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(Affiliated to Sant Gadge Baba Amravati University ,Amravati)

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Criterion- III

RESEARCH INNOVATIONS AND EXTENSION

3.2.1: Number of research papers published per teacher in the journals notified on UGC care list during the last year

Late Reverend Father Shri. Maskuji Biruji Burungale Education Society, Shegaon (R.No. F-422)

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3.2.1: Number of research papers published per teacher in the Journals notified on UGC care list during the last year
⇨ 26

3.2.1.1: Number of research papers in the Journals notified on UGC CARE list year wise during the last year (2023-24)
⇨ 26

Academic Year 2023-24

THE RUBRICS JOURNAL OF INTERDISCIPLINARY STUDIES
International, Indexed and Peer Reviewed e-Journal
ISSN 2454-1974

Phytochemical Screening of Ethanolic and Chloroform Extracts of the Tuber of *Eulophia nuda*.

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Introduction:-

Medicinal plants are the gift of nature to mankind so that humans can lead a healthy and disease-free life. The medicinal system of India is based on the ancient traditional scriptures including Ayurveda, Siddha, and Unani. In the Indian system, the earliest mention of the utilization of medicinal plants was observed between 4500 and 1600 BC in Rigveda. But with the emergence of urbanization the shift from traditional medicine to allopathic drugs occurred drastically. However, with the advent of synthetic pharmaceuticals traditional herbal drugs were forgotten but in recent years with the rising number of infections and complex disease conditions focus on the traditional medicinal systems and plant research for the isolation and identification of novel drugs has gained immense momentum in the global healthcare system. The phytochemical screening of the ethanolic and the chloroform extracts of the tuber of *Eulophia nuda* was performed during the study period. The phytochemical tests were performed for the detection of alkaloids, carbohydrates, phenols and tannins, glycosides, proteins and amino acids, saponins, fats and oils, steroids and gums and mucilage. The phytochemicals after isolation, identification and purification are used as drugs in pharmaceuticals. Earlier studies have also shown isolation of phytochemical compound Salicin extracted from the bark of willow tree and later used commercially for the development of pharmaceutical drug Aspirin. Taxol isolated from the Pacific yew tree is also one of the important anti-cancerous drugs approved by FDA. Studies have suggested that consumption of foods rich in phytochemical compounds can protect you from several chronic illnesses.

Materials & Methods:

For the study, Ethnomedicinal survey of plant species was conducted at the Amba Barwa forest region, Buldhana district, Maharashtra. During the study period of September-October, 2019 to October 2023. The medicinal plants *E. nuda* and *E. ochreata* was identified and collected with the help of locals, forest persons and the tribals.

Extraction:

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The collected plant material was washed thoroughly with distilled water and the cleaned plant parts were kept for shade drying. The plant tubers were selected as the study material and the cleaned tubers were shade dried for 15 days. Further the shade dried tubers were grinded to obtain a fine powder using a mechanical grinder and stored in air tight containers. The powdered samples were then used for the extraction of bioactive compounds using Soxhlet apparatus and ethanol and chloroform as extraction solvents. The ethanolic and chloroform extracts of the tubers were further evaluated for phytochemical evaluation.

Result and Discussion:

The results for the biochemical tests showed that the tests for alkaloids including Wagner's test, Mayer's test, Hager's test and Dragendroff's test showed positive results for the ethanolic extract of *E. nuda* while, for the chloroform extract Wagner's and Mayer's test showed positive results while Hager's test and Dragendroff's test showed negative results. For the tests for carbohydrates including Molisch's test, Benedict's test and Fehling's test positive results were observed for ethanolic and chloroform extracts. For the test for phenols and tannins including Ferric chloride test, Gelatin test, and Lead acetate test positive results were obtained for ethanolic and chloroform extracts. For the test for glycosides, including Borntragers Test positive results were obtained for ethanolic extract while negative results were obtained for chloroform extract. For the determination of proteins and amino acids involving Biuret and Ninhydrin test, positive test results were observed for ethanolic extract while negative results were obtained for chloroform extract. For the test for saponins consisting of Foam test, positive results were obtained for ethanolic and chloroform extract. For the test for fats and oils, including spot test negative results were obtained for both the ethanolic and chloroform extract. Similarly, for the test for gum and mucilage negative results were obtained for both the ethanolic and chloroform extract. Also, for the test for steroids positive results were obtained for ethanolic and chloroform extract.

From the overall phytochemical analysis, the ethanol and the chloroform extracts of the tuber of *E. nuda* demonstrated the presence of alkaloids, phenols, tannins, carbohydrates, glycosides, saponins, steroids and proteins and amino acids. The ethanolic extract of the medicinal plant was observed to be more efficient compared to the chloroform extract depicting strong presence of alkaloids, phenols, tannins, carbohydrates, proteins and amino acids, glycosides and steroids.

Secondary metabolites are bioactive compounds that are derived from plant, animals and living organisms. The study of plant secondary metabolites involves extraction and isolation of compounds from plant samples, characterization through spectroscopic studies and determination of the structure of the bioactive compound. The secondary metabolites present in the plants serve as a defence mechanism for them by protecting plants from predators and microbial infections. Some of the primary metabolites observed in the medicinal plants include presence of alkaloids,

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flavonoids, terpenoids, steroids, phenols and tannins that serve as the defense system of the plants. The medicinal properties of the plants are majorly due to the presence of these bioactive compounds. The isolation and identification of these compounds help in the discovery of novel pharmaceutical drugs that can further be used for curing several human ailments.

Tiwari *et al.*, (2012) studied the preliminary phytochemical analysis of the quantification of the bioactive compounds. Aqueous, methanolic and ethanolic extracts of the tubers were prepared using Soxhlet extraction. The phytochemical tests for alkaloids, flavonoids, phenols and tannins, carbohydrates, steroids and glycosides were performed. The results of the study depicted presence of alkaloids, flavonoids, steroids, saponins and glycosides in the respective three extracts.

Nagulwar*et al.* (2017) reported the phytochemical screening of three extracts of *E. nuda* for the investigation of the presence of bioactive compounds. The preliminary tests were performed by Soxhlet extraction of ethanol, acetone and chloroform extracts of tuber of *E. nuda*. The phytochemical screening revealed presence of alkaloids, flavonoids, phenols and tannins, glycosides, steroids, carbohydrates and saponins. The ethanolic extract of the tuber showed presence of flavonoid, alkaloid, glycosides, saponins and tannins while, the acetone extract depicted presence of cardiac glycosides, alkaloids and saponin.

Nanekar*et al.*, (2019) performed the preliminary phytochemical screening of aqueous, methanol, petroleum ether, and ethyl acetate extracts of *E. nuda* tubers for the estimation of the presence of the bioactive compounds. The results of the study depicted presence of alkaloids, flavonoids, phenols, tannins, terpenoids, saponins, coumarins, and glycosides. Dawande and Gurav (2021) investigated the phytochemical analysis of the methanolic extract of the tubers of *E. nuda*. The results of the phytochemical investigation depicted the presence of alkaloids, steroids, flavonoids, glycosides, carbohydrates, saponins, tannins and phenols.

Table : Phytochemical investigation of the *E. nuda* extracts.

Sr. No.	Name of the Test	Type of the Test	Ethanolic Extract	Chloroform Extract
01	Alkaloids	Wagner's Test	Positive	Positive
		Mayer's Test	Positive	Positive
		Hager's Test	Positive	Negative
		Dragendorff's Test	Positive	Negative

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02	Carbohydrates	Molisch's Test	Positive	Positive
		Benedict's Test	Positive	Positive
		Fehling's Test	Positive	Positive
03	Phenol & Tannins	Ferric Chloride Test	Positive	Positive
		Gelatin Test	Positive	Positive
		Lead Acetate Test	Positive	Positive
04	Glycosides	Borntragers Test	Positive	Negative
05	Proteins & Amino Acids	Biuret Test	Positive	Negative
		Ninhydrin Test	Positive	Negative
06	Saponins	Foam Test	Positive	Positive
07	Fat & Oils	Spot Test	Negative	Negative
08	Gum & Mucilage	-	Negative	Negative
09	Steroids	-	Positive	Negative

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ISSN 2454-1974

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IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Phytochemical screening, antimicrobial activity, antioxidant activity of chlorform and ethanol extract *Eulophia ochreata.*

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Abstract -The present research work explores the phytochemical and biological properties of *Eulophia ochreata*, a terrestrial orchid species with significant ethnobotanical importance. The tubers of *Eulophia ochreata* were selected for the study, and the plant material was identified with the assistance of local residents, forest guards, and botanists. The study focuses on evaluating the antimicrobial and antioxidant activities of the bioactive compounds extracted from *Eulophia ochreata*, along with determining the phenolic and flavonoid content.

Introduction

Eulophia ochreata, commonly known as Amarkand or Singadyakand, is a perennial herb belonging to the Orchidaceae family. This plant species holds medicinal significance and has been traditionally used by various ethnic tribes for its therapeutic properties[1]. The genus *Eulophia* comprises terrestrial orchid species distributed across India, including Maharashtra, Andhra Pradesh, Chhattisgarh, and other regions. The study area, Amba Barwa forest in Buldhana district, Maharashtra, is rich in tropical evergreen plants, providing a diverse landscape for medicinal plants like E. ochreata. The research aims to investigate the phytochemical composition[2,3] and biological activities of *Eulophia ochreata* to uncover its potential as a source of bioactive compounds with therapeutic benefits[3,4,5].

Material and Methods

3.1 Sample Collection

The tubers of *Eulophia ochreata* were collected from the Amba Barwa forest area in Buldhana district, Maharashtra, during September-October 2019. The plant material (Fig.1) was identified with the help of local residents, forest guards, and botanists.

3.2 Isolation and Extraction

The collected plant material was shade-dried, powdered, and extracted using Soxhlet apparatus with ethanol and chloroform as solvents.

3.3 The authentication

The authentication of the plant material was done by Dr. V. U. Pochhi, Professor, Department of Botany, Shri Shivaji Science and Arts college, Chikli, Buldhana district.


Figure.1 Images of *Eulophia ochreata* plant, flowers and tuber.

3.4 Antimicrobial Activity and Phytochemicals

The antimicrobial activity of the extracts was evaluated against E. coli, ***K. pneumoniae, S. aureus and E. faecalis*** and the phytochemical analysis was conducted to identify bioactive compounds. 6 The results of the antimicrobial activity study of the crude extracts in ethanol A showed the most efficient antibacterial activity against *E. coli*, *K. pneumoniae*, *E. faecalis* except that of *S. aureus*. Gentamicin (NA, 29 mm, NA, 27 mm), Control (NA, 15 mm, NA, 17 mm) 50mg (NA, 12 mm, NA, 15 mm), 100 mg (10 mm, 13 mm, NA, 17 mm) 200 mg (13 mm, 13 mm, NA, 16 mm), Ethanol B Gentamicin (NA, 29 mm, NA, 27 mm), Control (NA, 10 mm, NA, 14 mm), Control (NA, 10 mm, NA, 14 mm), 50mg (NA, 11 mm, NA, 15 mm), 100 mg (NA, 20 mm, NA, 14 mm), 200 mg(13 mm, 25 mm, 10 mm, 25 mm), Chloroform A Gentamicin (19 mm, NA, 22 mm, NA), Control (13 mm, NA, NA, NA), 50mg(12 mm, NA, 11 mm, NA), 100mg (12 mm, NA, 13 mm, 10 mm), 200mg (14 mm, 9 mm, 19 mm, 12 mm). While in case of chloroform extracts efficient activity was observed in case of *E. coli* and *S. aureus*. The given numbers are the mean value of the analysis carried out in triplicate.

Samples		Zone of Inhibition (mm)			
		E. coli	*K. pneumoniae*	*S. aureus*	*E. faecalis*
Ethanol extract	Gentamicin	NA	29 mm	NA	27 mm
	Control	NA	15 mm	NA	17 mm
	50	NA	12 mm	NA	15 mm
	100	10 mm	13 mm	NA	17 mm
	200	13 mm	13 mm	NA	16 mm
Chloroform extract	Gentamicin	19 mm	NA	22 mm	NA
	Control	13 mm	NA	NA	NA
	50	12 mm	NA	11 mm	NA
	100	12 mm	NA	13 mm	10 mm
	200	14 mm	9 mm	19 mm	12 mm

Table 1. Showing sensitivity results

Fig. Image showing Antimicrobial Activity and Phytochemicals

3.5 Antioxidant Activity of Bioactive Compounds

This assay measures the ability of test samples to donate hydrogen, quantifying their capacity to scavenge the stable organic free radical DPPH and induce reduction[7]. The evaluation involves measuring the absorption of the deep violet DPPH solution at 517 nm. After reduction, the absorption decreases, leading to decolorization from deep violet to a yellow-white hue. This reduction-induced decrease in absorption is directly proportional to the degree of reduction, as elucidated by Arulpriya *et al.*, (2010). The free-radical scavenging activity was estimated by DPPH assay.

S. No.	Conc.	CN (Mean ±SD)	EN (Mean ±SD)	CO (Mean ±SD)	EO (Mean ±SD)	Ascorbic Acid (Mean ±SD)
1	2 mg	4.43± 2.14	5.40±3.92	15.20±3.21	30.20±3.21	40.49±2.23
2	4 mg	18.85±3.3	27.78±8.80	19.17±0.74	39.17±0.74	55.33±2.20
3	6 mg	20.83±5.0	35.23±2.66	25.81±4.09	45.81±4.09	80.06±0.51
4	8 mg	21.99±6.32	47.33±2.76	28.30±0.72	60.30±2.72	84.49±2.23
5	10 mg	23.17±0.82	63.17±1.82	30.90±12.29	68.20±2.78	84.33±2.20
R2		0.7009	0.9754	0.9659	0.9866	0.8549
Y equation		y = 4.062x + 5.668	y = 13.509x - 4.745	4.053x + 11.717	9.713x + 19.597	11.684x + 33.888
IC 50		21.823	8.104	18.89	6.26	2.74

Table.2 Antioxidant Activity of Bioactive Compounds.

Results and Discussion

The phytochemical analysis revealed the presence of alkaloids, flavonoids, minerals, polyphenols, and saponins in the extracts of *Eulophia ochreata*. The antimicrobial and antioxidant activities of the extracts were significant, indicating their potential therapeutic value[8,9]. The high phenolic and flavonoid content correlates with the antioxidant activity observed.

Conclusion

In conclusion, the study highlights the promising bioactive compounds present in *Eulophia ochreata*, showcasing its potential as a valuable source of therapeutic agents. The significant antimicrobial and antioxidant activities, coupled with the rich phenolic and flavonoid content, underscore the medicinal importance of this orchid species. Further research on isolating and characterizing these bioactive compounds *could* lead to the development of novel pharmaceutical drugs with diverse health benefits.
Eulophia ochreata.

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Bulletin of the National Research Centre (2023) 47:130
https://doi.org/10.1186/s42269-023-01104-y

Bulletin of the National Research Centre

REVIEW

Open Access

Sustainable approaches for the synthesis of biogenic platinum nanoparticles

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Abstract

Background The era of nanotechnology become widespread for research and human resource development due to its functionalized tuning with economical, eco-friendly, effective and sustainable end-products. Hence, the present review illustrates the biogenic fabrication of platinum nanoparticles (PtNPs) through the different sustainable and cheaper approaches.

Main body of the abstract Over the physicochemical-based nanotechnology, the biogenic active substances-based synthesis displayed the more promising candidature due to its non-toxic, Broad-spectrum applicability and defendable type character. The biogenic synthesis method is capable with and without capping and highly motif of reducing agents. The morphology and stability of synthesized PtNPs are mostly mediated by various experimental conditions such as pH, temperature, incubation time, concentrations of biomaterials and salts or enzymes used. Hence, the review is aiming to discuss the methodology of biogenic synthesis of PtNPs by plant stem, root, leaf, flower, fruit, extracts, algae, fungi and egg yolk. Also, we have illustrated the pharmaceutical drug model application and its adverse effect.

Short conclusion Synthesized PtNPs are open a new trend in catalyst, drug and its carrier and in cancer treatment. PtNPs are utilized as a new therapeutic agent for inhibiting the microbial pathogens with non-toxic behavior. The characterization of PtNPs could estimate the bio-sensitized properties which leads the commercial applications.

Keywords PtNPs, Biogenic synthesis, Toxicity, Bioactive product, Pharmaceutical applications

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Background

Nanomaterials influence and cover the multivariate areas like catalytical, electrical, mechanical, photo-electrical, medicinal, paint, chemical application, food industry, etc., due to their surface property, material combination, size variants, electron configuration, surface area to volume ratio, energy variation, etc. (Sana et al. 2020; Singh et al. 2023). Among it, the interest in Platinum nanoparticles (PtNPs) is its unique structural, optical and catalytic properties that make it expeditious and a promising catalyst endowed with biomedical properties (Yerpude et al. 2023).

Platinum (Pt), a priceless transition metal which has exceptional results likes, electrical and catalytic unique features and superior resistance corrosion mechanisms have been commonly applied in atomic, pharmaceutical,

petrochemical, electronica and energy sector. Platinum component, as well as its Alloys have distinctive potential in dehydrogenation hydrogenation and limited oxidation catalysis, of a range of significant molecules, extremely important in several industrial processes. The different crystal surfaces of Pt may have substantially different atomic arrangements and electronic structures which lead to dramatically different response toward same reaction (Zhou et al. 2009). Pt, in a particular concentration, nanoparticles may behave as antioxidants (Zhang et al. 2010). Products that had properties like multiple anticancer activities, are being sought recently. Some studies suggested that the usage of nanoparticles in anticancer treatments produces a synergistic impact, very significant, decreases the possibility of side effects and affects patients increase in long-term prognosis (Manthe et al. 2010). The PtNPs however have a detrimental impact on cancer cells. Because of this, researchers have partly abandoned studies on the use of platinum as anticancer agent (Gu et al. 2019; Wang et al. 2022).

There are different kinds of methods like physical and chemical are employed to the synthesis of PtNPs preparation; however, eco-friendly approach is the promising approach and in now day's interest is due to the toxic behavior of nanoparticles (Agarwal et al. 2019). Biological methods can reduce the toxic effect of the particle. Biological processes are well known to have a good efficiency for generating spherical morphology, compact size and stable chemical nanoparticles (Jeyaraj et al. 2019; Gholami-Shabani et al. 2023). The plants and biological lichens are used as an option for the formulation of nanomaterials rather than dangerous chemicals by researchers because they are non-toxic, inexpensive and easily available. The plant's phytochemicals play a significant part in the production of nano-pharmaceuticals (Sana et al. 2021; Singh et al. 2022). Unlike other inorganic nanoparticles, bioactive molecules in plants help produce PtNPs. In addition, the organic PtNPs are competing with chemically synthesized nanoparticles in order to ensure adequate shape and size that the regulated reaction conditions provide better stability and it is right time to unveil the use of PtNPs as nanomedicine for vegetables. Nanoparticles synthesis for microorganisms, plants or its extracts and enzymes, proposed as possible environmentally friendly alternatives to physicochemical methods, systematic paradigm shown in Fig. 1 (Song et al. 2010; Singh et al. 2020; Muñiz-Diaz et al. 2022). Green-biogenic approaches of preparation of the platinum particle is the major aspects of this review. The current progress in biogenesis of PtNPs have been mentioned in the Table 1.

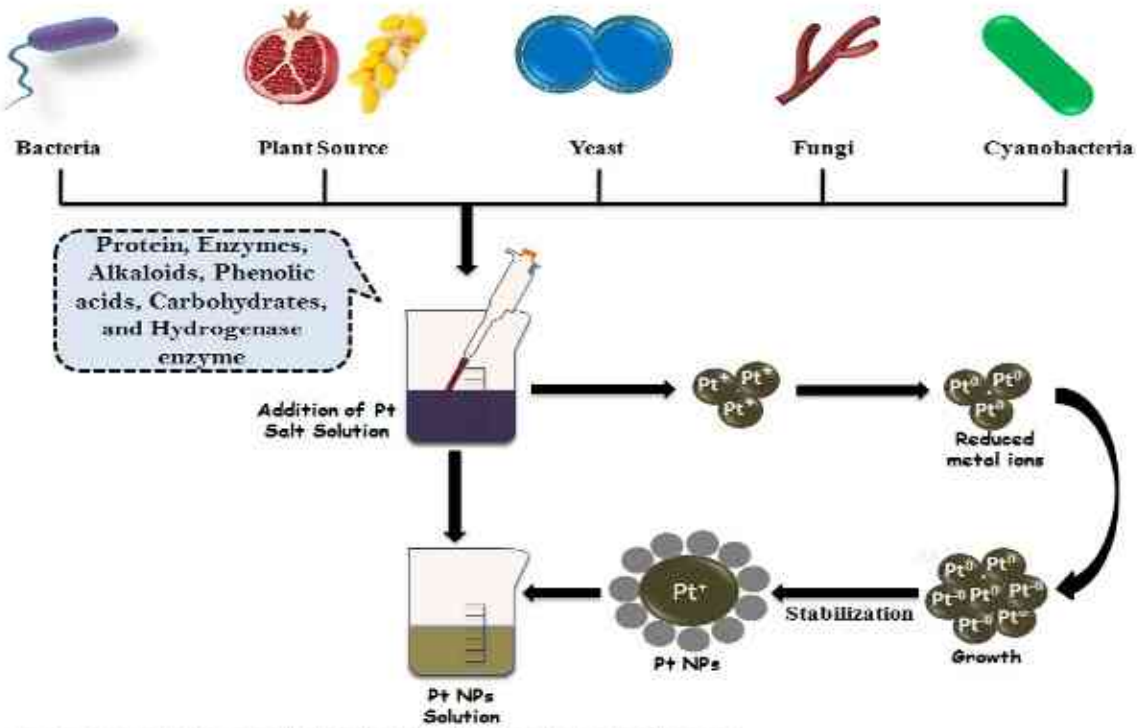

Fig. 1 A general process for the nanoparticle synthesis for algae, fungi, bacteria and Enzymes

Table 1 Biogenesis of PtNPs by various types of biomaterials

S. No.	Plant	Part used	Size (nm)	Shape	References
1.	*Azadirachta indica*	Leaves	5–50	Small and large spheres	Thirumurugan et al.(2016)
2.	*Phoenix dactylifera*	Fruit	1.3–2.6	Spherical	Sadalage et al. (2022)
3.	*Lantana camara*	Leaf	35	Spherical	Latif et al. (2019)
4.	*Prunus x yedoensis*	Gum	10–20	Circular	Guleria et al. (2022)
5.	*Camellia sinensis*	Leaf	30–60	Flower	Göl et al. (2020)
6.	*Antigonon leptopus*	Whole plant	5–190	Spherical	Ganaie et al. (2018)
7.	*Barleria prionitis*	Leaf	1–2	Spherical	Rokade et al. (2017)
8.	*B. prionitis*	Leaf	1–2	Monodispersed	Rokade et al. (2017)
9.	*Ocimun sanctum*	Leaves	23	Irregular	Soundarrajan et al. (2012)
10.	*Pinus resinosa*	Bark	6–8	Irregular	Jeyaraj et al. (2019)
11.	*Cacumen platycladi*	Whole biomass	2.4 ± 0.8	Spherical	Zheng et al. (2013)
12.	*Anacardium occidentale*	Leaf		Irregular and rod shaped	Sheny et al. (2013)
13.	*Diospyros kaki*	Leaf	2–20	Spheres and plates	Song et al. (2010)
14.	*Fumariae herba*	Whole herb	30	Hexagonal and pentagonal	Dobrucka (2015)
15.	*Punica granatum*	Peel	16–23	Spherical	Jha et al. (2018)
16.	*Piper betle L.*	Leaf	2.1 ± 0.4	Spherical	Rajasekharreddy and Rani (2014)
17.	*Dioscorea bulbifera*	Tuber	2–5	Spherical	Ghosh et al. (2015)
18.	*Gloriosa superb*	Tuber	0.83–3	Spherical	Rokade et al. (2018)
19.	*Eichhornia crassipes*	Leaf	3.74	Spherical	Oluwafemi et al. (2016)
20.	*Quercus glauca*	Leaf	5–15	Spherical	Karthik et al. (2016)
21.	*Bacopa Monnieri*	Leaf	5–20	Spherical	Nellore et al. (2013)
22.	*Cochlospermum gossypium*	Tree Gum	2.4	Spherical	Vinod et al. (2011)
Bacteria					
1.	*Acinetobacter calcoaceticus*	Intracellular	2–3.5	Cuboidal	Gaidhani et al. (2014)
2.	*Saccharomyces boulardii*	Intracellular	80–150		Borse et al. (2015)
3.	*Plectonema boryanum* UTEX 485	Cell extract	< 300	Spherical	Brayner et al. (2007)
4.	*Calothrix* cyanobacteria	Intracellular and extracellular	3.2		Jeyaraj et al. (2019)
5.	*Acetobacter xylinum*	bacterial cellulose (BC) matrix	6.3–9.3	Granulated	Aritonang et al. (2014)
6.	*Escherichia coli* MC4100	Cells biomass	2.3 ± 0.7	Spherical	Attard et al. (2012)
Fungi					
1.	*F. oxysporum*	Extracellular	10–50	triangle, hexagons, square, rectangles	Riddin et al. (2006)
2.	*Neurospora Crassa*	Intracellular	2–3, 4–35, 7–76 and 20–110	Quasi spherical, single crystalline and round nano-aggregates	Castro-Longoria et al. (2012)
3.	*Cordyceps sp.*	Whole fruiting body	13.34 ± 4.06 nm	spherical	Liu et al. (2022)
Algae					
1.	*Padina gymnospora*	–	25	Octahedral	Ramkumar et al. (2017)
2.	*Plectonemaboryanum UTEX 485*	Cell extract	< 300	Spherical	Lengke et al. (2006)
3.	*Halymenia dilatata*	Aqueous cell extract	15 ± 1.7	spherical	Sathiyaraj et al. (2021)

Main text

Phytochemicals approaches for green synthesis of PtNPs

Plant biomolecules-based synthesis has increased quality attention of the researcher for the synthesis of PtNPs. It is due to the seamless advantage cheaper, simple, speedy, facile, green, non- toxic and efficient. Moreover, the required form, shape and size can be generated easily by altering the parameters such as reducing agent, time, temperature and pH (Naseer et al. 2020). Plants are the richest sources of potential and novel biomolecules which make it a perfect candidate in nanotechnology application (Rawat et al 2020; Li et al. 2022; Wu et al. 2023). Moreover, phytochemical-based PtNPs are in need to be discover for multivariate uses and hence a critical review needs to done for the green synthesis of PtNPs. Remarkable studies of the synthesis *Ocimum sanctum* (Tulsi) leave extract mediated PtNPs synthesis was reported by Fahmy et al. (2020) which was accomplished at 100 °C for 1 h. Moreover, a successful PtNPs was achieved at room temperature by continuous stirring for 20 min. of the plant extract to Pt(IV) ions with the ratio of 1:9 (Fahmy et al. (2020). Similarly, Nellore et al. (2013) had reported the PtNPs by the interaction of leaf extract of *Bacopa monnieri* and Pt(IV) ions at room temperature, though the ratio was 1:4. Song et al. (2010) have described the *Diospyros kaki* (Persimmon) leaf extract-based green synthesis of PtNPs and achieved the > 90% of Pt(IV) ions reduction into PtNPs at 95 °C for 2–3 h. At same temperature (95 °C) Sheny et al. (2013) have synthesized the PtNPs by mixing the leaf powder of *Anacardium occidentale* with Pt(IV) ions.

Antimicrobial potential of green PtNPs

For PtNPs synthesis *Taraxacum laevigatum* was used to improve the bio-activity of nanoparticles. The resonance peak of the surface plasmon was seen the structure of platinum nanoparticles clearly represents 283 nm. The findings show that the genomics-synthesized particles were compatible, small and spherical in shape, dispersed (Tahir et al. 2017). These nanoparticles have been tested for the inhibition of 'gram positive' bacteria and 'gram-negative' bacteria (as *Pseudomonas aeruginosa* and *Bacillus subtilis*). The findings showed that 15 ± 0.5 mm and 18 ± 0.8 mm zone of inhibition were formed by PtNPs for *P. aeruginosa* and *B. subtilis*, respectively. The relevant consequence of this study is based on the strongest antibacterial activity of PtNPs against the multidrug resistant pathogenic bacterium *P. aeruginosa* and *B. subtilis*. It revealed the wide application of PtNPs as a good antibiotic against antibiotic defense mechanism (Hosny et al. 2022). The plant's phytochemicals play a significant role in the NPs synthesis. Organic water-soluble moieties of plants not only used to reduce but also stabilize the nanoparticles that prepared (Kharisov et al. 2014). The latest findings show that the extract of plants is more useful for metal NPs preparation over the conventional approaches because of its consistent particles with high bio-molecular concentrations, e.g., flavonoids, terpenoids, tannins, phenols, alkaloids, quinines, etc. These were accountable for metal nanoparticles reduction and stabilization (Botha et al. 2019; Gour and Jain 2019). The plant-based PtNPs have been manufactured from *Azadirachta indica* (Thirumurugan et al. 2016), *Antigone leptopus* (Selvi et al. 2020), Orange Peel extract (Karim et al. 2019) and Ajwa and Bardni dates (Aygun et al. 2020), which are used to decrease, cap and stabilize the plant growth and inhibits the phytopathogens. These synthesis are basically depending on the polyphenol mediated reduction of Pt ions which is present in the plant leaf, fruits or peel extract (Kumar et al. 2013).

