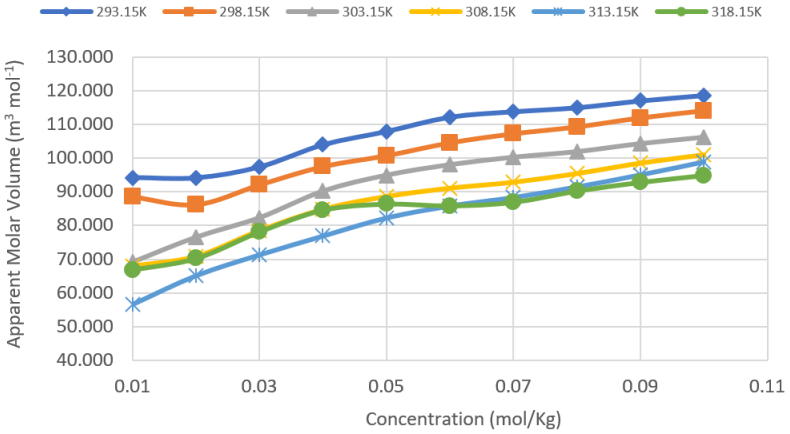

Fig.3.4. Variation of Apparent Molar Volume Vs Concentration of L-Arginine at different temperatures

Table 3.2 represents the small and positive $\Phi_v$values for the L-Arginine + water mixture is an indication of strong hydrophilic interactions of solute. As the concentration of L-Arginine in water increases, the increase in $\Phi_v$values indicates the hydration of solute (solute-solvent interactions) increases, and solute-solute interactions decreases due to an decrease in electrostatic attraction between solute molecules.[19] Further, a decrease in the value of Φ_v with temperature represents a decrease in the overall structure of the system due to the loss of solvent molecules in the secondary solvated layer causing contraction of solution.[20]The sudden increase at 318.5K may be due to water molecules that are trapped in the cage-like structure formed between solute and solvent molecules.

The variation of Φ_v was found to be linear with a molality. The plot of Φ_v versus molality is given in Figure3.4.

3.5. Partial Molar Volume

The partial molar volume ($\Phi_v{}^0$) was obtained using the least-squares method from the plot of $\Phi_v$against $\sqrt{c}$ with the help of Masson equation.[21]

$$\Phi_v = \Phi_v{}^0 + S_v^*\sqrt{c} \quad (2)$$

Where, $\Phi_v{}^0$is the Partial molar volume and S_v^* is the experimental slope. The plot of $\Phi_v{}^0$against the square root of molal concentration ($\sqrt{c}$) was found to be linear. The partial molar volume provides information about solute-solvent interactions. S_v^* is used to express the solute-solute interactions in the solution. Its value is not of much importance for non-electrolytes but is of great significance for electrolytes. S_v^* is found to be dependent on temperature, solute and solvent.[22] Values of $\Phi_v{}^0$ and S_v^* are reported in Table 3.2.

The $\Phi_v{}^0$ values are positive for an aqueous solution of L-Arginine indicating strong interactions

between solute and solvent molecules, while a decrease in its value with temperature shows contraction in volume of solution. This contraction in volume of solution is due to the loss of molecules in secondary solvated layers attached with solute molecules.[23] Decrease in value of $\Phi_v{}^0$with temperature is due to the increase in electrostriction of solvent molecules with solute particles.[24]As the temperature increases, kinetic energy of the solvent molecules associated with the solute increases, and some molecules of solvent gets disassociated. Hence, the size of hydrated solute is reduced. At 318.15K, it is observed that partial molar volume is slightly increased. This may be due to the formation of water cavities at higher temperature which traps the freed water molecules and results into increase in size of hydrated solute.

3.6.Viscosity Coefficient B and A

Viscosity data of the experimental solutions of L-Arginine have been analyzed using the Jones-Dole equation:

$$\frac{\eta}{\eta_0} = 1 + A + B\sqrt{c} \qquad (3)$$

Where, η_0 and η are the viscosities of solvent and solution respectively, c is molal concentration of the solution. The structure-making and breaking properties of solutes are reported by considering the Jones-Dole equation.[21] Constant A of the Jones-Dole equation is called the Falkenhagen coefficient and represents the contribution from interionic electrostatic forces and its value is independent of solution concentration. Constant B called Jones-Dole coefficient measures the order or disorder due to solute in the solvent structure.[25] Therefore, $(\frac{\eta}{\eta_0} - 1)/\sqrt{c}$values are plotted against $\sqrt{c}$ for L-Arginine+water mixtures to obtain slope B and intercept A. The viscosity values and constants of Jones-Dole equation are given inTable 3.2.

It is evident from Table 3.2, lower values of B indicate hydrophilic interaction of solute with water resulting in strong hydrogen bonding between solute and water as discussed in case of $\Phi_v{}^0$.[26] Decrease in value of B with temperature shows structure promoting effect of solute on water due to hydrogen bond formation.[27] The values of A are more useful in case of ionic solutes as it talks about interionic electrostatic forces. But in our present study, we are dealing with non-electrolytes; hence we get very small values of A because the interionic interactions are very poor in non-electrolytes. The very small values of intercept A may be due to hydrogen bonding or Vander Waal's forces.

3.7. Hydration Number

The hydration of solute molecules in water is explained on the basis of Frank and Wen's model of solute–solvent interaction, which pictures three different solvent structure regions in the neighborhood of the solute. Just outside the molecule, there is a layer of immobilized and compressed water due to electrostrictive and other attractive forces exerted by the solute. This layer is surrounded by a slightly less compressed layer of water molecules, distantly affected by these forces. The outermost layer is bulk water which has the typical tera-coordinated hydrogen-bonded structure which is not affected by any of the above forces. Compressibility measurements indicate the change in the first two layers of solvent around the solute molecule.[16]

In the case of L-Arginine, the water structure is slightly disturbed due to hydrogen-bonded network around the solute, this holds the water around solute firmly, making hydration layer even less compressible. Initially when the concentration of L-Arginine is low, number of water molecules are excess in number, hence hydration number is high and as the concentration increases, number of solute molecules increases and available number of water molecules remain same, results in decrease in hydration number with increase in concentration.

As the temperature increases, the vibration in molecules increases, which results in breakage of hydrogen bond from the solute-solvent sphere, as a result the hydration number decreases as the temperature increases. From the calculated values of n_h, it is found that in all concentrations and temperatures, each L-Arginine molecule is closely bound and forms a complex in cluster organization with a fixed number of water molecules.

Conclusion

A systematic study of L-Arginine in water has been carried out at different concentrations and at different temperatures using ultrasonic experiments. The ultrasonic velocity data and other acoustical parameters gave valuable information to understand the solute-solvent interactions in the aqueous solutions. It was observed that with increase in concentration showed strong solute-solvent interaction and molecular association in the solution. And increase in temperature showed contraction of molecules due to weakening of intermolecular cohesive forces between solute and solvent. It was also found that at higher temperatures, the slight change in followed linearity may be due to formation of water cavities which traps free water molecules.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Seasonal Variations of Airborne Fungal Spore of Different Locations of Amravati City, Maharashtra

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Abstract:

Fungi, one of the most residing microorganisms in atmosphere, which constitute a major part (at the level of mass and number) of the atmospheric aerosol entities. They are commonly found in internal and external environment. Fungi are not only act as a source of clinical manifestation occurs in human but also it affects the lifecycles of plants also.

The present study concerning with investigation and profiling of the seasonal variation of fungal spore concentration and their diversity. Conducted for 1 year at a selected region of Amravati city, Maharashtra. Using fine particulate sampler, samples were collected at 15 days intervals for every month during July 2018–June 2019. In the study the monthly seasonal variation may impact the fungi concentration along with variation of rainfall and temperature during the sampling at the primary conclusion it is found that, the fungi concentration peaked in the month of beginning to throughout the April where there is no rainfall and faces high temperature. While, the lower fungi concentration was found in the month of July to October. The monthly profiles of fungi spores in different studies showed maximum concentration in the summer and low in monsoon. The predominant fungi in selected area of Amravati city are Cladosporium, Penicillium, Aspergillus, and Alternaria. As said above the mentioned fungi having potential to create a certain health issue concerning with immunological responses of an individuals. These fungi initiate a hypersensitivity reaction common to anaphylaxis in exception. As per study the fungal count was at is peaked level in the month of April, that was 1210 CFU/m3, while it is observed lowest in its peak in the month of July that is 50 CFU/m3.Hence a greater correlation is found in temperature as well as rainfall, significantly impact the concentration of fungi in atmosphere. These metrological parameters partially decided the presence of mass and number of allergic fungi in Amravati cities selected areas.

Key Word. - seasonal variation, Fungal spore, Allergic fungi,

Introduction:-

Fungi are a diverse group of eukaryotic organisms that can be found in a variety of environments, including soil, air, water, and plants. Some fungi are known to cause allergic reactions in humans, such as asthma, rhinitis, and sinusitis. The presence and concentration of allergenic fungi can vary depending on the season, climate, and other environmental factors.

Fungi, despite their crucial role in ecosystems, can be sneaky allergy culprits. Unlike the more well-known pollen allergies, fungal allergies often go undiagnosed due to their year-round presence and less-distinctive symptoms. But these microscopic spores can trigger significant respiratory issues, impacting millions peoples.

Allergic Fungi

Actually all fungi are not allergenic, but some common spp.of fungi causes allergy,which are.. **Alternaria spp.,** the outdoor champion, thrives in warm, humid climates, blanketing dust, soil, and decaying vegetation with its allergenic spores. In damp environments like basements and bathrooms, **Aspergillus spp.** lurks, ready to trigger allergies and even lung infections. **Cladosporium spp,** another omnipresent outdoor mold, unleashes its year-round attack, even during winter. And who would have guessed that **Penicillium, spp.** the very mold that gave us the miracle drug penicillin, can also turn against us, causing allergies in damp areas and on moldy food. fungi are sneaky allergy culprits lurking year-round. These microscopic spores, released by molds and yeasts, can trigger significant respiratory issues for millions worldwide. Concentration and diversity of airborne fungal spores can vary significantly depending on various factors such as temperature, humidity, rainfall, and wind speed. Identifying these variations is crucial for understanding the potential health risks associated with fungal exposure and implementing appropriate preventive measures.

Alternaria spp.- The most common outdoor fungal allergen, found in dust, soil, and decaying

vegetation. It thrives in warm, humid climates and is a major culprit in seasonal allergies.

Aspergillus spp-.Found in damp environments like basements etc, Aspergillus spores can cause allergic reactions and even lung infections.

Cladosporium spp-.Another prevalent outdoor mold, Cladosporium spores are present year-round and can trigger allergy symptoms even during winter.

Penicillium spp.-Yes, the same genus that gave us penicillin the antibiotic can also cause allergies. Penicillium spores are found in moldy food and damp areas.

Methodology:

Study Area:

This study was conducted in Amravati City, Maharashtra, India, located in the Vidarbha region. Amravati has a tropical wet and dry climate with hot, dry summers and mild to cool winters. Summer lasts from March to June, monsoon season from July to October, and winter from November to March. Following selected areas viz. Kathora Naka,Itwara, Panchavati of Amravati city,Maharashtra, use fungal spore collection by the using fine particulate sampler.

Sampling:

Airborne fungal spores were collected using fine particulate sampler from three different locations within the city: residential, commercial, and pollution marked level.viz-Kathora Naka,Itwara, Panchavati Sampling was conducted monthly over a period of one year, covering all three seasons with investigation and profiling of the seasonal variation of fungal spore concentration and their diversity. Conducted for 1 year at a selected region of Amravati city, Maharashtra. Using fine particulate sampler, samples were collected at 15 days intervals for every month during July 2018–June 2019.

Fungal Culturing on Growth Media

Cultivating fungi in a controlled environment allows for by using basic methodology for fungal culture and growth on media:

Materials:

Fungal inoculums: This is done by obtain sample from outdoor collections.

Culture media: following media were used for different fungal types and purposes. Some common examples include:

Potato dextrose agar (PDA): Rich in nutrients, good for promoting growth and sporulation.

Selective media: These contain ingredients that inhibit the growth of certain organisms while allowing the target fungus to thrive.

Petri plates or culture flasks

Sterile tools: Inoculating loops, spatulas, forceps, etc., to handle the inoculum and media aseptically.

Bunsen burner or laminar flow hood: To maintain a sterile environment while working.

Incubator: Controlled environment for fungal growth, usually set at around 25°C (77°F).

Procedure:

First the start with preparation of media .

Then Autoclaved the Petri plates/flasks and culture media and according to the protocol.

The medium Allow them to cool and solidify in the plates/flasks.

Preparation the inoculums: were done by obtained sample from outdoor collections.

By using spores, the spore was suspended in sterile saline solution.

By using mycelia fragments, isolate a small portion of actively growing mycelium using sterile tools.

Inoculate the media:

Work in a sterile environment laminar flow hoodBy using the inoculating loop sample were transfer in the inoculum suspension.Gently streak the inoculums onto the surface of the agar medium in a zigzag pattern.for liquid cultures, directly add the inoculums suspension to the media in the flask.

Incubation:

The Seal the plates/flasks with parafilm or tape to prevent contamination.

Then we Incubate the cultures at the appropriate temperature and light conditions for the fungus (usually around 25°C in the dark).Thereafter we monitor the cultures regularly for signs of growth, such as hyphe extension, colony formation, or sporulation.

Subculturing:

Then we transfer actively growing hyphae to fresh media plates for further studies or maintenance

Spore Identification:

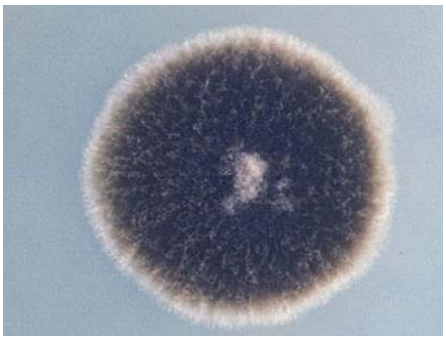
The collected samples were analyzed using standard microbiological techniques to identify and quantify the different fungal species present. Spores were cultured on specific fungal media and identified based on their morphological characteristics under a microscope in selected area of Amravati city,viz:- Kathora Naka,Itwara, Panchavati

Feature	Aspergillus spp	Cladosporium spp.	Alternaria spp.	Penicillium spp.
Spore color	Green, black	Dark brown	Black, olive-brown	Green, blue-green
Allergic potential	High	Moderate	High	Low
Dominant season(s)	Summer	Summer, monsoon	Monsoon, post-monsoon	Year-round
Medical significance	Aspergillosis, allergies	Allergies, allergic rhinitis	Allergies, asthma	Opportunistic infections

Allergenicity of fungi

Many different fungi can cause allergic reactions: Different people can be allergic to different types of fungi, and even the same fungi can cause different reactions in different people.Spores themselves are often non-specific: Fungal spores generally lack the distinct features..Allergy symptoms can be similar to other conditions: Symptoms like runny nose, sneezing, and itchy eyes can also be caused by other factors like pollen allergies, common colds, and even dust mites.However, the general types of fungi that commonly cause allergies, here are some of the most frequent causetives:

Alternaria spp: These spores are typically dark brown, elliptical, and have longitudinal ridges. They're found outdoors year-round, with peak concentrations in late summer and early fall. Alternaria spores are typically dark brown, elliptical, and have longitudinal ridges. They are a common cause of allergies, and can be found outdoors year-round, with peak concentrations in late summer and early fall. If you are experiencing allergy symptoms, it is important to consult with a healthcare professional to determine if you are allergic to Alternaria fungi



Alternaria alternate spp.**spore**

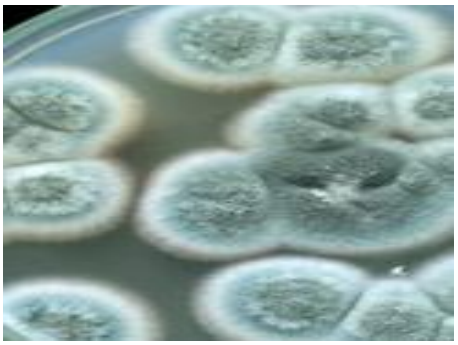
Cladosporium spp**:** These spores are also dark brown, but they're smaller and rounder than Alternaria spores. They're also found outdoors year-round, but their peak concentrations are in late summer and early fall.

Cladosporium spp.**spore**

Aspergillus spp: These spores are light brown to colorless, and they can be round, oval, or spiky. They're found both indoors and outdoors, but they're more common indoors in damp or humid environments.

Aspergillus spp.**spore**

Penicillium **spp:** These spores are light green to blue, and they're round or oval. They're found both indoors and outdoors, but they're more common indoors in damp or humid environments.



Penicillium spp.**spore**

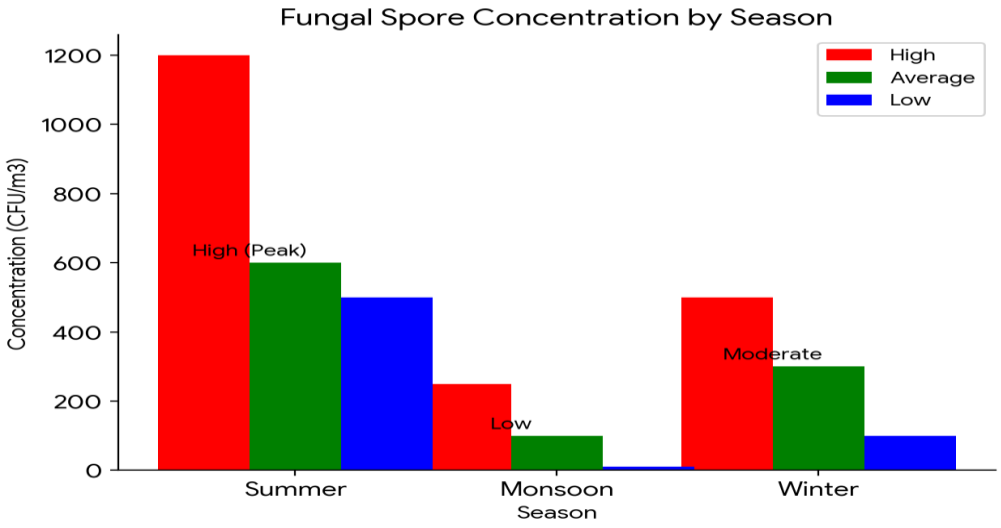
The collected samples were analyzed using standard microbiological techniques to identify and quantify the different fungal species present. Spores were cultured on specific fungal media and identified based on their morphological characteristics.

Result and Data Analysis:

The concentration of each fungal species was expressed as colony-forming units (CFUs) per cubic meter of air. Seasonal variations in total fungal concentration and the relative abundance of different species were analyzed using statistical methods.

Seasonwise Total fungal spore concentration in (CFU/m3)

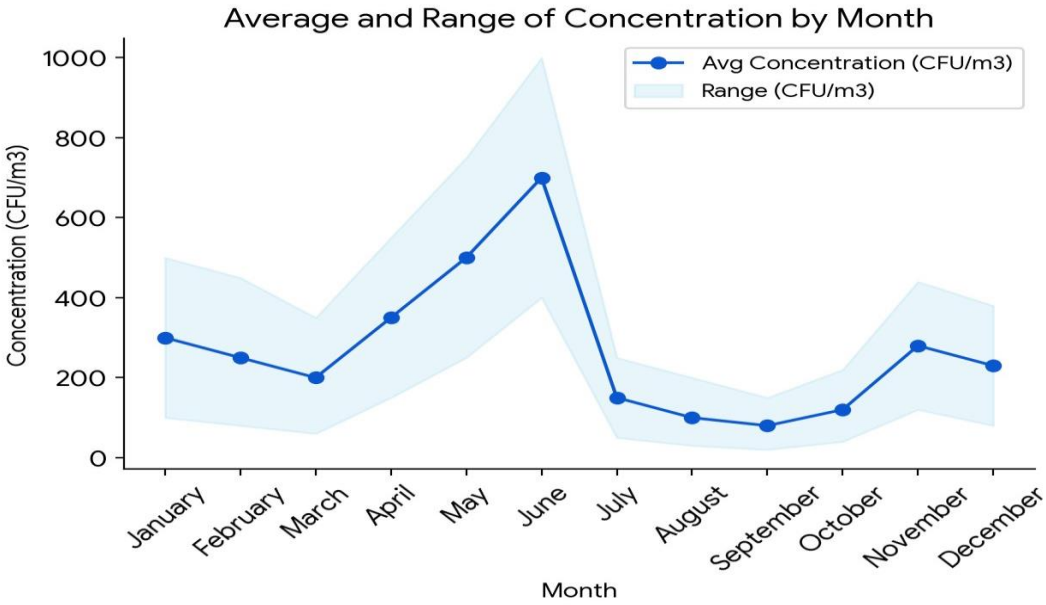
Sr. No	Season	Fungal Spore Concentration (CFU/m3)	Additional Notes
1	Summer (April-June)	High (Peak)	Average around 1200 CFU/m3, can range from 500 CFU/m3 to 2000 CFU/m3. Factors like high temperatures and low humidity favor fungal growth.
2	Monsoon (July-October)	Low	Average around 100 CFU/m3, can range from 10 CFU/m3 to 250 CFU/m3. Rainfall suppresses fungal spore release and dispersal.
3	Winter (November-March)	Moderate	Average around 300 CFU/m3, can range from 100 CFU/m3 to 500 CFU/m3. Moderate temperatures and humidity provide suitable conditions for some fungal species.