Smaller and spherical nanoparticles are more successful for antimicrobial activity than the uneven formed NPs (Raza et al. 2016). Metal nanoparticles have been suggested to inhibit various mechanisms for bacteria. Prior studies indicate that released nano-particular metals within pathogenic bacteria creates OH• and O_2-• superoxide radicals. If these reactive species are more than bacterial cell scavenging capacity, causes damage to the cell (Dahiya et al. 2013). High PtNPs activity can be directly accredited to its smallest size and the uniform distribution. Current research effort reveals that the PtNPs could be an environmentally friendly, more economical solution and active antibacterial agent for bacterial pathogen inactivation (Ye et al. 2022).

Clinical potentials of green PtNPs

Developing an economically viable and environmentally friendly technique for the production of NPs is also important in the Nanobiotechnology branch. Biological synthetical method of novel PtNPs have been investigated through *neem* extract in the present study and characterized (Thirumurugan et al. 2016). A green bio-synthetic path to PtNPs synthesis with *Xanthium strumarium* extract leaf is pointed out. The synthetic methodology is very straight forward and one step rather than using a capping and removal agent. The nanoparticles also have potent cytotoxic effect on HeLa, the cancer cell lines with an IC50 were also investigated by the MTT assay as well as other biological profiles, such as *In vitro* antibacterial activity and *In vitro* antifungal activity, and show significant activity (Kumar et al. 2019). Plant crude extracts are the source of such special secondary metabolites as flavonoids and terpenoids, and these compounds plays an important role in reducing ionic to bulk metallic nanoparticles formation. Biosynthesized nanoparticles tested successfully changes involving

apoptosis, genotoxicity and oxidative stress (Khan et al. 2021). Furthermore, nanoparticles are widely used in the agricultural, plant sciences and used in managing food waste (Singh et al. 2021). Plant related NPs in different areas have gained a lot of attention since, plant manufactured NPs can easily be produced without help of any special agent for capping/stabilizing and reducing agent. Metabolites of plants likes terpenoids, phenols, alkaloids, flavonoids, quinines etc. used for NPs. Material which acts as a reduction and stabilization agent and produces the Metal-NPs in an environmentally friendly manner as seen in Fig. 2.

Broad application of PtNPs

Because of the cytotoxic activity of platinum nanoparticles would be very precious in the field study of the biomedical applications and biosynthesis of PtNPs. PtNPs are also reported recently as an anticancer agent from *Punica granatum crusts* on human breast cancer cell lines (Sahin et al. 2018). The redox process to metabolize eco-friendly nano-sized particles is continuously correlated with certain primary and secondary metabolites. Different work carried out on the breast cancer cell line in human, MCF-7 has confirmed the cytotoxic effects of *Punica granatum* crusts biosynthesized PtNPs and acts as anti-tumor compound. Sphere-shaped PtNPs with size 20 nm were grown through this green synthesis method. Anti-microbial activity of synthesized PtNPs have been studied by several researchers. Keeping the same in mind, it has been revealed that PtNPs is in contrast to the bacterial negative zeta potentials which have been enhanced the antibacterial properties. Researches also indicated the potential application of PtNPs against the cancer. Membrane potential studies of PtNPs against cancer have been shown via cancer cell lines and were found significantly triggered by the increased concentration of the sample (Noah and Ndangili 2022). In all test concentrations of HeLa cell line displayed more proliferative effect in 24 h. In general, the inhibition of bacteria in combination with β-lactam drug class against antibiotic aminoglycosides class may be infringed. In this main sense, it may propose that the nanoparticles serve as an agent to use to damage the bacteria's cell wall and transmit streptomycin to the cells, and then operate upon the protein synthesizer that destroys bacteria shown in Fig. 3.

Colloidal platinum nano-structures adsorbent with organic capping agents plays key roles in many ways in the process management. Long organic capsulating chains have a hydrophobic and stereo obstacle effect, thus, stabilizing PtNPs to avoid direct contact with relatively high energy platinum surfaces (Lin et al. 2019). Because of the adsorption of capping agents, the

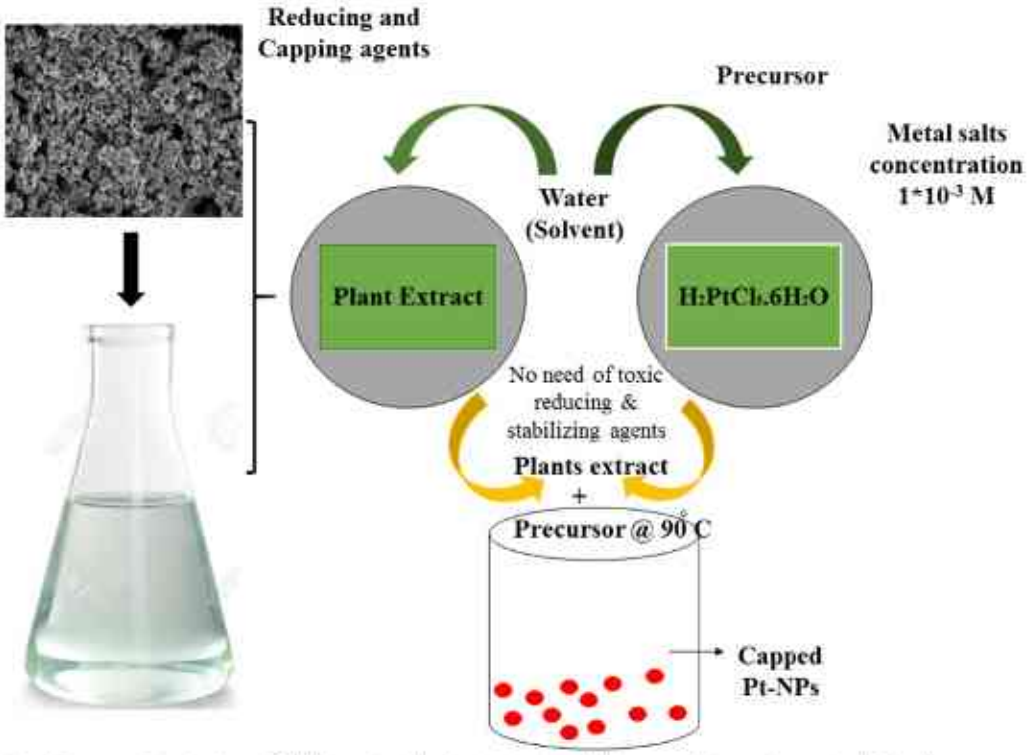

Fig. 2 Illustration of process of production of PtNPs by using the plant extract and platinum salt via environmentally friendly manner

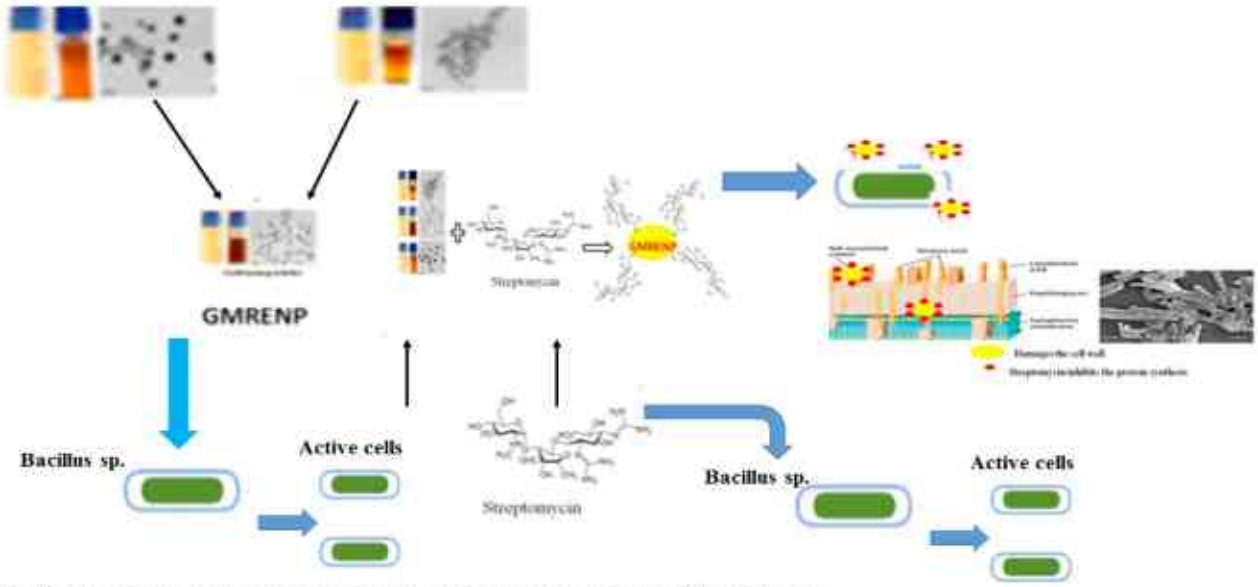

Fig. 3 Schematic description of the synergies of metal nanoparticles tagged with the antibiotics

reduction in total excess energy free prevents PtNPs from further growth and Ostwald maturation. Therefore, the morphology of the nano-crystals can be tested when capping agents adsorb very selectively on given platinum particles surfaces (Kuhn et al. 2008).

The platinum nano-crystals contain diverse electronic structures as well as nuclear configurations with different dimensions; one can assume that these surfaces absorb capping agents separately. The favored adsorption of one surface over another will lead to various development levels along different lenses. The solvent atoms will probably be more vulnerable to anisotropic growth in the less covered platinum surface region. The proper reactive interaction of guest molecules with different platinum faces, which must be balanced however choosy in desorption and adsorption, is a key criterion in choosing the right capping agent for both the shape regulation. The processing of PtNPs by plants has proved to be a feasible way to ensure the environment.

Aygun et al. (2020) have successfully synthesized the PtNPs by using the *Nigella sativa L.* (black cumin seed) extract as a reducing agent. Moreover, the results revealed its cytotoxic potential through the MDA-MB-231 breast (IC50: 36.86 µg/mL) and HeLa cervical cancer lines (19.83 µg/mL) and antibacterial potential against gram ± and gram- bacteria at the concentrations of 100 and 500 µg/ml. This inhibition was obtained by the proliferation of tested NPs. In addition, the microscopic analysis displayed that the cells morphology has been changed after 24 h during the treatment with synthetic nanoparticles with different concentrations. These findings revealed the PtNPs pharmaceutical potentials and indicating its eco-enterprising. Several researchers displayed the PtNPs synthesis by using the pomegranate and dates and indicated its impact on MCF-7 breast cancer cell line. Interestingly, the date extract PtNPs was found effective against the HepG-2 hepacellular carcinoma cell lines which is a common cancer of the colon. Previous studies have also shown that cytotoxic activity of biosynthesized PtNPs against the A549 human pulmonary adenocarcinoma (PA-1), ovarian teratocarcinoma, cell lines of Mia-Pa-Ca-2 and cell induction arrest of stage. Furthermore, the microscopic visualization of cell proliferation and morphological alteration in cytotoxic lines have proven the end application of it. Gurunathan et al. (2019) have visualize the PtNPs (conc. of 25–150 µg/mL) effect on Human Monocytic THP-1 Cell Line after the 24 h exposure and found a unique solution for the treatment of augmented oxidative DNA damage and impaired DNA integrity.

With the modernization of NPs studies, the plant derived specified compound coated PtNPs nanozymes displayed the impressive accomplishments in nanotechnology. Ma et al. (2021) developed the portable mini-drainage device with real-time monitoring assay powered by the VitaminC-coated PtNPs (AA-PtNPs) which can perform as a catalase to catalyze the breakdown of H_2O_2 to O_2. Apo-ferritin encapsulated PtNPs are also a good example of PtNPs powered nanozymes which exhibit super oxide dismutase (SOD) enzyme-like activities and also it retains the SOD derivative activity in cell culture models (Jawaid et al. 2014).

The green synthesized NPs are well known for their antimicrobial activity toward a broad range of gram negative as well as gram-positive pathogenic bacteria. Interestingly, the antimicrobial activity of PtNPs has been found massively effective on drug resistance as well as multidrug resistance (MDR) bacteria such as *Pseudomonas aeruginosa* ATCC13048, *E. coli K12*, *Enterobacter aerogenes*, etc. It is due to their unique features such as high surface area and stability against the broad range of chemicals, as well as rapid biocidal outcome toward the gram positive and gram-negative bacteria, viruses, molds, fungi and algae. It may enhance the production of "reactive oxygen species" (ROS), leading to accumulation and then loss of integrity of the cell membranes. Additionally, it can induce DNA protein kinase down-regulation, leading to oxidative stress and finally apoptosis (Fig. 4).

Though, only few of investigation has been done for the PtNPs antibacterial activity as compared to silver and copper (Zain et al. 2014). A baseline work was reported by the Gopal et al. (2013) and indicated that PtNPs with sizes less than 3 nm displayed efficient bactericidal activity against *P. aeruginosa*. The efficacy of green At-PtNPs against the gram-negative (*E. coli* and *Klebsiella pneumonia*) and gram-positive (*Bacillus subtilis* and *Staphylococcus aureus*) bacteria was determined by the zone of inhibition with the NPs concentration of concentration of 1 mg/L (Eltaweil et al. 2022). The findings showed that the zone of inhibition for *K. pneumonia* was 17 mm and zero growth was observed in *E. coli* plate which is indicating that At-PtNPs are extremely effective against *E. coli* as it completely prohibited the bacterial growth.

Platinum nanoparticles through egg yolk

With the advancement of nanoscience's and virtue-full results of Pt derived nanoparticles for clinical and commercial application. Hence, it emphasized the researches to propose the more controlled way of PtNPs synthesis with required composition, form, shapes and size for various proposes and from different higher organisms. The green synthesis of PtNPs using the quail egg yolk and a reducing agent peroxidase enzyme as well as without any reducing agents provided an eco-friendly way that has the reactive medium enriched with the high protein and vitamins content.

The pH, temperature, time and concentration of the reaction situation were optimized with the aid of quail egg yolk. The results demonstrated that at 20 °C (pH 6.0) for 4 h, the maximum PtNPs were synthesized within the size range 7–50 nm. A schematic methodology of egg yolk-based PtNPs synthesis is shown in Fig. 5.

Briefly, to prepare white, and yolk reaction medium, eggs of the quail were divided. 1.0 mL of egg yolk were added to 99 mL of distilled water and stirring at high-speed by magnetic stirrer for 30 min to obtain the homogeneous medium for reaction. Then medium was filtered which allowed the homogeneous components to be leached. Further, the egg yolk homogenate was stirred at 100 rpm with 10.0 mM of H2PtCl6 solution at normal atmospheric pressure and temperature. Formation of the

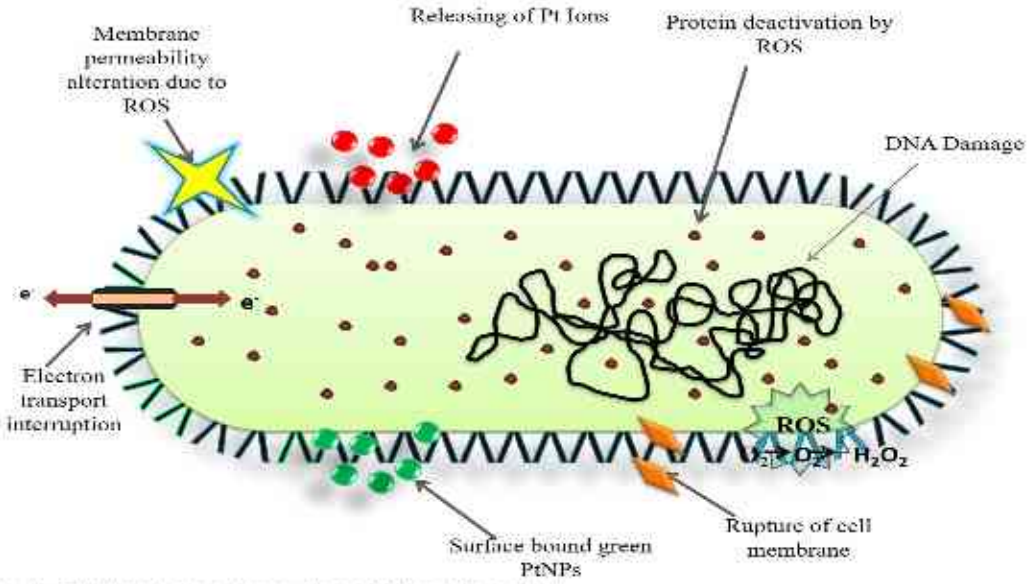

Fig. 4 ROS activity of PtNPs and interaction as well as inhibition of bacterial cell

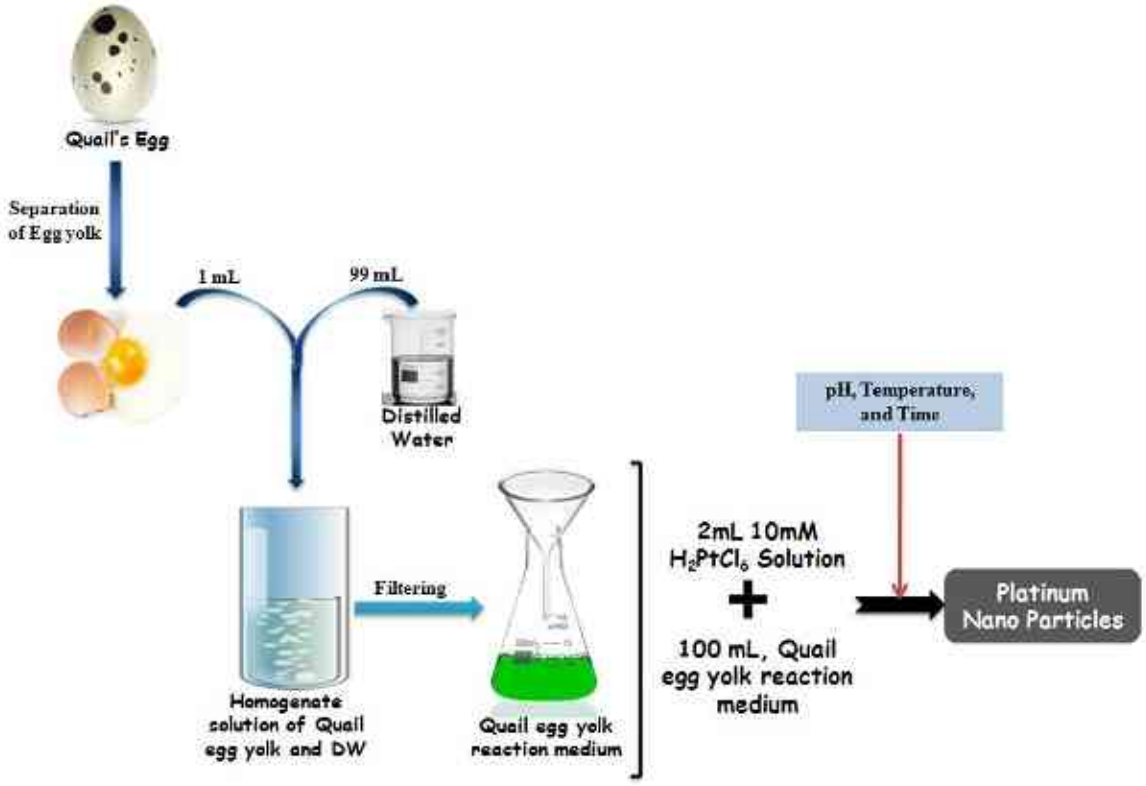

Fig. 5 Process of PtNPs synthesis through egg yolk and platinum salt

PtNPs was monitored with the scanning of reaction mixture by spectrophotometer.

The optimum reactive conditions such as metal ion concentration, reaction time, pH, temperature, etc., have determined to get maximum PtNPs by controlling the reaction parameter. Resultantly, cubic shape and sizes (7–50 nm) were observed by next generation microscopy of PtNPs that originated from quail egg yolk medium (Nadaroglu et al. 2017).

Platinum nanoparticles deposition with bio-reductive effect on algae

Algae have an exceptional aptitude to understand the metals and facilitate its uptake and accumulation and convert into more flexible forms through the hyper accumulations of heavy metal ions (Priyadarshini et al. 2019). Due to these potentials, algae are considered to be a model organism for bio-nanomaterial processing. Moreover, the algal extracts comprise of the mixture of bioactive compounds such as polyphenols, tocopherols, carotene, chlorophyll, phycocyanin, phycoerythrin, fatty acids, carbohydrates, vitamins, proteins, minerals, fats, and polyunsaturated fatty acids. Anju et al. (2020) have indicated that algae extracts are investigated for a wide number of biomolecules and metabolites that have the capability to reduce the metal ions and capped them to improve their cellular biocompatibility.

Previous research described the main active compounds of reduction and stabilizing agents for algae-based PtNPs synthesis and basically focused on the algae-mediated nanomaterial synthesis, solution of metal precursor, and metal-algae extracts reaction mixture incubation. The reaction is started when the liquid type algal extract is combined with the targeted metal precursor molar solution. Usually, the color shift in the reaction mix defines as a visible monitoring for reaction initiation and indicating the nucleation, accompanied by evolution of NPs with neighboring nucleonic particles cluster together. Resultantly, thermodynamically stable with various sized and shaped PtNPs obtained. The algae extract's bioactive portion facilitates the NPs synthesis cascade, and the regulatory factors that involved are concentration, time, temperature, and pH. Overall synthesis is accomplished by two roots, i.e., intracellular and extracellular, that keep a side the control factors. Initially the synthesis of nanoparticles was reported to be intracellular and later algae were oppressed for an extracellular synthesis mode (Fig. 6).

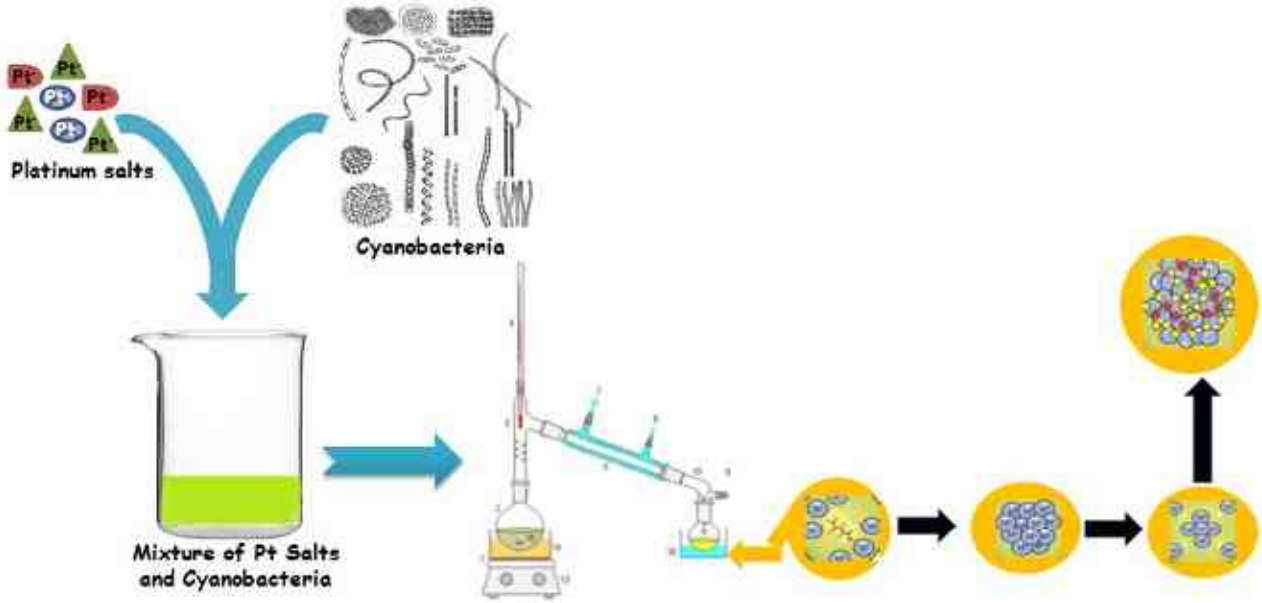

Fig. 6 Illustration of Cynobacterial species and platinum salt based Synthesis of PtNPs

Fungal mediated PtNPs synthesis

Fungi can be used with various way to synthesize the NPs such as total fungal biomass debris, cultured liquids, intracellular extracts, protein fractions, total metabolome, individual fungal metabolites. Though, biomass-based NPs needs to need to separate the synthesized NPs from the bio-objects of fungi. Other dis-advantages of this methodology are the long-time process. Interestingly, the materials derived from fungal biomass, such as cultured liquids, intracellular extract, proteins or individual metabolites can give us a perfect option for green synthesis of nanoparticles. This technique is reproducible, time saving and there is no need to destroy the fungal cells or to separate NPs from them. Though, only Ascomycota species are profoundly reported for the synthesis of Pt-based NPs nanoparticles and has been done with intracellularly as well extracellularly with the support of some enzymes or bioactive molecules. An intra- and extracellular synthesis of PtNPs from fungal cell is described in Fig. 7.

Biosynthesis of PtNPs is studied well in the Ascomycetes fungi *Fusarium oxysporum*. F. oxysporum mycelium biomass was used to produce the various shaped PtNPs such as circular, square, pentagon, hexagon, and rectangle within the size range of 10–100 nm (Riddin et al. 2006). Though, extracellular bioactive-based synthesized NPs found to be more significant. Syed and Ahmad (2012) done the reduction of platinum salt by Pt(IV)-reductase enzyme of *F. oxysporum*. The synthesized PtNPs of fungal hyphae extract and hydrogenase are showing different characteristics in the sense of size as well as in shape. The irregular shape and size range of 30–40 nm was obtained with extract and triangular, circular, pentagonal and hexagonal PtNPs with the size range of 40–60 nm were obtained with the enzyme, respectively. Further, Gupta and Chundawat (2019) synthesized the face-centered cubical shaped PtNPs (25 nm) by the using *F. oxysporum* culture filtrate which is endowed with the antimicrobial and photocatalytic potentials. Castro-Longoria (2012) has target the *Neurospora crassa* to synthesize the PtNPs by incubating the mycelium biomass with H_2PtCl_6 and obtained the extracellular PtNPs of size range 4–35 nm with spherical as well as nanoaggregates of size 20–110 nm. Sarkar and Acharya (2017) were formulated the Nano-platinum by using the fungal cultured filtrate of *Alternaria alternata* which is a common phytopathogen. The synthesized PtNPs are variable in size (50–315 nm) with irregular shape such as quasi-spherical, polygonal, rectangular, tetrahedral as well as hexagonal in morphology. The culture filtrate of model organism. *Penicillium chrysogenum* has shown the remarkable synthesis of vastly discrete non-aggregating Pt nanospheres with size range of 5–40 nm (Subramaniyan et al. 2018). Similarly, Pt nanospheres from *Saccharomyces boulardii* extract were obtained by Borse et al. (2015). It revealed that yeast cell biomass (500 mg/mL) and 0.5 mM chloroplatinic acid with the temperature 35 °C, pH 7.0 and 200 rpm needs to incubate for 36 h to achieve the significant concentration of PtNPs.

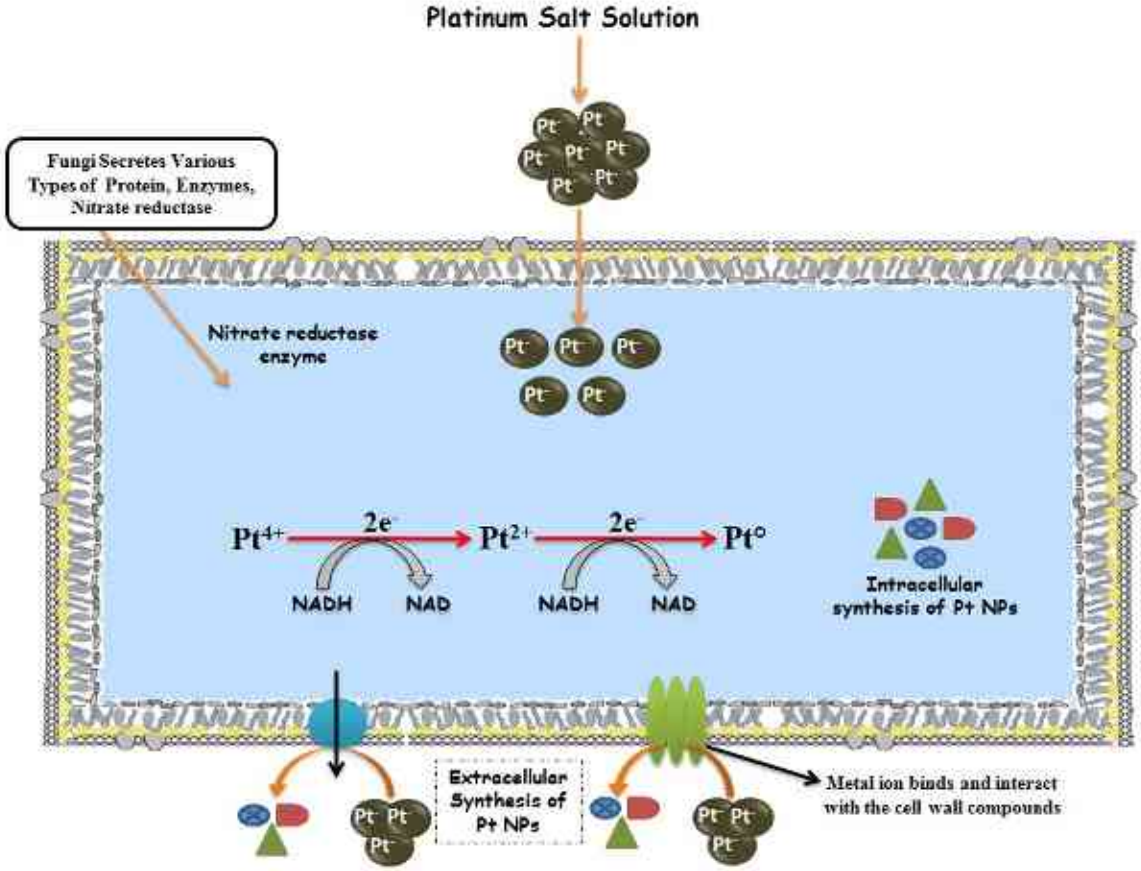

Fig. 7 Detailed process for the intracellular interaction of platinum ion and fungal metabolome and the mechanism of PtNPs synthesis

Toxicity of PtNPs

Due to the greater neoplastic patient population in recent years, substantial amounts of antineoplastic drugs based on Pt are discharged into the circumference through hospital effluents, urine patients and pharmaceuticals. Moreover, the widespread application of PtNPs in gas neutralizers for automobile drain has abruptly increased the amount of PtNPs pollution in the environment. Several species have recorded for toxic effect of cisplatin in marine organisms, such as microalgae (*Pseudokirchneriella subcapitata*), protozoans (*Tetrahymena pyriformis*), rotifers (*Brachionus calyciflorus*), crustaceans (*Daphnia magna*; *Ceriodaphnia dubia*), and fish (*Danio rerio*), which have shown their response on both inhibition in reproduction and growth (Asharani et al. 2011; Sørensen et al. 2016; Adeyemi et al. 2018; Hlavkova et al. 2018).

Koltan and Czaja (2014) have indicated that2.5 mg/kg dose of PtNPs abridged the total count of bacteria in soil and inhibited the nitrogen fixation. A recent study has revealed that PtNPs of doses 10 and 100 mg/kg has significant negative impact on the radish crops seed germination as well as root length (Kolesnikov et al. 2023).

Phytoplankton such as *C. vulgaris* are first marine food chain links which make it significant to assess the toxicity of various agents based on toxic on these species. Findings revealed that Cisplatin does have the highest rank of environmental toxicity among Platinum-based antineoplastic drugs PBADs according to a classification for chemical toxicity to the environment. *C. Vulgaris* has toxicity on all other cytotoxic agents. This has been studied in several previous research. Higher 'IC50' values of the PBADs to the algal cells as opposed to herbicides, engineered herbicides destroy the plant cells and they inhibit photosynthetic plant mechanisms (Das 2013). Microalgae are photosynthetic cells, and are highly susceptible to herbicide toxic effects compared to PBADs. Drugs based on platinum are designed to kill animal cancer cells, and their IC50s were below 1 mg/L in all the animal cell lines tested.

Different mechanisms of toxicity of PBADs in algae, human and *C. vulgaris* can occur in stable cell walls in IC50s. The results of this study have exposed that PBADs inhibit photosynthetic pigment production, cell

photosynthesis and algal cell proliferation (Safi et al. 2014). Those toxic effects depended on dosage and time.

More strongly, compared with carboplatin and oxaliplatin, Cisplatin inhibited the production of photosynthetic pigments in algal cells. From the photosynthetic stains, carotenoid reduction was suggestively greater than that of chlorophylls. The intracellular mechanisms related to this are not been cleared and it needs further study. Increased MDA production was consistent with predictable toxicity of PBADs (alkylation agents). Possible methods of action PBADs contrary to human cells and are DNA and DNA impairment via cross-link formation between DNA to atoms by the add-on alkyl groups (Dasari and Tchounwou 2014). There is no proof that cytotoxic drugs, like by photosynthetic enzymes, inhibit the process of photosynthesis from algal chloroplast; in literature, the prevailing mechanism by which PBADs prevent algal cell proliferation is likely to occur. Further studies on the possible toxic mechanism of PBADs in algal cells are necessary. Several experiments have shown that cytotoxicity causing PBADs is closely linked to ROS and additional free radicals. ROS is the outgrowth of normal cell metabolism; but excessive levels of cells with adverse effects can cause oxidative stress. Reducing the antioxidant capacity (as observed in this study) in algal cells confirmed the oxidative stress induction (Choi et al. 2015).

Interestingly, size of synthesized PtNPs is the key factors on significant cytotoxicity. The PtNPs sizes ranging from to 21 nm tested on to the neural cell line displayed the cyto-compatible nature with size 5–6 nm but other sizes causes cell damage (Manikandan et al. 2013),

Depending on sizes PtNPs of size 8 nm showed no harmful effects but the PtNPs of size 1 nm in culture induced cytotoxicity to renal cells in a dose dependent manner with the same concentration range (Buchtelova et al. 2017). Alternatively, polyvinylpyrrolidone PVP PtNPs of size 6 nm caused a decline in genotoxic effects and metabolic activity and did not change primary keratinocyte morphology, and migration capacity while PtNPs of size 57 nm are less hazardous to keratinocytes than the minor ones (Konieczny et al. 2013). Hence, the reviewed research made clear that it can control or reduce the toxicity offered by PtNPs by controlling their size during their preparation, which will in turn effect their possible applications for biomedical purposes.

Conclusions

The bio-synthetic NP pathway is a reliable, environmentally friendly and more specifically on the green aspect synthetic tackle. Huge attempts are being made in the last few decades for green NP development approach. In addition, microbes and plants are efficient producers of biologically active alkaloids and useful compounds which are found to have a broad range biological-based activity, like those of antimicrobial, anticancer, antibiofueling, antimalarial, antiparasitic, and antioxidant, etc. Platinum is the most rare and costly metals. This has highest corrosion resistivity and various catalytic applications include catalytic converters for catalysts for petrochemical cracking and automotive use. The PtNPs however have a detrimental impact on cancer cells. Because of this, researchers have partly abandoned studies on the use of platinum as an agent on anticancer. This is unclear since, according to other reports, PtNPs are in very low concentration: Biological stability and tolerance. These kinds of not established part can be the forthcoming challenges will be covered. The challenging recoveries of the toxicity of the NPs with greeno-biogenic inventory part of nanotech will be the suspicious event. Through this significant focus of discussed the upcoming pharmaceutical bioactive product PtNPs through the greeno-biogenic approach with different approaches like plant products, algae, fungi, and egg yolk, etc. This greeno-biogenic PtNPs scrutiny can help the rate of the upcoming pharmacological advances. In addition, the organic PtNPs are competing with chemically synthesized nanoparticles in order to ensure adequate shape and size that the regulated reaction conditions provide better stability and it is highly important to unveil the use PtNPs as nanomedicine in biological applications. The very less studies shows, it can be great evolution in the pharmacology and nanoscience. Mainly antioxidant, antibacterial, anticancer and catalytic action are the promising studied part which needs to explore in commercial prospectives.

Acknowledgements

Authors are thankful to management committee Bajaj College of Science Autonomous Wardha, Maharashtra for required support in above mentioned work.

Author contributions

UM, SN and RUT conceptualize and designed the work, YSP collected the materials, VN has revised the MS, helps in fig. designing and did the language editing, YNS, PRY and RPB has written and manuscript. All authors have read and approved the manuscript.

Funding

No funding was obtained for this study.

Availability of data and materials

The authors confirm that the data supporting the findings of this study are available within the article.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not required.

Competing interests
The authors declare that they have no competing interests.

Received: 26 May 2023 Accepted: 13 August 2023
Published online: 24 August 2023

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Publisher's Note

ISSN 2319 - 359X

AN INTERNATIONAL MULTIDISCIPLINARY
HALF YEARLY RESEARCH JOURNAL

IDEAL

Volume - XII Issue - II March - August - 2024

ENGLISH PART - VIII

Peer Reviewed Referred and
UGC Listed Journal No. 47026

Single Blind Review/Double Blind Review

ज्ञान-विज्ञान विमुक्तये

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Ajanta Prakashan
Aurangabad. (M.S.)

Printed by

Ajanta Computer, Near University Gate, Jaisingpura, Aurangabad. (M.S.)

Published by

Ajanta Prakashan, Near University Gate, Jaisingpura, Aurangabad. (M.S.)

Cell No. : 9579260877, 9822620877

E-mail : ajanta2023@gmail.com, www.ajantaprakashan.in

IDEAL - ISSN 2319 - 359X - Impact Factor - 7.537 (www.sjifactor.com)

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10. Isolation and Characterization of Bacterial Isolates from Agriculture Field Soil of Buldhana Region

Y. S. Patil
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Abstract

Microorganisms present in soil plays a major role in enhancing the plant growth. In our present study soil sample was collected from the agriculture field of Buldhana District and organisms were isolated by serial dilution technique. Well defined isolated colonies were selected and pure cultured. The isolates were named as S1, S2, S3, S4 and S5. Biochemical characterization of the above mentioned isolates determined and metabolism of various sugars was done at a maximum rate by the isolates S4 and S5. Based on their biochemical characterization and carbohydrate fermentation the isolates were identified to be *Bacillus, Pseudomonas, Streptomycis, Azotobacter* and *Alcaligenes.*

Keywords: *Agriculture soil, isolates, carbohydrate fermentation.*

Introduction

Microorganisms are present in every part of biosphere, including soil, hot springs, inside rocks and 19 kilometres deep underground etc., Microorganisms present in soil play an important role in maintaining the biogeochemical cycle and biological balance in the life of our planet. All soils contain different types of microorganisms viz. bacteria, fungi, viruses etc. in varying amounts depending on soil conditions. The permitted degree of acidity and the types of residue added also determine the relative abundance of microbes. The fertility of soil and the accumulation of organic matter within a short time are dependent on the bacterial amount (Kummerer, 2004). The products and the by products of microorganism in soil are beneficial to increase the nutrient contents in soil, plant growth and also play an important role in nutritional chains (Paul and Clerk, 1966; Kumerer, 2004). Microorganisms in soil also play a major role in changing the nutrients into a form that can be used (Tugel and Lewandowski, 2010). Microorganisms in soil play a crucial role in biogeochemical cycles and in sustainable development of biosphere (Diaz, 2004). Microorganisms present in soil produces and consume

two or three major naturally occurring green house gases that distinctly influence agriculture (Levine *et al.*, 2011). In our present study we have collected the soil sample from the agriculture land of Buldhana District region. The organisms were isolated and characterized.

Materials and Methods

Collection of Soil Sample

The soil sample was collected from uprooted area of the plants without breaking the secondary and tertiary roots and placed in a sterile plastic bags and safely transferred to microbiology laboratory. The adhering soils from the root parts were separated carefully and stored at 4°C for further studies.

Determination of Pysiochemical Properties of Soil

Fresh soil samples were subjected to determine physiochemical properties. Soil pH was determined according to the procedure described by Martin *et al.* (2013). The moisture content of the sample was measured in hot air oven at 105°C to constant weight. The temperature and humidity was determined using thermometer and hydrometer (Pramer and Schmidt, 1964; Iyengar and Bhave, 2005).

Isolation of Bacterial Isolate

The soil microorganisms were isolated by serial dilution technique on nutrient agar medium (NAM). One gram of soil from sample were separately suspended in 10 ml of distilled water and mixed well for 15 minutes and vortexed. Each suspension was serially diluted from 10^{-1} to 10^{-6}. Spread plate technique was carried out to isolate the organism form the diluted sample. 0.1 ml was pipette out onto plates with nutrient agar and spreaded with a glass L shape rod and incubated at 37°C for 24 hours. The most prominent colonies were isolated and maintained at 4°C for further studies.

Identification and Characterization of Bacteria

The shape, size and arrangement of the isolates and their differentiation into gram negative or gram positive bacteria were found. The bacterial isolates were characterized biochemically by various tests like Indole, MR, VP, Citrate etc., including carbohydrate fermentation (Collins and Lyne, 1989; Harold, 2002; Zaved *et al.*, 2008).

Results and Discussion

The soil sample was collected from the rooted region of the plants in the agriculture area of Buldhana District. The soil sample was observed for its physiochemical properties. The soil had pH of about 6.5. Soil with such pH conditions enhances the nutrient availability. The temperature notified benefits the plant in availability of nutrients and the moisture content enhances the nutrient availability and enriches the growth of microorganisms which intern aids in plant growth.

Biochemical Analysis of Isolates

Soil sample from the agriculture field of Buldhana District were serially diluted and five well defined colonies (S1, S2, S3, S4, and S5) were selected and were pure cultured. The isolates were subjected to gram reactions and several biochemical characterizations. Among five isolates three isolates were found to be gram positive and two were gram negative. Almost all the isolates were rod shaped in which S1 was spore former and S2, S4 and S5 were found to be motile.

S2 and S5 were found to be gram negative and the remaining all other isolates identified namely S1 and S3 were found to be gram positive in reaction. The maximum fermentation of sugars was carried out by S4, whereas S5 did not undergo fermentation process. Based on biochemical characterization and fermentation of sugars the isolate S1 was identified as *Bacillus* sp, S2 was identified as *Pseudomonas* sp, S3 was identified as *Streptomycis* sp, S4 was identified to be *Azotobacter* sp and S5 was found to be *Alcaligenes* sp (Table 2).

Chitra Bhattacharya *et al.* (2014) in their research work has stated that from the agriculture soil microorganisms like *Micrococcus* sp, *Escherichia* sp, *and Staphylococcus* sp. have been isolated. Several bacteria and fungi were isolated from soil using serial dilution method (Nakuteshwar Dut Jasuja, 2013).

Conclusion

Soil contains billions of microorganisms in which some bacterial species are very fragile and may be killed by slight changes in the soil environment. Others are extremely tough, able to withstand severe heat, cold or drying. Some bacteria are dependent on specific plant species. Soil food web supports other soil organisms and the functions of a healthy soil. Diversified nature of soil bacteria can suppress root diseases. The current study establishes that the soil from agriculture field of Buldhana District has bacteria that might enhance the growth of plants and can be used as plant growth promoting bacteria.

Table 1: Morphological and Biochemical Characterization of

Bacterial Isolates from Soil

Test	S1	S2	S3	S4	S5
Gram Reaction	+	-	+	+	-
Spore former	+	-	-	-	-
Motility	-	+	-	+	+
Morphology	Rods	Rods	Ariel Mycelium	Rods (Diploid)	Rods
Indole		-	-		-
Methyl Red	-	-	-	-	-
VP	+	-	-	-	-
Citrate	-		-		
TSI	-	-	-	-	-
Urea	-	-	-	+	-

Table 2: Carbohydrate Fermentation of Bacterial Isolates from Soil

Carbohydrates	S1	S2	S3	S4	S5
Arabinose	-	-	–	+	-
Arabitol	-	-	-	-	-
Fructose	+	-/+	–	+	-
Fructose	+	-	-	+	-
Glucose	+	–	-	+	-
Lactose	-	-	-		-
Mannitol	-	–	–	-	-
Maltose	+	–	-	-	-
Starch		-	-	-	-
Sucrose	+	-	-	+	-
Xylose	-	-	-	+	-
Identified genus	***Bacillus sp***	***Psuedomonas sp***	***Streptomycis sp***	***Azotobacter sp***	***Alcaligenes sp***

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International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 5 Sep-Oct 2023, pp: 423-430 www.ijprajournal.com ISSN: 2249-7781

Evaluation of Mentha piperitaL Extracts against Biofilm Producing Bacteria

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Submitted: 15-09-2023 Accepted: 25-09-2023

ABSTRACT:
The objective of this study was to determine the antibacterial properties of the extracts of Mentha piperita.In current study four extracts in different solvent (chloroform, acetone, ethanol, and methanol)were examined for their antibacterial potential against different biofilm forming Gram-positive Staphylococcus aureus, Gram-negative bacteria Escherichia coli,Klebsiella pneumoniae andPseudomonas aeruginosaisolates. Antimicrobial efficacy of various extracts was assessed by using agar-well diffusion method.The zone of inhibition of plant extracts Mentha piperita with their respective solvents (ethanol, methanol, acetone and chloroform) ranged between 10- 38 mm.The ethanolic extract of plant was found to be efficient for the antibacterial activity.

KEYWORDS: Mentha piperita, plantextracts, antibacterial, agar-well diffusion method

I. INTRODUCTION:

Medicinal plants or herbal products are becoming increasingly popular as the first line of self-treatment in developing countries, such as India, China, South Africa, and the United States, working together to prevent certain diseases. In primary health care, 70–80 percent of the world's population uses unconventional medicine, often of herbal origin (W.H.O. 2002) and herbal medicines are the only choice for poor people in some parts of the world. In Ethiopia, herbal medicine is used by more than 85% of the population for primary health care (Meena et al., 2010).

According to the literature, plants were crucial in treating various illnesses, from mild cold to life-threatening diseases like tuberculosis and malaria (Abera, 2014; Chekole, 2017). Plants are widely used throughout the world in herbal medicine and the agricultural and nutritional industries. However, the antimicrobial activities of several medicinal plants have not yet been thoroughly investigated. Plants are considered the most significant source of obtaining new antimicrobials. They produce secondary metabolites, phytochemicals, which protect the plant against pathogens. Plant extracts from medicinal plants have been used to treat infectious diseases due to their availability and affordability (Kose et al., 2021). They are effective against urinary tract infections, gastrointestinal disorders, respiratory diseases, and cutaneous infections (Ali-Shtayeh et al., 2000).Mentha spp. is well-known genus, humans have used for thousands of years. Oral care goods, chewing gum, liquors, and fragrances are among the most popular uses. Its promise is based on its various properties as a carminative, antioxidant, antifungal, and antimicrobial agent (Desam et al., 2017; Santini et al., 2018). They identified it as a possible nutraceutical and functional food for disease prevention and treatment. Mentha piperita L. (peppermint) is a perennial herb that grows 50-90 cm tall and has square-shaped stems with opposite leaves (Briggs, 1993). These plants grow in temperate climates worldwide, mainly in Europe, North America, and North Africa, but are now grown in all parts of the globe. With its well-known absorbing minty odour and cooling taste, menthol is the dominant compound in peppermint (Pushpangadan & Tewari, 2006).

II. MATERIAL AND METHODS:

1) **Collection of plant materials:**The medicinal plantMentha piperita (peppermint) parts like leaves and flowers, were collected from different localities of Amravati region, East of Maharashtra state, India by standard method (Harnischfeger, 2000). The collected plant materials were soon transported to the research laboratory and washed with sterile water. Plant were identified and authenticated by a competent authority. Plant material was allowed for complete shade drying and then

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 5 Sep-Oct 2023, pp: 423-430 www.ijprajournal.com ISSN: 2249-7781

made into a fine powder with a mechanical grinder.

2) **Preparation of Extract:** Collected plant materials powder (20 gm) were extracted sequentially using a Soxhlet extractor with 250 mL of pure organic solvents separately to extract non-polar and polar compounds, with solvents of increasing polarity such as chloroform, acetone, ethanol, and methanol until the extract was clear or colourless. The obtained crude extracts were then filtered through Whatman No.1 filter paper, then evaporated to dry. Extracts were stored in sterile capped bottles under refrigeration conditions (4°C) before use for subsequent assays.With the help of the following formula percent yield of plants crude extract, and the dry extract was calculated (Clifford et al., 1999).

$$\text{Dry extract percent yield}\,(\%) = 100\,x\,\frac{\text{weight of dry extract}\,(g)}{\text{weight of dry plant}\,(g)}$$

Figure: **Extraction of *Mentha piperita* (Peppermint)**

3) **Collection, Isolation and identification of clinical isolates**A total of 342 specimens from urine, catheter tip, pus, blood, and sputum were collected from government general hospitals and private pathology laboratories within Akola and Amravati city. The samples collected from Amravati and Akola regions were from individual patients and considered to include a distinct pathogenic strain. Hence all of the samples of urine, blood, sputum and catheter tips were used for bacterial isolation. The patients were primarily diagnosed for a probable causative pathogenic bacterium, which helped in presuming the type of media to be used. Though, every sample was spread on all the four selective media viz EMB media for E. coli and K. pneumoniae, Mannitol salt agar for S. aureus, and Cetrimide agar for P. aeruginosa. After spread plate, the selective isolates were made as pure cultures and used for routine cultural, morphological, biochemical characteristics, other tests using Bergey's Manual of Systematic Bacteriologyfurther confirmation of the isolated species.

4) **Biofilm Production Assay:** Biofilm production was assayed by the tube method: a loopful of isolated organisms was inoculated in 10 mL of trypticase-soy broth with 1% glucose in test tubes. Incubate the tubes for 24 hours at 37 °C. After incubation, tubes were decanted, washed with phosphate buffered saline (pH 7.3), and dried. Tubes were then stained with crystal violet (0.1%). Wash excess stains with distilled water. Tubes were dried in an inverted position. The scoring for the tube method was made corresponding to the results of the control. Biofilm formation was considered positive when a visible, thick film lined the wall and the bottom of the tube (Christensen et al., 1982).

5) **Antimicrobial activity testing of plant extracts:** The agar-well diffusion method was used for the screening of the antimicrobial potential of selected plant extracts against the test bacterial isolates. Mueller-Hinton agar plates were prepared by pouring about 25 mL of the sterilised medium into a Petri dish to a depth of 3–4 mm. The bacterial suspension was spread evenly over the surface of the Mueller Hinton agar plate. Wells were then bored into the agar medium with a 6 mm sterile cork borer. The stock solution of extracts (100 mg/ml) was prepared by dissolving crude extract with 2% DMSO. A hundred microliters of each solvent extract of

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plant materials, at a concentration of 100 mg/mL, were dispensed into each well in the Petri plate. Plates were incubated in an upright position, and after incubation at 37 °C for 24 hours, the plates were checked for the zone of inhibition as per the CLSI. (2012). DMSO was used as a negative control. The assessment of antibacterial activity was done by measuring the diameter of the growth inhibition zone formed around the well. The test was performed in triplicates.

III. RESULTSAND DISCUSSION:

The Leaf extract preparation and yield

Table1 shows the yield of the plant extract using different solvents. These extract showed variable percentage of yield relative to the polarity of the solvents. The potential of various solvents to remove extractable components from plant parts went in this order: Ethanol > Methanol > Acetone > Chloroform. Ethanolic extract showed a higher extractive yield.The extractive yield of the plant with Chloroform that is weakly polar was between 4.0 to 4.6 % while that of Ethanol that is highly polar was between 8.6 to 11.7 %. It may be inferred that compounds having high polarity showed percent yields higher than that of less polar compounds. The extraction was consistent throughout the experiment as shown by a low standard error in the dry mass and percent yield. The resultant dry mass was dissolved in 1 ml DMSO.

Table:1 The yield of the plant extract using different solvents

Sr. no	Name of the plant	Solvent used	Dry mass yield (g)	Percentage Yield (%)
1	Mentha piperita (Peppermint)	Chloroform	0.81 ± 0.06	4.05
		Acetone	0.89 ± 0.06	4.45
		Ethanol	2.32 ± 0.06	11.60
		Methanol	2.3 ± 0.06	11.50

Collection, Isolation and identification of clinical isolates

A total of 342 samples, 94 urine samples (27.5 %), 83 sputum samples (24.3 %), 77 blood samples (22.5 %), 46 pus samples (13.4 %) and 42 (12.3 %) catheter tip specimens were sampled. From those, 184 samples showed bacterial growth to give pure isolates. Every sample corresponded to a separate infectious microbe. Hence all isolates were cultured and maintained for further investigations.

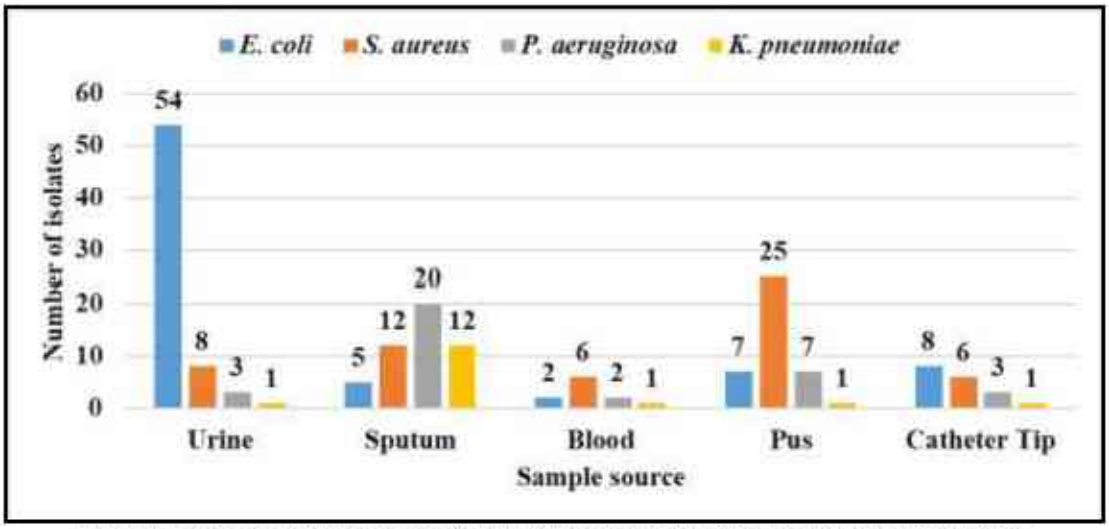

Figure 2: Comparative analysis of the distribution of isolates out oftotal 184 isolates

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Biofilm production potential of isolates

Out of 184 isolated 90 isolates (75 %) were shown to have biofilm production which included strong and moderate biofilm producers and 30 weak or non-biofilm producers. The highest biofilm producing percent isolates were of P. aeruginosa (100 %), followed by E. coli (74.07 %) and S. aureus (73.68 %). The lowest percentage of biofilm producers were of K. pneumoniae (25 %).

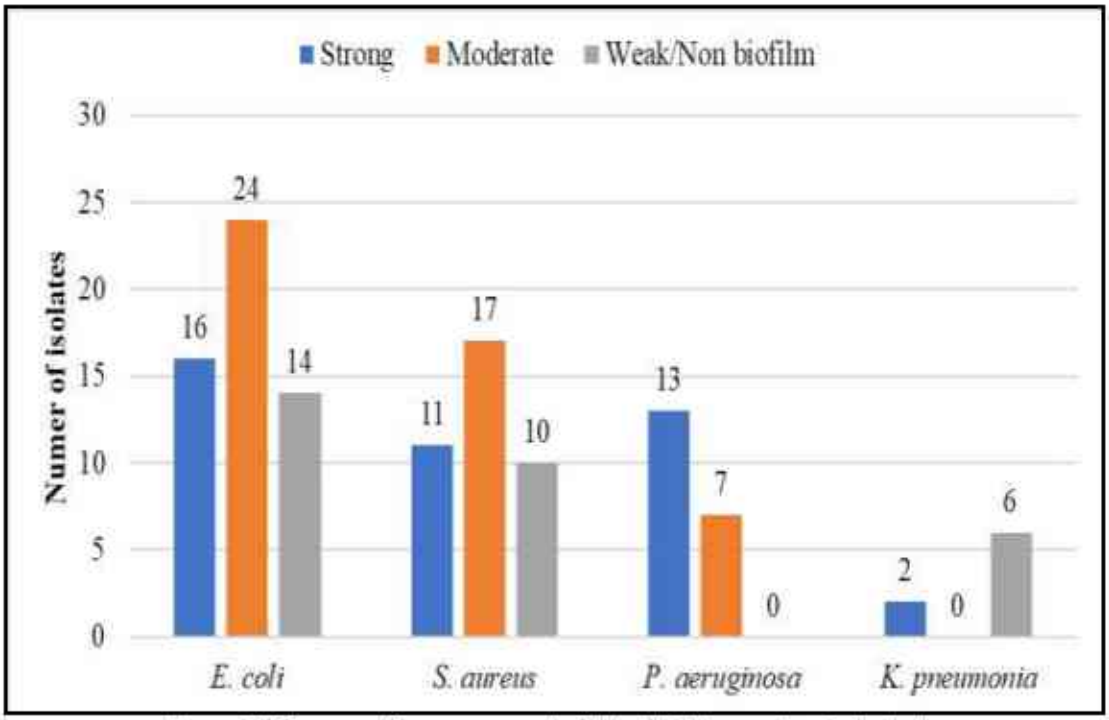

Figure 3: Comparative assessment of total biofilm producing isolates

Out of 184 bacterial isolates, total 90 biofilm producing were selected for susceptibility testing. The results of susceptibility testing of different solvent extracts of plantMentha piperitaagainst 90 biofilm producing isolates of E. coli, S. aureus, P. aeruginosa and K. pneumoniae are mentioned below in this section. Out of these, 40 E. coli, 28 S. aureus, 20 P. aeruginosa and 2 K. pneumoniae biofilm producing isolates have been studied and shown. The results of the susceptibility test of the leaf extracts were categorized similar to that done during the antibiotic testing (Resistant (≤ 13mm), Intermediate (14-16 mm), susceptible (≥ 17 mm). All the tested extracts demonstrated varying degrees of antibacterial activity against different isolates. DMSO was used as a negative control, which showed no growth inhibition of the bacterial isolates, denoting that it had no role in bacterial inhibition.