Month-wise Total fungal spore concentration (CFU/m3)

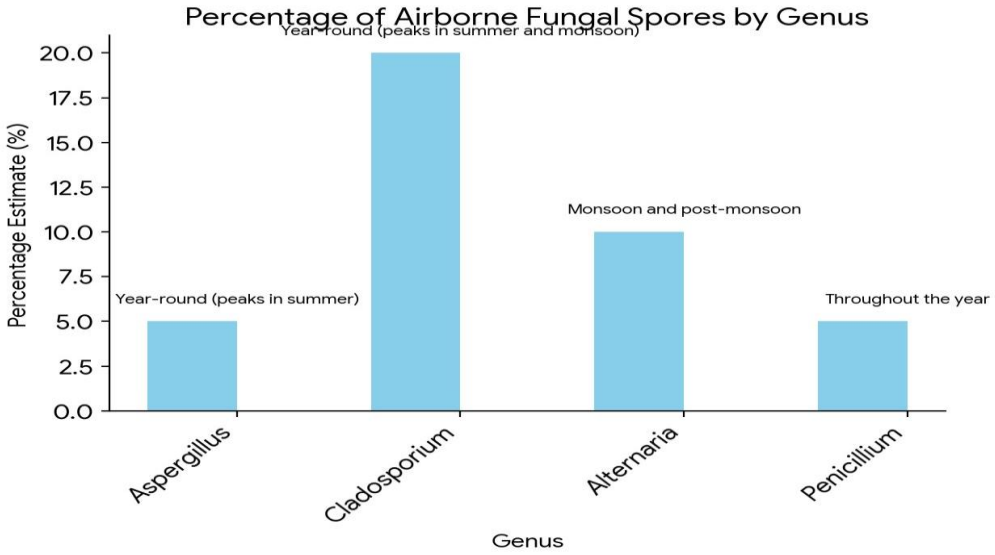
Sr. No.	Month	Average Concentration (CFU/m3)	Range (CFU/m3)
1	January	300	100 - 500
2	February	250	80 - 450
3	March	200	60 - 350
4	April	350	150 - 550
5	May	500	250 - 750
6	June	700	400 - 1000
7	July	150	50 - 250

8	August	100	30 - 200
9	September	80	20 - 150
10	October	120	40 - 220
11	November	280	120 - 440
12	December	230	80 - 380



Season wise Genus specific total fungal spore concentration in%

Genus	Percentage Estimate	Dominant Season(s)	Allergic Potential	Significance
Aspergillus spp.	5-15%	Year-round (peaks in summer)	High	Respiratory allergies, aspergillosis
Cladosporium spp.	20-35%	Year-round (peaks in summer and monsoon)	Moderate	Respiratory allergies, allergic rhinitis
Alternaria spp.	10-25%	Monsoon and post-monsoon	High	Respiratory allergies, asthma
Penicillium spp.	5-10%	Throughout the year	Low	Less allergenic than others, opportunistic infections



Discussion –

The following points are studied partially for getting information towards fungi and their seasonal variation throught the year in 2018-2019 in the selected area of Amravati.viz, Kathora Naka,Itwara, Panchavati ,and in primary conclusion we concluded with as bellows -

1. Seasonal Variation:

- **Summer (April-June):** Highest fungal spore concentration (average 1200 CFU/m3) due to high temperatures and low humidity.
- **Monsoon (July-October):** Lowest concentration (average 100 CFU/m3) due to rainfall suppressing spore release and dispersal.
- **Winter (November-March):** Moderate concentration (average 300 CFU/m3) due to suitable conditions for some fungal species.

2. Dominant Fungal Genera:

- **Cladosporium spp.:** Most abundant (20-35%), present year-round with peaks in summer and monsoon, moderate allergic potential.
- **Aspergillus spp.:** 5-15%, peaks in summer, high allergic potential and risk of aspergillosis.
- **Alternaria spp.:** 10-25%, dominant in monsoon and post-monsoon, high allergic potential, linked to asthma.
- **Penicillium spp.:** 5-10%, present throughout the year, low allergic potential, but can cause opportunistic infections.

3. Public Health Implications:

- High fungal spore concentration during summer and monsoon months poses a significant risk for individuals with allergies, especially those sensitive to Cladosporium, Aspergillus, and Alternaria.
- Awareness campaigns on seasonal variations and dominant allergens can help individuals with allergies take precautions, like using air purifiers or wearing masks during high-risk periods.
- Further research can be conducted to determine the specific Allergen index of the region and identify potentially allergenic species beyond the four major groups analyzed.

The study provides valuable insights into the seasonal variations and abundance of allergenic fungi in specific locations of Amravati,Maharashtra. This information can be used to raise public awareness, improve allergy management strategies, and inform further research for better air quality management and public health protection.

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भंडारा जिल्हयातील शेतकी जलसिंचनात झालेला बदल: एक कालिक अध्ययन

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सारांश:

कोनत्याही भागाच्या शेती क्षेत्रातील सिंचनाची स्थिती ही शेतीतील होणारे उत्पन्न ठरवित असते. भंडारा हा महाराष्ट्रच्या अतीपूर्व भागात वसलेला जिल्हा असून या जिल्हयातील मागील काही वर्षात झालेला जलसिंचनातील बदल हा भुगोलशास्त्रज्ञांनासाठी अभ्यासाचा विषय ठरलेला आहे. जसजसे सिंचन वाढत गेलेले आहे, त्यासोबजच या भागातील मुख्य पिक भात याचेही क्षेत्रफळ वढलेले दिसनू येते. सोबजच तांदळाचे उत्पादन वाढलेले दिसनू येते. १९८१ ते २०११ या काळात झालेला बइल सांगतो की, तांदळाचे उत्पादन वाढलेले आहे. जलसिंचनाच्या विविध स्त्रोतांच्याद्वारे हे सिचन वाढलेले आहे.

प्रस्तावना:

जगातील सर्वच देशातील अन्नधान्याची गरज ही शेतीद्वारे पूर्ण केली जाते. जलसिंचनाशिवाय शेतीतील उत्पादन वाढीची कल्पनाच करता येत नाही. कारण केवळ पर्जन्यावर अवलंबून असलेली शेती निश्चित स्वरूपाचे उत्पादन देऊ शकत नाही. त्यासाठी पाणीपुरवठयाच्या कृत्रिम सोयी असणे अत्यंत आवश्यक असते. पाणीपुरवठयामुळे शेतीचे उत्पादन वाढविणे आणि आधुनिक पद्धतीने लागवड करणे शक्य असते.

'जलसिंचन म्हणजे पावसाच्या पाण्याव्यतिरिक्त पिकांना दिलेले पुरक पाणी होय.' भारतातील एकूण जिल्ह्यपैकी बागायत क्षेत्र असलेल्या ४४ जिल्ह्यमधून देशाच्या अन्नधान्य उत्पादनापैकी ५० टक्के उत्पादन होते. या ४४ जिल्ह्यपैकी जास्त सिंचन क्षेत्र असणाऱ्या १४ जिल्ह्यत देशाच्या २५ टक्के अन्नधान्याचे उत्पादन मिळते. यावरून शेतीसाठी जलसिंचनाचे महत्त्व लक्षात येते. पृथ्वीचा ७१ टक्के भाग पाण्याने व्यापलेला आहे. यापैकी ९७ टक्के पाणी खारे असून ते समुद्रात आहे. जागतिक पाण्याच्या वितरणाच्या बाबतीत भारताचा जगात ब्राझील, रशिया, चीन, कॅनडा नंतर पाचवा क्रमांक लागतो. परंतु जलसिंचनाखालील क्षेत्रात या बाबतीत भारताचा जगात प्रथम क्रमांक लागतो.

परिकल्पना :—

''भंडारा जिल्हयातील प्राकृतिक व सांस्कृतिक घटकांचा परिणामामूळे जलसिंचनात कालिक बदल झालेले आहे''

उद्येश :—

सदर अध्ययनाचा मुख्य उद्देश भंडारा जिल्हयातील प्राकृतिक व सांस्कृतिक घटकांचा परिणामामूळे जलसिंचनात झालेल्या कालिक बदलाचे अध्ययन करणे आहे.

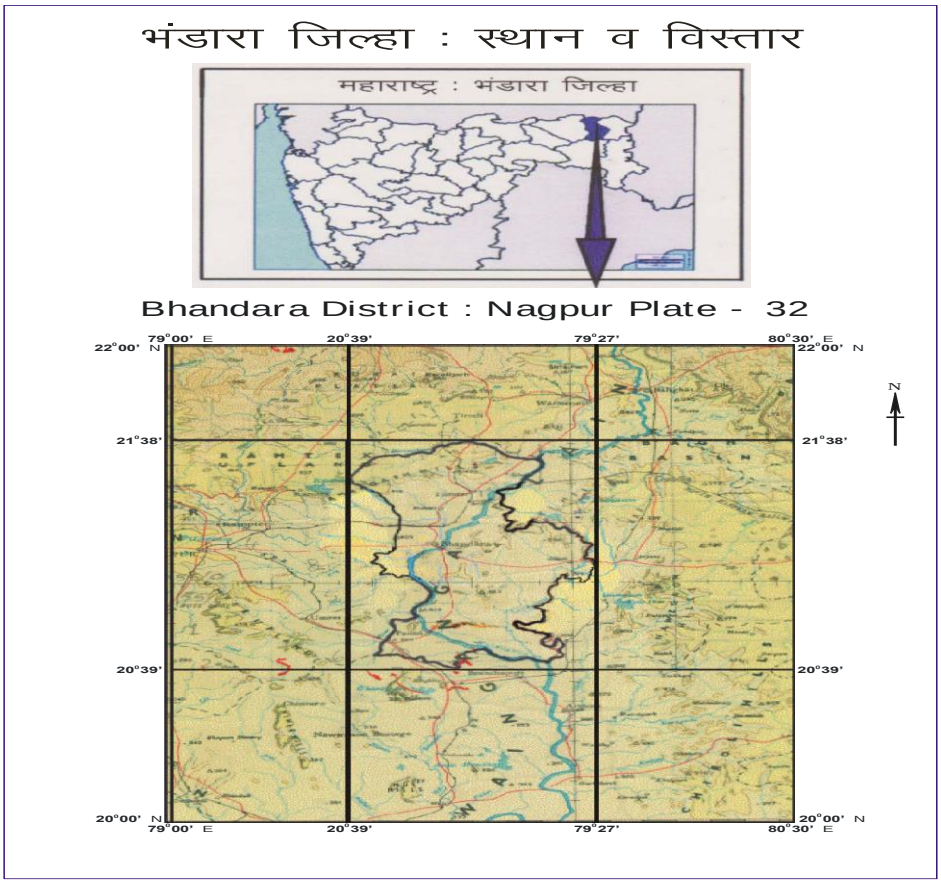
संशोधन पध्दती :—

सदर संशोधनात व्दितीय स्तरावरिल आकडेवारीचा उपयोग केलेला आहे. आकडेवारीसाठी भंडारा जिल्हा टक्के सामाजिक,—आर्थिक समालोचन, अर्थ व सांख्यिकी संचालनालय, महाराष्ट्र शासन, मुंबई या स्त्रोताचा उपयोग केलेला आहे. योग्य सांख्यिकिय पध्दतीने आकडेमोड करुन ती छायापध्दतीने नकाशात प्रदर्शित केलेली आहे.

भंडारा जिल्हयातील भौगोलीक पार्श्वभूमी :—

भौगोलिकदृष्टया भंडारा जिल्हयाची स्थिती भारताच्या मध्यभागात, महाराष्ट्र राज्याच्या पुर्व भागात सागरापासून दूर खंडाच्या अंतर्गत भागात व वैनगंगा नदी खोऱ्याच्या मध्य भागात आहे. भंडारा प्रदेशाचा अक्षवृत्तीय विस्तार २०°३९' ते २१°३८' उत्तर व रेखावृत्तीय विस्तार ७९°२७' पूर्व ते ८०°४२' पूर्व आहे. या प्रदेशाची उत्तर दक्षिण लांबी १०३ कि.मी. व पूर्व पश्चिम लांबी सुमारे ४५ किमी आहे. भंडारा जिल्हयाने एकुण ४४२७.५९ चौ.कि.मी. क्षेत्र व्यापलेले आहे.

जिल्हयात विविध भूरूपिकीय क्रियांमुळे नमुनेदार भुरूपे विकसित झालेली आहेत. भंडारा जिल्हयाची भूप्राकृतिक रचना दर्शवितो. प्राकृतिक दृष्टया भंडारा जिल्हा दख्खनच्या पठाराच्या पुर्वेकडील वैनगंगा नदी खोऱ्याचा मध्यभाग मानला जातो. हा मैदानी प्रदेश अतिप्राचीन आर्कियन खडकांचे बिधारण, खनन, वहन व संचयन कार्यामुळे तयार झालेला आहे. या विस्तृत मैदानी भागास वैनगंगेचे मैदान असे म्हणतात.



भूशास्त्रीय दृष्टया भंडारा जिल्हा प्रामुख्याने अतिप्राचीन आर्कियन खडकाने व्यापलेला आहे. यात मुख्यतटक्के रूपांतरित अग्निजन्य आणि रूपांतरीत खडकांचा समावेश आहे. उदा. शिष्ट, फिलाईट, निसेस व ग्रेनाईट खडकांचा समावेश होतो. भंडारा प्रदेशातून वाहणारी वैनगंगा नदी व तिला येऊन मिळणाऱ्या बावनथडी, सुर, कन्हान, चुलबंद व मरू इत्यादी उपनदया व त्यांच्या सहाय्यक नदया यांच्या वाहण्याच्या विशिष्ट क्रमामुळे वृक्षाकार नदीप्रणालीची निर्मिती झाली आहे. वैनगंगा व तिला येऊन मिळणाऱ्या नदयांनी आपआपल्या खोऱ्याचा विकास केला आहे. भंडारा प्रदेशातील मृदा अग्निजन्य व रूपांतरित खडकांपासून तयार झाल्या आहेत. यात ग्रेनाईट, निसेस व शिष्ट या खडकांचा समावेश होतो. तर नदीकाठावरील मृदा वैनगंगा व तिच्या उपनदयांनी वाहून आणलेल्या गाळाच्या संचयनापासून तयार झालेल्या आहेत. भंडारा व निकटवर्ती प्रदेशातील मृदेचे तिच्या गुण वैशिष्टयानुसार खालील प्रकारात वर्गीकरण केलेले आहेत. पद्ध वाळूयुक्त लाल मृदा पपद्ध लोमी लाल मृदा पपपद्ध मध्यम काळी मृदा. हवामानाचा प्रभाव प्रत्यक्षपणे भू—आकृती प्रक्रिया, नैसर्गिक वनस्पती, पिक पद्धती, मानवी व्यवसाय, घरांचे प्रकार, राहणीमान इत्यादी घटकांवर पडतो. उष्ण व कोरडा उन्हाळा, हिवाळा ऋतु थंड व कोरडा, हिवाळा—डिसेंबर ते फेब्रुवारी, उन्हाळा मार्च ते मध्य जुन, पावसाळा जुन ते सप्टेंबर आणि ऑक्टोंबर नोव्हेंबर मान्सुनेत्तर ऋतूचा काळ असतो.

जिल्हयात मे महिन्यात मासिक सरासरी कमाल तापमान ४७.५° सेल्सिअस पर्यंत वाढते. जून नंतर भंडारा प्रदेशात नोव्हेंबर ते फेब्रुवारी महिन्यात हिवाळा ऋतू सुरू असतांना मासिक सरासरी कमाल (३१.८° सेल्सिअस) व किमान (९.७° सेल्सिअस) तापमानात घट होत असल्याने हवामान अतिशय आल्हाददायक असते. डिसेंबर सर्वाधिक थंड महिना असतो. पावसाळयात आर्द्रतेचे प्रमाण ७० टक्के असते. उन्हाळयात आर्द्रतेचे प्रमाण कमी होत असल्यामुळे उन्हाळा उष्ण व कोरडा असतो.

- **विहिरीद्वारे जलसिंचीत क्षेत्रात झालेला बदल : १९८१—२०११**

भंडारा जिल्ह्यतील १९८१ ते २०११ या कालावधीतील एकूण जलसिंचीत क्षेत्रात विहिरीव्दारे होणाऱ्या सिंचन

क्षेत्राचे शेकडा प्रमाण पुढील सारणीत दिलेले आहे. यावरून सिंचनखालील क्षेत्रातील बदल लक्षात येतो.

विहिरीव्दारे जलसिंचीत क्षेत्र : १९८१—२०११
(क्षेत्र हेक्टर मध्ये)

अ. क्र.	तालुके	एकूण जल सिंचीत क्षेत्र	१९८१	१९९१	२००१	२०११
			विहिरीव्दारे जल सिंचीत क्षेत्र शे.प्र.	विहिरीव्दारे जल सिंचीत क्षेत्र शे.प्र.	विहिरीव्दारे जल सिंचीत क्षेत्र शे.प्र.	विहिरीव्दारे जल सिंचीत क्षेत्र शे.प्र.
१	भंडारा	९१०४	६.३४	९.६८	१८.२२	१८.२१
२	मोहाडी	१०५५०	११.४८	६.१२	१३.३४	१५.०५
३	तुमसर	१४४३८	५.५६	११.९९	१४.७३	१८.०५

४	साकोली	१६७४८	३.२१	१.०२	५.८५	७.४८
५	लाखनी	उ.ना.	उ.ना.	उ.ना.	उ.ना.	२२.६८
६	पवनी	६९२२	१८.५६	२६.६०	४८.०७	१७.३९
७	लाखांदूर	८२४७	७.८७	९.९२	२९.०३	७.५५
एकूण		**६६००९**	**७.६७**	**९.१३**	**१९.९२**	**१५.३०**

१९८१ या वर्षी जिल्ह्यत एकूण जलसिंचीत क्षेत्र ६६००९ हे. असून यापैकी ५०६३ हे. क्षेत्राला विहिरीद्वारे पाणीपुरवठा केला जातो. एकूण जलसिंचीत क्षेत्राच्या तुलनेत याचे प्रमाण केवळ ७.६७ टक्के आहे. १९९१ वर्षी एकूण जलसिंचीत क्षेत्रात किंचीत वाढ झालेली आहे. यावर्षी एकूण जलसिंचीत क्षेत्र ६९८३८ हे. एवढे झाले. यातील ६३७९ हे. क्षेत्रावर विहिरीद्वारे पाणीपुरवठा केला जातो. एकूण साधनांच्या प्रमाणात हे प्रमाण ९.१३ टक्के आहे. तर २००१ यावर्षी एकूण जलसिंचीत क्षेत्रात जवळपास दुप्पटीने वाढ झाली आहे. १२३६६९ हे. क्षेत्र सिंचनाखाली आहे. यापैकी २४६३१ हे. क्षेत्र विहिरीद्वारे सिंचीत आहे. १९९१ च्या तुलनेत ही वाढ जवळपास चारपट आहे. २०११ यावर्षी एकूण जलसिंचीत क्षेत्र १२८१६५ हे. एवढे असून त्यामध्ये विहिरीद्वारे १९६०७ हे. एकूण क्षेत्राच्या तुलनेत याचे प्रमाण १५.३० टक्के आहे. १९८१ ते २०११ या कालावधीत जिल्ह्यतील प्रत्येक तालुक्यात विहिरीद्वारे सिंचन क्षेत्रात वाढ झालेली दिसून येते. परंतु ही वाढ सर्वत्र सारखी नाही. १९८१ ला पवनी तालुक्याचे एकूण सिंचन क्षेत्र इतर तालुक्याच्या तुलनेत कमी असले तरी या तालुक्यात विहिरीद्वारे सिंचनाखलील क्षेत्र इतर तालुक्यांच्या तुलनेत सर्वाधिक म्हणजेच १८.५६ टक्के (१२८५ हे.) आहे.