Antibacterial activity of plant extracts

Antibacterial activity of four solvent extracts of Mentha piperita against E. coli, S. aureus,P. aeruginosa, and K. pneumoniae was examined. Overall, M. piperita was shown to be moderately efficient against E. coli,.However, among these extracts, the ethanolic extract efficiently inhibits the isolates and the zone of inhibition is found to be in the range of 15- 26 mm. as showed in **Figure 4 & 8.**

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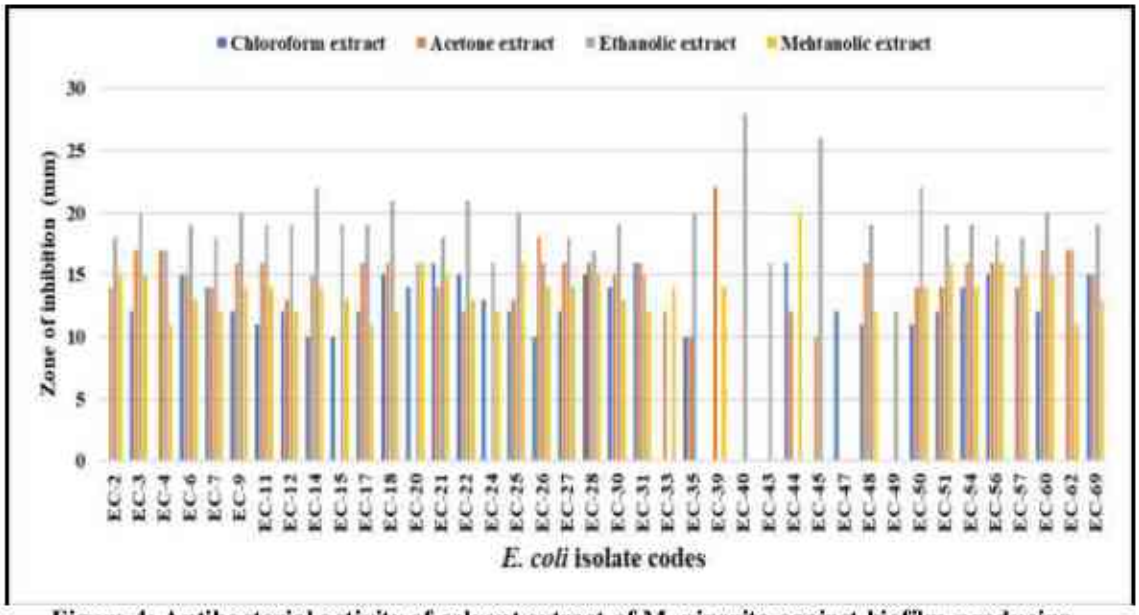

Figure 4: Antibacterial activity of solvent extract of M. piperita against biofilm-producing

E. coli isolates

S. aureus isolate was subjected to antibacterial assays using Mentha piperita. In these studies. Many isolates showed susceptibility against the ethanolic extract of M. piperita in the broader range of 10- 23 mm. The isolates that were susceptible to this extract were 93 %. The moderate zone of inhibition was shown by acetone extract in the range of 10- 24 mm with susceptibility of S. aureus isolates against acetone extract was 75 %. However, methanolic extract exhibited less inhibition against S. aureus and the susceptibility shown by the extractwas 40 %. The susceptibility and antibacterial activity of methanolic extract was found to be lower than acetone and ethanolic extract. The least performing was chloroform extract in the range of just 10- 15 mm in which merely 25 % isolates were inhibited. Details of the performance of the M. piperita extracts against S. aureus have been shown infigure 5& 8.

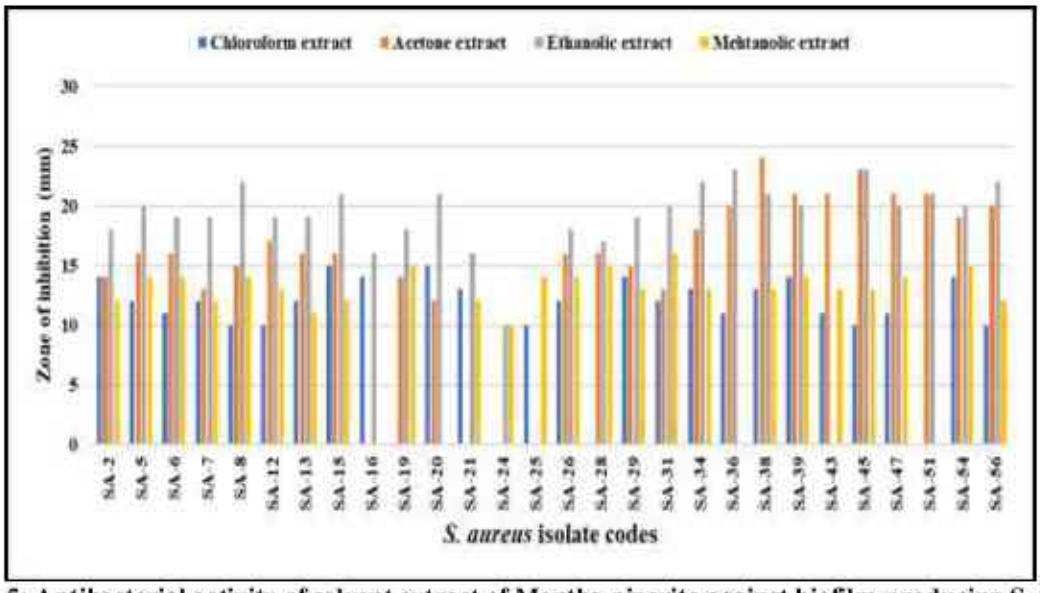

Figure 5: Antibacterial activity of solvent extract of Mentha piperita against biofilm-producing S. aureus isolates

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Mentha piperita acetone extract was efficient in inhibiting the P. aeruginosa isolates. The methanolic extract and chloroform extract shown the least activity towards the P. aeruginosa isolates with susceptibility found to be nearly just 5 %. Even the zone of inhibition was in the range of 10- 15 mm.Details of the performance of the M. piperita extracts against P. aeruginosa have been shown figure 6&8.

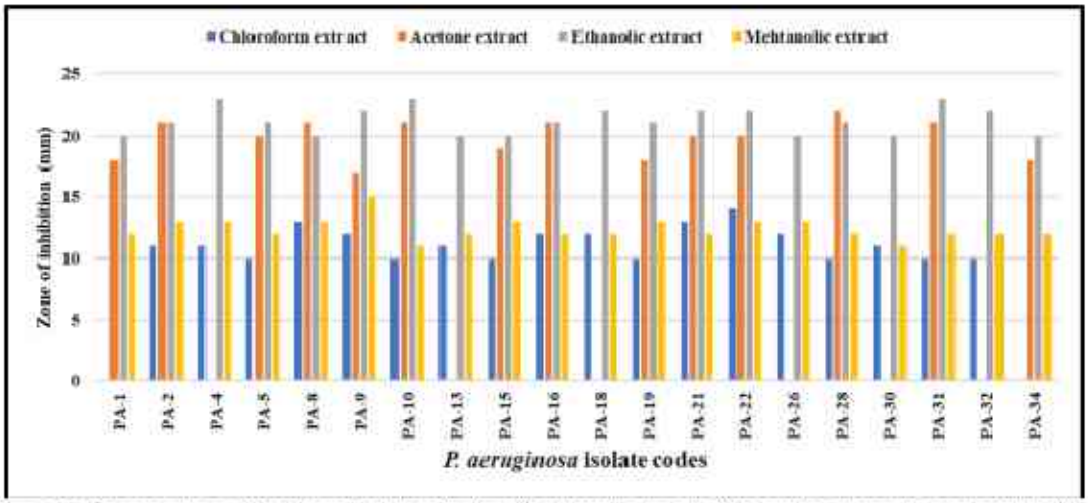

Figure 6: Comparison of antibacterial activity of solvent extract of Mentha piperita against biofilm-producing P. aeruginosa isolates

Two isolates of K. pneumoniae with biofilm formation were chosen for this experiment. Overall, the ethanolic extract showed stronger inhibition against K. pneumoniae isolates. KP- 06 was susceptible to both ethanolic and methanolic extract with 22 mm zone of inhibition. KP- 03 was found to be resistant to methanolic and chloroform extract. Details of the performance of the M. piperita extracts against K. pneumoniae have been shown in figure 7 & 8 .

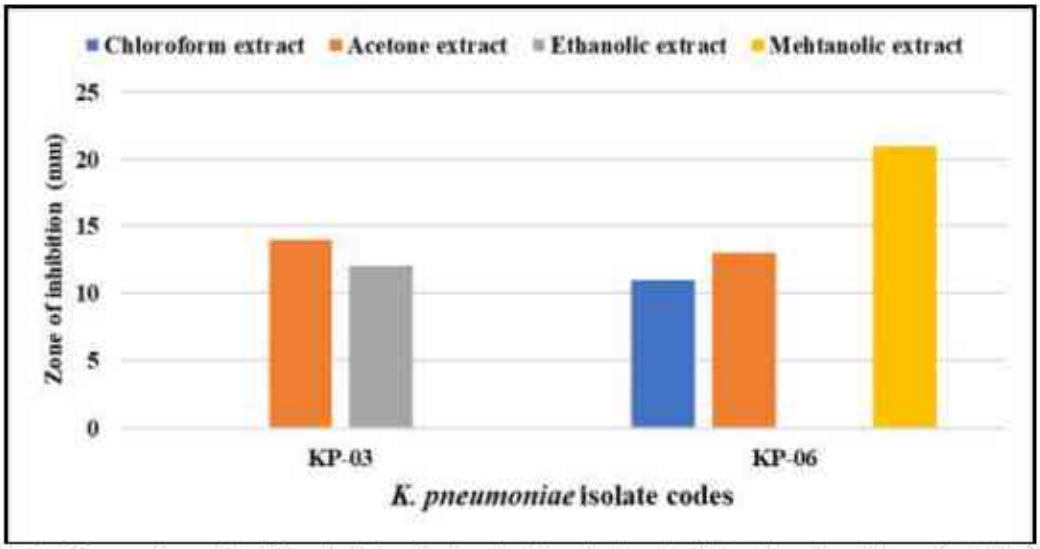

Figure 7: Comparison of antibacterial activity of solvent extract of Mentha piperita against biofilm-producing K. pneumoniae isolates

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 5 Sep-Oct 2023, pp: 423-430 www.ijprajournal.com ISSN: 2249-7781

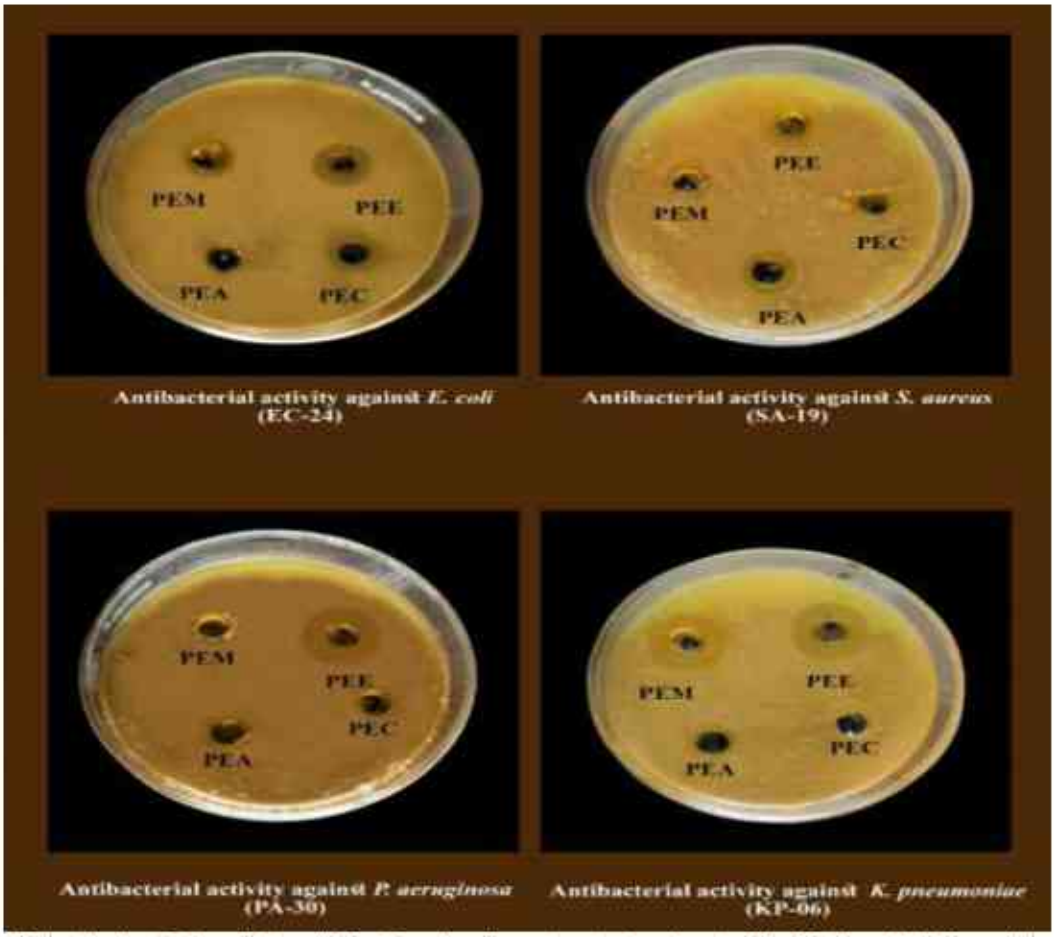

Figure 8: Antimicrobial activity of Mentha piperita extracts in solvents like Methanol, Ethanol, Acetone and Chloroform against biofilm producing bacterial isolates.

IV. CONCLUSION:

In this work, antimicrobial property of Mentha piperitaextract powder has been evaluated by agar well diffusion method. The zone of inhibition of plant extracts Mentha piperita with their respective solvents (ethanol, methanol, acetone and chloroform) ranged between 10- 38 mm. The ethanolic extract of plantwas found to be efficient for the antibacterial activity that was in the range of (20- 38 mm), followed by acetone, methanol and chloroform extracts respectively that exhibited less activity.The majorly of plant extracts of plants showed a very efficient antibacterial activity against E. coli (90 % inhibition),

A lack of detailed understanding of the mechanisms of the individual components of plant extracts thus accrediting our superficial consideration inhibitory activity. Future research should therefore explore the mechanisms of the individual components of plant extracts to combat against biofilm forming bacterial diseases. Therefore, innovative new strategies for drugs development could provide an interesting platform in the near future for this area of research.

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International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Int. J. of Life Sciences, 2023; 11 (4): 379-384
ISSN:2320-7817(p) | 2320-964X(o)

Research Article Open Access

Effect of plants essential Oils against biofilm forming pathogens *E. coli* and *S. aureus*.

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Manuscript details:
Received: 30.10.2023
Accepted: 24.12.2023
Published: 31.12.2023

Cite this article as:
Amol Prakash Nagrale (2023) Effect of plants essential Oils against biofilm forming pathogens *E. coli* and *S. aureus*., *Int. J. of Life Sciences*, 11 (4): 379-384.

Available online on http://www.ijlsci.in
ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

ABSTRACT

The objective of this study was to determine the antibacterial activities of plant essential oils of *Azadirachta indica* and *Ocimum sanctum*. These plant essential oils' antibacterial properties demonstrated their wide-spectrum inhibitory effect and severely restrained the growth of 90% of bacterial species, when tested using the Kirby-Bauer disc diffusion method. the antibacterial activity against pathogenic organisms of plant essential oils except *Azadirachta indica* was recorded in the range of 10- 40 mm. for their antibacterial potential against different biofilm forming Gram-positive *Staphylococcus aureus* and Gram-negative bacteria *Escherichia coli*, isolates.

Keywords: *Azadirachta indica*, *Ocimum sanctum*, **plant essential oils, antibacterial, Kirby-Bauer disc diffusion method.**

INTRODUCTION

Antibiotic resistance in microbes is one of the biggest problems facing global public health. The effectiveness of antimicrobial drugs has lost its potential due to the evolution of pathogen resistance. It is a fact that continuous exposure of bacteria to antibiotics resulted in the development of resistant microbial strains, which has created an interest in finding a substitute for antibiotics. In a quest to find an alternative to antibiotics, medical practitioners widely used medicinal plants to treat infectious diseases and were set into systematic scientific investigations. The emergence and spread of antibiotic-resistant micro organisms also triggered this plant investigation.

Multidrug-resistance of *Staphylococcus sp.*, *Pseudomonas sp.*, *Escherichia coli*, and a few other pathogenic bacteria to a wide variety of antibiotics has been linked to unwise use of the same antibiotics against infections in food and pet animals around the world, as well as in humans. Several methicillin-resistant S. aureus (MRSA) strains bear susceptibility markers for other antibiotics, and some strains have been shown to be resistant to up to 23 antibiotics (Maple *et al.*, 1989).

The major factor contributing to microbial resistance is the microbes' biofilm formation which permits them to withstand severe environmental conditions and antimicrobial agents. The biofilm-forming bacteria are resistant to antimicrobial agents due to the lack of penetration of antimicrobial agents (Frank & Koffi, 1990). Complex extracellular elements, such as polysaccharides, proteins, lipids, toxins, metabolites, and DNA, form biofilms (K Chan & T Abedon, 2015; Sharma *et al.*, 2016). The study of biofilm-forming pathogens has received significant attention over the past decades. Biofilms have tremendous consequences for public health consequent of their role in some infectious illnesses and device-related infections. Biofilm-forming bacteria are one of those that cause serious infections. Biofilms are implicated in a wide range of microbial diseases in the body. As many as 60% of bacterial infections treated by physicians worldwide are related to biofilm formation (Costerton *et al.*, 1999).

Plants can naturally produce a wide range of molecules, especially secondary metabolites, which have been shown to protect plants from pathogens due to their biological properties (Hancock *et al.*, 2015). More than 3000 essential oils (EO), complex mixtures primarily composed of secondary metabolites, have been identified and known among these molecules (Bassolé & Juliani, 2012). Many essential oils have long been known for their antiseptic, antioxidant, and anesthetic properties, and many have been used in traditional medicine.

Essential oils are rich in biologically active compounds with antibacterial, insecticidal, fungicidal, nematicidal, herbicidal, antioxidant, and anti-inflammatory properties (Bhavaniramya *et al.*, 2019; Turek & Stintzing, 2013). Three hundred have been commercialized and are commonly used in cosmetics, flavors, and the food industry (Bhavaniramya *et al.*, 2019; Van de Braak & Leijten, 1999). They are also utilised in the food industry as spices or to formulate drinks (Koul *et al.*, 2008).

MATERIAL AND METHODS

Collection of plant materials

The different common medicinal plants like Azadirachta indica (Neem), Ocimum sanctum (Tulasi), parts like leaves and flowers, were collected from different localities of Amravati region, East of Maharashtra state, India. The collected plant materials were soon transported to the research laboratory and washed with sterile water.

Extraction of essential oils

Essential oils are volatile, aromatic oily liquids that can be extracted from various parts of plants, particularly aerial parts like leaves and flowers. The extraction was carried out using the Clevenger apparatus (Desam *et al.*, 2019).

Collection of clinical samples

A total of 342 different clinical specimens were collected under aseptic conditions with universal safety precautions to minimize the risk of infection. The samples involved in this study were urine (94), catheter tip (42), pus (46), sputum (83), and blood (77), collected from Amravati and Akola district hospitals and private pathology laboratories using standard methods (Ho *et al.*, 2015). The samples were collected with universal safety precautions and transported to the laboratory without delay. Samples were obtained from both outpatients and those admitted to hospitals. The patients were primarily diagnosed for a probable causative pathogenic bacterium, which helped in presuming the type of media to be used. Though, every sample was spread on all the four selective media viz EMB media for *E. coli* and Mannitol salt agar for *S. aureus*, after spread plate, the selective isolates were made as pure cultures and used for further cultural characterization and confirmation of the isolated species.

Biofilm production assay

Biofilm production was assayed by the tube method: a loopful of isolated organisms was inoculated in 10 mL of trypticase-soy broth with 1% glucose in test tubes. Incubate the tubes for 24 hours at 37 °C. After incubation, tubes were decanted, washed with phosphate buffered saline (pH 7.3), and dried. Tubes were then stained with crystal violet (0.1%). Wash excess stains with distilled water. Tubes were dried in an inverted position. The scoring for the tube method was made corresponding to the results of the control. Biofilm formation was considered positive when a visible, thick film lined the wall and the bottom of the tube (Christensen *et al.*, 1982).

Antimicrobial activity testing of essential oils

The Agar disc diffusion method was used for the screening of the antimicrobial potential of plant

essential oils on Muller-Hinton agar as described by the Clinical and Laboratory Standard Institute (CLSI) standard manual (CLSI, 2012). The bacterial suspension was spread evenly over the surface of the Mueller Hinton agar plate. A sterile disc of 6 mm diameter (Hi-Media, Mumbai) was soaked with essential oil to be tested. The discs were placed on the surface of seeded Petri plates aseptically and essential oils were allowed to diffuse into the agar. The plates were then left undisturbed for 30 min. After incubation at 37 ºC for 24 hours, the plates were checked for the zone of inhibition. The assessment of antibacterial activity was done by measuring the diameter of the growth inhibition zone formed around the disc.

RESULTS AND DISCUSSION

Extraction of essential oils

The freshly collected leaves of *Azadirachta indica* yielded 0.16 % essential oil and *O. sanctum* yielded 0.181%, as found by the Clevenger method. The resultant essential oils were added to 2 % DMSO so as to facilitate its solubility in water and use in other experimentations later on. A standard working stock solution of essential oils was created in 1 ml DMSO and stored in a refrigerator.

Collection, isolation, and characterization bacterial isolates

A total of 342 specimens from urine, catheter tip, pus, blood, and sputum were collected from government general hospitals and private pathology laboratories within Akola and Amravati city. The samples collected from Amravati and Akola regions were from individual patients and considered to include a distinct pathogenic strain. Hence all of the samples of urine, blood, sputum and catheter tips were used for bacterial isolation. The patients were primarily diagnosed for a probable causative pathogenic bacterium, which helped in presuming the type of media to be used. Though, every sample was spread on all the four selective media viz EMB media for *E. coli* and Mannitol salt agar for *S. aureus*, After spread plate, the selective isolates were made as pure cultures and used for further cultural characterization and confirmation of the isolated species. Of a total of 342 samples, 94 urine samples (27.5 %), 83 sputum samples (24.3 %), 77 blood samples (22.5 %), 46 pus samples (13.4 %) and 42 (12.3 %) catheter tip samples were sampled. From those, 184 samples showed bacterial growth to give pure isolates.

Biofilm production of clinical isolates

Out of 184 isolated 90 isolates (75 %) were shown to have biofilm production which included strong and moderate biofilm producers and 30 weak or non-biofilm producers. The highest biofilm producing percent isolates were of *E. coli* (74.07 %) and *S. aureus* (73.68 %). This study focused on isolation research with a particular emphasis on biofilm development.

In the present study, a total of 342 different clinical specimens were collected from the government general hospitals and private pathology laboratories of Akola and Amravati cities of Maharashtra which stand as a representative developing city in underdeveloped countries.

Table 1: Essential oil yields of dried leaves of selected plants using the Clevenger method.

Sr. no	Plant	Weight of leaves (g)	Mean essential oil yield (g)	Mean percent yield (%)
1	*Azadirachta indica* (Neem)	1000	1.613 ± 0.004	0.16
2	*Ocimum sanctum* (Tulsi)	500	0.905 ± 0.002	0.18

Table 2: Distribution of clinical pathogenic microbial samples from Akola and Amravati regions

Sr. no	Type of sample	Bacterial isolate frequency	Predominant isolates	
			E. coli	*S. aureus*
1	Urine	66	54	8
2	Sputum	49	5	12
3	Blood	11	2	6
4	Pus	40	7	25
5	Catheter Tip	18	8	6
Total isolates and its percent		184	76 (41.3 %)	57 (30.98)

Table 3: Antibacterial activity of plant essential oils against *E. coli*

Sr. no	Test organism	*Azadirachta indica* (mm)	*Ocimum sanctum* (mm)	Negative Control (DMSO) (mm)
1	EC-2	2.6 ± 0.0	29.7 ± 0.3	0
2	EC-3	3.5 ± 0.0	24.5 ± 0.3	0
3	EC-4	5.4 ± 0.0	25.5 ± 0.3	0
4	EC-6	6.4 ± 0.0	29.8 ± 0.3	0
5	EC-7	4.7 ± 0.0	28.7 ± 0.3	0
6	EC-9	7.8 ± 0.0	26.1 ± 0.3	0
7	EC-11	8.4 ± 0.0	29.2 ± 0.3	0
8	EC-12	5.8 ± 0.0	27.4 ± 0.3	0
9	EC-14	7.7 ± 0.0	24.2 ± 0.3	0
10	EC-15	9.8 ± 0.0	25.3 ± 0.3	0
11	EC-17	10 ± 0.0	25.2 ± 0.3	0
12	EC-18	3.0 ± 0.0	26.7 ± 0.3	0
13	EC-20	2.6 ± 0.0	29.4 ± 0.3	0
14	EC-21	7.8 ± 0.0	28.3 ± 0.3	0
15	EC-22	8.9 ± 0.0	25.6 ± 0.3	0
16	EC-24	6.4 ± 0.0	24.3 ± 0.3	0
17	EC-25	7.1 ± 0.0	28.5 ± 0.3	0
18	EC-26	8.2 ± 0.0	27.6 ± 0.3	0
19	EC-27	5.4 ± 0.0	24.6 ± 0.3	0
20	EC-28	4.2 ± 0.0	29.6 ± 0.3	0
21	EC-30	5.6 ± 0.0	28.8 ± 0.3	0
22	EC-31	3.1 ± 0.0	27.7 ± 0.3	0
23	EC-33	2.8 ± 0.0	26.4 ± 0.3	0
24	EC-35	3.1 ± 0.0	25.8 ± 0.3	0
25	EC-39	5.2 ± 0.0	24.2 ± 0.3	0
26	EC-40	4.6 ± 0.0	28.9 ± 0.3	0
27	EC-43	8.8 ± 0.0	27.5 ± 0.3	0
28	EC-44	7.1 ± 0.0	28.1 ± 0.3	0
29	EC-45	6.5 ± 0.0	26.3 ± 0.3	0
30	EC-47	6.2 ± 0.0	29.9 ± 0.3	0
31	EC-48	8.4 ± 0.0	30.5 ± 0.3	0
32	EC-49	1.5 ± 0.0	21.3 ± 0.3	0
33	EC-50	2.8 ± 0.0	26.4 ± 0.3	0
34	EC-51	7.4 ± 0.0	27.7 ± 0.3	0
35	EC-54	5.4 ± 0.0	28.6 ± 0.3	0
36	EC-56	3.3 ± 0.0	25.4 ± 0.3	0
37	EC-57	4.1 ± 0.0	26.3 ± 0.3	0
38	EC-60	5.2 ± 0.0	29.5 ± 0.3	0
39	EC-62	4.6 ± 0.0	28.3 ± 0.3	0
40	EC-69	3.8 ± 0.0	27.8 ± 0.3	0

Table 4 : Antibacterial activity of plant essential oils against *S. aureus*

Sr. no	Test organism	*Azadirachta indica* (mm)	*Ocimum sanctum* (mm)	Negative Control (DMSO) (mm)
1	SA-2	2.1 ± 0.0	25.2 ± 0.3	0
2	SA-5	3.5 ± 0.0	23.4 ± 0.3	0
3	SA-6	7.4 ± 0.0	26.6 ± 0.3	0
4	SA-7	4.1 ± 0.0	28.4 ± 0.3	0
5	SA-8	8.6 ± 0.0	24.2 ± 0.3	0
6	SA-12	4.5 ± 0.0	23.5 ± 0.3	0
7	SA-13	3.8 ± 0.0	24.4 ± 0.3	0
8	SA-15	5.1 ± 0.0	26.7 ± 0.3	0
9	SA-16	4.7 ± 0.0	25.2 ± 0.3	0
10	SA-19	3.3 ± 0.0	23.1 ± 0.3	0
11	SA-20	3.5 ± 0.0	22.5 ± 0.3	0
12	SA-21	3.7 ± 0.0	23.3 ± 0.3	0
13	SA-24	1.6 ± 0.0	19.4 ± 0.3	0
14	SA-25	8.8 ± 0.0	25.5 ± 0.3	0
15	SA-26	6.2 ± 0.0	26.8 ± 0.3	0
16	SA-28	5.3 ± 0.0	24.8 ± 0.3	0
17	SA-29	4.8 ± 0.0	22.6 ± 0.3	0
18	SA-31	3.6 ± 0.0	21.9 ± 0.3	0
19	SA-34	2.4 ± 0.0	24.7 ± 0.3	0
20	SA-36	2.3 ± 0.0	23.8 ± 0.3	0
21	SA-38	7.4 ± 0.0	22.7 ± 0.3	0
22	SA-39	4.1 ± 0.0	24.3 ± 0.3	0
23	SA-43	8.6 ± 0.0	23.7 ± 0.3	0
24	SA-45	9.1 ± 0.0	25.4 ± 0.3	0
25	SA-47	7.4 ± 0.0	26.5 ± 0.3	0
26	SA-51	5.2 ± 0.0	24.8 ± 0.3	0
27	SA-54	3.5 ± 0.0	27.8 ± 0.3	0
28	SA-56	6.4 ± 0.0	26.9 ± 0.3	0

The study was conducted to understand the prevalence and type of the pathogenic bacteria at these sites. These samples were isolated from various body fluids such as urine, pus, sputum, blood and catheter tips since these samples are reservoirs of infectious and pathogenic bacteria for study of their distribution. The high incidence of pathogenic microbes denotes the prevalence, higher infectivity, low hygiene, high population density and lesser knowledge to avoid it. The high percentage of samples collected from urine (27.4 %) indicated the higher UTI related patients in the hospitals at the time of sampling. The low percentage of samples collected from catheter tips (12.2 %) were the only patients available in the entire sampling period. The higher amount of sampling is particularly necessary to draw out a logical and statistical result. Studies have indicated that *S. aureus* is generally found around wound infections like pus, while *E. coli* is typically predominant in urinary tract infections (Rai *et al.*, 2017; Russo & Johnson, 2003). Our research found that the essential oil of *O. sanctum* yielded 0.18% of its total yield, which was consistent with Mathew (2017) findings on the same plant. The least percent yield in

our study was recorded for *Azadirachta indica* (0.16 %). Dastan *et al.* (2010) reported the similar result for *A. indica* essential oil (0.1 %). Okhale *et al.* (2018) reported greater essential oil yield from *A. indica* (1.2 %) through a different explant using roots. This indicates that different yields can be obtained through the use of different parts of the plant (Fornari *et al.*, 2012).

The antibacterial activities of plant essential oils of *Azadirachta indica* and *Ocimum sanctum*, were tested. These plant essential oils' antibacterial properties demonstrated their wide-spectrum inhibitory effect and severely restrained the growth of 90% of bacterial species. When tested using the Kirby-Bauer disc diffusion method, the antibacterial activity against pathogenic organisms of plant essential oils except *Azadirachta indica* was recorded in the range of 10- 40 mm. The poorest inhibitory activity (00–10.0mm) against all the bacterial isolates is shown by *Azadirachta indica* oil.

A lack of detailed understanding of the mechanisms of the individual components of essential oils, thus accrediting our superficial consideration of dominant synergy and antagonism. Future research should therefore explore the mechanisms of the individual components of essential oils, as well as bring together efficient research into the synergistic mechanisms between two combinations to combat against biofilm forming bacterial diseases. Therefore, innovative new strategies for drugs development and synergistic studies could provide an interesting platform in the near future for this area of research.

Conflict of Interest: None of the authors have any conflicts of interest to disclose.

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JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Study of Transport properties of Aqueous Lithium, Sodium and Potassium salt solutions of Alanine Conductometrically

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Abstract : Alkali metal salts of various amino acids received more attention by researches because of their various industrial applications. Recently they are investigated for their used as carbon dioxides chemical absorption agents. These salts have conductance which closely depends on number of ions in solution, size of ions and mobility of ions in solution. Present work regards with conductometric study of lithium, sodium and potassium salts of alanine. In the present work conductometric parameters, observed conductance was measured and further, specific conductance, molar conductance and thermodynamic parameters (change in free energy, change in entropy and change in enthalpy) were calculated for their concentrations range of (0.01 to 0.15) M and at temperatures 298.15, 303.15, 308.15 and 313.15 K. Observed values of conductometric and thermodynamic parameters values helps to understand a solute-solute, solute-solvent and solvent-solvent interaction and this information will be helpful to evaluate their role in carbon dioxide removal and other industrial applications.

Keywords: **Salts of alanine, Ionisation, Molecular interaction, conductometrically.**

I. INTRODUCTION

Human civilisation is suffering through various health and environmental problem now a day due to climatic change, which is a result of excessively changes atmospheric background. Climatic change is mostly cause by global warming. Carbon dioxide emissions is main contributor for global warming-a most concerning environmental issue. CO_2 capture using post-combustion technique is mostly used in the chemical processing industries[1].Alkali metal salt solution of the amino acid is developing into an absorbent for CO_2 capture. For evaluation and thorough characterisation of the solvent for CO_2 collection and other industrial applications, the physicochemical properties of solvents are required[2-5]. Solubility, ionisation and mobilization of metal salt closely related to their conductivity. Ionisation and solubility strongly influence by molecular interaction like solute-solute interaction, solute-solvent and solvent-solvent interactions. Intra and intermolecular interaction effect on these conductivities. Conductometric measurements are one of the unique non-destructive, environmentally friendly, and simple to handle research techniques. The results and thermodynamic parameters obtained in conductometric measurements will also become a useful tool to predict drug activity and drug effect in medicinal and drug chemistry. Navarro *et al.*[6] studied the physicochemical properties such as densities, refractive indices, electrical conductivity and viscosities of aqueous potassium and sodium salt solutions of serine at normal atmospheric pressure and at various temperatures. Tirona *et al.*[7] reported the densities, viscosities, refractive indexes, and electrical conductivities of aqueous alkali (potassium or sodium) salts of the alanine at various temperatures but at higher concentrations. They used experimental validation to correlate the density, refractive index, and electrical conductivity of the amino acid salt solutions with temperature and amino acid salt concentration. This gave average absolute deviation values of 0.03%, studied densities, viscosity, refractive index and electrical conductivity of aqueous alkali salts of the α-alanine at various temperatures and concentrations for that an empirical equation was applied to correlate the density, refractive index and electrical conductivity of the amino acid salt solutions with temperature and concentration, which gave average absolute deviation values of 0.03%, 0.01%, and 0.6%, respectively.

Alanine have their own importance in medicinal sciences and pharmaceutical sciences due to their significant application. Metal salt of these amino acid affects the solubility and conductivity. Conductometric investigation received more attention of researchers for molecular interactions investigation at various concentration and different temperatures[8-14] by using different types of molecules.

Thermodynamic and conductometric properties for aqueous sodium, lithium and potassium salt solutions of L-alanine have not yet been discussed in the literature at a lower concentration range and different temperatures. Therefore, bearing these things in mind presently work designed this scheme deals with the study of conductometric properties such as observed conductance (G), ahead specific conductance (κ) and molar conductance (Λ), thermodynamic behaviour (ΔG, ΔH, and ΔS) and Walden product of lithium, sodium and potassium salts of L-alaninate different concentrations and different temperature. The conductivity was measured for their concentrations range (0.01 to 0.15) mol L^{-1} and at 298.15, 303.15, 308.15, and 313.15 K.

II. EXPERIMENTAL

All AR grade chemicals and solutions were used through this work. L-alanine (Ala CAS No. 56-41-7, 99% purity) was supplied by S D Fine-Chem Ltd, India. Lithium hydroxide (LiOH, CAS No. 1310-65-2, GR, % purity) was purchased from Sigma Aldrich, while sodium hydroxide (NaOH, CAS No. 1310-73-2, GR, 98 % purity) and potassium hydroxide (KOH, CAS No. 1310-58-3, GR, 98 % purity) were purchased from Merck. All the freshly prepared solutions were used for investigations. Concentrations of alanine solutions varied from 0.01 M to 0.15 M. Aqueous solutions of lithium alaninate (LA), sodium alaninate (SA), potassium alaninate (PA) were prepared by neutralising the amino acid with an equimolar quantity of base LiOH, NaOH, and KOH, respectively.

Figure 1. Structures of LA, SA, and PA.

lithium L-alaninate sodium L-alaninate potassium L-alaninate

III. METHODS AND METHODOLOGY: CONDUCTIVITY MEASUREMENTS

Measurements of electrical conductivity of each sample were done with a digital conductivity metre. A sample of the solution was taken using a sample tube that was suspended from a stand and dipped into a transparent water bath with glass walls and an opening above the water's surface. Each sample solution was put into the sample tube in a predetermined amount. To measure the conductivity, a conductivity cell was submerged in a sample solution. A thermostat was used to maintain the thermal stability of the water bath within ±0.01 K. A standard KCl solution from Merck was used to calibrate the conductivity metre. 20 mL of sample, with its temperature regulated by placing the sample tube in a water bath, were used for each measurement. Following each assessment, the conductivity. The conductivity was measured for their concentrations range (0.01 to 0.15) mand at 298.15, 303.15, 308.15, and 313.15 K. Further, molality is converted into molarity for molar conductance calculations.

The conductivity cell was cleaned with deionised water and ethanol after each test to get rid of any adhering material, and it was then dried before being used for the following measurement. Three measurements were made and the average reading was used. The calculated overall measurement uncertainty was ±1.0%.

IV. RESULTS AND DISCUSSION

For aqueous solutions of LA, SA and PA electrical conductivity were recorded for 0.1 to 0.15 m concentration. From the data observed conductance (G), ahead specific conductance (k) and molar conductance (Λ) were determined by known literature method and tabulated in Table-1 and Table-2 at 298.15 K, 308.15 K, 308.15 K and 313.15 K respectively

Table-1, Table-2, Figure 2, Figure 3 and Figure 4 reveals that along with increase in a concentration from 0.009 to 0.15 m observe conductance and specific conductance increases while molar conductance decreases for LA, SA and PA solutions. As temperature increases from 298 K to 313 K observe conductance, specific conductance and molar conductance increases same metal salts solution. From **Figure** 5 it is observed as Observe conductance increases from Li-salt to Na-salt and from Na-salt to K-salt for a particular amino acid. Similar trend is observed for specific conductance and molar conductance.

$$LA(G/k/\Lambda) < SA(G/k/\Lambda) < PA(G/k/\Lambda)$$

During this investigation it was also observed that the observed conductance (G), specific conductance (k) and molar conductance (Λ) values of PA are greater than SA and for SA greater than LA solutions, which clearly indicates that PA has good conductivity and mobility in solutions. This could be as a result of the creation of hydration spheres around metal ions that, depending on their size, impede the mobility of the ions in solution. This information is helpful for diffusion of ions or good drug effect of PA is comparatively good than SA and LA.

The (Ksp) and thermodynamics parameter viz. change in free energy (ΔG), change in entropy (ΔS) and change in enthalpy (ΔH) of MSA were determined by known literature method at various molar concentration and temperatures and result are presented in **Table 2, Table 3** and **Table-4.** From these tables it is observed as along with increasing concentration Ksp values increases continuously while decreases with the temperature. ΔG values shows exactly opposite trend to that of Ksp. As temperature increases from 298 K to 313 K, ΔG increases and decreases continuously with concentration of the solution. All the studied systems have positive ΔG values suggest that in the solvent, the dissociation process is favoured over the association process. The negative values of ΔH and ΔS suggest the dissociation process is exothermic and decrease in randomness in the solvent, respectively[15].

V. CONCLUSION

It was observed that the observed conductance (G), specific conductance (k) and molar conductance (Λ) values of PA are greater than SA and for SA greater than LA solutions. ΔG values exhibit an identical reversal of the Ksp trend. With the concentration of the solution, ΔG constantly increases and lowers as temperature rises. The fact that all of the systems under study have positive ΔG values indicates that the dissociation process is preferred to the attachment process in the solvent. The exothermic nature of the dissociation process and the decrease in solvent randomness, respectively, are suggested by the negative values of ΔH and ΔS.

The structure of the drug as well as nature of that drug directly affects these parameters. The temperature molar concentrations and percentage compositions are also responsible for changing the values of these parameters. The solute-solvent interactions, and solute-solute interactions can be studied from the above data. The internal geometry as well as internal and intra hydrogen bonding also affect these parameters. These experimental values as a function of temperature and concentration using suitable correlations, could be useful for the design of processes utilizing the studied solutions as solvents.

Table-1. Observed Conductance (G) and Specific Conductance (k) of LA, SA and PA at different temperatures.

M ($mol.L^{-1}$)	G $10^{-3}(S.cm^{-1})$				M ($mol.L^{-1}$)	k.10^{-3} ($S.cm^{-1}$)			
	298.15 K	308.15 K	308.15 K	313.15 K		298.15 K	303.15 K	308.15 K	313.15 K
LA					**LA**				
0.00982	0.75	0.84	0.95	1.05	0.00979	0.735	0.823	0.932	1.025
0.02905	1.90	2.15	2.44	2.68	0.02896	1.862	2.107	2.391	2.626
0.05094	2.96	3.33	3.71	4.07	0.05079	2.901	3.263	3.636	3.989
0.06990	3.64	4.10	4.53	4.99	0.06969	3.567	4.018	4.439	4.890
0.09129	4.39	4.89	5.41	5.97	0.09102	4.302	4.792	5.302	5.851
0.11086	5.05	5.62	6.21	6.82	0.11053	4.949	5.508	6.086	6.684
0.13040	5.72	6.34	7.01	7.72	0.13001	5.606	6.213	6.870	7.566
0.15069	6.35	7.10	7.84	8.64	0.15024	6.223	6.958	7.683	8.467
SA					**SA**				
0.01004	0.82	0.92	1.02	1.12	0.01001	0.804	0.902	1.000	1.098
0.02963	2.35	2.62	2.88	3.15	0.02955	2.303	2.568	2.822	3.087
0.05123	3.79	4.22	4.63	5.07	0.05108	3.714	4.136	4.537	4.969
0.07307	5.18	5.75	6.34	6.92	0.07285	5.076	5.635	6.213	6.782
0.09265	6.43	7.14	7.86	8.61	0.09238	6.301	6.997	7.703	8.438
0.10831	7.43	8.21	9.06	9.92	0.10799	7.281	8.046	8.879	9.722
0.13476	8.94	9.92	10.95	11.95	0.13436	8.761	9.722	10.731	11.711
0.15057	9.73	10.74	11.89	12.98	0.15012	9.535	10.525	11.652	12.720
PA					**PA**				
0.01000	0.94	1.04	1.15	1.26	0.00997	0.921	1.019	1.127	1.235
0.03163	2.66	2.95	3.22	3.50	0.03154	2.607	2.891	3.156	3.430
0.05155	4.23	4.66	5.08	5.54	0.05139	4.145	4.567	4.9784	5.429
0.07331	5.77	6.35	6.95	7.60	0.07309	5.655	6.223	6.811	7.446
0.08932	6.95	7.65	8.40	9.12	0.08905	6.811	7.497	8.232	8.938
0.10603	8.11	8.92	9.75	10.56	0.10571	7.948	8.742	9.555	10.349
0.13095	9.65	10.58	11.58	12.59	0.13056	9.457	10.368	11.348	12.338
0.15514	11.10	12.25	13.39	14.50	0.15468	10.878	12.005	13.122	14.210

Table-2. Molar Conductance (Λ) and Ksp of LA, SA and PA at different temperatures.

M ($mol.L^{-1}$)	Λ ($S.cm^2.mol^{-1}$)				M ($mol.L^{-1}$)	Ksp			
	298.15 K	308.15 K	308.15 K	313.15 K		298.15 K	303.15 K	308.15 K	313.15 K
LA					**LA**				
0.00979	75.069	84.078	95.188	104.697	0.00979	0.0998	0.0995	0.0992	0.0989
0.02896	64.287	72.745	82.558	90.678	0.02896	0.8735	0.8711	0.8682	0.8651
0.05079	57.115	64.254	71.586	78.532	0.05079	2.6859	2.6784	2.6697	2.6599
0.06969	51.185	57.653	63.699	70.168	0.06969	5.0574	5.0432	5.0269	5.0085
0.09102	47.267	52.650	58.249	64.279	0.09102	8.6261	8.6019	8.5741	8.5427
0.11053	44.775	49.828	55.060	60.468	0.11053	12.7209	12.6852	12.6441	12.5979
0.13001	43.116	47.789	52.839	58.191	0.13001	17.6003	17.5510	17.4942	17.4301
0.15024	41.420	46.312	51.139	56.357	0.15024	23.5035	23.4377	23.3617	23.2762
SA					**SA**				
0.01001	80.286	90.078	99.869	109.660	0.01001	0.1043	0.1040	0.1037	0.1033
0.02955	77.948	86.903	95.527	104.483	0.02955	0.9089	0.9064	0.9034	0.9001
0.05108	72.720	80.970	88.837	97.279	0.05108	2.7163	2.7087	2.6999	2.6900
0.07285	69.678	77.346	85.282	93.084	0.07285	5.5267	5.5112	5.4933	5.4732
0.09238	68.212	75.744	83.382	91.338	0.09238	8.8860	8.8611	8.8323	8.8000
0.10799	67.427	74.506	82.220	90.024	0.10799	12.1424	12.1084	12.0692	12.0250
0.13436	65.208	72.357	79.869	87.163	0.13436	18.7961	18.7434	18.6827	18.6143
0.15012	63.517	70.110	77.617	84.733	0.15012	23.4665	23.4007	23.3249	23.2395
PA					**PA**				
0.00997	92.393	102.222	113.034	123.846	0.00997	0.1035	0.1032	0.1029	0.1025
0.03154	82.651	91.662	100.051	108.752	0.03154	1.0358	1.0329	1.0295	1.0258
0.05139	80.658	88.857	96.866	105.637	0.05139	2.7503	2.7426	2.7338	2.7237
0.07309	77.360	85.136	93.180	101.868	0.07309	5.5631	5.5476	5.5296	5.5093
0.08905	76.483	84.186	92.440	100.363	0.08905	8.2574	8.2342	8.2075	8.1775
0.10571	75.182	82.691	90.385	97.894	0.10571	11.6363	11.6037	11.5661	11.5238
0.13056	72.432	79.413	86.919	94.500	0.13056	17.7496	17.6999	17.6425	17.5780
0.15468	70.327	77.613	84.836	91.869	0.15468	24.9116	24.8418	24.7613	24.6707

Table-3. ΔG values of LA, SA and PA at different temperatures.

M ($mol.L^{-1}$)	$\Delta G (J.mol^{-1})$				M ($mol.L^{-1}$)	$\Delta H (J.mol^{-1})$			
	298.15 K	308.15 K	308.15 K	313.15 K		298.15 K	303.15 K	308.15 K	313.15 K
LA					**LA**				
0.00979	22839.46	23229.55	23621.00	24013.82	0.00979	-346014.31	-357602.71	-369382.06	-
0.02896	17461.46	17761.36	18062.62	18365.25	0.02896	-345981.86	-357563.96	-369336.87	-
0.05079	14676.61	14929.81	15184.37	15440.30	0.05079	-345955.72	-357532.75	-369300.47	-
0.06969	13107.65	13334.54	13562.79	13792.41	0.06969	-345936.10	-357509.33	-369273.16	-
0.09102	11783.85	11988.54	12194.59	12402.01	0.09102	-345915.48	-357484.73	-369244.48	-
0.11053	10820.78	11009.32	11199.22	11390.48	0.11053	-345897.31	-357463.05	-369219.21	-
0.13001	10015.83	10190.87	10367.27	10545.04	0.13001	-345879.45	-357441.74	-369194.37	-
0.15024	9298.75	9461.76	9626.13	9791.88	0.15024	-345860.94	-357419.65	-369168.63	-
SA					SA				
0.01001	22730.17	23118.43	23508.05	23899.03	0.01001	-346013.81	-357602.11	-369381.36	-
0.02955	17362.91	17661.16	17960.77	18261.75	0.02955	-345981.08	-357563.03	-369335.78	-
0.05108	14648.71	14901.44	15155.54	15411.00	0.05108	-345955.40	-357532.38	-369300.03	-
0.07285	12887.65	13110.85	13335.41	13561.33	0.07285	-345932.96	-357505.59	-369268.80	-
0.09238	11710.27	11913.73	12118.54	12324.73	0.09238	-345914.20	-357483.20	-369242.69	-
0.10799	10936.16	11126.64	11318.47	11511.67	0.10799	-345899.66	-357465.85	-369222.47	-
0.13436	9852.87	10025.17	10198.84	10373.87	0.13436	-345875.48	-357437.00	-369188.85	-
0.15012	9302.66	9465.74	9630.17	9795.98	0.15012	-345861.05	-357419.78	-369168.78	-
PA					SA				
0.00997	22749.39	23137.97	23527.91	23919.22	0.00997	-346013.90	-357602.21	-369381.48	-
0.03154	17039.02	17331.84	17626.01	17921.56	0.03154	-345978.45	-357559.88	-369332.11	-
0.05139	14617.82	14870.04	15123.61	15378.55	0.05139	-345955.06	-357531.96	-369299.55	-
0.07309	12871.33	13094.26	13318.55	13544.20	0.07309	-345932.73	-357505.31	-369268.47	-
0.08905	11892.17	12098.68	12306.54	12515.78	0.08905	-345917.34	-357486.94	-369247.06	-
0.10571	11041.72	11233.96	11427.56	11622.53	0.10571	-345901.76	-357468.35	-369225.40	-
0.13056	9994.89	10169.58	10345.63	10523.04	0.13056	-345878.95	-357441.14	-369193.67	-
0.15468	9154.50	9315.09	9477.04	9640.37	0.15468	-345856.86	-357414.79	-369162.97	-

Table 4.4. ΔS values of LA, SA and PA at different temperatures

M (mol.L^{-1})	ΔS(J.mol^{-1} K^{-1})			
	298.15 K	308.15 K	308.15 K	313.15 K
LA				
0.00979	-1237.14	-1256.25	-1275.36	-
0.02896	-1218.99	-1238.08	-1257.18	-
0.05079	-1209.57	-1228.64	-1247.72	-
0.06969	-1204.24	-1223.30	-1242.37	-
0.09102	-1199.73	-1218.78	-1237.84	-
0.11053	-1196.44	-1215.48	-1234.52	-
0.13001	-1193.68	-1212.71	-1231.74	-
0.15024	-1191.21	-1210.23	-1229.25	-
SA				
0.01001	-1236.77	-1255.88	-1274.99	-
0.02955	-1218.66	-1237.75	-1256.84	-
0.05108	-1209.47	-1228.55	-1247.62	-
0.07285	-1203.49	-1222.55	-1241.62	-
0.09238	-1199.48	-1218.53	-1237.58	-
0.10799	-1196.83	-1215.87	-1234.92	-
0.13436	-1193.12	-1212.15	-1231.18	-
0.15012	-1191.22	-1210.24	-1229.27	-
PA				
0.00997	-1236.84	-1255.95	-1275.06	-
0.03154	-1217.57	-1236.65	-1255.75	-
0.05139	-1209.37	-1228.44	-1247.52	-
0.07309	-1203.43	-1222.50	-1241.56	-
0.08905	-1200.10	-1219.15	-1238.21	-
0.10571	-1197.19	-1216.24	-1235.28	-
0.13056	-1193.61	-1212.64	-1231.67	-
0.15468	-1190.71	-1209.73	-1228.75	-

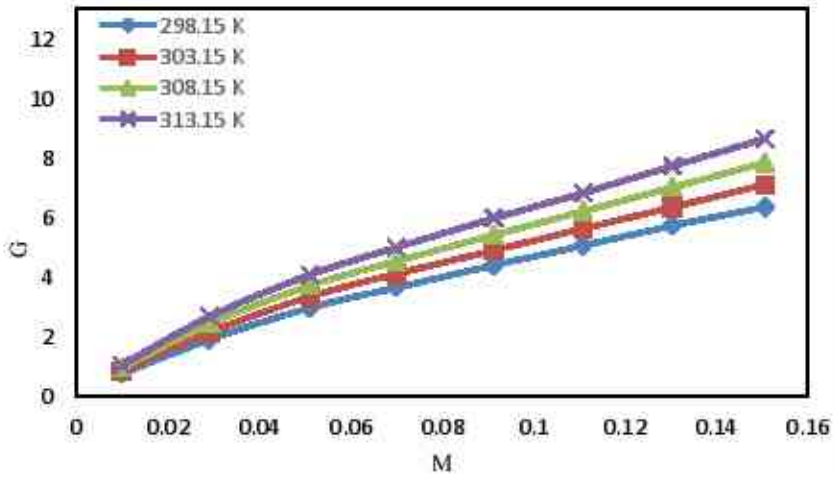

Figure 2. Plot of Conductance (G) vs molality (m) of lithium alaninate in water at different temperatures (T)

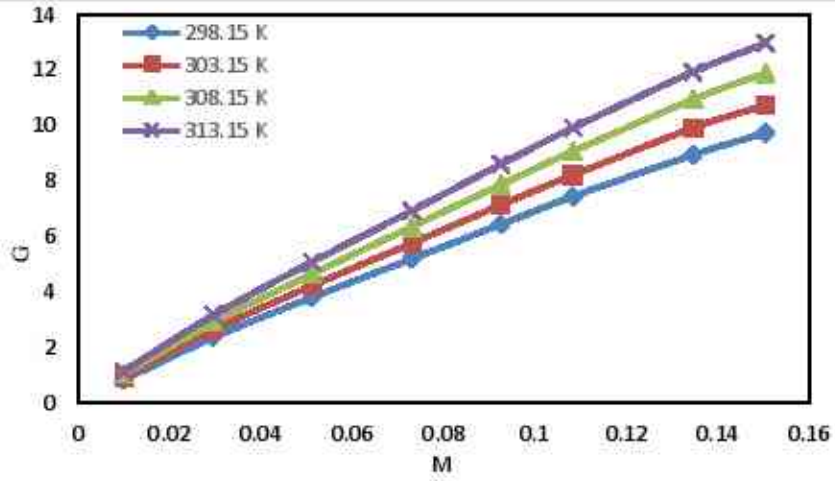

Figure 3. Plot of Conductance (G) vs molarity (*M*) of sodium alaninate in water at different temperatures (*T*)

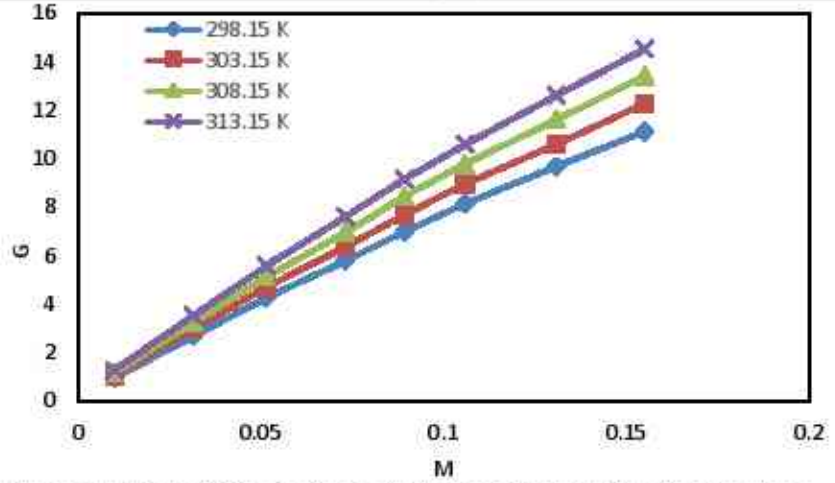

Figure 4. Plot of Conductance (G) vs molarity (*M*) of potassium alaninate in water at different temperatures (*T*)

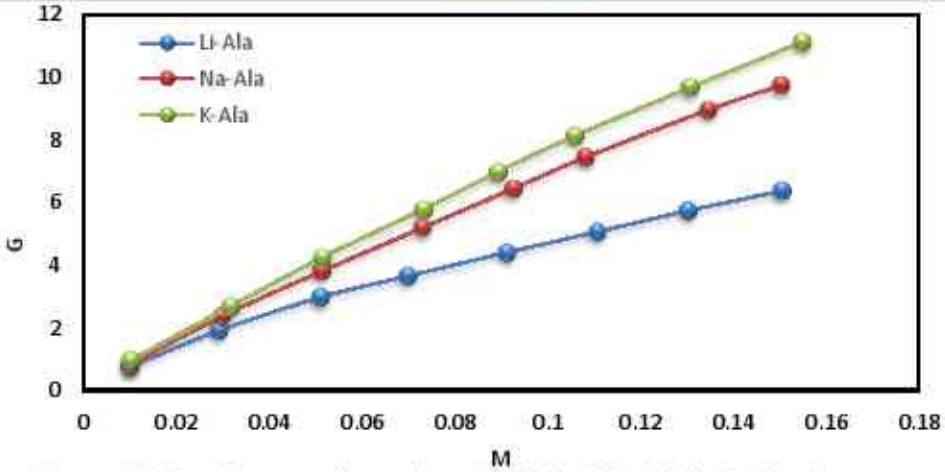

Figure 5. Plot of comparison of conductivity (G) of Li-ala, Na-ala and K-ala vs molarity (*M*) in water at 298.15 K.

IV. ACKNOWLEDGMENT

MBD thanks Director, Government Vidarbha Institute of Science and Humanities, Amravati, India and Principal, HPT Arts and RYK Science College, Nashik, India..

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Identification of Removal of Pollutants from the Wastewater by using Aquatic Plants: A Review

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This study indicates the significance of aquatic plants in eliminating pollutants and treating wastewater. Aquatic plants deliver several benefits to humans. However, under specific condition leading aquatic plant species become challenging placing both marine and freshwater environments at risk right now. For medicinal and horticultural purposes these plant species are often imported from other regions, but they finally escape domestication and establish natural populations. However by using these plants pollutants, such as hydrocarbons and other hazardous and carcinogenic substances, can be removed. Due to their much lower cost and higher efficiency aquatic plants have numerous applications in wastewater treatment. According to several studies aquatic plants to be sinks for wastewater treatment and to reduce pollutants of wastewater. According to the international effluent standards for irrigation the treated wastewater by aquatic plants was with acceptable quality.

Keywords: Wastewater, aquatic plants, pollutant, wastewater treatment.

Introduction :

Vegetation's are the chief source of nutrition. However, numerous aquatic plants can benefit to remove pollutants in wastewater. Toxic pollutants and artificial chemicals have increased dramatically in ecosystems in recent years. Ecology gets damage due to the toxic pollutants such as solvents, pesticides, dyes, and other chemicals which found in waste water. Such toxic chemicals get removed by using aquatic plants such as Water Typha, Colocasia Hyacinth, Canna, and Arabica. In a competitive environment these aquatic plants absorb organic and inorganic pollutants. A name for this technique is Phytoremediation (Garad, 2022; and Anning et al., 2013). Potable water is an expected necessity in human life apart from food and shelter. Surface and underground water are the major sources of clean water. However, with the rapid growth in population and increasing industrial development many water sources have become polluted.More than 40 % of the world's population suffers water scarcity (Ali et al., 2020; and Connell, 2018).For natural flora, fauna and all Environmental components it is dangerous to releasing waste material and residuals directly in water bodies. Proper treatment method should be given to waste water before being released into the environment. Presently, old wastewater treatment methods aren't always beneficial in reducing contaminants but however slight amounts of pollutants can still be present in the treated water.

Since these pollutants are toxic in nature which may affect the habitat as well as many cellular functions in plants (Ahmadi et al., 2020, Mohebi, and Nazari, 2021).Contaminated wastewater is immensely harmful to aquatic health and the environment (Ahmed et al., 2017; Carstea et al., 2016, and Mendoza et al., 2015). Wastewater reclamation is the only remaining alternative for increasing requirement of water in the agricultural and industrial sectors (Tee et al., 2016).The current study lightens the treatment method which is environment friendly as well as eliminate pollutants from wastewater.