१९९१ या वर्षी सुद्धा विहिरीद्वारे पवनी तालुक्यात सर्वाधिक क्षेत्र सिंचीत केले जाते. आणि क्षेत्रामध्ये जवळपास ०८ टक्कनी वाढ झालेली आहे. त्याचप्रमाणे साकोली तालुक्यात सर्वात कमी क्षेत्र विहिरीद्वारे सिंचीत केले जाते. त्याचे प्रमाण केवळ १.०२ टक्के एवढे आहे. २००१ वर्षी विहीर सिंचनात पवनी तालुक्याने आपला क्रम कायम राखला आहे. तर त्या पाठोपाठ लाखांदूर तालुक्याचा क्रम लागतो. त्याचे एकूण स्त्रोतांच्या तुलनेत शेकडा प्रमाण अनुक्रमे ४८.०७ टक्के व २९.०३ टक्के एवढे आहे. तसेच साकोली तालुक्यात यावर्षी सुद्धा खूपच कमी प्रमाणात विहिरीद्वारे सिंचन केले जाते. २०११ ला भंडारा तालुक्यात विहीर सिंचनात लक्षणीय वाढ झाली आहे. येथे एकूण सिंचनामध्ये विहिरींचा वाटा १८.२१ टक्के झाला आहे. त्यासोबतच तुमसर तालुक्यात सुद्धा विहिर सिंचन क्षेत्रात वाढ झाली असून येथील सिंचन क्षेत्रात १८.०५ टक्के वाटा विहिरीचा आहे. यावरून असे दिसून येते की, पवनी तालुक्यातील एकूण सिंचन क्षेत्र कमी असले तरी सुरवातीपासूनच या तालुक्यात विहिरीद्वारे सिंचीत क्षेत्राचे प्रमाण सर्वाधिक आहे. परंतू २०११ यावर्षी यामध्ये किंचीत घट झाली आहे. तर भंडारा आणि तुमसर तालुक्यात विहिर सिंचन क्षेत्रात वाढ झाली आहे.

- **कुपनलिकाद्वारे जलसिंचीत क्षेत्रात झालेला बदल : १९८१—२०११**

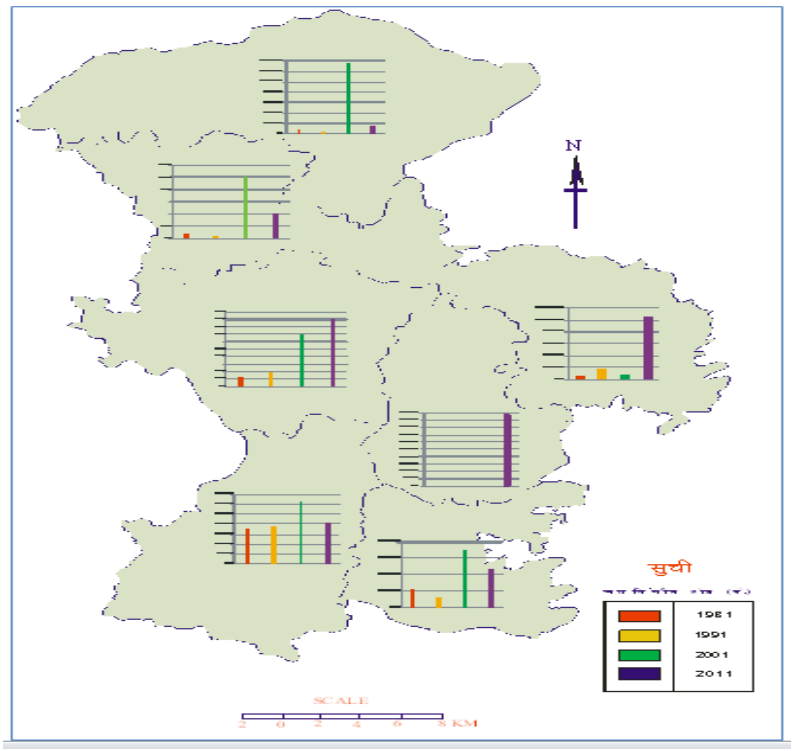
भंडारा जिल्ह्यतील तालुकानिहाय कुपनलिकेद्वारे जलसिंचीत क्षेत्र पुढील सारणीत दिलेले आहे. यामध्ये १९८१ ते २०११ या कालावधीतील कुपनलिकांचा जलसिंचीत क्षेत्रातील शेकडा प्रमाण लक्षात घेतला आहे.

कुपनलिकांव्दारे जलसिंचीत क्षेत्र : १९८१—२०११
(क्षेत्र हेक्टर मध्ये)

अ. क्र.	तालुके	एकूण जलसिंचीत क्षेत्र	१९८१	१९९१	२००१	२०११
			कुपनलिकांव्दारे जलसिंचीत क्षेत्र शे.प्र.	कुपनलिकांव्दारे जलसिंचीत क्षेत्र शे.प्र.	कुपनलिकांव्दारे जलसिंचीत क्षेत्र शे.प्र.	कुपनलिकांव्दारे जलसिंचीत क्षेत्र शे.प्र.
१	भंडारा	९१०४	२.६९	४.४७	८.१२	७.५९
२	मोहाडी	१०५५०	८.३६	२.८२	३२.८३	१५.१८
३	तुमसर	१४४३८	५.२१	३.००	४९.८३	८.२३
४	साकोली	१६७४८	३.६५	१०.६२	६.५३	७४.८९
५	लाखनी	उ.ना.	उ.ना.	उ.ना.	उ.ना.	३.९३
६	पवनी	६९२२	२५.६७	२३.६६	२०.८७	१४.२५
७	लाखांदूर	८२४७	२८.४३	१७.५७	३७.९०	२७.४२
एकूण		**६६००९**	**१०.०२**	**८.९२**	**२९.१९**	१९.७२

१९८१ वर्षी जिल्ह्यत ६६१३ हे. क्षेत्र कुपनलिकाद्वारे सिंचनाखाली होते. इतर स्त्रोतांच्या तुलनेत हे प्रमाण केवळ १०.०२ टक्के आहे. १९९१ ला कुपनलिकाद्वारे होणाऱ्या सिंचीत क्षेत्रात घट झाली असून केवळ ६२२९ हे. क्षेत्र याद्वारे सिंचीत केले जाते. इतर स्त्रोतांशी याचे प्रमाण फक्त ८.९२ टक्के आहे. २००१ ला एकूण जलसिंचीत क्षेत्रात लक्षणीय वाढ झालेली आहे. त्यानुसार कुपनलिकाद्वारे सिंचीत क्षेत्रातसुद्धा वाढ झाली आहे. यावर्षी ३६०९४ हे. क्षेत्राला कुपनलिकाद्वारे पाणीपुरवठा केला जातो. इतर स्त्रोतांशी त्याचे प्रमाण २९.१९ टक्के आहे. तर २०११ यावर्षी यामध्ये किंचीत घट झाल्याचे दिसून येते. एकूण साधनांमध्ये कुपनलिकांचा वाटा २२.५५ टक्के आहे.

१९८१ वर्षी तालुकानिहाय कुपनलिकाद्वारे जलसिंचीत क्षेत्राचा विचार करता लाखांदूर तालुक्यात सर्वाधिक २८.४३ टक्के क्षेत्र याद्वारे सिंचीत केले जाते. तर सर्वात कमी भंडारा तालुक्यात २४५ हे. क्षेत्र म्हणजेच एकूण साधनांच्या तुलनेत केवळ २.४९ टक्के क्षेत्र कुपनलिकेद्वारे सिंचीत आहे.



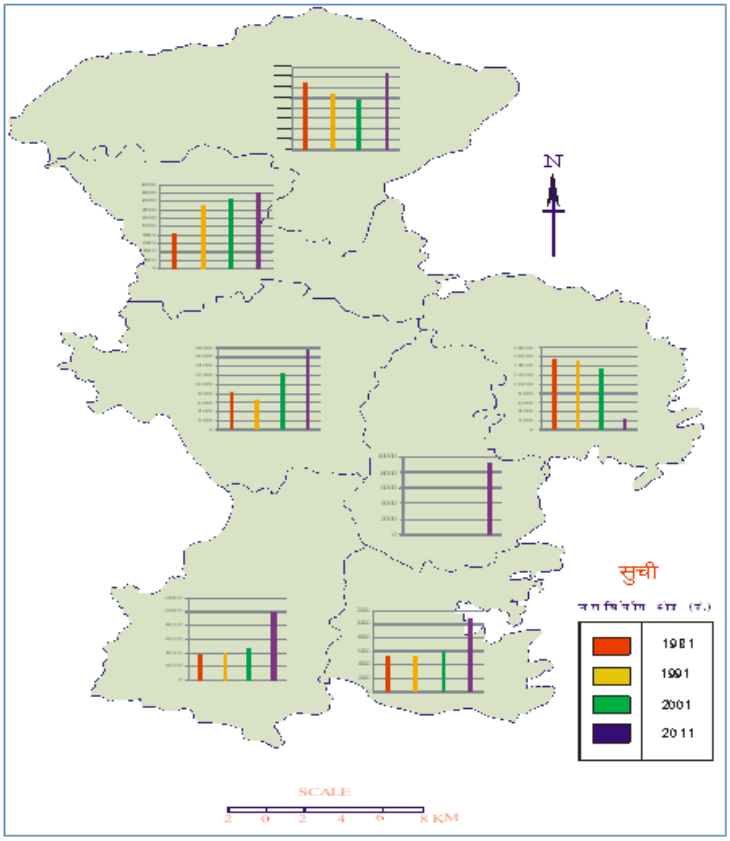
१९९१ वर्षी पवनी आणि लाखांदूर तालुक्यातील कुपनलिकाद्वारे सिंचीत क्षेत्र सर्वाधिक असले तरी १९८१ च्या तुलनेत त्यामध्ये घट झालेली आहे. हे क्षेत्र अनुक्रमे २३.६६ टक्के व १७.५७ टक्के एवढे आहे. परंतु भंडारा आणि साकोली तालुक्यात या क्षेत्रात वाढ झाली आहे. याचे प्रमाण अनुक्रमे ४.४७ टक्के व १०.६२ टक्के एवढे आहे.

२००१ यावर्षी कुपनलिकाद्वारे सिंचीत क्षेत्रात जवळजवळ सर्वच तालुक्यात वाढ झाली आहे. आणि ही वाढ लक्षणीय स्वरूपाची दिसून येते. यावर्षी तुमसर तालुक्यामध्ये सर्वाधिक ४.८३ टक्के क्षेत्र कुपनलिकाद्वारे सिंचीत केले जाते. तर त्यानंतर लाखांदूर तालुक्यात ३७.९० टक्के क्षेत्र कुपनलिकाद्वारे सिंचीत केले जाते. सर्वात कमी क्षेत्र साकोली तालुक्यातील असून ते ६.३३ टक्के आहे. २०११ यावर्षी इतर तालुक्याच्या तुलनेत लाखांदूर तालुक्यातील सर्वाधिक क्षेत्र (३७.८१ टक्के) कुपनलिकाद्वारे सिंचीत केले जाते. त्यानंतर पवनी तालुक्याचा क्रम लागतो. येथे ३६.८४ टक्के क्षेत्र कुपनलिकाद्वारे सिंचीत केले जाते तर सर्वात कमी प्रमाण मोहाडी तालुक्यात आहे. येथे केवळ १४.२२ टक्के क्षेत्र कुपनलिकाद्वारे सिंचीत केले जाते.

यावरून १९८१ ते २०११ या तीस वर्षाच्या कालावधीत कुपनलिकांद्वारे सिंचीत क्षेत्रात भंडारा तालुक्यामध्ये सतत वाढ होत गेली. मोहाडी तालुक्याचा विचार करता १९९१ ला यामध्ये घट झाली आणि २००१ ला कुपनलिकाद्वारे सिंचीत क्षेत्रात वाढ झाली. तर २०११ यावर्षी या क्षेत्रात किंचीत घट झाली. तुमसर तालुक्यामध्ये १९८१ ला ५.२१ टक्के क्षेत्र कुपनलिकेद्वारे सिंचीत होते. यापुढील वर्षात म्हणजेच १९९१ ला या क्षेत्रात घट होऊन त्याचे शेकडा प्रमाण ३.०० टक्के एवढे आहे. २००१ मध्ये कुपनलिकाद्वारे सिंचीत क्षेत्रात लक्षणीय वाढ झाल्याचे दिसून येते. एकंदरीत विचार करता कुपनलिकेद्वारे सिंचनाच्या बाबतीत लाखांदूर तालुका इतर तालुक्यांच्या तुलनेत अग्रेसर राहिला आहे.

भूपृष्ठीय स्त्रोताद्वारे जलसिंचीत क्षेत्रात झालेला बदल: १९८१—२०११: भंडारा जिल्ह्यतील तालुकानिहाय भूपृष्ठीय स्त्रोताद्वारे होणारे जलसिंचीत क्षेत्र व त्यातील बदल पुढील सारणीत दिलेले आहे.

अ. क्र.	तालुके	एकूण जलसिंचीत क्षेत्र	१९८१	१९९१	२००१	२०११
			भूपृष्ठीय जल सिंचीत क्षेत्राचे शे.प्र.	भूपृष्ठीय जल सिंचीत क्षेत्राचे शे.प्र.	भूपृष्ठीय जल सिंचीत क्षेत्राचे शे.प्र.	भूपृष्ठीय जल सिंचीत क्षेत्राचे शे.प्र.
१	भंडारा	९१०४	९०.९७	८५.८५	७३.६५	७४.१९
२	मोहाडी	१०५५०	८०.१६	९१.०५	५३.८२	६९.७७
३	तुमसर	१४४३८	८९.२३	८५.०१	३५.४३	७३.७२
४	साकोली	१६७४८	९३.१३	८८.३६	८७.६२	१७.६३
५	लाखनी	उ.ना.	उ.ना.	उ.ना.	उ.ना.	७३.३९
६	पवनी	६९२२	५५०७६	४९.७३	३१.०६	६८.३६
७	लाखांदूर	८२४७	६३०७०	७२.५१	३३.०७	६५.०३
एकूण		**६६००९**	**६६००९**	**८१.९५**	**५०.९०**	६४.९८



१९८१ ला भंडारा, मोहाडी, तुमसर, साकोली या तालुक्यातील जलसिंचीत क्षेत्रात भूपृष्ठीय स्त्रोतांचा हिस्सा सर्वाधिक आहे. परंतु १९९१ व २००१ या वर्षामध्ये भूपृष्ठीय स्त्रोतांद्वारे जलसिंचीत क्षेत्रात व शेकडा प्रमाणात उत्तरोत्तर घट होत गेली. या तालुक्यातील प्रमाण अनुक्रमे ९० टक्के ते ९३ टक्के वरून ५० टक्के ते ५५ टक्के पर्यंत कमी झाले आहे. परंतु पवनी आणि लाखांदूर तालुक्यातील भूपृष्ठीय स्त्रोताद्वारे जलसिंचीत क्षेत्रात आणि शेकडा प्रमाणात २००१ हे वर्ष वगळता सतत घट होत गेली. २०११ मध्ये तर भूपृष्ठीय स्त्रोतांचा जलसिंचनातील वाटा सर्वाधिक आहे. तो अनुक्रमे ३८. ३६ टक्के व ६५.०३ टक्केएवढा आहे.

संपूर्ण जिल्ह्याच्या बाबतीत विचार करता १९८१ ते २०११ या कालावधीत भूपृष्ठीय जलसिंचीत क्षेत्रात सतत वाढ होत गेली. १९ ८१ ला जिल्ह्यत भूपृष्ठीय जलसिंचीत क्षेत्र ५४३३३ हे. होते ते २०११ पर्यंत वाढून ७०६१० हे. पर्यंत पोहोचले. परंतु इतर स्त्रोतांशी असणाऱ्या शेकडा प्रमाणात सतत घट झालेली आहे. ८२.३१ टक्के वरून ते ५५.०९ टक्के पर्यंत कमी झालेले आहे.

सारांश व निष्कर्ष :

१. १९८१ ते २०११ या कालावधीत जिल्ह्यतील एकूण सिंचीत क्षेत्रात सतत वाढ झालेली आहे.
२. या कालावधीत विहिरीद्वारे जलसिंचीत क्षेत्रात व शेकडा प्रमाणात वाढ झाली आहे.
३. कुपनलिकेद्वारे सिंचीत क्षेत्रात सुरवातीला घट नंतर वाढ आणि परत घट झालेली दिसून येते.
४. भूपृष्ठीय जलसिंचीत क्षेत्रात काही तालुक्यात सतत घट झाली आहे. तर काही तालुक्यात वाढ झाली आहे.
५. विहीर व कुपनलिका या स्त्रोतांची संख्या जास्त आहे. त्या तुलनेत भूपृष्ठीय स्त्रोतांची संख्या कमी आहे.
६. भूपृष्ठीय स्त्रोतांची संख्या कमी असली तरी यांची सिंचनाची क्षमता सर्वाधिक आहे. कारण विहीर आणि कुपनलिका मर्यादित क्षेत्राला सिंचीत करू शकतात. तर भूपृष्ठीय स्त्रोत विस्तृत क्षेत्रात सिंचन करू शकतात.

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सारांश:

हा प्रदेश धार्मिक व प्राकृतिक पर्यटनाच्या दृष्टीने अतिशय महत्वाचा आहे. या भागातील पर्यटनावर प्राकृतीक व सांस्कृतिक घटकाचा विशेष प्रभाव झालेला आहे. पर्यटनाच्या दृष्टीने हे क्षेत्र अनुकुल आहे. या क्षेत्रात पर्यटनाच्या आधारभुत सोयी—सुविधा मोठया प्रमाणावर विकसित झाल्या आहेत. सांस्कृतिक पर्यटन व नैसर्गिक पर्यटन, दोन्ही मोठया प्रमाणावर विकसित झालेले आहे. रस्ते मार्ग, रेल्वे मार्ग, विमाण सेवा, लॉजिंग व हॉटेलींग सुविधा, इ. सुविधा विकसित झाल्या आहेत. त्यामुळे हे क्षेत्र पर्यटनाच्या दृष्टीने महत्वाचे आहे. परिणामत: येथे पर्यटक मोठया प्रमाणावर भेटी देतात. या क्षेत्रात अनेक आंतरराष्ट्रीय पर्यटन केंद्राचा विकास झालेला आहे.

बिजशब्द :— सांस्कृतिक पर्यटन, नैसर्गिक पर्यटन

प्रस्तावना :—

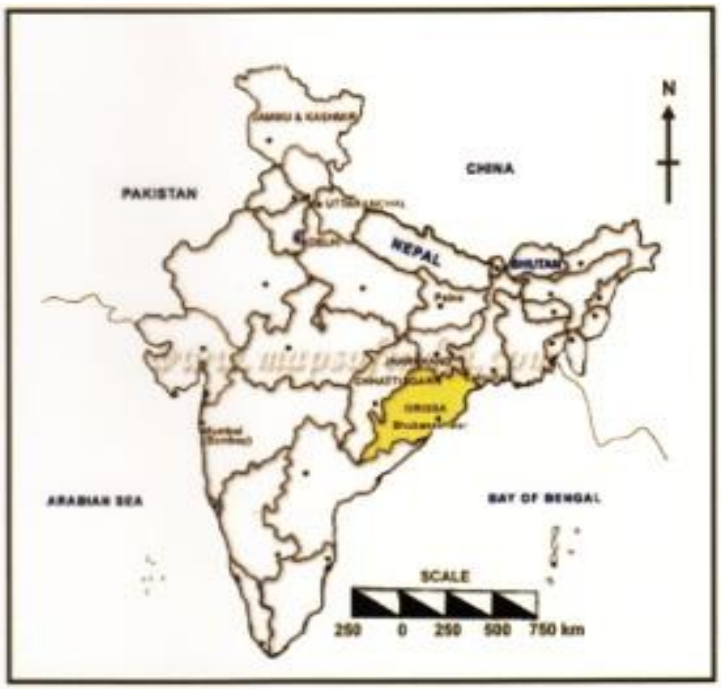
भूगोल हे अत्यंत व्यापक, यथार्थ व वास्तविक स्वरूपाचे एक विज्ञान आहे. भूगोलशास्त्राच्या अध्ययनाची सुरूवात ही अतिप्राचीन काळापासून झाली आहे. ज्या कालखंडात मानव अविकसित अवस्थेत होता, त्यास सभोवतालच्या पर्यावरणाचे ज्ञान अवगत नव्हते. वेगवेगळया प्रदेशात भटकत असतांना त्याला पर्यावरणात भिन्नता दिसून येत होती व पर्यावरणात वेगवेगळे बदल होत असल्याचे त्यास दिसत होते. (उदा. दिवस—रात्र, वारा, ढग, पर्जन्य इ.) तसेच कोणत्याही दोन प्रदेशात सारखेपणा नाही हेही त्यास जाणवू लागले होते. त्यातूनच त्यांच्या मनात या गोष्टी जाणून घेण्याची जिज्ञासा निर्माण झाली. या जिज्ञासेतूनच मानवाने भौगोलिक घटकाबद्दल विचार व निरीक्षण करण्यास सुरूवात केली.

प्राचीन संस्कृतीचा उदय व विकासाबरोबर भूगोल शास्त्राच्या विकासाला गती मिळत गेली. त्यातून क्रमाक्रमाने विविध संकल्पना व वैज्ञानिक सिद्धांत मांडण्यात येऊ लागले. आणि भूगोल विषयाचा विकास वेगाने होऊ लागला. भूगोल या विषयाचा अभ्यास करण्यासाठी तसेच त्याचे स्वरूप समजून घेण्यासाठी पुस्तकाची मदत नक्की होते परंतु कोणत्याही क्षेत्राची खरी परिस्थिती निरीक्षणाद्वारे चांगल्या रितीने स्पष्ट होऊ शकते. उंच पर्वत, शिखरे, सखल मैदाने, वेगवान नद्या व नैसर्गिक बंदरासाठी अनुकुल असा समुद्रकिनारा इत्यादी विविधतेमुळेच भूगोल विषयाचा सखोल अभ्यासाला सुरूवात झाली व त्यातूनच पर्यटन क्षेत्राचा विकास होण्यास मदत झाली.