Wastewater Pollution: Due to growing industrialization, rising population, and urbanization huge quantities of polluted wastewater are discharged into the environment (Rezania et al., 2015), about 359.4×109 m3/year (Jones et al., 2021).According to the United Nations a percent of all public and industrial wastewater in developing countries is released without being treated (Joseph et al., 2019). In developing countries with limited water supplies wastewater is utilized for irrigation, posing a health concern to all people (farmers and consumers) while providing agricultural systems with nutrients (Werner et al., 2018). Significant amount of agriculturally important nutrients as well as a Non-biodegradable heavy metals (HMs), zinc (Zn), Nickel (Ni), Copper (Cu), Chromium (Cr), Mercury (Hg), Cadmium (Cd), Lead (Pb), and Arsenic (As) may be present in wastewater (Turan et al., 2018).

Hence worldwide Environment friendly wastewater treatment technologies that allow for the reuse of important nutrients are gaining traction (Rezania et al., 2015).In recent decades the term "heavy metals (HMs)"has been widely used . High atomic weight and a density of at least five times that of water are metallic elements. Microorganisms can't decompose hence it is non-biodegradables thus they are hazardous compounds (Paul, 2017, and Goher et al., 2017).Majorly in the natural water bodies heavy metals enhance the risk. As toxicity, bioaccumulation, and persistence of environment is concern heavy metals play dangerous role which rise pollution level. Because carcinogenic and poisonous properties of heavy metals which directly plays detrimental effects on public health. In impoverished nations, many drinking water treatment procedures such as chlorination, sun sterilization, and boiling, are inadequate at removing HMs (Joseph et al., 2019). Air deposition and volcanic eruptions is the natural process by which heavy metals get dissolved in natural water. HMs can form as a result of a variety of factors, including as normal erosion and weathering, as well as human activities (Brevik and Burgess, 2015). Usual sources of HMs from rock weathering and leaching in the environment are normally of little consequence given the high level of natural activity that defines the modern world (Paul, 2017; Goher et al., 2017; Tchounwou et al., 2012; and Elbehiry et al., 2019).HMs into the environment can also be release by bio-geochemical processes (Chowdhury et al., 2016). Despite allowed guidelines and updated legislation, metal ions are commonly emitted as dangerous pollutants in aqueous effluents from various metalworking, chemical, electrolytic plating, coal mining, and pharmaceutical sectors (Humelnicu et al., 2020). HM-containing paints, coatings, pigments, pesticides, and fertilizers, electronics, coal-fired power plants, petroleum combustion, microelectronics, galvanization, chemical, pharmaceutical, plastics, fabric, and electroplating industries, battery, high voltage lines, refineries, and paper mills produces heavy metals (Paul, 2017).As well as industrial activity, the photo engraving method, photochemical treatment, or chemical milling, can expose water sources to metal ions in varying quantities and combinations.

Each year, large quantities of agricultural waste are produced across the world. Apart of these agricultural wastes is dumped straight into water bodies, causing severe water pollution. Furthermore, adding kitchen waste into untreated or inadequately treated wastewaters can have a variety of harmful environmental consequences with the introduction of HMs If sensitivity level is exceeded these metals become harmful to humans and other bio systems. In many developing countries heavy metal pollution is a significant concern affecting both the quality of drinking water and the aquatic ecosystem. So it is very important to sensibly managed and monitored to ensure that they meet environmental standards for each kind of water supply (Chowdhury et al., 2016; Goher et al., 2017; Paul, 2017; Elbasiouny et al., 2020; Humelnicu et al., 2020, and Mostafa et al., 2020).According to European water regulation water regulation; the annual

average ecological quality standards (AA-EQS) for internal groundwater are < 1.2 and 0.25 µg/L for Pb and Cd, respectively.The highest allowable amounts of Cd and Pb in natural water for human preventive care are 0.72 - 1.8 µg/L and 2.5- 65 µg/L, respectively. According to the World Health Organization recommendations for Pb and Cd content in drinking water are 0.01 and 0.003 µg/L, respectively, (Yap et al., 2017; Elbehiry et al., 2018; and Grenni et al., 2019).

Several national authorities have enacted severe laws and restrictions because heavy metals are one of the principal priority contaminants and are quickly becoming one of the most critical environmental issues (Karkra et al., 2017).Metals (Co, Cu, Cr, Fe, Mg, Mn, Mo, Ni, Se, and Zn) have been known as important elements for numerous physiological and biochemical activities. Additional metals (Al, Sb, Ba, Cd, Au, In, Pb, Hg, Pt, Ag, Sr, Sn, Ti, V, and U) are non-essential since they have unknown biological roles (Tchounwou et al., 2012). In various matrices of the environment utmost of these heavy metals are careful elemental residues, found in low amounts (ppb : < 10 ppm). Many physiological disorders are associated with toxicity and carcinogenicity caused by heavy metals that are unknown. Physical and chemical characteristics of every metal have its particular physical and chemical characteristics, this provides it with ecological methods of operation (Tchounwou et al., 2012).The diseases like cancer, Parkinson's, Alzheimer's disease, anemia, as well as harm to the gastrointestinal, neurological, skeletal, and cutaneous systems observed due to acute human exposure to high levels of heavy metals (Brevik, and Burgess, 2015; and Goher et al., 2017).Water quality of open lakes and rivers has been deteriorating because of dumping of Municipal waste, unprocessed wastewater from various industries, and agrochemicals (Ali et al., 2016).In many regions of the world increasing demands of clean water as well as the remediation of water pollution get affected (Yap et al., 2017).

Treatment of Wastewater: Unlike organic pollutants, heavy metal does not degrade and can saturated in the body cells and thus entered in to the food system, causing various diseases. Consequently, to resolve pollution problems, heavy metals essential to be removed from the water or soil. The most important goals of remediation is to Reduce bioaccumulation of heavy metals which damage animals and plants (Wang, and Liu, 2018; Elbasiouny and Elbehiry, 2017).According to WHO (2011) list cadmium, Arsenic, benzene, asbestos, dioxin, and dioxin-like compounds, mercury, lead, inadequate or excess fluoride, and very toxic pesticides are among the top 10 dangerous chemicals out of which Arsenic, cadmium, lead, and mercury are heavy metals. Vollprecht et al., 2019 stated that from industrially polluted wastewater, essential metals must be removed from the aqueous solution before being recycled. It is essential to design inexpensive solutions and produce negligible additional waste.

Gupta, and Balomajumder, 2015 stated that microorganisms were used as bio-sorption for reduction of heavy metals and organic compounds from wastewater, Both active and non-active microbial cells are employed to change or adsorb heavy metals and their derivatives. Kumar, and Chauhan, 2019 stated that for eliminating heavy metals agricultural waste adsorbents have great adsorption which is investigated by many researcher. Naturally we can reduce pollutants from wastewater by using phytoremediation. Thus Rezania et al., 2015 stated that today, the objective is to find a long-term solution for increasing treating wastewater capability.

Techniques for removal of wastewater pollution :

Ecofriendly against traditional treatment techniques:

We should treat the aqueous solution initially before it reaches to natural water bodies (Ahmad et al., 2018).Bioremediation, electrocoagulation, chemical precipitation, membrane

separation, ion-exchange resins, adsorption, coagulation, reduction, reverse osmosis, evaporation, solvent extraction, and flocculation are the methods for eliminating heavy metals from aqueous solutions.

All of these methods has strengths and weaknesses; however, the bulk of them are expensive, ineffective when it comes to minimizing heavy metals from large volumes of water, and have benefits such as non-selectivity, high energy consumption, and the use of chemical products, all of these factors need careful dumping of the injurious waste produced (Grenni et al., 2019; Ahmad et al., 2018; and Doula, 2006).For eliminating heavy metals the most auspicious todays technique is adsorption which is highly efficient, low cost, simple design, and ease of use (da-Silva et al., 2018; Lin et al., 2019; and Patil et al., 2019).Activated carbon, fly ash, peat, woody biomass, zeolites, sewage sludge ash, and other biomaterials have all been shown to have a high potential to eliminate specific metals (such as lead and cadmium) from wastewater (Yap et al., 2017).Heavy metals have been efficiently detached from aquatic environments using a variety of aquatic plants, including water primrose (Ludwigia stolonifera), water hyacinth (Eichhornia crassipes), blue water well (Veronica anagallis- aquatica), and duckweed (Lemna gibba). In aquatic systems the heavy metals can be absorbed and immobilized by living organisms which is ultimately accumulate as solid wastes, leaving cleaned aqueous solutions.The two significant advantages of this method is cost efficient and convenience of processing (Saleh et al., 2020).The dissolved elements are detached from the aqueous media by adsorption on the roots or translocation in the plant shoot, and the elements are then stabilized through physical and/or chemical interactions. Hence, phytoremediation is being used to treat heavy metal contaminated wastewater more frequently.In most cases it is still important to evaluate terrestrial and aquatic plants their performance and efficacy through many terrestrial and aquatic plants. There is also an important to observe at plants that haven't been studied for their ability to purify aquatic ecosystems (Saleh et al., 2020; and Elbehiry et al., 2020).

Low-cost Treatment of wastewater (adsorbents):

Additional growth in this sector needs bigger performance at convenient prices to raise industrial profit margins. Due to global availability and abundance agricultural wastes have gained much attention (Thines et al., 2017; and El-Ramady et al., 2020).Low cost absorbents is more useful in treating polluted wastewater. The ability of long-term absorption ,porous architectures, clays, zeolites, alumina, solid wastes, and activated carbon have been used , but potentially harmful solid wastes are generated is the primary issue.Otherwise, many low-cost adsorbents have an inadequate adsorption potential, needing more study to progress their composition and performance before they can be employed in widely used applications (Pourrahim et al., 2020) Agricultural wastes like wheat bran, maize cobs, tree leaves, barks, rice husks, and aquatic weeds are just a few of the green wastes that have been considered for their ability to absorb heavy metals (Malakahmad et al., 2016). Usually Activated carbon is used in wastewater treatment as an outstanding adsorbent (Grenni et al., 2019).

Because of its amorphous and porous nature and having a large surface area for adsorption of heavy metals or other compounds (Tatarchuk et al., 2019).The progress of innovative sorbents based on solid waste for eliminating heavy metals from water might be a cost-effective solution to decrease treatment expenses (Grenni et al., 2019).

Aquatic plants Mechanisms to treat wastewater:

In the recent years most attracting suitable treatment technologies for various wastewaters are natural treatment systems like soil systems, aquatic systems, and wetlands.

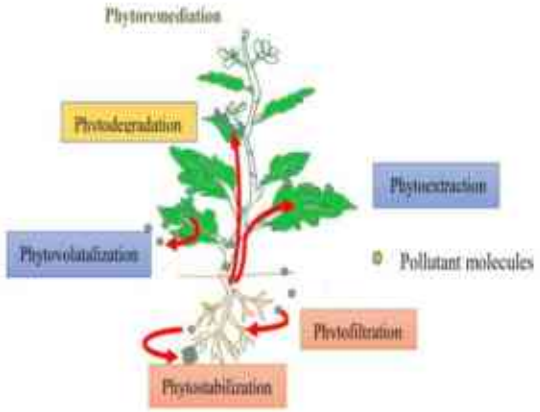
These systems depend on renewable energies such as solar, wind, and stored energy in biomass and soil. After stabilizing the pond system, one of the natural treatment systems that have been considered in many countries in the last few decades, especially in developed countries, is the wastewater treatment system with plants' help (phytoremediation) or wetland systems. In current situation application of plant systems and a more comprehensive range of research in the understanding plants ability to help decompose and purify pathogenic microorganisms and the excretion of many contaminants has led to increased (Keddy, 2010). The number of contaminants including organic matter, inorganic matter, and a variety of pathogenic microorganisms get reduced by wetlands to an acceptable level in secondary treatment unit (Vymazal, 2010). In the land treatment Pollutant reduction effectiveness, pollutant toxicity reduction, and cost-effectiveness are the success of short- and long-term treatments (Abdullah et al., 2020). Land pollution and marine pollution has increased due to industrialization and urbanization (Zaghloul et al., 2020). Contaminated ecosystem statuses estimated with the help of plants are stationary and quickly strike a balance in their natural environment (Zaghloul et al., 2020). Primary source of food and oxygen are the aquatic plants. It is critical for the conservation of biological equilibrium in the aquatic ecosystem (Kumar, and Arisdason, 2020). In the broad contaminated region of marine environment method of aquatic plant treatment is a resourceful and cost-effective cleanup method, it naturally reduce pollutants and heavy metals (Pratas et al., 2014).The most competent and cost-effective method for removing heavy metals and other environmental pollutants is using aquatic plants (Guittonny-Philippe et al., 2015).Worldwide constracted wetlands and aquatic plants have been used to treat wastewater(Gorito et al., 2017; and Mesa et al., 2020). For heavy metal accumulation selection of aquatic plant species is vital to aquatic plant treatment (Galal et al., 2014).For the cleaning capacity to clean up polluted environments all across the world throughout the years aquatic plants have got an excellent standing (Gorito et al., 2017).Aquatic plants have a complex root structure that facilitates them to accumulate contaminants in their roots and shoots, creating them an excellent choice for this (Ali et al., 2020). The growth and culture of aquatic plants take period, which might delay the expanding demand for aquatic plant treatment (Said et al., 2015). However, this flaw is compensated by the numerous benefits this technology offers in wastewater treatment (Kozminska et al., 2018; and Syukor et al., 2014).The most vital benefit of aquatic plant treatment is that it is a green technology that indorses long-term growth. It uses plant and microbe natural resources, minimize degradation of the environment, safeguards ecosystems, and recovers lives and health other welfares include the fact that together organic and inorganic pollutants are excellently treated by aquatic plants, building them suited for the treatment of diverse types of pollutants using numerous mechanisms. (Phytoaccumulation, Phytodegradation, Phyto- transformation,

Figure 1. Aquatic plant treatment mechanisms of treat wastewater (Mohebi, and Nazari, 2014).

Phytovolatilization, and Phytoextraction) to clear-out or detoxify pollutants; at low-to-moderate concentrations, it works well on soil that has been contaminated in huge quantities and widely scattered pollutants; polluted soil can be reinstated for agricultural use, and treated wastewater can be used for cleaning or landscaping, reducing the negative influence of the ecosystem. Additionally, since phytotechnology is modest to install and maintain, it is less affluent and less expensive than additional technologies for chemical and physical treatment

(Abdullah et al., 2020).The figure shows the overall mechanisms involved in aquatic plant pollution remediation. The treatment procedures for aquatic plants can be fragmented into three categories i.e. pollutant degradation, suppression, and extraction, or a combination of these three categories (Santos, and Maranho, 2018; Mohebi and Nazari, 2014).

The procedures used by aquatic plants to eliminate or detoxify contaminants can also be classified. Removal of contaminants from groundwater or soil, biotic and abiotic mechanisms that degrade contaminants, contamination levels in plant tissue, volatile pollutant evaporation or transpiration from the plant into the air, and contaminant immobilization in the root zone are



Examples of these mechanisms (Abdullah et al., 2020).In the process of hydraulic monitoring plants gets absorb and transfer large volumes of groundwater in phytoremediation of contaminated sites. For the prevention of horizontal movement and contaminants vertical leaching this method play vital role. The consequent uptake and evaporation of volatile compounds through the leave are known as plant volatilization (Figure 2) (Mohebi, and Nazari, 2014). Organic compounds introduced into the plant can be degraded by plant enzymes, which are called plant degradation. Plant accumulation is the absorption and accumulation of minerals in plant tissues.

Figure 2. Phytoremediation by plants for refining and absorbing metals in wastewater (Mohebi, and Nazari, 2014).

The collective anaerobic and phytoremediation systems evaluated their potential and efficiency for sanitary wastewater treatment. COD remove up to 80% and BOD remove up to 90% using a hybrid method of anaerobic and phytoremediation systems. Total coliform and intestinal nematode abolition efficiency were 99,999 and 100%, respectively, by using this system. According to international effluent irrigation regulations, the treated wastewater quality

was acceptable (Mohebi, and Nazari, 2014). These are the plants with underwater roots and floating leaves. Several aquatic plants have long been identified for their capacity to eliminate metals from contaminated environments: water hyacinth (Eichhornia crassipes) (Gunathilakae et al., 2018), water ferns (Salvinia minima) (Iha, and Bianchini, 2015), duckweeds (Lemna minor or Spirodela intermedia), (da-Silva et al., 2017; Daud et al., 2018), water lettuce (Pistia stratoites) (Abbas et al., 2019), and watercress (Nasturtium officinale) (Shi et al., 2020). Table 1 framework the potential of several aquatic plants for phytoremediation of aquatic environments. Figure 3 displays several aquatic plants used for water and wastewater phytoremediation (Mohebi, and Nazari, 2014; Mustafa and Hayder, 2020; Patel and Kanungo, 2012; and Priya and Selvan, 2017).Water pollution with effluents from industries and heavy metals growths, which has led to amplified safety cautions. In the near future clean water supply get reduce due to increase in Industrialization and urbanization. This has directed scientists to training and search ways to purify water. Purifying water using traditional ways is costly and time- consuming; therefore, scientists have crooked to more cost-effective substitutes like phytoremediation, which uses particular phytoplankton's to filter water, and hydrophytes. Several plants (Eichhornia crassipes) have been issued as purifiers of organic matter pollution (Rai, and Panda, 2014). Like this, using plants to decrease pollutants may contribute to their operational applications (Rai, 2015). Also, as a consequence of recent breakthroughs and advances in phytoremediation techniques, the use of aqueous Hyacinth in wastewater treatment has been widely recognized, and treatment schedules have been developed (Patel, and Kanungo, 2012). In all over the world the percentage of Arsenic in drinking water has caused great concern, which has previously affected many people. While different aquatic plants were revealed to absorb Arsenic and have been recommended for arsenic phytoremediation, the management, transfer, and burial of these aquatic macrophytes is a significant consideration in excellently using the phytoremediation initiative, given the materials available (Raju et al., 2015).

Conclusion:

In recent times, Aquatic plants offer much assistance to humans, with many new applications still to be identified. Nevertheless, familiarizing aquatic plant species that become difficult under specific conditions is putting both marine and freshwater atmospheres at threat right now. These plant species are often introduced from other areas for medicinal or horticultural purposes, but they ultimately escape domestication and begin natural populations. Additional pollutants, such as hydrocarbons and other hazardous and carcinogenic substances, can be detached from water using these aquatic plants. The application of growth-promoting bacteria that stimulate the growth of rhizosphere plants and the dense plants could be another modification that can have the maximum treating effect. In wastewater treatment aquatic plants have many applications, due to their much lower cost and higher efficiency. Many studies have proved Aquatic plants to be sinks for wastewater treatment, and they are also used in the treatment process and to decrease or limit pollutant wastewater. The treated wastewater's quality was suitable, according to the international effluent standards for irrigation.

Table 1. Different aquatic plants' phytoremediation capabilities (Mohebi and Nazari, 2014)

Aquatic Plants			
Common Name	**Scientific Name**	**Pollutants**	**Type of Wastewater**
Water hyacinth	Eichhornia crassipes	BOD, COD, Fe, Zn, Ni, Oil, grease,	Industrial wastewater

Water lettuce	Pistia stratiotes	Cd, Zn, Ni, Pb, Cu, NO –	Industrial wastewater
Narrow-leaf cat-tail	Typha angustifolia L.	*BOD, COD, color, TDS*	Textile wastewater
Common duckweed	Lemna minor	BOT, Cl-, SO^{2-}, BOD, COD, TDS, Cu,	Industrial wastewater
Water spinach	Ipomeo aquatica	COD, TDS, NO –, NH - N, P, Ni, Pb, Cd	Palm oil mill effluent
Parrot-feather	Myriophyllum aquaticum	BOT, Cl-	River water
Coontail	Ceratophyllum demersum	N, P	Fish pond wastewater
Floating fern	Salvinia natans	BOD, COD, NH4-N	Raw wastewater
Vetiver	Vertiveria zizaniodes	NH3, NO2, NH4, PO4	Fish pond wastewater
Spiked water-milfoil	Myriophyllum spicatum	COD, TN, TP, NH4-N	Polluted rural river water
Bulrush	Typha orientalis	BOD, Na, TOC, turbidity, NO –	Municipal wastewater
Water-thymes	Hydrilla verticillata	BOD, COD, TSS, TP	Secondary domestic wastewater

Water hyacinth (Eichhornia crassipes)

Water lettuce (Pistia stratiotes)

Water spinach (Ipomeo Aquatica)

Common reed (Phragmites australis)

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Estimation of Noise Pollution in Akola City

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Abstract :

The present research paper deals with a calculation of atmospheric conditions and noise level at Akola city during the months of January to June of year 2022.The sites carefully chosen for experimentation includes Railway Station, Bus Stand, Civil line Square, Sindhi camp Square, Jawahar Nagar Area, Akot Road and old city Square. The results shows that the noise pollution level at some sites are exceeding the standard limit particularly at Railway Station, Bus Stand, old city Square Area and Akot Road whereas Jawahar Nagar Area show certain parameters within limits. Decibel Meter was the device used for the experimentation. The assessment of monitoring system therefore would demonstrate very useful for control the noise pollution.

Keywords: Noise pollution, Jawahar Nagar Area, Decibel Meter, Sound level.

Introduction :

Akola city is located in the middle east of Maharashtra State. It is situated between North 20.17 to 21.16 latitude and East 76.7 to 77.4 longitudes. It is the third largest city in Vidarbha after Nagpur and Amravati and tenth largest town in Maharashtra. Akola is positioned north-central of Maharashtra state, western India, on the banks of the Morna River. It is a vital city due to its history, culture, politics, and agriculture. It also has a projecting road and rail junction in the Tapti River valley those roles as a marketable trading center. Akola is a vital educational midpoint with a number of colleges affiliated with the Sant Gadge Baba Amravati University. The city is becoming as the market center. Marathi is vital language spoken by most of the people of Akola. Air born mechanical energy striking the human ear drum is called Noise. Normally conversion with the person at the distance of one meter 65dB is the Normal Level. A sound of frequency 125dB gives the feeling of discomfort to the ear while 150 dB frequencies might kill human being. The noise is moreover natural or manmade. Thenatural noise includes thunder, lightning, earthquake etc. While manmade noise consists of use of electrical devices, musical instruments etc. The chief categories of noise pollution are:

- Transportation noise
- Construction noise
- Neighborhood noise
- Indoor noise
- Outdoor noise
- Industrial noise

The typical examples of noise production sources with their frequency in decibels are given inTable 1.

Table 1: Noise production sources and their frequency in decibels :

Sr. No.	Sources	Frequency (dB)
1	Aero plane noise at 1 meter	130
2	Siren at 5 meters	100

3	Newspaper press	102
4	Farm Tractor	103
5	Loudspeakers	83
6	Theatre	90
7	Human Heartbeats	13
8	Breathing	10
9	Telephone	70
10	Chewing Gum	20
11	Generator	120
12	Crackers (Bomb)	110

Due to high frequency above the normal audible range inner ear circular canals get disturb and make one suffer from nausea and dizziness. Low frequency noise can yield resonance in the body organs giving the effects of amplified heartbeat variations in blood pressure, breathing difficulties. Along with vomiting, deafness, loss of appetite, loss of sleep, fatigue and even cardiac failure may happen. Noise causes frustrations and is associated with difficulty in concentration, trouble of rest. It causes alteration in normal sleep pattern and stops sound sleep. It roots hypertension which rises in sweating, hepatic ulcer, undesirable change in gastrointestinal tract, behavioral and emotional stress. loud and sudden noise such as that of jet aero plane affected Brain and causes psychiatric illness. Noise is responsible for the augmented drinking of alcohol, drugs, tranquilizers, increased reliance on sedatives and sleepingpills. High noise levels affect the development of fetus. It associates with low weight birth babies and high sound levels irregularity includes harelip, cleft pallet, defects in spine, neuron and immune deficiencies.

Control Measure:

Peoples must be made alert and educated about noise pollution and its consequence through suitable news, media, TV, radio etc. The convex lens should be attached on the traffic square it is the round mirror which gives the image of person coming from the backside so, there is no essential of giving horn and indicator and we can decrease the noise up to 25%. In industries, the noisymachines must be walled in a box like structure having sound absorbing materials on its internal surfaces. There will decrease the noise from propagating and will cut off the noise at the source only.

Plantation of trees:

It has been originating that Neem, Babul, Ashok, tamarind are the effective absorbers of sound particularly of great frequency. To propagate the need of awareness amongst employees about the ill effects of noise pollution on their health workers should use ear plugs or ear muffs which will diminish the sound up to 15-20 dB. For dropping noise pollution enclosures, shields, barriers and sophisticated machineries is an effective and efficient method because they can cut off the sound waves from spreading. Bus, car, truck drivers should be instructed not only for beyond speed limits, but also not to top the noise limit of 82 dB. By increasing the number of blades or by decreasing the rotational speed of fan the noise from the fan can be reduced. Great demand for quieter appliance, Usage of silencers, U s a g e of rubber tires instead of steel wheels of vehicles. One should evade long hours spent listening of MP3 players. Useof loud speakers, music players on festivals and marriages should be considered crime and strictpenalty or fine be given launching complaint about the neighborhood noise.

Methodology:

To study and analyze the noise pollution in Akola town, a study was carried out from the month of January to June of year 2022. In these study, 7 traffic areas were selected, namely Railway Station, Bus Stand, Civil line Square, Sindhi camp Square, Jawahar Nagar Area, Akot Road and Old City Square. The two timings were selected viz. morning time (9 AM to 12 Noon) and evening time (6 PM to 9 PM) continuously ten readings were recorded forten days for the selected area. The average reading gives the noise pollution produced in the area.

Table 2: Average readings :

Sr. No.	Area	Time	Average Reading (dB)
1	Railway Station	9.00 AM – 12.00 Noon 6.00 PM – 9.00 PM	107.39 105.8
2	Bus Stand	9.00 AM – 12.00 Noon 6.00 PM – 9.00 PM	94.9 95.0
3	Civil line Square	9.00 AM – 12.00 Noon 6.00 PM – 9.00 PM	94.17 95.63
4	Sindhi camp Square	9.00 AM – 12.00 Noon 6.00 PM – 9.00 PM	94.17 95.63
5	Jawahar Nagar Area	9.00 AM – 12.00 Noon 6.00 PM – 9.00 PM	102.2 105.9
6	Akot Road	9.00 AM – 12.00 Noon 6.00 PM – 9.00 PM	82.5 85.97
7	Old City Square	9.00 AM – 12.00 Noon 6.00 PM – 9.00 PM	65.9 63.8

Table 3: Noise recorded in Decibel in different areas during 9 AM to 12 Noon up to 10 days :

Area	Ist	IInd	IIIrd	IVth	Vth	VIth	VIIth	VIIIth	IXth	Xth	Average
Railway Station	105.5	108	109.2	107.2	104.8	107.9	106.7	105	109.6	110	107.39
Bus Stand	88	83.5	87.2	90.4	84.1	81.9	85.7	82.1	89	86	85.79
Civil line Square	94.9	95	94	93.1	94	91.9	94.2	95.8	93	95.8	94.17
Sindhi camp Square	103.9	99.8	98.5	103.9	99.8	100.8	105	103.6	104	102.4	105.4
Jawahar Nagar Area	89.9	81	87.7	82.4	86	88.8	90.6	83.5	85.1	84.25	85.92
Akot Road	71	72.1	73.8	79.2	72	77.4	74.7	70.3	76.5	75	74.2
Old City Square	71	75	70.1	68.3	76.2	72.5	77.4	73.8	75	74.7	73.4

Table 4: Noise recorded in Decibel in different areas during 6 PM to 9 PM up to 10 days :

Noise recorded in Decibel in different areas during 6 PM to 9 PM up to 10 days											
Area	**Ist**	**IInd**	**IIIrd**	**IVth**	**Vth**	**VIth**	**VIIth**	**VIIIth**	**IXth**	**Xth**	**Average**
Railway Station	104.3	102.3	103.4	101.4	105.4	107.4	106	108.4	109.4	110	105.8
Bus Stand	98.1	110	108.7	97.2	100.5	99.4	105.3	107.6	109.9	105.9	105.9
Civil line Square	94.9	92.8	95.7	97.6	94.4	95.3	98.5	96.2	91.9	99	95.63
Sindhi camp Square	103.9	99.9	98.7	104.2	100.8	101.4	103	103.2	104	102.9	101.7
Jawahar Nagar Area	87.9	81.5	86.7	81.4	86.2	87.8	89.6	82.5	84.1	83.25	84.92
Akot Road	70.4	71.1	72.8	76.2	75.2	75.4	73.7	69.3	75.5	75.3	73.2
Old City Square	71.1	74.3	69.1	67.3	75.2	71.5	76.4	72.8	74.9	73.7	72.4

Results and Discussion:

From the Table 4, we can come to know that there is quite fluctuation in the readings. All the values in different area are exceeding the normal. It is found that, railway station is the highest noise producing area in the morning time. The least noise producing area is old city and so it is quite safest. Again in the evening time, the railway station produces maximum noise and the least noise producing area is again old city and it is quite nearer to the normal values. The best way for controlling the noise pollution is educating the public about the hazards and bad effects of noisepollution.

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'RESEARCH JOURNEY' International E- Research Journal
Issue – 326 : Multidisciplinary Issue
Peer Reviewed Journal
Impact Factor 6.625
E-ISSN : 2348-7143
July-2023

The Impact of Water Intake on Kidney Stone Formation and Prevention : A Comprehensive Research Review

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Abstract :

Kidney stones are a common urological condition with significant morbidity and healthcare costs. The prevention and management of kidney stones require a multifaceted approach, and one crucial aspect is the impact of water intake on stone formation. This research paper aims to provide a comprehensive review of the current literature on the relationship between water consumption and kidney stone development.

The abstract starts by acknowledging the prevalence and impact of kidney stones on individuals and healthcare systems. It emphasizes the need for a comprehensive approach to prevention and management. The focus is then directed towards the specific topic of water intake and its influence on kidney stone formation.