प्राकृतिक दृश्य, पर्वत, पठार, हिरवेगार मैदान, हिमनद्या, नद्या, वनस्पती आणि प्राणी यातील विभिन्नता मानवाला आपल्याकडे आकर्षित करते. जगातील सर्वात जास्त पर्यटन हे नैसर्गिक स्थळांना पाहण्यासाठी होते. मानवाला एकाकी जीवन व निराशा यातून मुक्त होण्यासाठी पर्यटन हे चांगले माध्यम आहे. जर्मन भूगोल तज्ञ फ्रेड्रिक रॅटझेल यांनी असे मत मांडले आहे की, ष्ष्ज्तंअमससमकए ए ेामजलबीमकए ए कमेबतपइमक जीने ए ूे समक जव जीम कमेबतपचजपवद व िदंजनतमष

''मी प्रवास केला, मी रेखाटन केले, मी वर्णन केले आणि अशा रितीने निसर्गाचे वर्णन करण्यास मी आकर्षित झालो.'' हे कथन भूगोलाच्या अध्ययन पद्धतीकडे स्पष्टपणे संकेत करणारे आहे. ''प्रत्येक भूगोल अभ्यासक हा नेहमी चांगला निरीक्षक असायला हवा'' असे म्हटले जाते. भारताच्या पूर्व—आग्नेय किनारपट्टीवरील ओडिसा या राज्यातील काही भौगोलिक व पर्यटन स्थळांना भेट दिल्या.

२) अभ्यासक्षेत्र (स्थान व स्थिती) :—



या राज्याचा अक्षांशिय विस्तार १७°४५' उत्तर ते २२°४५' उत्तर असून रेखावृत्तीय विस्तार ८१°१५' पूर्व ते ८७°३०' पूर्व आहे. ओडिसा राज्याचे क्षेत्रफळ १,५५,७०७ चौ.कि.मी. आहे. भुवनेश्वर ही ओडिसा राज्याची राजधानी आहे. या राज्यात एकुण ३० जिल्हे आहेत. या राज्याच्या पुर्व भागात सदर पर्यटन केंद्रे आहेत.

संकल्पना :—

''जगन्नाथ पुरी, कोणार्क, भुवनेश्वर, चिल्का सरोवर, नन्दनकानन राष्ट्रीय उद्यान, खण्डगिरी—उदयगिरी गुफा या पर्यटन केंद्राची भौगोलिक परिस्थिती सांस्कृतिक घटक, रस्त्यांचा विकास, राहण्याची सुविधा इत्यादी अनेक घटकांच्या अनुकूलतेमुळे विकास झालेला आहे.''

क्षेत्रिय भ्रमण हे भूगोलाचे मुख्य अंग असून याद्वारे वेगवेगळया स्थळाचे नवीन ज्ञान प्राप्त करता येते. प्राचीन काळात देखील भूगोलाचा क्षेत्रिय भ्रमण व निरीक्षणाद्वारे अभ्यास केला जात होता. यातूनच पर्यटनाचा विकास होण्यास सुरूवात झाली.

फोएनेसिअन व सुमेरियन हे खऱ्या अर्थाने आधुनिक प्रवासी समजले जातात. त्यांनी आर्थिक क्रियेतुन व्यापार करण्यासाठी देश—विदेशात प्रवास केला.

निसर्ग सौंदर्याचा आकर्षणामुळे मनुष्य निसर्गाचा मनसोक्त आनंद घेण्यासाठी प्रवासाची सुरूवात करतो. प्राचीन काळापासून मनुष्याला प्रवासाविषयीचे आकर्षण आहे. परंतु तो प्रवास आनंद घेण्यासाठी होत नसून फक्त नवीन प्रदेशाचा शोध घेणे व व्यापार करणे हा एक हेतू असतो. नंतर जगातील विविध भागात हळूहळू नवीन व्यापारी मार्ग अस्तीत्वात आले व प्रवासाला गती प्राप्त झाली. या अनुषंगाने मी भारताच्या पूर्व—आग्नय किनारपट्टीवरील ओडिसा राज्यातील उपरोक्त भौगोलिक पर्यटन स्थळांना भेटी देऊन सदर अध्ययन करण्यात आले.

उद्देश :—

- भारताच्या पूर्व किणारपट्टीवरील ठिकाणांच्या भौगोलिक परिस्थितीचे अध्ययन करणे.
- पर्यटन स्थळांच्या विकासाचे अवलोकन करणे.

- पर्यटन स्थळाच्या विकासास कारणीभूत पार्श्वभूमीचे विवेचन करणे.
- रस्ते, विकास व हॉटेलिंगचा अभ्यास करणे.

अध्ययन पद्धती :—

ओडिसा हे ठिकाण भौगोलिक सहलीच्या दृष्टिकोनातून निवडल्या गेले. सर्वसाधारणपणे भौगोलिक सहल ही केवळ निरीक्षण किंवा अवलोकनावर अवलंबून असते. त्यामुळे तेथील भौगोलिक निरीक्षण पद्धतीचा उपयोग केला.

ओडिसा राज्याची भौगोलिक पार्श्वभूमी :—

इतिहासात ओडिसा हे राज्य विविध नावांनी परिचित आहे. त्यामध्ये कलिंग, उत्कल, कोंगद आणि ओट्रदेश इत्यादी. भारताच्या पुर्व—आग्नेय किनारपट्टीवर स्थित ओडिसा हे राज्य प्राचीन कलाकृती, भव्य मंदिरे, मनोरम हस्तशिल्प आणि विस्तृत फुले आणि फळांनी परिपूर्ण आहे. या राज्यातील समृद्ध वनसंपदा, रमणीय हद, आकर्षक सामुद्रिक विश्राम स्थळ आणि चिल्का सरोवर पर्यटकांसाठी नेहमी आकर्षण राहिले आहे. पुरीतील जगन्नाथ मंदीर, कोणार्कचे सुर्यमंदीर आणि राजधानी भुवनेश्वर येथील लिंगराज मंदिर यांना ओडिसाचे स्वर्णत्रिभुज मानले जाते. सुवर्णरिखा नदीपासुन ऋषीकल नदीपर्यंत ओडिसा किनारी मैदानाचा विस्तार असून त्याला 'उत्कल मैदान' म्हणतात. त्याची लांबी सुमारे ४०० किमी आहे.

उठाव :—

ओडिसा हे राज्य किनारपट्टीय प्रदेशात पसरलेले आहे. या राज्याच्या पुर्वेस बंगालचा उपसागर आहे. तसेच येथे पठारी प्रदेश सुद्धा आहे. चिल्का सरोवराच्या पश्चिम दिशेला महेंन्द्रगिरी पर्वत आहे. त्याची उंची १५०१ मी. आहे. तसेच पुर्वघाट, गजरथ, शेषाचलम, निलगिरी इत्यादी पर्वत आहेत. सर्वसामान्यपणे हा घाटप्रदेश मैदानी स्वरूपाचा आहे. बराचसा भाग दलदल स्वरूपाचा आहे.

हवामान :—

ओडिसा हे राज्य भारताच्या पुर्व किनारपट्टीय प्रदेशात असल्याने तेथील हवामान उष्ण व दमट आहे. ऑक्टोबर ते जून हा पर्यटनाचा काळ असतो. तेथे पावसाचे प्रमाणही जास्त आहे.

तापमान :—

या राज्यातील उन्हाळा या ऋतूतील कमाल तापमान ४९°से. तर किमान तापमान २७°से. असते. तर हिवाळा ऋतूतील कमाल तापमान १६°से. तर किमान तापमान ८°से. पर्यंत असते. येथील जानेवारी महिन्यातील सरासरी तापमान २०° से. तर जुलै मध्ये २५°से. इतके आढळते.

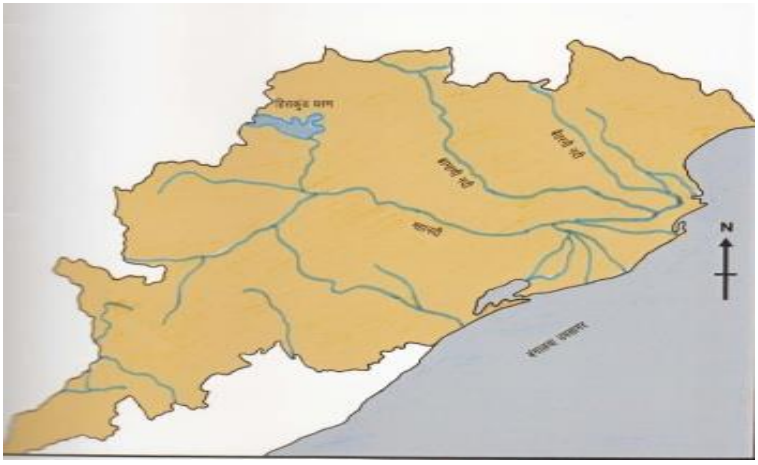
पर्जन्य :—

जुलै ते ऑक्टोबर या महिन्याचा कालावधी पर्जन्याचा आहे. या राज्यातील सरासरी वार्षिक पर्जन्य १०० ते २०० से.मी. इतके आहे. हिवाळा या ऋतुतील समुद्र किनारी प्रदेशातील पर्जन्य २० ते ४० सेमी इतके असते.

पओडिसा राज्यातील नदीप्रणाली :—

या भागातील उतार हा मंद स्वरूपाचा आहे. या राज्याला लागूनच बंगालचा उपसागर उथळ असल्यामुळे याला येऊ मिळणाऱ्या नद्यांच्या मुखाशी त्रिभुज प्रदेशाची निर्मिती झाली आहे. या राज्यातील मुख्य नदी महानदी असुन तिच्यावर हिराकुंड हे धरण आहे. तसेच या ठिकाणी इंद्रावती, सेलेरू, शबरी इ. नद्या सुद्धा आहेत.

ओडिसा राज्याची सांस्कृतिक पार्श्वभूमी :—



ओडिसा या राज्याची राजधानी भुवनेश्वर आहे. या राज्याची प्रमुख भाषा उडिसा असून प्रदेशानुसार बोलीभाषेत भिन्नता आढळते. या राज्यात विविध जमातीचे लोक राहतात. प्रदेशानुसार त्याला भिननता आढळते. ओडिसा या राज्याची एकूण लोकसंख्या ३. ६७.०६.९२० (२०११)इतकी आहे. तसेच तेथील लोकसंख्येची घनता २३६ चौ.कि.मी. आहे. येथील साक्षरतेचे प्रमाण ६३.६१: तसेच लोकसंख्येची दशवार्षिक वाढ १५.९४: आहे. या राज्याची मुख्य भाषा उडिया आहे. राज्याचे दरडोई उत्पन्न ३०६६ इतके आहे. ओडिसा या राज्यात कुरूख, गोंड, खोंड इ. आदिवासी जमाती आढळतात. येथील लोकांचे मुख अन्न भात व मासे आहे. या राज्याचा नृत्यप्रकार ओडिसी आहे. येथे रथयात्रा, ढोलजत्रा, पतुआ जत्रा, चंदक पुजा इत्यादी उत्सव साजरे केले जातात. ओडिसी, चित्रपाडा, धूबपाडा, पांचल इत्यादी नृत्य व संगीत प्रकार आहेत.

रस्ते :—

ओडिसा हे राज्य किनारपट्टीवर स्थित असल्यामुळे येथे जलमार्गाचा विकास झालेला आहे. या ठिकाणी पाराद्वीप हे प्रमुख बंदर आहे. तसेच विमानमार्ग, रेल्वेमार्ग व राष्ट्रीय महामार्गाचा सुद्धा विकास झालेला आहे. या राज्यात राष्ट्रीय महामार्ग क्र. ५,६,४२,४८

इत्यादी महामार्ग या राज्यातुन जातात. त्यामुळे येथे अनेक पर्यटन केंद्राचा विकास झाला आहे. जगाच्या कानाकोपऱ्यातुन पर्यटन येथे सहजतेचे पोहचू शकतात.

पर्यटन क्षेत्रे :—

जगन्नाथ पुरी :—

पुरी हे ठिकाण भुवनेश्वरपासुन ६० किमी अंतरावर आहे. या क्षेत्राचे प्राचीन नाव पुरूषोत्तम क्षेत्र आणि श्री क्षेत्र होते. धार्मिक दृष्टीकोनातूनच नाहीतर पर्यटक येथे बाग, नवे, सरोवर, समुद्र या प्राकृतिक सौंदर्याचा आनंद घेण्यासाठी येतात. आज ज्या ठिकाणी पुरी येथील श्री जगन्नाथ मंदीर आहे तेथे पुर्वी बुद्धाचे दात ठेवलेले होते. म्हणुन त्यावेळेस पुरीला दंतपुर म्हटले जात होते. समुद्रापासुन दिड कि.मी. अंतरावर निलगिरी पर्वतावर श्री जगन्नाथ मंदिर वसलेले आहे.

i) स्थानाचे महत्व :—

श्री. मंदिराचे निर्माण १२ व्या शतकात गंगवंशाचे प्रतापी राजा अनंगभीम देव यांनी केले. जवळपास ८०० वर्ष प्राचीन हे मंदिर प्राचीन स्थापत्यकला आणि शिल्पकला याचे उदाहरण आहे. या मंदिरांची उंची २१४ फुट आणि या मंदीराचा आकार पंचरथ सारखा आहे. या मंदिराच्या चारही बाजूला भिंती आहेत. ज्यांना मेघनाद प्राचीर म्हणतात. याची लम्बाई ६६० फुट आणि उंची २० फुट आहे. या मंदिराचे चार भाग आहेत. विमान, जगमोहन, नाटयमंण्डप आणि भोगमण्डप.

पर्यटन केंद्र विकसीत होण्यास कारणीभुत घटक :—

जगन्नाथ पुरी येथे श्री जगन्नाथचे भव्य मंदिर आहे. भारतातील सर्वात मोठा रथोत्सव येथे साजरा केला जातो. हे स्थळ मंदिरांची नगरी आहे. चार पवित्र धामापैकी श्री जगन्नाथचे धाम हे चौथे धाम आहे. तसेच उत्कृष्ठ गोल्डन बीच आहे. येथे रस्ते व लोहमार्गाचा विकास झालेला आहे.

स्थान :—

पुरी हे शहर ८५°५५' पुर्व रेखावृत्त व १९°४५' उत्तर अक्षवृत्तावर वसलेले आहे.

यवसाय :—

पुरी हे ठिकाण समुद्रकिनाऱ्यावर असल्यामुळे तेथे मोठया प्रमाणात मासेमारी व्यवसाय केला जातो. तसेच पर्यटन स्थळ असल्यामुळे पर्यटन व्यवसाय विकसीत झाला आहे. तसेच शेतीत विविध पिके घेतले जातात. तसेच येथे मोती व शंख—शिंपले, हॅटिल्स यावर आधारीत व्यवसाय केले जातात.

कोणार्क :—

कोणार्क हे स्थळ सूर्य उपासनेचे प्रधान पीठ आहे. ऐतिहासीक आणि पुरातात्वीक दृष्टीने कोणार्क एक महत्वपुर्ण पर्यटन स्थळ आहे.

स्थानाचे महत्व :—

समुद्राच्या सानिध्यात रथाच्या आकाराचे प्राचीन भव्य सूर्यमंदिर आहे. हे मंदिर प्राचीन भारतीय स्थापत्यकला व शिल्पकलेचे अत्युच्च शिखर समजले जाते. सुंदर समुद्रकिनारा यामुळे या स्थळाला अधिक महत्व प्राप्त झाले.

पर्यटन केंद्र विकसीत होण्यास कारणीभुत घटक :—

कोणार्क येथे सूर्यमंदिर आहे, हे मंदिर रथाच्या आकाराचे आहे. या मंदिराच्या चहुबाजुला २४ चक्र आहे. या प्रत्येक चक्रात ८ आरे आहेत. कोणार्क मंदिरात तीन आकृतीचे सूर्यदेवता आहेत. मंदिराच्या दक्षिणेला सूर्यदेवतेला उदित सूर्य ज्याची उंची ८.३ फूट, पश्चिमेला मध्यान्ह सूर्य ज्याची उंची १.७ फुट, उत्तरेला अस्त सूर्य ज्याची उंची ३.४९ मीटर आहे. यामुळे या क्षेत्राचा पर्यटन स्थळ म्हणुन विकास झाला.

स्थान :—

कोणार्क हे ठिकाण ८६°१५' पुर्व रेखावृत्त व १९°५०' उत्तर अक्षवृत्तावर वसलेले आहे.

व्यवसाय :—

या ठिकाणी पर्यटन, कोरीव काम, शंख शिंपले इ. वर आधारीत उद्योग केले जातात.

भुवनेश्वर :—

भुवनेश्वर हे शहर ओडिसाची राजधानी आहे. या शहरात ५०० पेक्षा अधिक मंदिरे आहेत. त्यामुळे यास मंदिराची नगरी म्हणतात. प्राचीन काळात हे मंदिर कलिंग राज्यामध्ये होते. आध्यात्मिक दृष्टीने नाही तर ऐतिहासीक दृष्टीने सुद्धा मशहूर पर्यटन स्थळ आहे. सन १९५० मध्ये उडिसाची राजधानी कटकवरून भुवनेश्वर केली गेली. तेव्हापासून या शहराचे आकर्षण वाढले. इतिहासानुसार सम्राट अशोकने आपले शेवटचे युद्ध येथे

लढले आणि नंतर तो बौद्ध धर्म व अहिंसेचा पुजारी झाला.

स्थानाचे महत्व :—

भुवनेश्वर ही मंदिराची नगरी आहे. येथे पाचशेच्या जवळपास मंदिरे आहेत. येथील लिंगराज मंदिर हे सर्वात मोठे मंदिर आहे. या मंदिराचे निर्माण इ. स. ११०० मध्ये उत्कलचे केशरी वंशी नरेश ललाटेन्दु केशरी यांनी केली. याची उंची १८० फुट आहे. येथे भगवान शंकराचे मंदिर आहे. या मंदिराची कलाकौशल्य सगळयांना आकर्षित करतो. तसेच येथील धऊलीगिरी येथील शान्तिस्तूप यांचे निर्माण जपानी लोकांनी इ.स. १९०० मध्ये केले. मुक्तेश्वर मंदिर याचे निर्माण १० व्या शतकात झाले. इत्यादी विविध मुख्य स्थळे या ठिकाणी आहेत.

पर्यटन केंद्र विकसित होण्यास कारणीभुत घटक :—

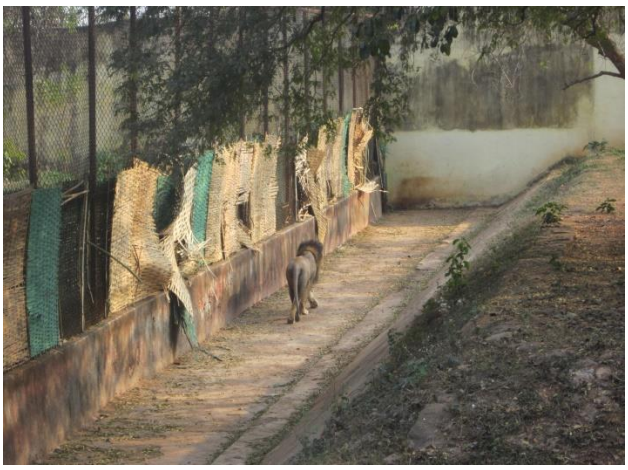
भुवनेश्वर येथे प्रसिद्ध विविध मंदिरे, शांती स्तूप, गुफा आहेत. तसेच या स्थळाला ऐतिहासीक महत्व प्राप्त झाले आहे. त्यामुळे हे स्थळ पर्यटन केंद्र म्हणुन विकसीत झाले आहे. तसेच येथे रस्ते व लोहमार्गाचा विकास झाला आहे. तसेच येथे विमानतळ सुद्धा आहे.

स्थान :—

भुवनेश्वर हे शहर ८५°५०' पूर्व रेखावृत्तावर तसेच २०°३०' उत्तर अक्षवृत्तावर वसलेले आहे.

व्यवसाय :—

भुवनेश्वर हे शहर राजधानीचे शहर असल्यामुळे येथे विविध व्यवसायाचा विकास झाला आहे. त्यामध्ये कारखाने, वस्त्र, पर्यटन, शेतीवर आधारीत लहान—मोठे उद्योग दिले जातात.



नन्दनकानन राष्ट्रीय उद्यान :—

नन्दनकानन पशु संग्रहालय हे भुवनेश्वर पासून २५ किमी अंतरावर आहे. हे ४०० हेक्टर क्षेत्रामध्ये पसरलेले आहे. हे मनोरंजन क्षेत्र आहे. नन्दन कानन वन पशुचे अभयारण्य आहे. नन्दन कानन पशु संग्रहालय बंगाली वाघ आणि पांढरा वाघ यासाठी प्रसिद्ध आहे. हे संग्रहालय सकाळी ८ वाजतापासुन सायंकाळी ५ वाजता पर्यंत चालू असते. हे संग्रहालय सोमवारी बंद असते. येथे एक चिडीयाघर सुद्धा आहे आणि सुंदर सरोवर सुद्धा आहे. या संग्रहालयात विविध प्राणी, पक्षी पाहावयास मिळतात.

चिल्का सरोवर :—

चिल्का सरोवर हे भारतातील खा—या पाण्याचे सर्वात मोठे सरोवर आहे. यात मोठया प्रमाणावर डाल्फिन बघायला मिळतात. त्यामुळे हे पर्यटकासाठी आकर्षणाचे केंद बनले आहे. येथे पोचण्यासाठी आवश्यक सुविधा उपलब्ध आहेत. येथे हॉटेलींगची सुविधा सुध्दा मोठया प्रमाणावर विकसित झाली आहे.

सारांश :—

या भागाचे निरीक्षण केले असता असे लक्षात येते की, हा प्रदेश धार्मिक व प्राकृतिक पर्यटनाच्या दृष्टीने अतिशय महत्वाचा आहे. या भागातील पर्यटनावर प्राकृतीक व सांस्कृतिक घटकाचा विशेष प्रभाव झालेला आहे. पर्यटनाच्या दृष्टीने हे क्षेत्र अनुकुल आहे. या क्षेत्रात पर्यटनाच्या आधारभुत सोयी—सुविधा मोठया प्रमाणावर विकसित झाल्या आहेत. सांस्कृतिक पर्यटन व नैसर्गिक पर्यटन, दोन्ही मोठया प्रमाणावर विकसित झालेले आहे. रस्ते मार्ग, रेल्वे मार्ग, विमाण सेवा, लॉजिंग व हॉटेलींग सुविधा, इ. सुविधा विकसित झाल्या आहेत. त्यामुळे हे क्षेत्र पर्यटनाच्या दृष्टीने महत्वाचे आहे. परिणामत: येथे पर्यटक मोठया प्रमाणावर भेटी देतात.

संदर्भ ग्रंथ :—

१) पर्यटन भूगोल — प्रा. डॉ. प्रभाकर मारोतराव नाकतोडे, प्रा. डॉ. दिगांबर पारधी, विद्या प्रकाशन, नागपूर.

२) पर्यटन भूगोल — डॉ. सुनिता शंकरराव शिंदे, एज्युकेशनली पब्लिशर्स, औरंगाबाद.

३) महाराष्ट्र पर्यटन कोश — र.य. साने, विद्या विकास पब्लीशर्स, नागपूर.

४) पर्यटन भूगोल — डॉ. विठ्ठल घारपूरे.

५) प्राथमिक स्त्रोत — प्रत्यक्ष भेटी.

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गोंदिया जिल्ह्यतील पीक प्रारुपाचे अभिक्षेत्रीय विश्लेषण

कीशोरकुमार हूकरे
अशोक मोहरकर कला आणि वानिज्य महाविद्यालय, अडयाळ, भंडारा, महाराष्ट्र
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DOI- 10.5281/zenodo.11274871

सारांश

गोंदिया जिल्ह्यतील प्रमुख पीक तांदूळ असून सर्वत्र एक पीकप्रणाली (डवदवबनसजनतम) आढळते. त्याचे मुख्य कारण हे की येथे तापमान व पर्जन्याची विपुल प्रमाणात उपलब्धता होय. परिणमता: या प्रदेशात तांदुळ पीकाचे केंद्रिकरण उच्च स्वरुपाचे असून तांदुळाचा केद्रिकरण निर्देशांक १.०० पेक्षा जास्त आहे. तांदुळानंतर गव्हु पीकाचे केंद्रिकरण झालेले असून त्याचा निर्देशांक सुध्दा १.०० पेक्षा जास्त आहे. याव्यतीरीक्त जिल्हयात थोडयाफार प्रमाणात भाजीपाल्याचे पीके, डाळी, रब्बी ज्वारी व तेलबिया, इ. पीकांचे केंद्रिकरण झालेले आहे.

बिजशब्द :— पीकप्रणाली, पीकांचे केंद्रिकरण व पीक प्रारुप

प्रास्ताविक

कोणत्याही प्रदेशातील पीक प्रारूप हे त्याठीकाणच्या नैसर्गिक, सामाजिक व आर्थिक घटकांमूळे निश्चित होत असते. नैसर्गिक घटक साधारणपणे स्थिर असतो परंतु सामाजिक व आर्थिक घटकात मात्र सतत बदल होत असते, परिणामत: पीक प्रारूपही बदलत असतो.

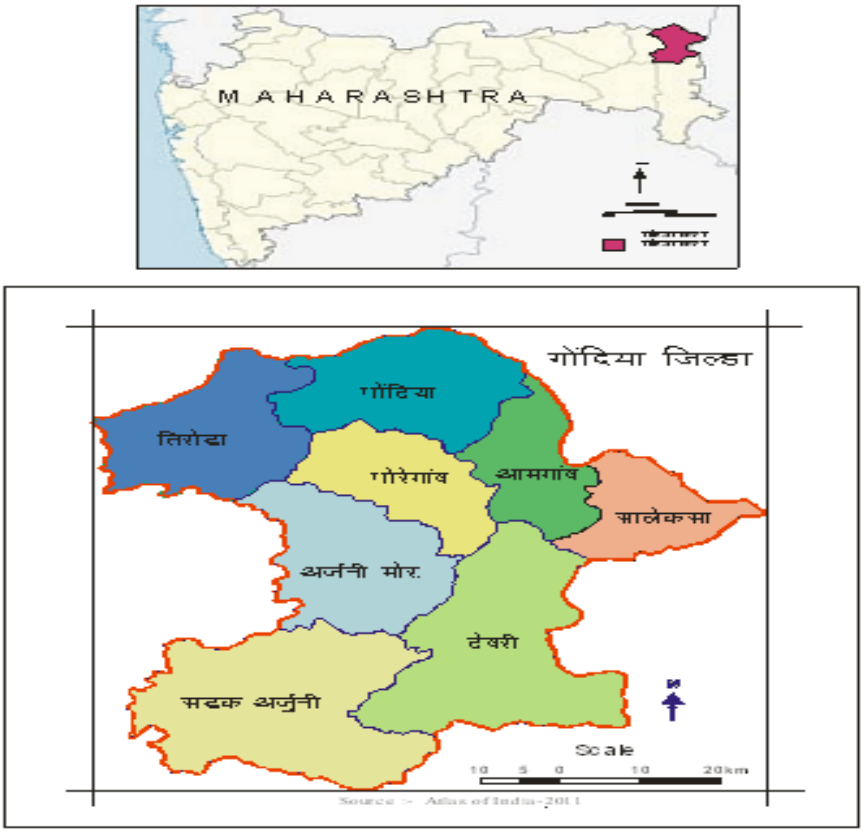
पीक प्रारूप हे सावकाश बदलत असल्यामूळे या अभ्यासात २०११ या वर्षातील प्रकारानुसार पीक गट व प्रत्येक पीक गटातील वेगवेगळ्य पीकांना अनुसरून पीक संयोजन व केंद्रिकरणाचा अभ्यास केलेला आहे.

गोंदिया जिल्ह्यची ऐतिहासिक व भौगोलिक पार्श्वभूमी

प्राचीन काळी गोंदिया जिल्ह्यचे क्षेत्र घनदाट जंगलांनी व्याप्त असल्यामुळे हे क्षेत्र झाडीपट्टी म्हणून प्रसिद्ध होते. येथिल मुळ निवासी गोंड या आदिवासी जमातीचा मुख्य व्यवसाय गोंद व लाख गोळा करून गावामध्ये विकणे हा होता. या व्यवसायावरून या क्षेत्राला गोंदिया हे नाव पडले. गोंदिया जिल्हयाला तलावाचा जिल्हा व भाताचे कोठार म्हणून प्रसिद्धी प्राप्त झाले आहे. महाराष्ट्राच्या अतिपूर्व बाजूला बसलेल्या गोंदिया जिल्हा नैसर्गिक सौंदर्याने पूर्णत: नटलेला असुन पर्वत टेकड्यंनी वेढलेला असुन येथील सर्वात उंच टेकडी प्रतापगड टेकडी आहे. गोंदिया जिल्ह्यमध्ये अनेक प्रेक्षणिय स्थळे आहेत. नवेगावबांध व नागझिरा ही उभयारण्ये देशी व विदेशी पर्यटकांना विशेष आकर्षित करतात. सालेकसा जवळ दरेकसा या खेड्यजवळ एक वैशिष्ट्यपूर्ण नैसर्गिक गुहा आहे.

गोंदिया जिल्ह्यचा विस्तार २०°४५' उत्तर अक्षवृत्त ते २१°३०' उत्तर अक्षवृत्त आणि ८०°००' पूर्व रेखावृत्त ते ८०°३०' पूर्व रेखावृत्ताच्या दरम्यान आहे. जिल्ह्यचे एकूण क्षेत्रफळ २०११ नुसार ५८५८.९५ चौ.किमी आहे. गोंदिया जिल्ह्यत एकूण आठ तालुक्याचा समावेश होतो.

गोंदिया जिल्हयाचे स्थान व विस्तार



गोंदिया जिल्हयातील उत्तर व ईशान्य भाग डोंगराळ असुन या टेकड्यंची उंची २०० ते ३०० मीटर आढळते. गोंदिया आमगाव भागात समुद्र सपाटीपासुन उंची ३३४ मीटर पर्यंत आढळते. सालेकसा, दरैकसा, गायखूरी व इतर अनेक डोंगररांगांची उंची समुद्र सपाटीपासुन ३५० ते ६०० मीटर आहे. गायखुरी रांगेत खुराला येथे समुद्र सपाटीपासुन ६१०.५१ मीटर आहे. दरेकसा डोंगररांगांची उंची ६०० मीटर पर्यंत आढळते. नवेगावबांध टेकड्यंची समुद्र सपाटीपासुन उंची ७०२ मीटर तर वायव्य भागात टेकड्यंची उंची ६०० मीटर पेक्षाही जास्त आढळते. हा भाग जुन्या आग्नेय खडकापासुन बनलेला आहे. जिल्हयचा ८४: भागात भूगर्भशास्त्रानुसार प्राचीन अग्नीजन्य व रूपांतरित खडक आढळतात तर उर्वरीत १६: भागापैकी ५: भागात गोंडवाना काळातील गाळाचे खडक व अर्वाचीन काळातील नदीचा गाळ आढळतो. या व्यतिरिक्त ११: भागात कडप्पा काळातील खडक आढळतात. गोंदिया जिल्हयत सधन काळी पर्वतीय मृदा, तांबडी मृदा आढळते.

२००१ या वर्षामध्ये २८३३ चौ.कि.मी. क्षेत्र अस्थाई वनाने व्यापले होते. हे जिल्हयच्या ५०.२२: आहे. गोंदिया जिल्हयतील सर्व नदय वैनगंगा नदीच्या उपनदय आहेत, असे असले तरी जिल्हयचा अधिकांश क्षेत्र चुलबंद, पांगोली व वाघ या नदयंनी व्यापलेला असुन दक्षिण भागात वाहणारी मुख्य नदी गाढवी आहे. गोंदिया जिल्हयतील हा भाग उष्ण कटीबंधीय असल्यामूळे येथिल हवामान मान्सूनी स्वरूपाचे असून जून ते सप्टेंबर या काळात ७०: च्या वर पर्जन्य पडतो.

परिकल्पना :

ष्गोंदिया जिल्हयातील प्राकृतीक, सामाजिक व आर्थिक घटकाच्या प्रभावामूळे येथे एका विशिष्ट पीक प्रारुपाची निश्चिती झाली आहेष

उद्येश:

गोंदिया जिल्हयातील प्राकृतीक, सामाजिक व आर्थिक घटकाच्या प्रभावामूळे निश्चित झालेली पीक प्रणाली व पीक केंद्रिकरणाचा अभ्यास करणे, हा सदर संषोधनाचा मुख्य उद्येश आहे.

संशोधन पध्दती :

सदर अभ्यासात व्दितीय स्तरावरील आकडेवारी एकत्रीत करुन त्यांची आकडेमोड केल्यानंतर त्यांचे विश्लेषण केले आहे व योग्य त्या नकाशाशास्त्रीय पध्दतींचा व सांख्यीकीय आकृत्यांचा उपयोग करून त्यांचे सादरीकरण केले आहे यात प्रादेशिक व विष्लेशण दृष्टीकोण अभ्यास पध्दतीचा उपयोग करण्यात आला आहे.

गोंदिया जिल्हयतील पीक संयोजन :

''सर्वप्रथम अमेरिकेच्या पश्चिम भागातील पीक संयोजन (साहचर्य) निश्चित करण्याचा व त्या आधारावर कृषि प्रादेशिकीकरण करण्याचा प्रयत्न जे.सी. विवर यांनी केला.'' तसेच इतर अनेक भूगोल तज्ञांनी 'विवर'च्या प्रमाणित 'विचलन पद्धती'च्या आधारावर अन्य प्रदेशात पीक संयोजन निश्चित करण्याचा प्रयत्न केला. त्यावेळी त्यांना अनेक अडचणी आल्या त्यामुळे त्यांनी 'विवर'च्या पद्धतीमध्ये काही परिवर्तन करून अनेकांनी पीक संयोजनाच्या आधारावर प्रादेशिकीकरण केलेले आहे.

यामध्ये डोई, विवर, कोपाक आणि भारतामध्ये अय्यर, आठवले, भाटीया, माजीद हुसैन इ. भूगोलतज्ञांनी वेगवेगळ्य प्रदेशाची निवड करून ''पीक संयोजन प्रदेश'' निश्चित करण्याचा प्रयत्न केला आहे.

गोंदिया जिल्ह्यतील पीक संयोजन निश्चित करण्याकरिता सदर अध्ययनात विवर यांनी सुचविलेल्या पद्धतीचा उपयोग करून पीक संयोजन निश्चित केले आहे. एखाद्या विभागातील प्रत्येक पीकाखालील जमीनीची टक्केवारी करून ती उतरत्या क्रमात लावल्यावर विवर यांनी सांगितलेल्या पद्धतीवरून पीक संयोजन सहज निश्चित करता येते.

वेगवेगळ्य प्रदेशात वेगवेगळी पीक महत्त्वाची असली तरी इतर वेगवेगळ्य पीकाखाली लहान मोठे क्षेत्र असते. म्हणूनच काही अभ्यासकांनी वेगवेगळ्य पीकांनी व्यापलेल्या जमीनीची टक्केवारी अनुक्रमाने लावल्यावर ५: पेक्षा किंवा १०: पेक्षा कमी जमीन व्यापणारी पीके विचारात घेतली नाही. परंतु या अभ्यासात असे न करता पीकांची टक्केवारी अनुक्रमाने लावल्यावर सर्वच पीकांना टक्केवारीत विभागून म्हणजे एका पीकाला १००: मुल्य, २ पीकांना ५०:—५०: अशाप्रकारे सर्व पीकांना १००: मध्ये विभागून खालील सूत्राचा वापर केलेला आहे.

सूत्र – $\frac{\sum d^2}{h}$

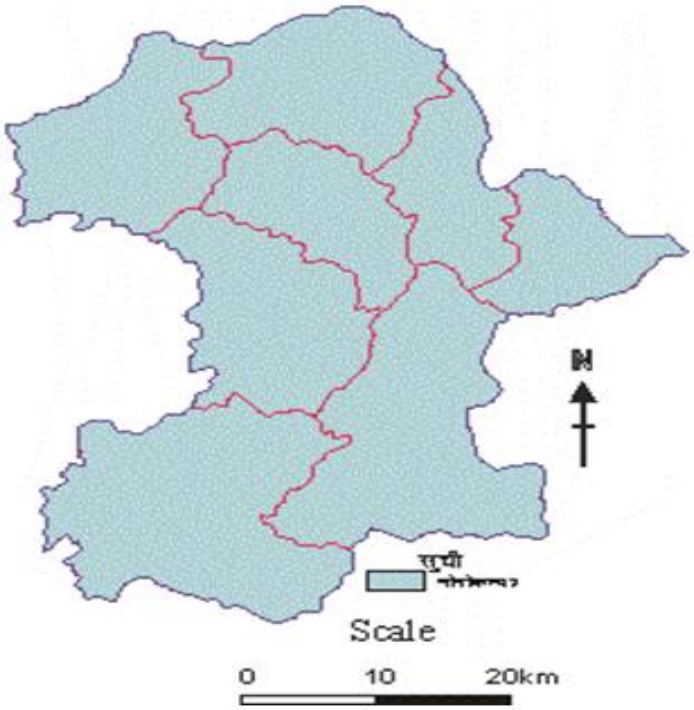
h = एकूण पीकांची संख्या

d = एकूण पीके व एकूण टक्केवारी यातील फरक

गोंदिया जिल्ह्यतील पीक संयोजन : २०११

अ. क्र.	तालुका	पीक संयोजंनाचे मुल्य	पीक संयोजंन	पीक प्रारुप
१	तिरोडा	35.88	एक पीक	तांदूळ
२	गोंदिया	21.16	एक पीक	तांदूळ
३	गोरेगांव	28.27	एक पीक	तांदूळ
४	आमगांव	30.38	एक पीक	तांदूळ
५	सालेकसा	16.94	एक पीक	तांदूळ
६	सडक अर्जुनी	93.41	एक पीक	तांदूळ
७	अर्जुनी मोर.	64.92	एक पीक	तांदूळ
८	देवरी	10.33	एक पीक	तांदूळ

Source :- Calculated by Researcher



२०११ वर्षी जिल्ह्यतील सर्व तालुक्यामध्ये एका पीकाचे संयोजन आढळते. आणि त्यातील प्रमुख पीक तांदूळ आहे. तिरोडा, गोंदिया, गोरेगांव, आमगांव, सालेकसा, सडक अर्जुनी, अर्जुनी मोर. व देवरी या आठही तालुक्यात तांदळाचे क्षेत्र लागवडीखालील निव्वळ क्षेत्रात ९०: ते ९५: च्या दरम्यान आहे. त्यामुळे सर्व तालुक्यात फक्त एक पीक संयोग ;डवदवबनसजनतमद्ध आढळते.

गोंदिया जिल्ह्यतील पीकांचे केंद्रीकरण

कोणत्याही प्रदेशातील पीकांच्या केंद्रीकरण रचनेवरून पीकांच्या घनतेतील फरक समजतो. या प्रकारच्या अभ्यासाचा हेतू म्हणजे वेगवेगळ्य प्रदेशातील

कमी किंवा जास्त पीकांची घनता समजून घेणे होय. पीक केंद्रीकरणाच्या अभ्यासामूळे विशिष्ट वेळेला पीकांची घनता कशी बदलत जाते, याचे आकलन होते. घनता बदलते म्हणजे त्या पीकाखालील क्षेत्रात बदल होतो. ज्यावेळी घनता जास्त असते त्यावेळी त्या विशिष्ट पीकाखालील क्षेत्राचे प्रमाण जास्त असते. ''यालाच उच्च पीक केंद्रिकरण असे म्हणतात.''

कृषि भूगोलात पीक केंद्रिकरण सुरूवातीपासूनच अभ्यासले जात असले तरी सांख्यिकीय पद्धतीच्या उपयोगानंतर त्यात अधिक अचूकता आली आहे. पीक केंद्रिकरणाच्या आधारे कृषि विभाग पाडण्यासाठी अनेक कृषीतज्ज्ञांनी प्रयत्न केलेत. त्यात फ्लोरेन्स (१९४८), बिशोल्म (१९६२), भाटीया (१९६५), जसबीर सींग (१९७६) हे प्रमुख आहेत.

''भारतातील पीकांचे प्रादेशिक गुणधर्म निश्चित करण्यासाठी भाटीया (१९६५) यांनी स्थान भागाकार (Location Quotient Method) पद्धतीचा अवलंब केला आहे.'' भाटीया यांनी पीक केंद्रीकरण स्पष्ट करण्यासाठी पुढील सुत्राचा वापर केला.

$$\text{पीक केंद्रीकरणाचा निर्देशांक} = \frac{\text{'क्ष' पीकाचे त्या उपविभागातील क्षेत्र}}{\text{सर्व पीकाखालील उपविभागीय क्षेत्र}} \div \frac{\text{संपूर्ण प्रदेशात 'क्ष' पीकाखालील क्षेत्र}}{\text{संपूर्ण प्रदेशात सर्व पीकाखालील क्षेत्र}}$$

या अभ्यासात 'भाटीया' यांच्या वरील सुत्राचा उपयोग करून गोंदिया जिल्ह्यतील तीन प्रमुख पीकांचे (तांदूळ, गहू व रब्बी ज्वारी) पीक केंद्रीकरण काढलेले आहे.