The abstract outlines the objective of the research paper, which is to review existing literature and consolidate the current understanding of the relationship between water intake and kidney stone development. It highlights the significance of this topic in the context of stone prevention and management.

The methodology employed in this review involves an extensive search and analysis of relevant studies, including observational studies, clinical trials, and meta-analyses. The findings of these studies are synthesized to provide an overview of the effects of water intake on kidney stone formation.

The abstract concludes by summarizing the key findings of the review. It highlights the positive association between higher water intake and a decreased risk of kidney stone formation. The potential mechanisms underlying this relationship are briefly discussed, including increased urine volume, dilution of stone-forming substances, and improved urinary tract function.

The implications of these findings are briefly addressed, emphasizing the importance of promoting adequate water intake as a preventive measure against kidney stone formation. The abstract concludes by highlighting the need for further research to explore optimal water intake strategies, taking into account individual patient characteristics, geographical factors, and lifestyle considerations.

Overall, this research paper provides a comprehensive overview of the impact of water intake on kidney stone formation. It consolidates current evidence and highlights the importance of promoting adequate hydration as an essential component of kidney stone prevention and management strategies.

Keywords: Kidney stones, Urolithiasis, Water intake, Prevention strategies, mathematical data on kidney stones.

1 Introduction :

Kidney stones, also known as urolithiasis, are a common and often painful condition affecting a significant portion of the population worldwide. They are formed when certain substances in the urine crystallize and aggregate, leading to the development of solid masses within the uri- nary tract. Kidney stones can cause excruciating pain, urinary obstruction, and potentially seriouscomplications if left untreated. Furthermore, the economic burden associated with kidney stone management and treatment places a significant strain on healthcare systems.
The prevention and management of kidney stones require a comprehensive approach that encompasses various aspects, including dietary modifications, lifestyle changes, and medical interventions. Among these factors, the role of water intake has emerged as a crucial element in the prevention and recurrence of kidney stones. Adequate hydration has long been advocated as an important measure in stone prevention, but the precise impact of water consumption on kidney stone formation remains an area of ongoing research and investigation.

The objective of this research paper is to provide a comprehensive review of the current under- standing of the relationship between water intake and kidney stone development. By synthesizing existing literature and analyzing relevant studies, we aim to elucidate the effects of water intake onkidney stone formation, explore potential mechanisms involved, and discuss the implications for stone prevention and management strategies.Understanding the influence of water intake on kidney stone formation is crucial for several reasons. First, kidney stones are a prevalent condition, with a significant impact on quality of lifeand healthcare resources. Second, prevention is paramount, as recurrent kidney stones are com- mon, and individuals who have had one stone are at increased risk of developing additional stones in the future. Third, identifying effective and practical preventive measures, such as promoting adequate water intake, can potentially reduce the incidence and burden of kidney stone disease.

In this paper, we will examine the available evidence regarding the association between water intake and kidney stone formation. We will explore the potential mechanisms through which water intake affects stone formation, including increased urine volume, dilution of stone-formingsubstances, and improvement in urinary tract function. Additionally, we will discuss the implications of these findings for stone prevention strategies and highlight areas for further research and investigation.

By gaining a better understanding of the impact of water intake on kidney stone formation, healthcare professionals can provide evidence-based recommendations for patients at risk of developing kidney stones. Furthermore, public health initiatives and educational campaigns can emphasize the importance of adequate hydration as a preventive measure against this common andburdensome condition.

Case Study 1: The Role of Water Intake in Kidney Stone Prevention Patient Profile:
Name: John
Age: 42
Occupation: Office worker
Medical History: No previous history of kidney stones or urinary tract disorders
Presenting Complaint:

John visited his primary care physician with complaints of intermittent flank pain and occasional blood in his urine. After a thorough examination and diagnostic tests, he was diagnosed with a calcium oxalate kidney stone, a common type of kidney stone.

Background:

John's diagnosis prompted his healthcare provider to discuss the importance of preventive mea- sures to reduce the risk of recurrent kidney stones. They focused on the role of water intake in stone prevention, emphasizing the potential benefits of adequate hydration.

2. Assessment and Intervention:

1. Evaluation of Water Intake Habits:

John's healthcare provider conducted a detailed assessment of his daily water intake habits it was revealed that John's water consumption was significantly below the recommended daily intake.

2. Education on Hydration and Kidney Stone Prevention:

John's healthcare provider explained the link between inadequate water intake and kidney stone formation. They discussed how insufficient hydration can lead to concentrated urine, facilitating the crystallization and formation of kidney stones. The importance of maintaining optimal urine volume and dilution of stone-forming substances was emphasized.

3. Setting Realistic Hydration Goals:

Based on John's age, activity level, and overall health, his healthcare provider recommendeda specific daily water intake target. They explained that achieving this goal would help reduce the risk of stone formation and support overall urinary tract health.

4. Practical Strategies for Increasing Water Intake:

To help John meet his hydration goals, his healthcare provider provided practical strategies, including:

- Carrying a reusable water bottle and keeping it readily accessible throughout the day.
- Setting reminders to drink water at regular intervals.
- Replacing sugary and caffeinated beverages with water.
- Incorporating hydrating foods, such as fruits and vegetables, into his diet.

5. Follow-up and Monitoring:

John's healthcare provider scheduled regular follow-up appointments to monitor his progress and assess any changes in symptoms or urine analysis. They also planned to evaluate the impact of increased water intake on his urinary stone risk factors.

Outcome:

Over the course of several months, John made conscious efforts to increase his water intake and implement the recommended strategies. He noticed significant improvements in his overall hy- dration levels and gradually increased his daily water consumption to meet the target set by his healthcare provider.

Follow-up appointments revealed a positive impact of increased water intake on John's uri- nary stone risk factors. His urine analysis showed a decreased concentration of stone-forming substances, indicating a reduced risk of stone formation. Additionally, John reported a significantreduction in flank pain episodes, suggesting improved kidney stone management and prevention.

3. Mathematical Data on Kidney Stones :

3.1 Stone Size Distribution

The Stone Size Distribution refers to the distribution or prevalence of different stone sizes within a specific dataset or population. In this case, the distribution is described based on

three categories: small stones, medium stones, and large stones.

According to the provided information, small stones (less than 5mm) make up the largest pro- portion, accounting for 60% of the cases. Medium stones, ranging in size from 5mm to 10mm, constitute 30% of the cases. Lastly, large stones (greater than 10mm) represent 10% of the cases.

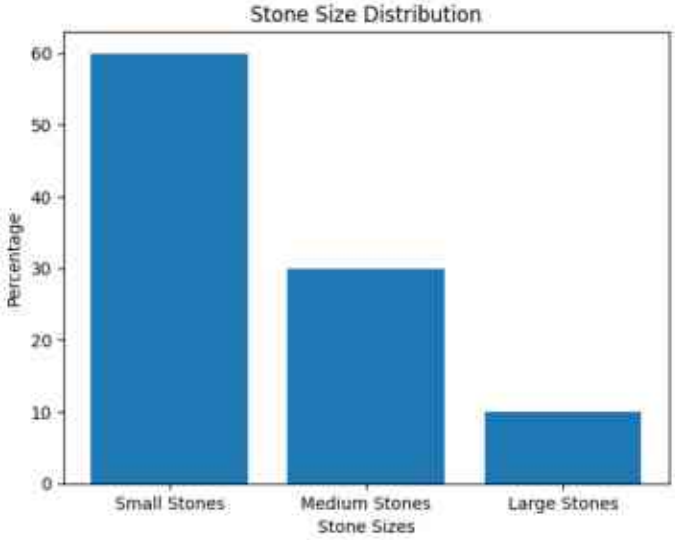

Fig 1

This distribution provides insight into the relative frequency or occurrence of stone sizes in the dataset or population under consideration. It allows for a better understanding of the prevalence of different stone sizes, which can be useful for medical professionals in diagnosing and treating stone-related conditions.

3.2 Stone Composition :

The Stone Composition refers to the distribution or prevalence of different types of stones within a specific dataset or population. In this case, the composition is described based on several cate- gories:

- Calcium Oxalate: 70% of cases
- Calcium Phosphate: 10% of cases
- Uric Acid: 5% of cases
- Struvite: 10% of cases
- Cystine: 5% of cases

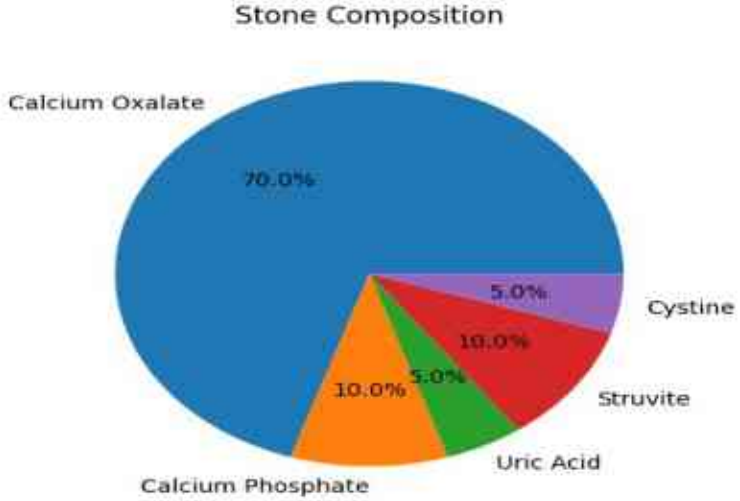

Fig 2

This composition provides information on the relative occurrence of different types of stones in the dataset or population under consideration. It is essential in diagnosing and treating

stone- related conditions, as different types of stones may require specific treatment approaches. Understanding the stone composition can aid medical professionals in determining the appropriate prevention and management strategies.

3.3 Stone Growth Rate :

The Stone Growth Rate refers to the rate at which stones increase in size over time. In this case,the growth rate is described based on two categories.

- Average Growth Rate: 1-2mm per year
- Rapid Growth Rate: 5mm or more per year

The average growth rate indicates that stones typically grow at a rate of 1-2mm per year. How-ever, some stones may exhibit a rapid growth rate, growing at 5mm or more per year. It's importantto monitor stone growth rates as it can affect the management and treatment decisions.

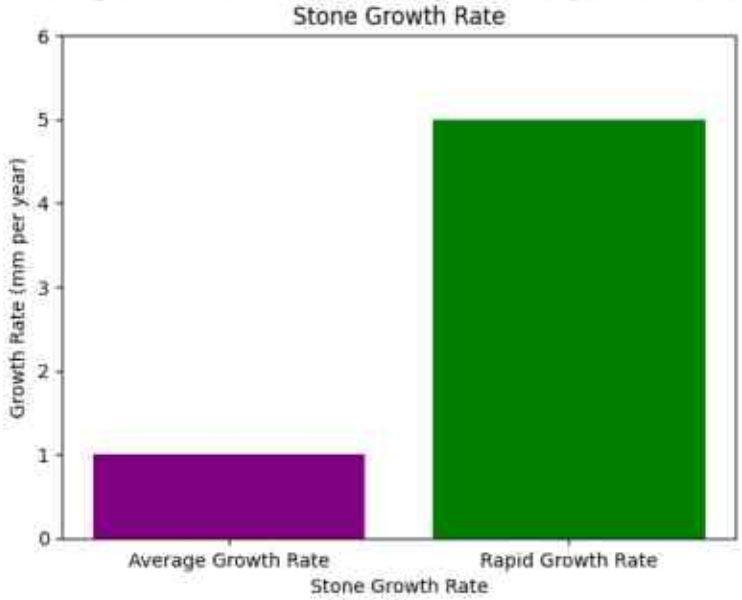

Fig 3

Understanding the stone growth rate is crucial for determining the appropriate intervention strategies and monitoring the progression of stone-related conditions. Medical professionals can utilize this information to assess the need for preventive measures, treatment options, and regularfollow-up for patients with stones.

3.4 Stone Passage Rate :

The Stone Passage Rate refers to the likelihood or probability of stones passing through the urinarysystem spontaneously. In this case, the passage rate is described based on different stone sizes.

- Small Stones (less than 5mm): 85% pass spontaneously within 4 weeks
- Medium Stones (5-10mm): 50% pass spontaneously within 4-6 weeks
- Large Stones (greater than 10mm): Less than 20% pass spontaneously, often requiring medical intervention

According to the provided information, small stones, with a size less than 5mm, have a high passage rate of 85% within 4 weeks without requiring medical intervention. Medium-sized stones, ranging from 5mm to 10mm, have a lower passage rate of 50% within 4-6 weeks.

However, larger stones greater than 10mm have a significantly lower passage rate of less than 20%, often necessitating medical intervention for removal.

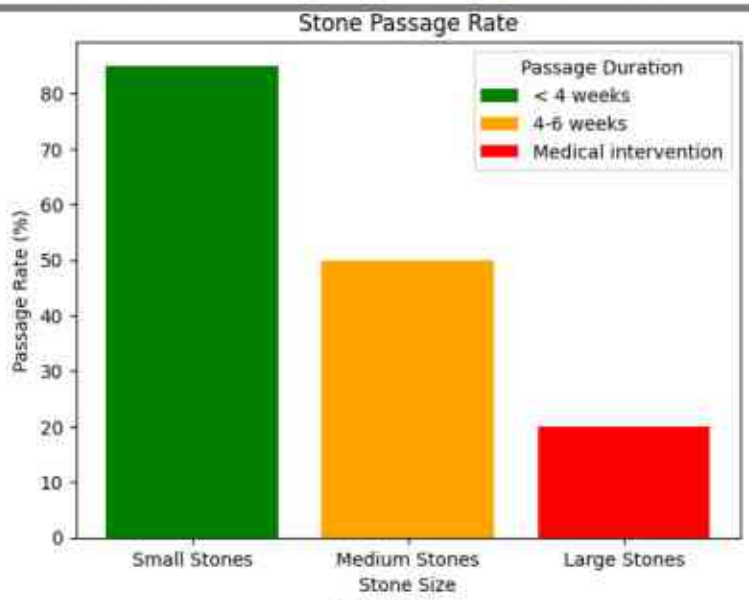

Fig 4

Understanding the stone passage rate is crucial for determining the appropriate management and treatment options for patients with urinary stones. Medical professionals can utilize this in- formation to guide decisions regarding the need for intervention, such as medication or surgical procedures, to facilitate stone passage and prevent complications.

3.5 Recurrence Rate :

The Recurrence Rate refers to the likelihood or probability of stone recurrence within a specifictimeframe. In this case, the recurrence rate is described based on two categories of stone formers.

- First-Time Stone Formers: 30% recurrence within 5 years
- Multiple Stone Formers: 50% recurrence within 5 years

According to the provided information, among first-time stone formers, there is a recurrence rate of 30% within a 5-year period. This means that 30% of individuals who have experienced theirfirst stone episode are likely to experience another stone episode within 5 years.

For multiple stoneformers, individuals who have had multiple stone episodes in the past, there is a higher recurrencerate of 50% within the same 5-year timeframe.

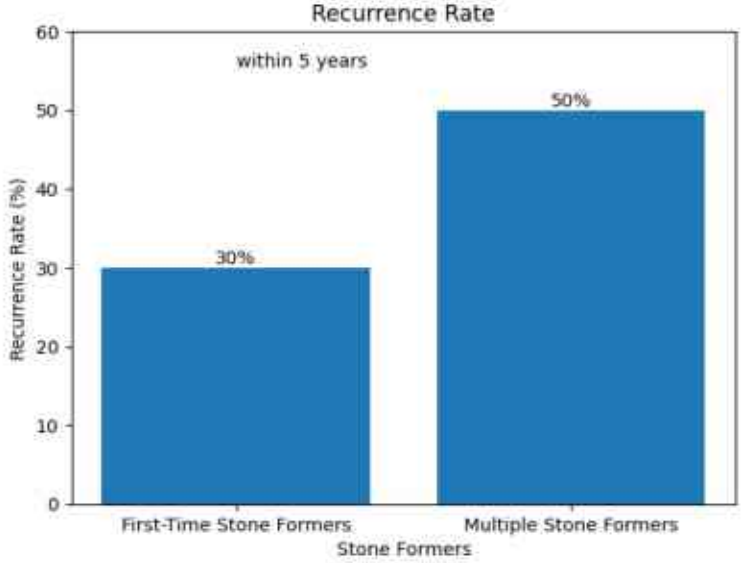

Fig 5

Understanding the recurrence rate is crucial in managing and preventing stone-related conditions. Medical professionals can utilize this information to develop appropriate prevention

strategies and treatment plans tailored to the specific needs of patients with a history of stone formation. Regular monitoring and follow-up may be necessary to minimize the risk of recurrence and opti- mize patient care.

3.6 Treatment Success Rate :

The Treatment Success Rate refers to the effectiveness or likelihood of successful outcomes for different treatment methods used for stone management. In this case, the success rate is describedbased on several treatment modalities.

- Extracorporeal Shock Wave Lithotripsy (ESWL): 70-90% success rate
- Ureteroscopy with Laser Lithotripsy: 90-95% success rate
- Percutaneous Nephrolithotomy (PCNL): 85-95% success rate
- Open Surgery (Rarely performed): 95-100% success rate

According to the provided information, Extracorporeal Shock Wave Lithotripsy (ESWL) has a success rate ranging from 70% to 90%. Ureteroscopy with Laser Lithotripsy has a success rate ranging from 90% to 95%. Percutaneous Nephrolithotomy (PCNL) has a success rate ranging from 85% to 95%. Open Surgery, although rarely performed due to advancements in minimally invasive techniques, has a success rate ranging from 95% to 100%.

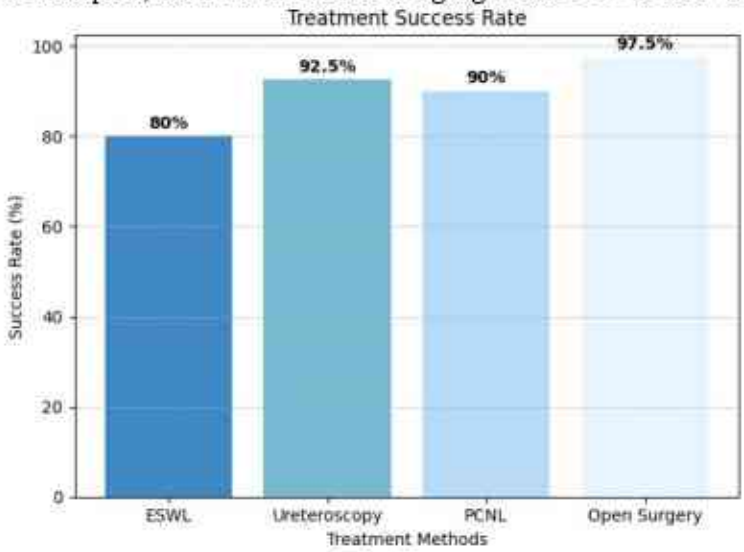

Fig 6

Understanding the treatment success rates is crucial in selecting the appropriate treatment modality for patients with stone-related conditions. The success rate provides valuable information regarding the effectiveness and potential outcomes of each treatment option. Medical professionals can utilize this information to guide their decision-making process and offer the most suitable treatment approach for each patient, considering factors such as stone characteristics, patient pref- erences, and overall health status.

Please note that the above data is based on general statistical trends and may vary in specific cases. It is important to consult reliable sources and healthcare professionals for accurate and personalized information regarding kidney stones.

This case study highlights the importance of addressing water intake as a preventive measure in kidney stone management. Through education, goal setting, and practical strategies, healthcare providers can empower patients like John to make positive lifestyle changes and reduce their risk of recurrent kidney stone formation. Adequate hydration, as part of a comprehensive stone prevention plan, can play a significant role in improving patients' urinary

tract health and overall well-being. In conclusion, the stone-related parameters described in the preceding sections provide valuable insights into various aspects of stone formation, characteristics, management, and outcomes. The Stone Size Distribution indicates the prevalence of stones of different sizes within a specific dataset or population. The majority of cases consist of small stones (less than 5mm), followed by medium stones (5-10mm), and a smaller percentage of large stones (greater than 10mm). Understanding the distribution helps in identifying the frequency and relative occurrence of different stone sizes.

The Stone Composition highlights the distribution of stone types observed within the dataset or population. Common stone compositions include calcium oxalate, calcium phosphate, uric acid, struvite, and cystine. Knowing the composition aids in diagnosis, treatment, and preventive strategies specific to each stone type.

The Stone Growth Rate characterizes the rate at which stones increase in size over time. Stones typically exhibit an average growth rate of 1-2mm per year, but some stones may grow rapidly at a rate of 5mm or more per year. Monitoring the growth rate assists in assessing the progression of stone-related conditions and determining appropriate intervention.

The Stone Passage Rate indicates the likelihood of stones passing through the urinary system spontaneously. Small stones have a higher passage rate, with a significant percentage passing within 4 weeks. Medium stones have a lower passage rate, with around 50

The Recurrence Rate denotes the probability of stone recurrence within a specified timeframe. First-time stone formers have a recurrence rate of 30% within 5 years, while multiple stone formers experience a higher recurrence rate of 50% within the same period. Understanding the recurrence rate aids in implementing preventive measures and developing appropriate treatment plans.

The Treatment Success Rate showcases the effectiveness of different treatment modalities for stone management. Various techniques, such as Extracorporeal Shock Wave Lithotripsy (ESWL), Ureteroscopy with Laser Lithotripsy, Percutaneous Nephrolithotomy (PCNL), and Open Surgery, exhibit success rates specific to each method. Treatment success rates guide medical professionals in selecting the most suitable treatment approach based on factors such as stone characteristics, patient preferences, and overall health status.

Collectively, these insights into stone-related parameters contribute to a comprehensive under- standing of stone formation, characteristics, management, and outcomes. They assist medical professionals in making informed decisions regarding diagnosis, treatment, prevention, and follow-up care, ultimately optimizing patient outcomes and quality of life.

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'RESEARCH JOURNEY' International E- Research Journal
Special Issue – 327 : Multidisciplinary Issue
Impact Factor 6.625 Peer Reviewed Journal
E-ISSN : 2348-7143
August - 2023

Phytoremediation as an Substitute Method to Eliminate Heavy Metals from Wastewater

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Abstract :

Water pollution by heavy metals is the most worldwide existence as a result of human activates agricultural and industrial activities. Lead and cadmium are easily absorbed and collected in different plant parts; however, they are counting as non-essential elements. Together internupt the food chain and are toxic even at little concentrations to plants. Despite of having several traditional methods using for elimination of pollutants from wastewaters, they cause many negative impact on environment, and very expensive, as well. Phytoremediation is energy efficient, ecofriendly and simply pleasing technologies, which are both ecologically, sound and economically showed as a proper alternative option to purify polluted water. It is based on the usage of plants to remove impurities from the environment and aquatic plants are efficient and suitable plants to eradicate, detoxify or immobilizing methods. This review article deals with the assessing state of phytoremediation as an environmentally friendly skill, and also to discuss the potentiality of different aquatic plants in the remediation of lead and cadmium in wastewater.

Keywords: Aquatic plants, lead, cadmium, phytoremediation, wastewater.

Introduction :

Due to speedy industrialization, mining activity, irrigation by wastewater, and the application of sewage sludge to agricultural farms have dramatically amplified the release of metals into water, soil and air ecosystems, causing thoughtful damage at different steps to living systems (Chen, Zheng, Tu, and Shen, 2000).Twenty three metals have been classified as heavy metals, the utmost common are chromium (Cr), lead (Pb), cadmium (Cd), cobalt (Co) and mercury (Hg), those have the toxicity effects at high concentration also at low concentration for plants. Lead and cadmium are measured the maximum toxic heavy metal and have been documented for its harmful influence on environment where it's accumulate via food chain having a thoughtful threat to human health, animals and plants (Nagajyoti et al., 2010). So, it is very crucial to treat lead and cadmium from wastewaters properly. Ion exchange, chemical precipitation, and reverse osmosis are the most conventional methods that have being using to eliminate lead and cadmium form wastewaters. They are fairly expensive and also they yield a large amount of sludge requiring special disposal. Recently, there has being a great interest in developing an effective and environmentally friendly technology involving the elimination of heavy metals from wastewaters. Some aquatic plants from submerged, emerged and free floating have been used to eradicate lead and cadmium from natural as well as wastewaters. This review article exemplifying the phyto-accumulation potential of various aquatic vascular plants for remediation of lead and cadmium in polluted water.

Source of lead and cadmium :

Lead and cadmium are majors' environmental pollutants and fairly widespread. They generally reach water system via discharges like sewage treatment plants and industrial plants or urban runoff. Above the natural processes, the main sources are upcoming from factories using

lead and cadmium, batteries, mining operation, alloys and smelting of lead ores, lead piping used in water circulation system, metal plating and finishing operations, fertilizers, pesticides and additives in pigments and gasoline (Eick et al., 1999 & Demiezen et al., 2007)

Effects of lead and cadmium on plants :

Lead and cadmium plays an important pollutants by reason of solubility in water, which results in wide circulation in aquatic ecosystems and both are powerfully toxic to organisms. The extreme amount of lead and cadmium in water causes many physiological and biochemical pressure symptoms in plants, such as growth drop, troubled mineral nutrition, water disparity, and growth productivity and root elongation. When they come in the cell wall, like any other heavy metals, they produce an oxidative stress in plant and lead to cell injuries (Sharma and Dubey, 2005).

Traditional methods for treatment of metal :

Among heavy metals lead and cadmium have involved remarkable notice from scientist, as they are very toxic to human as well as aquatic life. In water, they have to be shortened to levels in correspondence to the rules of regulatory agencies. Numerous traditional methods exist for the remediate of lead and cadmium from wastewater that methods were as follows,
Table (1): Traditional methods for elimination of lead and cadmium.

Phytoremediation :

The word phytoremediation comes from a Greek preface "Phyto" and involved to Latin word remediation "to correct". Just, it mentions to use green plants to eliminate contaminants from soil and water. It is cost effective, as morally accepted, and it is fewer disturbed to the environment. The plants used in this ecofriendly technology must have a considerable capacity of metal uptake. There are many methods through which plants remediate contaminated sites.

Phytoextraction :

Phytoextraction is the remediation of impurities by roots and trans-located into aerial parts, which improve with metals. To reach the acceptable level of metals, plants should use continuously. However, phytoextraction is among the best approach to remove contaminants from soil, sludge and sediment, it takes a long time (Malik and Biswas, 2012).

Advantageous:

- The contaminants are removed permanently from soil
- It is an expensive method

Disadvantageous:

- The plants are growing very slowly with small biomass and shallow root systems
- The plants must be gathered and followed by metal retrieval

Rhizofiltration :

Rhizofiltration is the absorption and adsorption of contaminants by roots from polluted places. The patience and translocation of the metals to aerial parts are unrelated (Jadia and Fulekar, 2009).

Advantageous:

- Water plants and terrestrial plants can be used in-situ applications
- The pollutants do not have to translocate to the aerial parts.

Disadvantageous:

- pH adjustment needs
- Metal collectors might need to grow on a greenhouse

Phytovolatilization :

In this method contaminants from, soil, sediments and sledges altering them into volatilized compounds after that, emerging them into the atmosphere.

Advantageous:

- It is possible to transform impurities to a lesser amount of toxic compounds
- As a result of releasing contaminants to the atmosphere, they may be degraded quickly.

Disadvantageous:

- There is a probability to accumulate.

Phytostabilization :

It is defined as the use of transcription and root growth to decrease the flexibility bioavailability of contaminants in the environment through generating an aerobic condition in the root zone and could be attained via the addition of organic matter and soil alteration.

Advantageous:

- Due to the presence of plants, soil erosion reduces also the availability of water decreases
- The biomass is not requiring disposing.

Disadvantageous:

- The majority of contaminants remain in soil
- In this case, the soil needs a lot of amendments and monitoring

Potential of diverse aquatics in showing water quality

Phytoremediation comprises the use of plants to diminish, transfer, stabilize or damage pollutants in soil, sediment and water. Since the stand point of accumulation, aquatic plants known as to accumulate and concentrate of heavy metals. Research has exposed that aquatic plants are very effective to remove heavy metals from polluted water. Low cost, quite easy to culture in the laboratory, great growth rate and very gentle to various pollutants make the aquatic plant system more good-looking to utilize for Eco toxicological and environmental investigations (Kanabkaew and Puetpaiboon, 2004).

Aquatic plants yield up metals from wastewater, producing an internal concentration several fold larger than their surroundings. So, aquatic macrophytes are progressively used as a beneficial treatment for wastewater. The accretion of metals in various parts of macrophytes is usually trailed an induction of a variety of cellular changes, part of which straight participate to metal tolerance capacity of the plants (Prasad et al., 2001). Aquatic plants are capable of eliminating the heavy metals from the water as a result of the solubility of the metals in water. In fact, in an aqueous solution, metals are in soluble shapes, which are collected by plants much easier.

In the recent past, research has been attentive on using roots and rhizomes of semi-aquatic and aquatic plants to mitigate of heavy metal from contaminated water (Maine et al., 2001 and Pei-ying Xue et al., 2010). Hydrila verticillata, is a common underwater aquatic angiosperm and has a worldwide circulation. It grows fast and reproduces speedily. It has been recognized as a potential and convenient to use in bioassay to monitoring the appearance of

heavy metal toxicity (Sinha and Pandey, 2003 andXue, et al., 2010). In an examination, Hydrila verticillata showing to different concentrations of lead and cadmium. The uptake was concentration dependent, at lesser concentrations (2.5, 5, 10 mg/l Pb and 0.5 and 1 mg/l Cd), the accumulation was higher than 20 mg/l Pb and 10 and 20 mg/l Cd, respectively. In addition, cadmium found to be more deadly which affected the development of the plant than lead (Singh et al., 2011). Research stated that submerged plants, have important potential to bio concentrate metals because of their greater surface area compare to non-submerged plants (Guilizzoni 1991 and Sinha et al., 1997).