तांदूळ —

गोंदिया जिल्ह्यतील प्रमुख पीक तांदूळ आहे, त्याचे पीक केंद्रिकरण अभ्यासण्याकरिता जिल्ह्यच्या प्रत्येक तालुक्यातील एकूण लागवडीचे क्षेत्र, तांदळाखालील क्षेत्र व केंद्रीकरणाचा निर्देशांक पुढील सारणीत दिलेला आहे. प्रादेषिक बदल स्पष्ट होण्याकरिता २०११ या वर्षातील तांदुळाच्या केंद्रिकरणाच्या आकडेवारीस निर्देशांकानुसार गट करून ते नकाशात दर्शविले आहे.

२०११ या वर्षातील तांदुळ पीकाचे केंद्रिकरण

अ.क्र.	तालुका	केंद्रीकरणाचा निर्देशांक
१	तिरोडा	1.01
२	गोंदिया	1.03
३	गोरेगांव	0.98
४	आमगांव	0.98
५	सालेकसा	1.03
६	सडक अर्जुनी	0.96
७	अर्जुनी मोर.	1.00
८	देवरी	0.94
एकूण		0.99

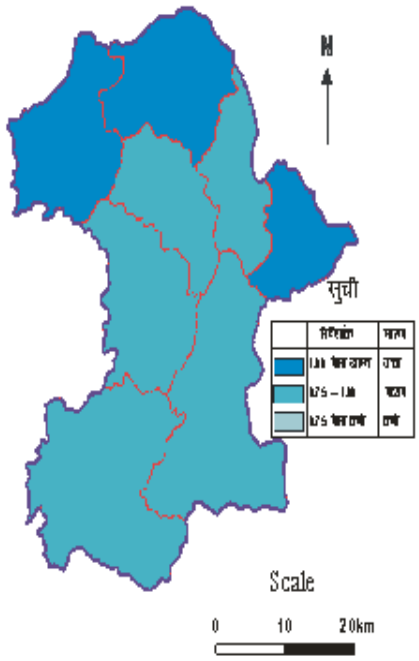
२०११ या वर्षातील गव्हु पीकाचे केंद्रिकरण

अ.क्र.	तालुका	केंद्रीकरणाचा निर्देशांक
१	तिरोडा	0.81
२	गोंदिया	0.72
३	गोरेगांव	0.74
४	आमगांव	1.05
५	सालेकसा	0.72
६	सडक अर्जुनी	2.97
७	अर्जुनी मोर.	3.23
८	देवरी	0.5
		एकूण

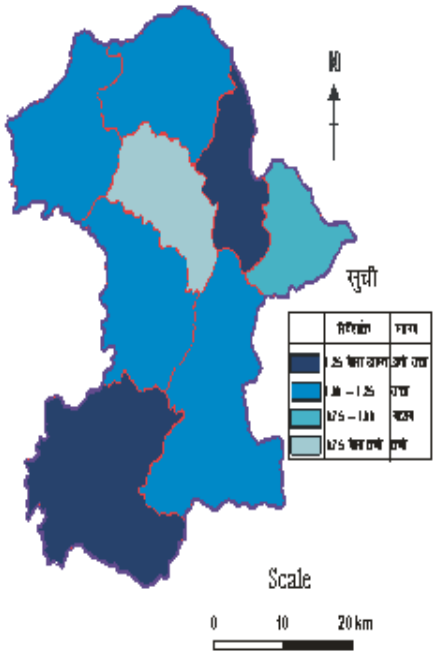
Source :- Calculated by Researcher

२०११ वर्षी गोंदिया जिल्ह्यतील गोंदिया व अर्जुनी मोर. तालुक्यात तांदळाचे केंद्रीकरण उच्च स्वरूपाचे असून केंद्रीकरणाचा निर्देशांक १.०० पेक्षा जास्त आहे. तर तिरोडा, गोरेगांव, आमगांव, सालेकसा म्हणजे जिल्ह्यच्या उत्तर भागात आणि दक्षिण भागात सडक अर्जुनी व देवरी तालुक्यात तांदळाचे मध्यम स्वरूपाचे केंद्रिकरण आढळते. त्याचे केंद्रिकरणाचा निर्देशांक ०.७५ ते १.०० आहे. २०११ वर्षी कोणत्याही तालुक्यात तांदळाचे कमी केंद्रीकरण आढळत नाही. २००१ वर्षी जिल्ह्यत तांदळाचे सरासरी केंद्रीकरण १.०० आहे.

गोंदिया जिल्ह्यातील एकूण लागवड क्षेत्रात तांदूळाचे केंद्रिकरण



गोंदिया जिल्ह्यातील एकूण लागवड क्षेत्रात गव्हाचे केंद्रिकरण



गहू —

गहू हे रब्बी हंगामात घेतल्या जाणाऱ्या प्रमुख पीकापैकी एक पीक आहे. जिल्ह्याच्या काही भागात गव्हाचे पीक घेतले जाते. उत्तर व दक्षिण भागात गव्हाचे केंद्रिकरण झालेले आढळते. पुढील सारणीमध्ये जिल्ह्यातील २०११ वर्षी एकूण लागवडीखालील क्षेत्र, गव्हाखालील क्षेत्र व त्यांच्या केंद्रीकरणाचा निर्देशांक पुढील सारणीत दिले आहे.

२०११ वर्षी जिल्ह्यत सडक अर्जुनी व अर्जुनी मोर. तालुक्यात म्हणजे जिल्ह्याच्या दक्षिण भागात गव्हाचे अति उच्च केंद्रिकरण झाले आहे व त्यांचा केंद्रिकरणाचा निर्देशांक १.२५ पेक्षा जास्त आहे. सडक अर्जुनी व अर्जुनी मोर. तालुक्यात हा निर्देशांक २.९७ व ३.२३ आहे. आमगांव तालुक्यात गव्हाचे केंद्रीकरण उच्च स्वरूपाचे असून निर्देशांकाचे प्रमाण १.०० ते १.२५ आहे. जिल्ह्याच्या आग्नेय भागात म्हणजे तिरोडा तालुक्यात गव्हाचे मध्यम केंद्रीकरण झाले आहे व त्याचे प्रमाण ०.७५ ते १.०० आहे तर गोंदिया, गोरेगांव, सालेकसा व देवरी या चार तालुक्यात गव्हाचे केंद्रीकरण कमी असून त्याचे निर्देशांक ०.७५ पेक्षा कमी आहे.

रब्बी ज्वारी :—

जिल्ह्यत २०११ वर्षी रब्बी ज्वारीचे क्षेत्र जवळजवळ शुन्य आहे. फक्त तिरोडा तालुक्यात २०११ वर्षी फक्त ०७ हेक्टरमध्ये गव्हाची लागवड करण्यात आली. पुढील १० वर्षात २०११ ला ती शुन्यावर आली. या व्यतिरीक्त इतर कोणत्याही तालुक्यात रब्बी ज्वारीची लागवड झालेली नाही. त्यामुळे सर्व तालुक्यामध्ये २०११ वर्षी रब्बी ज्वारीचे केंद्रीकरणाचे प्रमाण शुन्य आहे. बदलत्या पर्जन्य, तापमान, उत्पादकता व विपनन या कारणामुळे ज्वारीचे पीक जवळजवळ नाहीसे झाले आहे. या व्यतिरीक्त जिल्ह्यत कुठेही कापसाचे पीक घेतले जात नाही.

निष्कर्ष :—

गोंदिया जिल्ह्यत सर्वत्र एक पीक प्रणाली (डवदवबनसजनतम) आढळत असून त्यातील प्रमुख पीक तांदूळ आहे. त्याचे मुख्य कारण हे की येथे तापमान व पर्जन्याची विपुल प्रमाणात उपलब्धता होय. त्यामुळेच या प्रदेशात तांदुळ पीकाचे केंद्रिकरण उच्च स्वरुपाचे असून तांदुळाचा केंद्रिकरण निर्देशांक१.०० पेक्षा जास्त आहे. तांदुळानंतर गव्हु पीकाचे केंद्रिकरण झालेले असून त्याचा निर्देशांक सुध्दा १.०० पेक्षा जास्त आहे. याव्यतीरीक्त जिल्हयात थोडयाफार प्रमाणात रब्बी ज्वारी, भाजीपाल्याचे पीके, डाळी व तेलबियांच्या पीकांचे केंद्रिकरण झालेले आढळते.

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सारांश :

गोंड राज्याच्या इतिहासाचा मागोवा घेतांना त्यात सुसंगती आढळून येत नाही. तरीही गतकाळातील राजकीय पटलावर कोणत्याही प्राचीन लोकांना प्राप्त झाले नव्हते इतके श्रेष्ठत्व या गोंड राज्यकर्त्यांना प्राप्त झाले होते. गोंड जमात ही भारताच्या मध्यभागात फार मोठया भूभागावर वसलेली होती. तत्कालीन हिंदू राजांच्या राजवटीशी तुलना केल्यास यांनासुध्दा त्यांच्या बरोबरीचे मानाचे स्थान प्राप्त झालेले होते हे स्पष्ट झाले. ही द्रविडीयन परिवाराची मूलभूत जमात आणि कदाचित अनार्य किंवा जंगली जमातीतील सर्वात महत्वाची जमात आहे. असे रसेल यांनी केलेले विधान गोंड राजवटीची ग्वाही देण्यास पुरेसे आहे. ज्या विशाल भूप्रदेशावर ही जमात आपल्या सामाजिक, आर्थीक आणि सांस्कृतीक जीवनासोबतच आपल्या राजकीय जीवनाचे संचालन करीत होती, तो विशाल भूप्रदेश गोंडवन या नावाने ओळखला जात होता. गोंडवनाच्या याच भूमीवर तेथील भूमीपूत्रांनी वेगवेगळी लहानमोठी राज्य स्थापन केली. इ.स.१३ व्या शतकात मध्यप्रदेश आणि विदर्भ या भागात गोंड राज्य उदयास आली. असे मत सेतू माधवराव पगडी यांनी व्यक्त केले आहे. चंद्रपूरच्या गोंड शासकांमध्ये महाराणी हिराईचे स्थान अनन्य साधारण आहे. राणी हिराईने प्रजेच्या कल्याणासाठी व धार्मीक कार्यासाठी चंद्रपूरातच नाही तर चंद्रपूरच्या बाहेरसुध्दा मंदिरे व वास्तुंची निर्मीती केली. सोबतच जुन्या मंदिरांचा व किल्ल्यांचा जीर्णोध्दार केला. ज्याप्रमाणे उत्तर भारताच्या सांस्कृतीक योगदानात अहिल्याबाई होळकरचे नाव घेतल्या जाते, त्याच तोलामोलाचे स्थान चंद्रपूरच्या इतिहासात राजकीय, सामाजीक, धार्मीक, आर्थीक व सांस्कृतीक योगदानाबद्दल राणी हिराईचे नक्कीच आहे यात शंका नाही. चंद्रपूर व माणिकगड किल्ल्यांचा विकास करून हिराईने आपल्या राजकीय व प्रशासनीक कौशल्याची चुणूक दाखवून दिली. मंदीरांचा जिर्णोध्दार व मंदीरांची निर्मीती करून तीने सामाजीक व धार्मीक बांधीलकी जपण्याचा प्रयत्न केला. तलाव व विहीरी बांधून सामाजीक व आर्थीक समन्वय साधण्याचा प्रयत्न केलेला दिसून येतो. तसेच अनेक वास्तू व मंदीरांची निर्मीती करून आपल्या सांस्कृतीक औदार्याचा परिचय करून दिला. अशी ही महान राणी हिराई की जी एकमेव स्त्री शासक चंद्रपूरच्या राजगादीवर विराजमान होती. तिच्या शासनकाळात तीने अनेक प्रजाकल्याणकारी निर्णय घेवून लोकहिताचे कार्य केले. तीचा कार्यकाळ चंद्रपूरच्या गोंड शासनकाळात सुवर्णअक्षराने लिहील्या गेला आहे.

बिजशब्द :— भूमीपूत्र, द्रविड, गोंडवन, सामाजिक, प्रजाकल्याण

प्रस्तावना :—

गोंडवाना प्रदेशाच्या राजकीय विकासाचे १४ व्या शतकापासूनचे वर्णन कालक्रमानुसार मुस्लीम लेखकांनी आपल्या ग्रंथामधून केलेले दिसून येते. त्याचेच अनुकरण पुढे मराठेकालीन लेखकांनी केल्याने पुढील इतिहास समाजापुढे आला. गोंड जमातीने एकेकाळी केलेला विकास त्या जमातीने वेगवेगळया ठिकाणी स्थापन केलेल्या राज्यांवरून दिसून येतो. विविध कालखंडात गोंडांची चार प्रमुख राज्य होती.

१. उत्तरेकडील गढा मंडल्याचे राज्य
२. बैतूल जिल्हयातील खेरल्याचे राज्य
३. दक्षिणेकडील चंद्रपूरचे गोंड राज्य
४. छिंदवाडा जिल्हयातील देवगडचे राज्य

या व्यतिरिक्त कवर्धा, मकडाई, सारंगड, रायगड, सक्ती इ. लहान गोंड राज्य होती. यापैकी खेरल्याचे राज्य मोगलांचा अंमल होण्यापूर्वीच नष्ट झाले. परिणामी हे राज्य फारसे नावारूपास आले नाही. तर उर्वरीत तिनही राज्य इतिहासात आपले स्थान मजबूत करण्यासाठी धडपडू लागली. त्यादृष्टीने या राज्यांपैकी चंद्रपूरचे राज्य व तेथील किल्ल्याच्या निर्मीतीचा इतिहासाविषयी माहिती घेणे आवश्यक आहे.

गोंड शासक विरशहा (इ.स.१६९६ ते १७०४) याच्या निधनानंतर त्याची पत्नी राणी हिराईने पुत्र नसल्यामुळे ३ वर्षाच्या मुलाला दत्तक घेवून त्याचे नाव रामशहा ठेवले, तो सज्ञान होईपर्यंत राणी हिराईने उत्कृष्ठरित्या राज्यप्रशासन सांभळले. तिचा कार्यकाळ लोककल्याणकारी व प्रजाहितदक्ष असून प्रजेसाठी अनेक सोयी सुविधा उपलब्ध करून दिल्या. त्या काळात शिक्षणाच्या सोयी उपलब्ध नसल्याने व शिक्षण आणि संस्कृती यांची जोपासना मंदिरात होत असल्याने पुष्कळसा दानधर्म करून अनेक मंदिरे बांधली. त्यातून शिक्षणाची सोय उपलब्ध करून दिली, तसेच सामाजीक बांधीलकी सुध्दा जोपासली.

संशोधनाचा आराखडा व संशोधन पध्दती :—

या संशोधन कार्यासाठी निरीक्षण व वर्णनात्मक पध्दतीचा अवलंब करण्यात आलेला आहे. यामध्ये तथ्य संकलन करतांना प्रत्यक्ष त्या स्थळाला भेट देवून व त्याविषयीची माहिती गोळा करून संशोधनाचा आराखडा तयार करण्यात आलेला आहे. यामध्ये चंद्रपूरच्या गोंड शासनकालीन इतिहासाविषयीची माहिती गोळा करण्याकरीता प्राथमिक साधने व दुय्यम साधनांचा उपयोग करण्यात आलेला आहे. साधनांचा अभ्यास

करून संशोधनाची उद्दीष्टये व गृहीतके मांडण्यात आलेली आहे.

संशोधनाची उद्दीष्टये :—

१) चंद्रपूरच्या गोंड राजवटीचा संक्षिप्त अभ्यास करणे.

२) गोंड राजवटीत राणी हिराईच्या धार्मीक, व सांस्कृतीक योगदानाचा संक्षिप्त अभ्यास करणे.

संशोधनाची गृहीतके :—

१) चंद्रपूर व आजूबाजूच्या प्रदेशात गोंड शासकांची भूमीका महत्वाची आहे.

२) राणी हिराईचे चंद्रपूरच्या धार्मीक व सांस्कृतीक इतिहासात अनन्य साधारण महत्व आहे.

• राणी हिराईचे सांस्कृतीक योगदान :—

१) महाकाली मंदिराचा जिर्णोध्दार :—

राजा बिरशहाचा जावई दुर्गशहाने बिरशहाच्या मुलीचा अपमान केल्याने बिरशहाने आपल्या जावयावर आक्रमण केले. या युध्दात बिरशहाला विजय मिळावा म्हणून राणी हिराईने देवी महाकालीला नवस बोलला अशी आख्यायीका आहे. त्यानुसार बिरशहाला विजय मिळून त्याने जावयाचा शिरच्छेद केला. महाकालीमुळे आपल्याला विजय मिळाला अशी भावना मनाशी बाळगुन हिराईने आपला नवस समारंभपूर्वक पूर्ण केला. नवसाप्रमाणे महाकालीचे जुने मंदिर पाडून त्याठिकाणी नविन मंदिर बांधले आणि विजयाची स्मृती कायम राहावी म्हणून दगडाचे शिर बनवून ते मंदिरावर उत्तराभिमुख बसविले.

मंदिराचा आकार ६०६० फूट असून उंची ५० फूट आहे. मंदिरात जमीनीच्या सपाटीपासून १० फूट उंच फरसबंदी आहे. मंदिराच्या मध्यभागी ६ फूट ख्मंदिराच्या आवारास उत्तर व पूर्व दिशेला दगडांच्या दोन भिंती बांधून दिल्याचा उल्लेख आहे. सोबतच इंग्रज सरकारने मंदिराच्या देखभालीकरीता एक प्रॉमीसरी नोट लिहून दिल्याचासुध्दा उल्लेख सापडतो. या मंदिरात दरवर्षी चैत्र पोर्णीमेस खूप मोठी यात्रा भरत असून यामध्ये सहभागी होण्याकरीता नांदेड, परभणी, यवतमाळ व शेजारच्या तेलंगाना राज्यातून खूप मोठया प्रमाणात भाविक येत असतात. यात्रेचे व्यवस्थापन चंद्रपूर महानगर पालीका करीत असते. देविच्या पुरूष भक्तांना पोतराजे व स्त्रि भक्तांना देवकरीण म्हटले जाते. देविसमोर आजही कोंबडे व बकऱ्यांचा बळी दिला जातो. राणी हिराई ही उत्कृष्ट राज्यकर्ती असून तिने केवळ आपल्या जमातीचा विचार न करता सर्वधर्मसमभावाची भूमिका घेवून सर्व धर्मीयांसाठी मंदिरांची निर्मीती केली. यामागे तिची धार्मीक स्वातंत्र्याची भावना दिसून येते.

२) अंचलेश्वर मंदिर :—

कृतयुगात चंद्रपूरचे नाव लोकपूर असे असून तिथे देवी महाकाली प्रकट झाली. तिला भूतनाथ नावाचा खोडकर मुलगा होता. त्याच्या दिवसेंदिवस वाढणाऱ्या खोडया पाहून देवीने त्याला झरपट नदीच्या काठावर जिवंत पुरून अचल करून ठेवले, आणि त्या जागेची ओळख म्हणून गाईचे खुराचे चिन्ह तयार केले अशी आख्यायिका आहे.

एकदा बल्लापूरचा गोंड शासक खांडक्या बल्लाळशहा शिकारीला गेला असतांना त्याने या खुरातील साचलेल्या पाण्याने शरीर स्वच्छ केले असता त्याचा असाध्य रोग बरा झाला. तो दैवी गुण पाहून त्याने त्या ठिकाणी छोटेसे मंदिर बांधले व त्या मंदिराचे नाव अंचलेश्वर महादेव असे ठेवले.राणी हिराईने जेव्हा महाकाली मंदिराचा जिर्णोध्दार केला त्यावेळेस अंचलेश्वर मंदिराचासुध्दा जिर्णोध्दार केला. आज या ठिकाणी भव्य व सुंदर असे अंचलेश्वर महादेव मंदिर उभे आहे. पुढे भोसल्यांची जेव्हा चंद्रपूरवर सत्ता स्थापन झाली तेव्हा इ. स. १७८८ मध्ये व्यंकोजी भोसल्यांनी या मंदिरास सभामंडप व विहीर बांधून दिल्याचा उल्लेख इतिहासात आहे. अंचलेश्वर मंदिराचा राणीने जिर्णोध्दार करून गोंड शासक हे शिवाचे उपासक होते हे यावरून सिध्द होते.

३) एकविरा देवी मंदिर :—

महाकालीचा पुत्र भूतनाथ याची समजूत याला समजाविण्यासाठी माहुरची रेणूकादेवी चंद्रपूरला आली आणि त्याची समज काढून परत माहूरला परत गेली अशी आख्ययीका आहे. त्याची खूण म्हणून राणी हिराईने एक देवीचे स्वतंत्र मंदिर बांधून मूर्ती स्थापना केली. पुढे ते मंदिर एकविरा देवी मंदिर म्हणून प्रसिध्द झाले. पुढे या एकवीरा शब्दाचा अपभ्रंश होवून एकोरी माता मंदिर असे नाव पडले. पुढे भोसल्यांचे चंद्रपूर येथील सुभेदार संक्रांजीपंत शेष यांनी इ.स. १८०८ मध्ये या मंदिरास सभामंडप बांधून दिल्याचा उल्लेख चंद्रपूरच्या इतिहासात आहे.

४) गणपती मंदिर :—

या मंदिराचे बांधकाम राजा बिरशहा याच्या कार्यकाळात सुरू झाले. परंतू त्याच्या निधनामुळे ते अपूर्ण राहीले. पुढे राणी हिराईने या मंदिराचे बांधकाम पूर्ण केले. मंदिराला चार कोपऱ्यांवर चार मनोरे असून मंदिर भव्य उंचे शिखराचे आहे. पुढे व्यंकोजी भोसल्यांच्या कार्यकाळात चंद्रपूर येथील अंबाबाई खटी नावाच्या स्त्रिने आपली संपत्ती या मंदिरास दान दिली. या पैशातून मंदिराचा जिर्णोध्दार करण्यात आला. तेव्हापासून या मंदिरास खटीचा गणपती मंदिर असे नाव पडले.

५) महादेव मंदिर (जोड देऊळ) :—

महाराणी हिराईचा दिवाण बापूजी वैद्य याने राणीच्या प्रेरणेने जोड मंदिराची निर्मीती केली. यापैकी एका मंदिरात महादेवाची पिंड असून दुसऱ्या मंदिरात लक्ष्मीनारायण व मूर्लीधराची मूर्ती आहे. मंदिरात सभोवताल इंद्र, वरूण, गणपती, देवी, अग्नी, नाग इ. देवी देवतांच्या मूर्ती कोरलेल्या आहेत. मंदिराच्या समोर एक उंच खांब असून त्यावर दशावताराच्या प्रतिमा कोरलेल्या आहेत. सभामंडपात नंदीची मूर्ती असून भिंतीवर त्रिपाद या वैदीक देवतेची मूर्ती कोरलेली आहे. मंदिराला लागून जवळच एक मोठी पायऱ्यांची विहीर आहे.

६) शंखाकृती विहीर व राममंदीर :—

राणी हिराईचा दिवााण बापूजी वैद्य यांनी राणीच्या प्रेरणेने एक शंखाकृती विहीर तयार करून त्यावर एक हौदाची निर्मीती केली. त्या हौदावर राम, लक्ष्मण, सिता, भरत, शत्रुघ्न व हनुमान या देवीदेवतांच्या मूर्ती स्थापन केल्या. पुढे या मूर्ती बाजूला काढून त्यांची मंदिरात स्थापना करण्यात आली. यालाच काळाराम असे म्हणतात. दिवाण बापूजी वैद्य यांनी मंदिराच्या देखभालीसाठी २.३० एकर जमीन मंदिरास दान म्हणून दिली. राणीने आपल्या शासनकाळात अनेक तलाव व विहीरी बांधल्या. यावरून हे स्पष्ट होते की, तिने प्रजेच्या

पिण्याच्या पाण्याची व शेती सिंचनाची व्यवस्था केलेली दिसून येते.

७) राजा बिरशहाची समाधी :—

इ.स.१७०४ मध्य राजा बिरशहाचे निधन झाल्यानंतर राणी हिराईने त्याची समाधी बांधली. ती अंचलेश्वर मंदिराला लागून असलेल्या हडवाडा येथे आहे. हडवाडा हे गोंड शासकांची खाजगी स्मशानभूमी असून तिथे एकूण १४ शासकांच्या समाध्या आहेत. प्रवेशव्दारातून आत जाताच प्रथम समोर दिसणारी भव्य व उंच गुंबज असलेली समाधी राजा बिरशहाची असून तिची निर्मीती राणी हिराईने केली. समाधीचे बांधकाम १५ फूट उंच चबुतऱ्यावर असून त्यावर चढण्यासाठी १० फूट लांबीच्या १५ पायऱ्या आहेत. मध्यभागी मोठया आकाराचा घुमट असून चार कोपऱ्यांवर चार लहान घुमट आहेत. समाधीची लांबी ४० फूट व रूंदी ४० फूट असून उंची ६० फूटाच्या जवळपाासआहे. आजही ही समाधी चांगल्या स्थितीत असून ती अत्यंत देखणी व भव्य आहे. राणी हिराईने राजा बिरशहाची सुंदर अशी समाधी चंदपूरमध्ये निर्माण केली. या वास्तूवर मुघल बांधकाम शैलीचा प्रभाव दिसून येतो. समाधीच्या चार कोपऱ्यावर चार मिनार, समाधीवरती भव्य गोल गुंबज आणि समाधीच्या सभोवताल नक्षीदार जाळीकाम ही मुगल वास्तूकलेची वैशिष्टये दिसून येतात.

८) घुटकाळा तलाव :—

राणी हिराईने शहराच्या वायव्य दिशेला घोडयाच्या पागेच्या जवळच एक तलाव बांधला. विशेषत: घोडयांच्या पिण्याच्या पाण्याची व्यवस्था व्हावी म्हणून या तलावाची निर्मीती करण्यात आली. यामुळे याला घोडतळे असे नाव पडले. पुढे त्याचा अपभ्रंश होवून घुटकाळा तलाव असे नाव सध्या प्रचलीत आहे.

९) गोरजाई मंदिर :—

राणी हिराईने चंद्रपूरातच नव्हे तर बाहेरसुध्दा मंदिरांची निर्मीती केली. त्यामध्ये वैरागड येथे वैरागडी नदीच्या काठावर एक मंदिर बांधून त्यात देवीची मूर्ती स्थापन केली. ते मंदिर गोरजाई देवीचे मंदिर म्हणून प्रसिध्द आहे.

१०) मार्कंडा मंदिराचा जिर्णोध्दार :—

चंद्रपूरच्या पूर्वेस जवळपास १०० कि.मी. अंतरावर गडचिरोली जिल्हयात वैनगंगा नदीच्या काठावर मार्कंडेश्वराचे मंदिर आहे. अर्धमंडप, सभामंडप, अंतराळ आणि गर्भगृह यावर कमी अधिक उंचीची शिखरे असून एक मुख्य शिखर व तीन आधारभूत शिखरे अस्तित्वात होती. राणी हिराईच्या काळात मंदिरावर विज पडून गर्भगृहावरचे शिखर तुटून सभामंडपावर पडले. त्यास आधारभूत असलेले तीन शिखरसुध्दा ढासळले.

राणी हिराईने सभामंडपाला पुन्हा खांब व कमानी तयार करून सपाट छत तयार करून दिले. नविन खांबांवर व मंदिरात काही मूर्ती स्थापन केल्या. राणी हिराईने वेळीच दखल घेवून या पुरातन वास्तूचे संरक्षण व संवर्धन केले. तीचे हे कार्य संस्मरणीय आहे. यानंतर राणीने तिथे यात्रा सुरू केली, ती आजही दरवर्षी महाशिवरात्रीला भव्य यात्रा भरते.

११) माणिकगड किल्ल्याची दुरूस्ती :—

सिंदखेडचे अंमलदार बाबासाहेब जाधव यांनी माणिकगड किल्ला जिंकून घेतला. परंतू हा प्रदेश विराण असल्याने त्यांनी तिथे जास्तकाळ अंमल केला नाही. त्यानंतर राणी हिराईने आपला मनसबदार नरसिंग ठाकूर याला पाठवून किल्ल्यावर अधिकार प्रस्थापित केला व किल्ल्याची दुरूस्ती करून आपला अंमल बसविला. राणीने आपल्या प्रशासन काळात माणिकगड किल्ला जिंकून आजूबाजूच्या प्रदेशावर वचक ठेवण्यासाठी त्या किल्ल्यावर सैनिक छावणी निर्माण केली. यावरून राणी हिराईची प्रशासनीक दुरदृष्टी दिसून येते.

निष्कर्ष :—

राणी हिराईने प्रजेच्या कल्याणासाठी व धार्मीक कार्यासाठी चंद्रपूरातच नाही तर चंद्रपूरच्या बाहेरसुध्दा मंदिरे व वास्तुंची निर्मीती केली. सोबतच जुन्या मंदिरांचा व किल्ल्यांचा जीर्णोध्दार केला. हिराईने प्रजेसाठी अनेक सोयी सुविधा उपलब्ध करून आपले नाव चंद्रपूरच्या इतिहासात अजरामर केले. ज्याप्रमाणे उत्तर भारताच्या सांस्कृतीक योगदानात अहिल्याबाई होळकरचे नाव घेतल्या जाते, त्याच तोलामोलाचे स्थान चंद्रपूरच्या इतिहासात राजकीय, सामाजीक, धार्मीक, आर्थीक व सांस्कृतीक योगदानाबद्दल राणी हिराईचे नक्कीच आहे यात शंका नाही. चंद्रपूर व माणिकगड किल्ल्यांचा विकास करून हिराईने आपल्या राजकीय व प्रशासनीक कौशल्याची चुणूक दाखवून दिली.

मंदीरांचा जिर्णोध्दार व मंदीरांची निर्मीती करून तीने सामाजीक व धार्मीक बांधीलकी जपण्याचा प्रयत्न केला. तलाव व विहीरी बांधून सामाजीक व आर्थीक समन्वय साधण्याचा प्रयत्न केलेला दिसून येतो. यात्रा व मेळे सुरू करून आर्थीक विकास करण्याचा प्रयत्न केला. तसेच अनेक वास्तू व मंदीरांची निर्मीती करून आपल्या सांस्कृतीक औदार्याचा परिचय करून दिला. अशी ही महान राणी हिराई की जी एकमेव स्त्री शासक चंद्रपूरच्या राजगादीवर विराजमान होती. तिला प्रजाकल्याणाची आवड होती. तिच्या शासनकाळात तीने अनेक प्रजाकल्याणकारी निर्णय घेवून लोकहिताचे कार्य केले. तीचा कार्यकाळ चंद्रपूरच्या गोंड शासनकाळात सुवर्णअक्षराने लिहील्या गेला आहे.

संदर्भ :—

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गोषवारा :-

देवराया शेकडो वर्षांपासून भारत देशात अस्तित्वात आहेत. निसर्गाचं संरक्षण आणि संवर्धन करण्याचं अत्यंत महत्त्वाचं कार्य देवराया करत आलेल्या आहेत. 'देवराई' या संकल्पनेला जसा नैसर्गिक अर्थ आहे तसाच अध्यात्मिक अर्थ देखील आहे. प्रत्येक देवराईच्या ठिकाणी कोणत्या ना कोणत्या देवीचं किंवा देवाचं छोटस मंदिर अस्तित्वात असतं. सुजाण आणि दूरदृष्टी असणाऱ्या आपल्या पूर्वजांनी देवराई टिकावी तिचं संवर्धन व्हावं म्हणून देवीच्या कोपाची भिती जनसामान्य लोकात पसरवली होती. याचमुळे 'देवराई' मधील झाडाच्या पानाला सुद्धा इजा पोहचत नव्हती. याचमुळे पिढयानपिढया देवराया आजतागायत टिकून आहेत. महाराष्ट्रात एकूण 3570 हेक्टर एवढे क्षेत्र देवराईसाठी राखीव आहे. अशाचप्रकारे प्रत्येक राज्यात 'देवराई' साठी राखीव असलेलं दिसून येत.

प्रस्तावना :-

जैवविविधता हा पर्यावरणीय अभ्यासातील अतिशय महत्त्वाचा घटक आहे. पृथ्वीवरील सर्व प्रकारच्या जीवसृष्टीचा समावेश जैवविविधतेत होतो. परिस्थितीय संतुलनाच्या दृष्टीने जैवविविधता महत्त्वाची मानली जाते. जैवविविधतेचे जनुकांमधील विविधता, जैविक घटकांतील विविधता आणि परिसंस्थांतील विविधता अशा तीन प्रकारांमध्ये वर्गीकरण केले जाते. भारताच्या संदर्भात विचार करता वेगवेगळया भौगोलिक प्रदेशांमध्ये जैवविविधतेचे स्वरूप भिन्न असलेले दिसून येते.

वाढती लोकसंख्या, नैसर्गिक साधन संपदेचा अमर्याद वापर, वृक्षतोड, जमिनीच्या वापरामध्ये होत जाणारे बदल यामुळे सजीवांच्या अनेक प्रजाती नष्ट झाल्या आहेत व बऱ्याच नष्ट होण्याच्या मार्गावर आहेत. जैवविविधता टिकविण्यासाठी गरज आहे ती जंगल संवर्धनाची भारतातील समाजाने यासाठी 'देवराई' ही संकल्पना रुजवली आहे. 'देवराई' ही संकल्पना धार्मिक असली तरी त्यामार्फत जैवविविधतेचे संरक्षण व संवर्धनाचे कार्य केले जाते. "देवराई म्हणजे 'देवांचे जंगल' किंवा 'देवांच्या नावाने राखलेले एक पवित्र समजले जाणारे वन' होय." इंग्रजी भाषेमध्ये याला 'Sacred grove' असे म्हणतात. 'देवराई' या समाजाने परंपरेने सांभाळल्या आहेत. प्रस्तुत शोधनिबंधामध्ये 'देवराई' ची जैवविविधतेच्या संरक्षण व संवर्धनातील भूमिका, देवराईचे महत्व, सध्या 'देवराई' समोर असणारी आव्हाने व त्यावरील उपाययोजना यावर विवेचन केले आहे.

संशोधनाची उद्दिष्टे :-

1) 'देवराई' संकल्पना समजून घेणे. तसेच देवराईचे महत्त्व विषद करणे.
2) 'देवराई' ची जैवविविधतेच्या संरक्षणातील भूमिका समजावून घेणे.
3) 'देवराई' मध्ये आढळणाऱ्या जैवविविधतेची माहिती करून घेणे.
4) 'देवराई' समोर असणाऱ्या आव्हानांचा आढावा घेणे.

शोधन पद्धती:-

प्रस्तुत शोधनिबंधात वर्णनात्मक व विश्लेषणात्मक संशोधन पद्धतीचा वापर करण्यात आलेला आहे.

संशोधनाची गृहितके:-

1) 'देवराई' एक पर्यावरणीय संकल्पना आहे.
2) दुर्मिळ प्रजातीचे संरक्षण देवराईमुळे होते.
3) जैवविविधतेच्या संरक्षणामध्ये 'देवरायांची' महत्त्वाची भूमिका आहे.
4) महाराष्ट्रात परंपरागत अनेक देवराया अस्तित्वात आहेत.

5) भौतिक विकासामुळे देवरायांचे अस्तित्व धोक्यात आले आहे.

'देवराई' या संकल्पनेचा अर्थ :-

"देवराई म्हणजे देवांचे जंगल. देवांच्या नावाने राखले जाणारे वन म्हणजे 'देवराई' होय". जे. डोनाल्ड हयुजेस आणि एम. डी. एस. चंद्रन यांनी देवराईची उत्कृष्ट व्याख्या केली आहे. ती म्हणजे "भूभागाचा असा कुठलाही हिस्सा ज्यात वनसंपदा, जीव-जंतू आणि भौगोलिक वैशिष्ट्ये जे बाकीच्या जागांपेक्षा किंवा कुठल्याही भागांपेक्षा सुरक्षित व अविभाज्य ठेवले जातात." ही संकल्पना मानवाचं जीवन व निसर्ग आणि त्यातील दैवी शक्ती यांच्यातलं अतूट नातं या अर्थाने अतिशय महत्त्वाची ठरते.

देवराई' एक सामाजिक संकल्पना :-

मानवाच्या सर्व गरजा या निसर्गातून भागविल्या जातात. निसर्गाबद्दलचा आदर, श्रद्धा, भीती व जीवनावश्यक संसाधनांसाठीचा एकमेव स्त्रोत म्हणून निसर्गाला देवत्व मिळत गेलं. वेगवेगळ्या शक्तींना त्याच्या स्त्री किंवा पुरुष अनुसार देव-देवतांचे रूप मिळालं. त्याचा आदर व मान राखण्यासाठी व त्यांची कृपादृष्टी प्राप्त करण्यासाठी काही ना काही रितीरिवाज सुरू झाले, अशा अनेक रितीरिवाजांपैकीच एक म्हणजे देवाच्या नावानं निसर्गाचे काही घटक त्यांच्या मूळ स्वरूपात जतन करून ठेवण्याची प्रथा सुरू झाली. अशाच देवांच्या नावाने राखून ठेवलेल्या जंगलांना 'पवित्र जंगलाचा' दर्जा मिळाला. ज्याला आपण 'देवराई' म्हणून ओळखतो.

'देवराई' तील वृक्षांची तोड केली तर देवाचा कोप होईल. म्हणून देवराईतील सुक्या लाकडांना सुद्धा हात लावला जात नाही, इतकेच काय झाडावरून फुल आपोआप गळून पडले, तरच ते देवाला वाहिले जाते. 'देवराई' बद्दलच्या या धार्मिक व श्रद्धेच्या भावनेतून पर्यावरणाचे संरक्षण व संवर्धनाचे कार्य होत असे.

'देवराई' या संकल्पनेत फक्त देवपूजा किंवा धार्मिक श्रद्धा महत्वाच्या होत्या असे नाही तर आपल्या सर्व गरजा ज्या निसर्गाकडून पूर्ण केल्या जातात, त्याच्याबद्दलची कृतज्ञता देखील होती.

पर्यावरणीय दृष्टिकोनातून जैवविविधतेच्या संरक्षण व संवर्धनाच्या बाबतीत 'देवरायांची' भूमिका आणि महत्त्व :-

'देवराई' आणि जैवविविधता या अंगाने विचार करायचा झाला तर देवराया ह्या जिवंत संग्रहालयासारखे आहेत. इतर ठिकाणी दुर्मिळ असणारी झाडे, मोठ्या वेली, पक्षी, कीटक, फुलपाखरे, सरपटणारे प्राणी हे देवराईत बहुसंख्येने आढळतात. तसेच या देवराया ह्या औषधी वनस्पतीचे खूप मोठे भांडार आहेत.

देवराई एक शिखर परिसंस्था (Climax Ecosystem) आहे. ती एक जनुक पेढी (Gene Bank), बीज पेढी (Seed Bank) आणि जलपेढी (Water Bank) सुद्धा आहे.

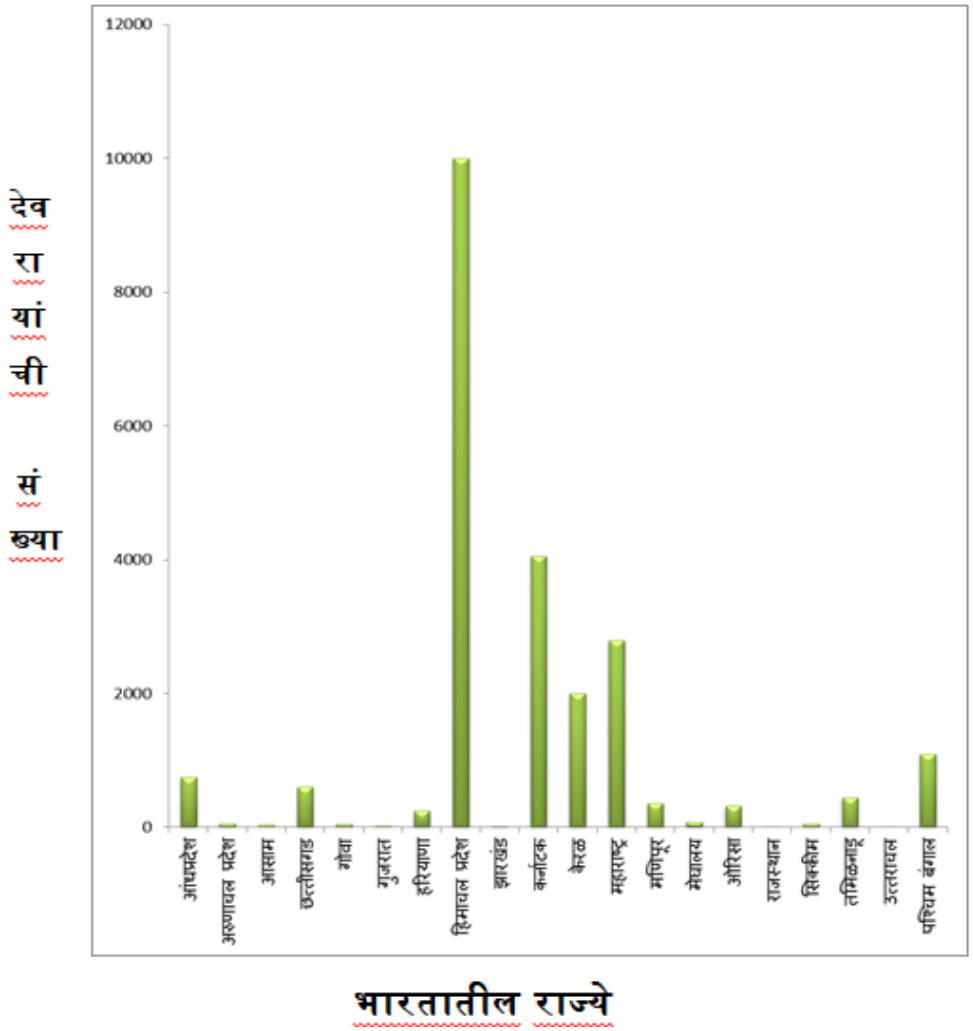
देवरायांमधील जैवविविधता

वृक्ष	वेली	औषधी वनस्पती	पशू	पक्षी	सरीसृप
सातवीण	कांचनवेल	हिरडा	भेकर	सुर्यपक्षी	देवगांडूळ
लोध्र	पळसवेल	बेहडा	पिसोरी	माडगरुड	विविध रंगाच्या पाली,
फणसाडा	गारंबी	आवळा	ससे	बुलबुल	सरडे,
कळंब	सोनजाई	बाहवा	मोर	कुकू	विषारी मण्यार,
हेदू	पिळूक मडवेल	नरक्या	सांबर	धनेश	नाग,
ऐन	शिकेकाई	मंजिष्ठ	रानडुकरे	घुबडे	अजगर
काटेसावर	करंजवेल	कुडा	शेकरन	तांबट	
मोह	पळसवेल	रामेठा	उदमांजर	कोतवाल	
पायर		कळलावी	सायाळ	पोपट	
डंबर		डिकेमाली			
वारंग		राळधूप			
भेर्ली माड		देवसावर			
बिब्बा		गुळवेल			

अशाप्रकारे अनेक दुर्मिळ वनस्पती, लुप्त होण्याच्या मार्गावर असणारे प्राणी, पक्षी, कीटक वर्गातील सजीव यांचे आश्रयस्थान म्हणून देवराया महत्वाची भूमिका बजावतात.

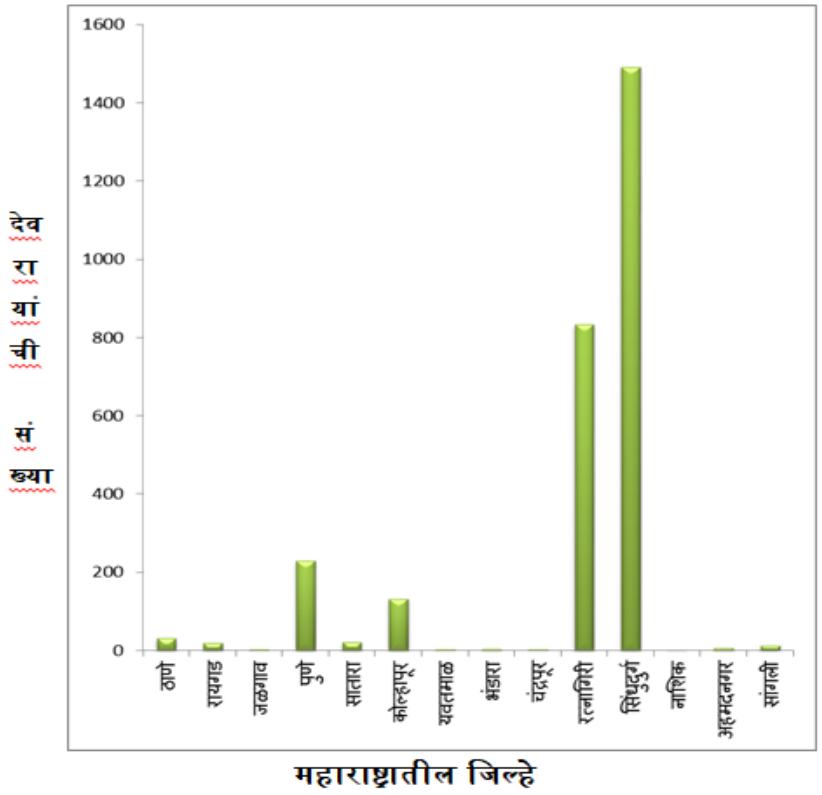
भारतातील विविध राज्यांतील देवरायांची संख्या :-

अ. क्र.	भारतातील राज्ये	देवरायांची संख्या
1	आंध्रप्रदेश	750
2	अरुणाचल प्रदेश	58
3	आसाम	40
4	छत्तीसगड	600
5	गोवा	50
6	गुजरात	29
7	हरियाणा	248
8	हिमाचल प्रदेश	10,000
9	झारखंड	21
10	कर्नाटक	4,050
11	केरळ	2,000
12	महाराष्ट्र	2,799
13	मणिपूर	365
14	मेघालय	79
15	ओरिसा	322
16	राजस्थान	9
17	सिक्कीम	56
18	तमिळनाडू	448
19	उत्तराचल	1
20	पश्चिम बंगाल	1093
	एकूण	**23,018**



महाराष्ट्रातील विविध जिल्ह्यातील देवरायांची संख्या :-

अ.क्र.	महाराष्ट्रातील जिल्हे	देवरायांची संख्या
1	ठाणे	32
2	रायगड	20
3	जळगाव	04
4	पुणे	230
5	सातारा	22
6	कोल्हापूर	132
7	यवतमाळ	04
8	भंडारा	05
9	चंद्रपूर	04
10	रत्नागिरी	834
11	सिंधुदुर्ग	1,492
12	नाशिक	01
13	अहमदनगर	07
14	सांगली	12
	एकूण	**2,799**



- **देवरायांच्या संवर्धनातील अडथळे / आव्हाने :-**

1) शहरीकरणाची लाट खेड्यापर्यंत आल्यामुळे देवरायांचे अस्तित्व धोक्यात आले आहे.

2) रस्ते बांधणी, धरण निर्मिती या कारणाने सुद्धा देवराईचे क्षेत्र दिवसेंदिवस कमी होत आहे.

3) दिवसेंदिवस देवरायांचे धार्मिक आणि सामाजिक दृष्ट्या कमी होत असलेले महत्त्व यामुळे देवरायांच संरक्षण करणे आव्हानात्मक बनत आहे.

4) विकास कामांच्या निमित्ताने अनेक देवराया नष्ट केल्या जात आहेत. (1985 ते 1990 च्या दरम्यान सिंधुदुर्ग जिल्ह्यात 35 देवराया पाडण्यात आल्या.)

5) व्यावसायिक शेती प्रदूषण, जंगलतोड, नैसर्गिक संसाधनांचा प्रमाणापेक्षा जास्त वापर, जमीन वापराच्या पद्धती ही सर्वसाधारणपणे देवराया नष्ट होण्याची कारणे आहेत.

सारांश :-

जैवविविधतेच्या संरक्षणामध्ये देवराया अत्यंत महत्त्वाची भूमिका पार पाडत असतात. अतिशय दुर्मिळ वनस्पतीचे जतन करण्याचे कार्य देवरायांमुळे शक्य होते. 'देवराई'शी लोकांच्या श्रद्धा जोडल्या गेल्या असल्यामुळे देवरायांमध्ये वृक्षतोड केली जात नाही. देवरायांमध्ये फक्त दुर्मिळ वनस्पती, वेलींचे संवर्धन होते असे नाही तर, अनेक दुर्मिळ पशु, पक्षी, सरीसृप व किटकवर्गीय प्राण्यांचे अधिवास ही असतात.

देवरायांचे संवर्धन व संरक्षण करणे गरजेचे आहे. यासाठी समाजामध्ये जाणीवजागृती निर्माण करण्याची गरज आहे. दुर्मिळ वनस्पतीच्या बीज गोळा करून रोपवाटिका निर्माण करणे, या संदर्भात कार्यशाळा आयोजित करणे गरजेचे आहे. देवरायांचे संवर्धन करणे ही काळाची गरज आहे. कारण यातूनच अत्यंत दुर्मिळ असलेल्या जैवविविधतेचे संरक्षण होत राहील आणि ही दुर्मिळ संपत्ती पुढच्या पिढीकरीता राखून ठेवता येईल.

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हंसराज अहिर यांचे विकासात्मक कार्य

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गोषवाराः

सर्वसाधारण बहुजन कुटुंबातील एक सामान्य व्यक्ती त्यांच्या परिवारातील राजकारणामध्ये कधीच कोणत्याही प्रकारचा सहभाग नसताना, सामाजिक – वैचारिकतेच्या प्रेरणेतून स्वामी विवेकानंद यांना आपले आदर्श मानून, राजकारण समाजकारणाचे सर्वोत्तम माध्यम आहे तथा तरुण पिढीने सामाजिक परिवर्तनाकडे पाऊल उचलणे ही काळाची गरज आहे. सकारात्मक प्रेरणेतून राजकारणामध्ये लोकप्रतिनिधी म्हणून 1994 मध्ये विधानपरिषद आमदार म्हणून निवडून आले. ' हिरवळ ' या संस्थेच्या माध्यमातून वृक्षारोपण चळवळ, जय भवानी व्यायाम शाळेच्या माध्यमातून रक्तदान, क्रीडा स्पर्धांचे आयोजन व व्यायाम क्षेत्रात युवकांना नवे वळण–दिशा देण्याचे महत्त्वपूर्ण कार्य प्रारंभ करणारे लोकप्रतिनिधी म्हणून उद्यास आले. लोकसेवा– जनसेवा– ईश्वरसेवेचे सूत्र मानून विधानपरिषद आमदार ते केंद्रीय गृहराज्यमंत्री पर्यंतचा प्रवास यशस्वीरीत्यांनी निभवत आपल्या लोकसभा क्षेत्रात तथा देशाच्या विकासात विशेष महत्त्वपूर्ण योगदान प्रदान केलेले आहे. २००६ पासून २०१४ पर्यंत सलग पाच वर्षात संसदीय कामकाजात अव्वल स्थानावरील त्यांच्या कार्याबद्दल चेन्नई येथे "प्राईम टाईम फाउंडेशन" संस्थेतर्फे उत्कृष्ट संसद रत्न पुरस्काराने गौरविण्यात आले.

बीजशब्द – सामाजिक सुधारणा,युवा परिवर्तन, संघर्षमय जीवन, सकारात्मक दृष्टिकोन.

प्रस्तावनाः–

समाजकारणाला प्रथम प्राधान्य देत आपल्या साध्या व सरळ स्वभावाच्या तथा सहकार्याच्या भावनेतून जनमाणसांमध्ये 'भैय्या' नावाची उपाधी प्राप्त केली. स्वामी विवेकानंद, स्वातंत्र्यवीर विनायक दामोदर सावरकर यांना राजकीय गुरू म्हणून स्व. अटल बिहारी वाजपेयी यांच्या वैचारिक भावनेतून प्रेरित होऊन समाजकारणापासून राजकारणाचा प्रवास प्रारंभ केला. 'हिरवळ' या संस्थेच्या माध्यमातून वृक्षारोपण चळवळी, रक्तदान शिबिर, रुग्णवाहिका, क्रीडा स्पर्धा, व्यायाम मंडळ, मैदानी खेळ युवकांना नवी वळण व दिशा देण्याचे महत्त्वपूर्ण कार्य करणारा लोकप्रतिनिधी म्हणून हंसराज गंगाराम अहिर हे लोकाभिमुख झाले.

लोकांच्या विश्वासाला, स्नेहाला त्यांनी सार्थक ठरविण्यासाठी मागील १९९० पासून त्यांच्या लोकसभा क्षेत्रात लोकाभिमुख, शाश्वत असे कार्य केले. शेतकरी, बेरोजगार, प्रकल्पग्रस्त, विद्यार्थी, कष्टकरी, बलुतेदार, अलुतेदार, आरोग्यसेवा, तांत्रिक शिक्षण, सर्वसामान्य लोकांच्या न्याय व हक्कासाठी लढा देत विधानपरिषद आमदार ते केंद्रीय गृहराज्यमंत्री पदापर्यंत त्याचा प्रवास त्यांनी यशस्वीरित्या पार पाडला व आजही त्यांच्या कार्याचा प्रकाश निरंतर आहे. केंद्रीय मागासवर्गीय आयोगाचे अध्यक्ष म्हणून धुरा हाती घेतलेली आहे. इतर मागासवर्गीय समाजाच्या प्रश्नांना न्याय देण्याचे कार्य सातत्याने सुरू आहे.

अत्यंत संवेदनशील आणि महत्त्वपूर्ण अशा केंद्रीय गृह मंत्रालयाची राज्यमंत्री म्हणून सांभाळलेली जबाबदारी आव्हानात्मक होती, तरी ती जबाबदारी अतिशय संयमपणे आणि कणखरपणे त्यांनी सांभाळली. मंत्रीपदाचे निर्वहन करताना मतदार क्षेत्रातील समस्या, अडचणी, लोक तक्रारींचे निवाडा मतदारांच्या अपेक्षांना तळा जाऊ न देण्याचा प्रयत्न त्यांनी केला. राज्य व केंद्र शासनाच्या लोकाभिमुख योजना पोहोचविण्यासाठी परिश्रम घेतले. केंद्र शासनाचे महत्त्वकांशी योजना 'सिपेट' (सेंट्रल इन्स्टिट्यूट ऑफ प्लास्टिक इंजीनियरिंग अँड टेक्नॉलॉजी) चे केंद्र चंद्रपूर शहरात आणले. कोळसा प्रकल्पग्रस्त शेतकरी बांधवांना भरीव मोबदला आणि नोकरी मिळवून देण्यात अभूतपूर्व यश मिळाले. 'प्रधानमंत्री मुद्रा' योजनेच्या माध्यमातून मतदार संघातील युवकांना स्वयंरोजगारासाठी अर्थसहाय्य मिळवून देण्यात पुढाकार घेतल्याने हजारो युवकांना स्वयंरोजगार उभारता आले. तसेच 'औद्योगिक जिल्हा' म्हणून चंद्रपूर जिल्ह्यातील लोकांना रेल्वे सुविधांसाठी अनेक महत्त्वपूर्ण रेल्वे गाड्या सुरू करण्यात आल्या व सुपरफास्ट गाड्यांचे थांबे मिळवून देण्यात यश मिळवले.

लोकसभा क्षेत्रातील विकास कामे

आरोग्य सुविधा

* सिकलसेल, थलेसेमिया व हिमोफेलीया या रूग्णांवर उपचारासाठी देशातील ४थ्या क्रमांकाचे अद्ययावत हिमोग्लोबिनोपॅथी सॅटेलाईट सेंटर चंद्रपूरात सुरू करण्यात आले.

* चंद्रपूर लोकसभा क्षेत्रात सर्व तालुक्यातील प्रमुख स्थानी मोफत नेत्र तपासणी व सुमारे १० हजाराहून अधिक रूग्णांना चष्मे वाटप करण्यात आले . चंद्रपूर महानगर तसेच जिल्हयात अनेक ठिकाणी रूग्णांना स्वस्तात औषधी उपलब्धतेसाठी जेनेरीक, अमृत औषधी केंद्रांची स्थापना करण्यात आले.

* स्व.डॉ. गंगारामजी अहीर चॅरिटेबल ट्रस्टद्वारा लोकसभा क्षेत्रात मोठया प्रमाणात रक्तदान शिबीरांचे आयोजन करण्यात आले.

* सन २०१६ मध्ये चंद्रपूर, वरोरा व गडचांदूर येथे केंद्राच्या अलिम्को संस्थेच्या मदतीने ६७८ दिव्यांग लाभार्थ्यांपैकी ६३३ लाभार्थ्यांना साहित्य वाटप करण्यात आले.

* लोकसभा क्षेत्रातील चंद्रपूर आर्णी, घाटंजी आणि जिवती येथे रूग्णांचे तपासणी व औषधोपचार शिबीराचे आयोजन करण्यात आले.

* चंद्रपूर येथे शासकीय वैद्यकीय महाविद्यालय सुरू करण्यात सिंहाचा वाटा उचलला.

* केंद्र सरकारकडे सतत पाठपुरावा करून सिकलसेल, थलेसेमिया व हिमोफेलिया रूग्णांचा दिव्यांगाच्या यादीत समावेश करण्यास यश मिळविले.

* देशात पहिल्यांदाच चंद्रपूर येथे 'डिस्ट्रीक्ट अर्ली इंटरवेशन सेंटर' स्थापन. या केंद्रामुळे जन्मजात विकलांगतेचे दोष आणि आजार दूर करण्यात साह्य होणार २४० कोटी निधी मंजूर १३६ उपकरण उपलब्ध करण्यात आले.

* चंद्रपूर येथे जानेवारी २०१६ ला सर्व आजाराच्या रूग्णांसाठी आरोग्य तपासणी मोफत औषधोपचार यासाठी आरोग्य महाशिबीराचे आयोजन सुमारे २०० मधुमेही मुलांना मोफत ग्लुकोमिटरचे वाटप करण्यात आले.

* आयुष योजनेच्या माध्यमातून मानसिक दिव्यांगांना घरपोच औषधी उपलब्ध करून देण्यात यश प्राप्त करण्यात आले.

* यवतमाळ जिल्हयातील पोहरादेवी येथे सुसज्ज रूग्णवाहिकेचे लोकार्पण करण्यात आले.

आयुषमान भारत :–

*मा. पंतप्रधान नरेंद्र मोदी जी यांची अत्यंत महत्वाकांक्षी योजना या अंतर्गत चंद्रपूर जिल्हयात ३,१४,८५४ लाभार्थी कुटूंबाचा समावेश पैकी २,१६,४७१ ग्रामीण, ६५,३८३ शहरी लाभार्थ्यांचा समावेश करण्यात आले. १३४१ सर्जिकल व मेडिकल उपचार मान्यताप्राप्त खासगी व शासकीय रूग्णालयाद्वारा होईल. प्रती कुटूंबास उपचारासाठी प्रती वर्ष ५ लक्ष मिळणार.

* जिल्हयातील सामान्य सुविधा केंद्र (सीएससी) मार्फत ई–गोल्ड कार्ड वितरण प्रक्रीया सुरू चंद्रपूर जिल्हयार ७०००० लोकांना गोल्डकार्ड वितरण महाराष्ट्रातील ई–गोल्ड कार्ड लाभ घेणारा चंद्रपूर हा दुसरा जिल्हा ठरला.

केंद्र पुरस्कृत राष्ट्रीय बाल आरोग्य कार्यक्रमः–

* चंद्रपूर जिल्हयात गत ५ वर्षात ० ते १८ वयोगटातील बालकांवर उपचार करण्यात आले. ३५८ हृदय शस्त्रक्रीया झाल्या असून २३६८ शस्त्रक्रीया करण्यात आल्या यात आदींचा समावेश आहे.

* राष्ट्रीय आरोग्य अभियान अंतर्गत २०१४–१५ ते १८–१६ पर्यंत केलेला खर्च ११८२७.११ लक्ष रूपये एकूण खर्च करण्यात आले.

* राष्ट्रीय शहरी आरोग्य अभियान २०१४–१५ ते १८–१६ पर्यंत २८४.५८ लाख रूपये खर्च करण्यात आले.

* राष्ट्रीय आरोग्य अभियान – २०१४–१५ ते १८–१६ पर्यंत कुटूंब कल्याण कार्यक्रम शस्त्रक्रीया – ४१६६२ पर्यंत कुटूंब कल्याण कार्यक्रम शस्त्रक्रीया – ४१६६२ एकुण खर्च ४०६.५७ लक्ष रूपये करण्यात आले.

* जननी सुरक्षा योजनेअंतर्गत महिलांना मिळालेला लाभ लाभार्थी – ४३७०६, खर्च ३७०.६३ लक्ष रूपये करण्यात आले.

* जननी शिशू सुरक्षा कार्यक्रम अंतर्गत माता व बालकांना मिळालेला लाभ– माता ७६४७०, बालक १६६१२ खर्च ३३७. ५४ लक्ष रूपये करण्यात आला.

* सिकलसेल आजार नियंत्रण कार्यक्रमात २०१४–१५ ते १८–१६ पर्यंत चाचणी व खर्च सोल्युबिलीटी चाचणी ६१३४६६ खर्च ४०५.३५ करण्यात आले.

राष्ट्रीय आरोग्य अभियान हा शहरी व ग्रामीण अशा दोन्ही भागात राबविण्यात येत असून ही योजना शंभ टक्के केंद्र सरकार अर्थसाहय आधारीत आहे. सन २०१४–१५ ते २०१८–१६ या कालावधीत ग्रामीण १५०७१.६६ तर शहरी भागासाठी ४८६.४३ असे एकूण १५५६१.०६ लक्ष रूपये उपलब्ध झाले.

निष्कर्ष :–

महाराष्ट्रात सर्वसाधारण समाजाच्या खालच्या थरात जन्म घेतलेली व्यक्ती हे देशाचे केंद्रीय गृहराज्यमंत्री पद प्राप्त करते, ही गोष्ट आपल्या सामाजिक उत्क्रांतीच्या संदर्भात मोठी अर्थपूर्ण आहे. युवा संघात, शेतकरी कृतज्ञता, देशाच्या आर्थिक, सामाजिक, शैक्षणिक उत्कर्षासाठी त्यांचे निरंतर कष्ट सुरूच आहे. आपले आयुष्य समाजकारण ते राजकारण तर सध्या संविधानिक पदावरून देशातील मागासवर्गीय समाजाला न्याय तथा मार्गदर्शन केला जात आहे. आजही सामाजिक दायित्व, पर्यावरण चळवळ, शेतकरी चळवळ, रक्तदान शिबिरं, आरोग्य शिबिर यामध्ये अमूल्य मार्गदर्शनपर कार्य यशस्वीपणे दृष्टीत येत आहे.

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