Lemna spp. is a general, free, fragile floating aquatic plant. It is fast rising and reproduces more quickly than other vascular plants and adapt easily to different aquatic situations. They can produce at a range of pH (3.5-10.5) with a wide temperature ranging from 7-35 oC with optimal growth between 20-31 oC (Naumman et al., 2007). Up to now, 40 species belonging to four genera (Lemna, Spirodela, Wollia, and Wolffiella) have been recognized, which are universal distribution in wetlands from fresh water to brackish estuaries (Skillicorn et al., 1993). It is minor size, speedy vegetative reproduction and easy handling in laboratory condition. Also, it is high sensitivity to diverse chemicals and tolerance to great nutrient levels and excellent nutrition uptake. It is a source of food for different organisms and shelters for minor aquatic invertebrate (Wang, 1990). Due to its special, is frequently chosen as a potential test organism to represent aquatic vascular plants toxicity studies and in wastewater treatment (Wang, 1986 and Axtell et al., 2003). Recently, lead and cadmium accretions in various parts of different species of free-floating aquatic plants have been reported (Mohan and Hosetti, 1998 and Singh et al., 2011). Some studies detected a higher lead and cadmium accumulations in roots than shoots (John, R., et al. 2008 and Matagi and Mugabe, 1998) as well, though, other authors reported a higher buildup in shoots than in roots (Roosens et al. 2003). Due to alterations in root morphology, plants capabilities of metals accumulation are different. Plants with plenty of tinny roots would accumulate additional metal than one few thick roots (Schierup and Larsen, 1981).

Conclusion :

Phytoremediation is the use of plant to eliminate and accumulate contaminants from environment. It appears that foliage plants and tree is quite motivating and it might be better than other methods to improve the quality of water. This review exposed the capacity of a submerged (Hydrila verticillata) and free- floating aquatic plant (Lemna spp.) to mitigate lead and cadmium from wastewater. Therefore, the uptake of heavy metals by aquatic plants depends on type of species and sort of metals.

Lemna spp. Seem it to be an effective alternative that have been recommended for wastewater treatment as they have a rapid development on a vast range of pH and can survive in different water systems. They yield biomass more rapidly than any other aquatic plants. Additionally, it discovered a better mitigate of lead and cadmium by Lemna spp. than other aquatic plants from contaminated water and might be supportive in more investigations.

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International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(Review Article)

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Role of Relativistic Charged Perfect Fluid in Bianchi type-III Space-time in Brans-Dicke theory of gravitation

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International Journal of Science and Research Archive, 2024, 11(02), 035–044

Publication history: Received on 13 January 2024; revised on 24 February 2024; accepted on 27 February 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.11.2.0355

Abstract

In this paper, we investigate the role of relativistic charged perfect fluid in Bianchi type-III cosmological model in Brans-Dicke theory of gravitation. Solutions of the model are obtained by volumetric exponential expansion, power law expansion and power law relation between scalar field ϕ and the scale factor a. Some physical and kinematical properties of the model also are studied.

Keywords: Bianchi type-III universe; Brans-Dicke theory of gravitation; Electromagnetic field; Perfect fluid; Constant vector potentials

1. Introduction

Brans - Dicke theory of gravitation is a well-known modified version of Einstein's theory. Brans and Dicke [1] formulated a theory of gravitation in which, besides a gravitational part, a dynamical scalar field is introduced to account for variable gravitational constant and to incorporate Mach's Principle in Einstein's theory. In this theory, the scalar field has the dimension of the universe of a gravitational constant and its role is confined to its effect on gravitational field equations. Brans-Dicke scalar-tensor theory of gravitation is quite important in view of the fact that scalar fields play a vital role in inflationary cosmology. There has been a renewed interest in gravitational constants in recent years. "The new inflationary models [2], the potential problem of "graceful exit" [3] and extended chaotic inflation [4] are based on the gravity theory of Brans-Dicke.

The scalar-tensor theories have been the subject of considerable interest in the study of various cosmological models due to their relevance for the inflationary expansion of the universe and to solve many outstanding problems in cosmology. Several aspects of Brans-Dicke theory have been widely examined by many authors. Bardeen et al. [5] explored the inflationary universe models which provide a mechanism for galaxy formation by generating small scale density fluctuation in the universe, Bianchi type-I string cosmological models with and without a source-free magnetic field have been examined by Banerjee et al.[6]. Johari and Desikan [7] have investigated cosmological models with constant deceleration parameter in Nordtvedt's theory. In Brans-Dicke theory of gravity, Bianchi type-III cosmological model with a negative constant deceleration parameter in presence of perfect fluid have been studied by Adhav et al.[8], Katore et al. [9] explored a plane symmetric space-time filled with dark energy models in Brans-Dicke theory. Bhoyar et al.[10] studied Bianchi type-III and Kantowski Sachs cosmological model containing a magnetic field with variable cosmological constant. Lorenz-Petzold [11], Kumar et al.[12], Pawar et al. [13], Rao et al.[14], Naidu et al.[15], Kandalkar et al. [16],Mete et al. [17],Sireesha et al. [18],Hegazy et al.[19],Trivedi et al.[20] are some of the authors who have

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investigated several aspects of Brans-Dicke theory of gravitation. In the presence of the magnetic field, Tikekar and Patel [21] have acquired some exact Bianchi type-III cosmological solutions of massive string. Singh and Shri Ram [22] have presented a technique to generate new exact Bianchi type-III cosmological solutions of massive strings in the presence and absence of the magnetic field. Tripathy et al. [23] and Pradhan [24] studied string cosmological models in the presence of the electromagnetic field. A detailed discussion of Brans-Dicke cosmology is given by Singh et al. [25,26] have investigated some Bianchi type-II cosmological models in Brans-Dicke theory, Shamir et al. [27] explored anisotropic dark energy Bianchi type-III cosmological models in Brans-Dicke theory of gravity, Solanke and Karade [28,29] have investigated Bianchi type-I and III universe field with perfect fluid and scalar field coupled with electromagnetic fields in theory of gravity. Katore et al. [30] have investigated Bianchi type-I dark energy cosmological model with power-law relation in Brans-Dicke theory of gravitation. Recently Jumi Bharali et al. [31] studied bulk viscous magnetized locally rotationally symmetric Bianchi type- I cosmological model in general relativity. In the context of the Brans-Dicke theory of gravitation, Nimkar et al. [32] investigated the Bianchi type-VI Cosmological model andstudiedsome observational parameters such as jerk parameter, redshift, Look-back time, Luminosity distance redshift, and angular diameter distance.

Inspired by the aforementioned study, we examined the Bianchi type-III perfect fluid cosmological model in the Brans-Dicke theory of gravitation with an electromagnetic field. We also discussed some physical and kinematical properties of the model.

2. The metric and field equation

We consider a spatially homogeneous Bianchi Type-III space time in the form

$$ds^2 = -dt^2 + A^2dx^2 + B^2e^{-2mx}dy^2 + C^2dz^2 \,.....(1)$$

where A, B and C are functions of t and m is a constant.

Brans-Dicke field equations for the combined scalar and tensor fields are

$$G_j^i = \frac{-8\pi}{\phi}T_j^i - \frac{\omega}{\phi^2}\left(g^{ii}\phi_{,j} - \frac{1}{2}g_j^i\phi_{,k}\phi^{,k}\right) - \frac{1}{\phi}\left(g^{ii}\phi_{i;j} - g_j^i\phi_{;k}^{;k}\right).....(2)$$

where G_j^i is Einstein's tensor, ϕ is a dimensionless coupling constant and T_j^i is energy momentum tensor for perfect fluid with conservation equation

$$\phi_{;k}^{;k} = \frac{1}{\sqrt{-g}}\left[\sqrt{-g}\,\phi^k\right]_{,k} .....(3)$$

2.1 Energy Momentum Sources

The energy momentum tensor for matter under discussion given by

$$T_j^i = {}^pT_j^i + E_j^i \,.....(4)$$

where ${}^pT_j^i$ is energy momentum tensor for perfect fluid and E_j^i is energy momentum tensor for electromagnetic field is given by

$$E_{ij} = \frac{1}{4}F_{ab}F^{ab}g_{ij} - F_{ai}F_{bj}g^{ab} .....(5)$$

Here the electromagnetic field tensor F_{ij} has the expression

$$F_{ij} = \frac{\partial A_i}{\partial x^j} - \frac{\partial A_j}{\partial x^i}. \qquad \text{..... (6)}$$

where A_i is a four potential vector.

To achieve the compatibility with the metric (1), we assume electromagnetic vector potential as

$$A_i = [\lambda(x)v_1(t), v_2(t), v_3(t), v_4(t)] \text{ ..... (7)}$$

From equations (6) and (7), we deduce

$$F_{14} = \lambda\dot{v}_1,\ F_{24} = \dot{v}_2,\ F_{34} = \dot{v}_3,\ F_{43} = -\dot{v}_3 \text{ ..... (8)}$$

Using equations (6), (7) and (8), we obtained

$$F_{ab}F^{ab} = -2\left[\frac{\lambda^2\dot{v}_1^2}{A^2} + \frac{\dot{v}_2^2}{B^2e^{-2mx}} + \frac{\dot{v}_3^2}{C^2}\right], \qquad \text{..... (9)}$$

The energy momentum tensor for a perfect fluid is given by

$${}^pT_j^i = (\rho + p)u^iu_j - p\delta_i^j \text{ .....(10)}$$

where ρ is the density, p is the pressure of perfect fluid and four velocity u_i is given by

$$g_{ij}u^iu^j = -1.$$

For co-moving coordinate system, we have

$$u_x = 0, u_y = 0, u_z = 0, u_t \neq 0 \text{ ..... (11)}$$

Accordingly equation (10), provides

$${}^pT_1^1 = {}^pT_2^2 = {}^pT_3^3 = -p,\ {}^pT_4^4 = \rho,\ T_i^j = 0 \quad \forall i, j \text{ ..... (12)}$$

Using equations (5), (9) and (12), we obtained

$${}^pT_1^1 + E_1^1 = \frac{1}{2}\frac{\lambda^2\dot{v}_1^2}{A^2} - \frac{1}{2}\frac{\dot{v}_2^2}{B^2e^{-2mx}} - \frac{1}{2}\frac{\dot{v}_3^2}{C^2} - p \text{ ..... (13)}$$

$${}^pT_2^1 + E_2^1 = {}^pT_1^2 + E_1^2 = \frac{\lambda\dot{v}_1\dot{v}_2}{A^2} \text{ ..... (14)}$$

$${}^pT_3^1 + E_3^1 = {}^pT_1^3 + E_1^3 = \frac{\lambda\dot{v}_1\dot{v}_3}{A^2} \text{ ..... (15)}$$

$${}^pT_2^2 + E_2^2 = -\frac{1}{2}\frac{\lambda^2\dot{v}_1^2}{A^2} + \frac{1}{2}\frac{\dot{v}_2^2}{B^2e^{-2mx}} - \frac{1}{2}\frac{\dot{v}_3^2}{C^2} - p \text{ ..... (16)}$$

$$^{p}T_3^2 + E_3^2 = {}^{p}T_2^3 + E_2^3 = \frac{\dot{v}_2\dot{v}_3}{B^2e^{-2ms}}, \ldots\ldots\ldots\ldots (17)$$

$$^{p}T_3^3 + E_3^3 = -\frac{1}{2}\frac{\lambda^2\dot{v}_1^2}{A^2} - \frac{1}{2}\frac{\dot{v}_2^2}{B^2e^{-2ms}} + \frac{1}{2}\frac{\dot{v}_3^2}{C^2} - p \ldots\ldots\ldots\ldots (18)$$

$$^{p}T_4^4 + E_4^4 = \frac{1}{2}\frac{\lambda^2\dot{v}_1^2}{A^2} + \frac{1}{2}\frac{\dot{v}_2^2}{B^2e^{-2ms}} + \frac{1}{2}\frac{\dot{v}_3^2}{C^2} + \rho \ldots\ldots\ldots\ldots (19)$$

2.1. Conservation Law:

The Conservation equation is given by

$$\frac{\partial}{\partial x^j}\left(\sqrt{-g}F^{ij}\right) = 0 \ldots\ldots\ldots\ldots (20)$$

Equation (20) with different combination of i and j gives following equations

$$\left[\frac{\dot{v}_1}{v_1}\right]^{\bullet} + \frac{\dot{v}_1^{\,2}}{v_1^{\,2}} + \frac{\dot{v}_1}{v_1}\left[\frac{\dot{B}}{B} + \frac{\dot{C}}{C} - \frac{\dot{A}}{A}\right] = 0 \ldots\ldots\ldots\ldots (21)$$

$$\left[\frac{\dot{v}_2}{v_2}\right]^{\bullet} + \frac{\dot{v}_2^2}{v_2^2} + \frac{\dot{v}_2}{v_2}\left[\frac{\dot{A}}{A} + \frac{\dot{C}}{C} - \frac{\dot{B}}{B}\right] = 0 \ldots\ldots\ldots\ldots (22)$$

$$\left[\frac{\dot{v}_3}{v_3}\right]^{\bullet} + \frac{\dot{v}_3^2}{v_3^2} + \frac{\dot{v}_3}{v_3}\left[\frac{\dot{A}}{A} + \frac{\dot{B}}{B} - \frac{\dot{C}}{C}\right] = 0 \ldots\ldots\ldots\ldots (23)$$

$$\phi_{,k}^{k} = -\ddot{\phi} - \ddot{\phi}\left[\frac{\dot{A}}{A} + \frac{\dot{B}}{B} - \frac{\dot{C}}{C}\right] \ldots\ldots\ldots\ldots (24)$$

From the vanishing components of Einstein's tensor and using (5) and (7), we deduce

$$\frac{\dot{v}_1\dot{v}_2}{v_1v_2} = \frac{\dot{v}_1\dot{v}_3}{v_1v_3} = \frac{\dot{v}_2\dot{v}_3}{v_2v_3} = 0 \ldots\ldots\ldots\ldots (25)$$

$$\frac{\dot{v}_1}{v_1} = \frac{\dot{v}_2}{v_2} = \frac{\dot{v}_3}{v_3} = \frac{\dot{D}}{D} \ldots\ldots\ldots\ldots (26)$$

where D is an unknown function of t

Integrating equation (26) with respect to t, we get

$$v_1 = k_1D,\ v_2 = k_2D,\ v_3 = k_3D, \qquad \ldots\ldots\ldots\ldots (27)$$

where k_1, k_2 and k_3 are constants.

Using equations (25) and (27), we get

$$\left(\frac{\dot{D}}{D}\right)^2 = 0 \text{ . ..... (28)}$$

With an aid of equation (27), we can write the equations (21) to (23) as

$$\left(\frac{\dot{D}}{D}\right)^{\bullet} + \left(\frac{\dot{D}}{D}\right)^2 + \frac{\dot{D}}{D}\left(\frac{\dot{B}}{B} + \frac{\dot{C}}{C} - \frac{\dot{A}}{A}\right) = 0, \text{ ..... (29)}$$

$$\left(\frac{\dot{D}}{D}\right)^{\bullet} + \left(\frac{\dot{D}}{D}\right)^2 + \frac{\dot{D}}{D}\left(\frac{\dot{A}}{A} + \frac{\dot{C}}{C} - \frac{\dot{B}}{B}\right) = 0, \text{ ..... (30)}$$

$$\left(\frac{\dot{D}}{D}\right)^{\bullet} + \left(\frac{\dot{D}}{D}\right)^2 + \frac{\dot{D}}{D}\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B} - \frac{\dot{C}}{C}\right) = 0. \text{ .....(31)}$$

We attempt to express the component of T_j^i in terms of T_4^4 already used [28,29] .

For this, we consider the expression as

$$\frac{\lambda^2 \dot{v}_1^{\,2}}{A^2} + \frac{\dot{v}_2^{\,2}}{B^2 e^{-2mx}} + \frac{\dot{v}_3^2}{C^2} = \left[\frac{\lambda^2 v_1^{\,2}}{A^2}\left(\frac{\dot{D}}{D}\right)^2 + \frac{v_2^{\,2}}{B^2 e^{-2mx}}\left(\frac{\dot{D}}{D}\right)^2 + \frac{v_3^{\,2}}{C^2}\left(\frac{\dot{D}}{D}\right)^2\right] = 0 \quad \text{..... (32)}$$

$$\frac{\lambda^2 \dot{v}_1^{\,2}}{A^2} + \frac{\dot{v}_2^2}{B^2 e^{-2mx}} + \frac{\dot{v}_3^2}{C^2} = \left[\frac{\lambda^2 v_1^{\,2}}{A^2} + \frac{v_2^{\,2}}{B^2 e^{-2mx}} + \frac{v_3^{\,2}}{C^2}\right]\left(\frac{\dot{D}}{D}\right)^2 = 0$$

$$T_4^{\,4} = \frac{1}{2}\frac{\lambda^2 \dot{v}_1^{\,2}}{A^2} + \frac{1}{2}\frac{\dot{v}_2^{\,2}}{B^2 e^{-2mx}} + \frac{1}{2}\frac{\dot{v}_3^2}{C^2} + \rho = \rho. \quad \text{..... (33)}$$

$$T_1^1 = -p = T_2^2 = T_3^3. \quad \text{..... (34)}$$

3. Solution of field equations

Considering the non-vanishing component of Einstein's tensor from equation (3), we derive

$$\frac{\ddot{B}}{B} + \frac{\ddot{C}}{C} + \frac{\dot{B}\dot{C}}{BC} = \frac{8\pi p}{\phi} - \frac{1}{2}\omega\left(\frac{\dot{\phi}}{\phi}\right)^2 - \frac{\ddot{\phi}}{\phi} - \frac{\dot{\phi}}{\phi}\left(\frac{\dot{B}}{B} + \frac{\dot{C}}{C}\right), \quad \text{..... (35)}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{C}}{C} + \frac{\dot{A}\dot{C}}{AC} = \frac{8\pi p}{\phi} - \frac{1}{2}\omega\left(\frac{\dot{\phi}}{\phi}\right) - \frac{\ddot{\phi}}{\phi} - \frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A} + \frac{\dot{C}}{C}\right), \quad \text{..... (36)}$$

$$-\frac{m^2}{A^2} + \frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} = -\frac{8\pi p}{\phi} - \frac{1}{2}\omega\left(\frac{\dot{\phi}}{\phi}\right)^2 - \frac{\ddot{\phi}}{\phi} - \frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right), \quad \text{..... (37)}$$

$$-\frac{m^2}{A^2}+\frac{\dot{A}\dot{B}}{AB}+\frac{\dot{B}\dot{C}}{BC}+\frac{\dot{A}\dot{C}}{AC}=\frac{8\pi\rho}{\phi}+\frac{1}{2}\omega\left(\frac{\dot{\phi}}{\phi}\right)^2-\frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}+\frac{\dot{C}}{C}\right), \quad \text{.....(38)}$$

$$\frac{\dot{A}}{A}-\frac{\dot{B}}{B}=0. \quad \text{.....(39)}$$

Integrating (39) with respect to t, we get

$$A=k_4B, \quad \text{.....(40)}$$

where k_4 is a constant of integration. Without loss of generality let us assume k_4 as unity so that equation (40) written as

$$A=B. \quad \text{.....(41)}$$

Using equations (41) and (35) to (38), we yield

$$\frac{\ddot{B}}{B}+\frac{\ddot{C}}{C}+\frac{\dot{B}\dot{C}}{BC}=\frac{8\pi p}{\phi}-\frac{1}{2}\omega\left(\frac{\dot{\phi}}{\phi}\right)^2-\frac{\ddot{\phi}}{\phi}-\frac{\dot{\phi}}{\phi}\left(\frac{\dot{B}}{B}+\frac{\dot{C}}{C}\right), \quad \text{.....(42)}$$

$$-\frac{m^2}{B^2}+\frac{2\ddot{B}}{B}+\frac{\dot{B}^2}{B^2}=\frac{8\pi\rho}{\phi}-\frac{1}{2}\omega\left(\frac{\dot{\phi}}{\phi}\right)^2-\frac{\ddot{\phi}}{\phi}-\frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}\right), \quad \text{.....(43)}$$

$$-\frac{m^2}{B^2}+\frac{2\dot{A}^2}{A^2}+\frac{\dot{B}\dot{C}}{BC}+\frac{\dot{A}\dot{C}}{AC}=\frac{8\pi\rho}{\phi}+\frac{1}{2}\omega\left(\frac{\dot{\phi}}{\phi}\right)^2-\frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}+\frac{\dot{C}}{C}\right). \quad \text{.....(44)}$$

Since the field equations are highly nonlinear with three equations and five unknown. Therefore two extra conditions can be considered to solve the field equations.

Let us choose power law form of metric potential [30] given by

$$B=\alpha t^n, \text{ and } C=\beta t^n \quad \text{.....(45)}$$

The power law relation between scalar field ϕ and the scale factor a has already been used by Johri and Desikan [7] in the context of Robertson Walker Brans-Dicke models. Thus the power law relation between ϕ and the scale factor a is $\phi=\eta a^m$, where a is constant of proportionality. The average scale factor is given by

$$a=(ABC)^{\frac{1}{3}}=k_5t^n, \quad \text{.....(46)}$$

where $k_5=\alpha^{\frac{2}{3}}\beta^{\frac{1}{3}}$ is a constant.

Hence scalar field ϕ is obtained as

$$\phi=k_5t^{mn}=k_5t^s,$$

where $s = mn$ is a constant.

Using equations (24) and (25), we have

$$\frac{\dot{D}}{D} = k_6, \qquad \text{..... (47)}$$

where k_6 is a constant of integration.

Which on integration, yield

$$D = e^{k_6 t}. \qquad \text{..... (48)}$$

Using equations (46) and (27), we have

$$v_1 = k_1 e^{k_6 t}, \qquad \text{..... (49)}$$

$$v_2 = k_2 e^{k_6 t}, \qquad \text{..... (50)}$$

$$v_3 = k_3 e^{k_6 t}, \qquad \text{..... (51)}$$

v_4 remained undetermined.

The metric in (1), with the help of (45), can be redefined in the form

$$ds^2 = \alpha^2 t^{2n}(dx^2 + e^{-2mx})dy^2 + \beta^2 t^{2n} dz^2 - dt^2. \qquad \text{..... (52)}$$

3.1. Physical and Kinematical Properties of the Model:

The physical and kinematical properties of the model (52) are obtained as follows.

For the investigated model, the pressure p and the density ρ are given by

$$p = \frac{k_5 t^s}{8\pi}\left[\frac{2n(n-1)+n^2}{t^2} + \omega\frac{s^2}{2t^2} + \frac{s^2(s-1)}{t^2} + \frac{2sn}{t^2}\right], \qquad \text{..... (53)}$$

$$\rho = \frac{k_5 t^s}{8\pi}\left[\frac{4n^2}{t^2} - \frac{m^2}{\alpha t^n} - \omega\frac{s^2}{2t^2} + \frac{3sn}{t^2}\right], \qquad \text{..... (54)}$$

where k_5 is a constant of integration.

The physical quantities of observational interest in cosmology are,

The spatial volume is obtained as

$$V = \sqrt{-g} = \left(\alpha^2 \beta t^{3n}\right)e^{-mx}. \qquad \text{..... (55)}$$

The expansion scalar becomes

$$\theta = 3H = \left(2\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right) = \frac{3n}{t}, \qquad \text{.....(56)}$$

The shear scalar is given by

$$\sigma^2 = \frac{1}{2}\sum_{i=1}^{3} H_i^2 - \frac{\theta^2}{6} = 0 \qquad \text{.....(57)}$$

The mean anisotropic parameter A_m as

$$\Delta = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 = 0 \qquad \text{.....(58)}$$

The mean Hubble parameter

$$H = \frac{n}{t}. \qquad \text{.....(59)}$$

The deceleration parameter is given by

$$q = \frac{d}{dt}(H) - 1 = \frac{1-n}{n} \qquad \text{.....(60)}$$

The cosmic Jerk parameter is given as,

$$J = q + 2q^2 - \frac{\dot{q}}{H}$$

$$= \frac{(n-1)(n-2)}{n^2} \qquad \text{.....(61)}$$

4. Conclusion

In this paper, we have presented Bianchi Type-III charged fluid universe in Brans-Dicke theory of gravitation in presence of perfect fluid with electromagnetic field. The spatial volume V of the model increases with time showing the spatial expansion of the universe. It is observed that Hubble's parameter H vanishes with extremely large value and continues to decrease with time. The scalar expansion and the physical parameters energy density and pressure diverge at $t = 0$ and they all vanish as t approaches to infinity. The scalar field increases with time and at $t = 0$, it vanishes. The recent observations of type Ia supernovae reveal that the present universe is accelerating and the value of deceleration parameter lies somewhere in the range $-1 < q < 0$. It follows that one can choose the value of n in the range $0 < n < 1$ to ensure that the derived model is consistent with observations. It is also seen that the value of the cosmic jerk parameter is positive throughout the entire history of this model. This shows that our model strongly agrees with present day observations.

Compliance with ethical standards

Disclosure of conflict of interest

The authors certify that they have no Conflict of Interest in the subject matter or materials discussed in this manuscript.

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Journal of Rajasthan Academy of Physical Sciences
ISSN: 0972-6306; URL: http://raops.org.in
Vol.22, No.3&4, July-December, 2023, 237-256

LRS BIANCHI TYPE-I TWO FLUID COSMOLOGICAL MODEL IN $f(T)$ THEORY OF GRAVITATION

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Abstract: In this paper, we have studied Locally Rotationally Symmetric (LRS) Bianchi type-I space-time with two fluid in $f(T)$ theory of gravitation. The field equations are solved by using the physical assumption that expansion scalar θ is proportional to shear scalar σ and also using the deceleration parameter. It is observed that Hubble parameter H and expansion scalar θ have a singularity at initial epoch and at $t=-b/a$. Hubble parameter, scalar of expansion and shear scalar are vanishing for large values of cosmic time. We discussed different types of universe with the help of Equation of State (EoS) Parameter. We observe that the energy density for matter and radiation approaches zero for a large value of cosmic time. We conclude that the energy density for matter and radiation diverges initially and at $t=-b/a$ in all type of universes. The physical significances of jerk parameter, statefinder pair and luminosity distance are also discussed in the light of the recent scenario of accelerated expansion of the universe and cosmological observations.

Keywords: Bianchi type-I, $f(T)$ theory, Torsion, Two fluid.

1. Introduction

It has been found that there is a contradiction between recent cosmological observations and Friedmann–Robertson–Walker (FRW) cosmology. Recent observations from high redshift supernovae type-Ia [5,17,18,20] state that the universe is under accelerated expansion, but the FRW model shows that it is not. There are two approaches to explain this acceleration. The first one suggests that dark energy (DE) is the cause of this acceleration. Another approach involves modifying the gravitational action. Most of the work in the modified theories of gravitation relies on conventional formulation based on curvature. However, the reason to start from the Teleparallel Equivalent of General Relativity is to build a gravitational modification. The simplest such modification is the $f(T)$ theory of gravity, where T is the torsion scalar.

The $f(T)$ theory of gravity was developed by Ferraro and Fiorini [11] which is extension of the Teleparallel theory of gravity. Bengochea and Ferraro [4] investigated that the acceleration of the universe can be explained by modifying Teleparallel equivalent of GR. The $f(T)$ theory of gravity uses the weitzenbök connections which have no curvature but only torsion. In this case, the accelerated expansion of the universe is caused by torsion. Wu and Yu [27] have stated an important advantage of this theory is that its field equations are second order and hence easy to solve as compared to the fourth order equations of $f(R)$ theory.

The $f(T)$ theory of gravity has recently attracted a lot of attention. Shaikh *et al.* [23] studied the $f(T)$ gravity model in the presence of dark matter and modified holographic Ricci dark energy in LRS Bianchi type-I space-time. Dawande *et al.* [10] analysed the LRS Bianchi type-I universe in $f(T)$ theory of gravity using a conservation equation. Myrzakulov [14] has investigated different $f(T)$ models including scalar fields and given analytical solutions for the scale factors and scalar fields. Cai *et al.* [7] have studied cosmological solutions arising from $f(T)$ gravity. Sharif and Rani [24] have developed $f(T)$ models with perfect fluid in Bianchi type-I universe. Nashed [15] derives the exact Bianchi type-I solution, in the framework of $f(T)$ gravity. Bhoyar *et al.* [6] have studied LRS Bianchi type-I space-time with the linear equation of state filled with a perfect fluid in $f(T)$ gravity. Some exact solutions of Bianchi type-I space-time in $f(T)$ theory of gravity have been obtained by Raut and Mete [19].

The anomalies found in the cosmic microwave background (CMB) and large scale structure observations stimulated a growing interest in anisotropic cosmological models of the universe. A Bianchi type-I universe, being the straightforward generalization of the flat Friedmann-Robertson-Walker (FRW) universe, is of particular interest because it is the most simplest spatially homogeneous and anisotropic universe. Unlike the FRW universe which has the same scale factor for each of the three spatial directions, Bianchi type-I universe has a different scale factor in each direction, thereby introducing anisotropy to the system. Due to its importance, several authors have studied Bianchi type-I universe from different aspects.

Bianchi Type-I universe has been studied by several researchers to discuss the effect of anisotropy in several contexts. Kumar and Singh [12] have studied the exact solutions for the Bianchi Type-I universe in various theories. Adhav *et al.* [1] have investigated the anisotropic and homogeneous Bianchi Type-I and V model with interacting Dark Matter and Holographic Dark Energy. Sharif and Waheed [25] investigated exact solutions for anisotropic fluid by considering the LRS Bianchi type-I universe. Sahoo and Sivakumar [21] studied Bianchi type-I cosmological models in $f(R,T)$ gravity.

Two fluid cosmological models have been discussed through various aspects by numerous researchers. Adhav [2] investigated two fluid cosmological model in Bianchi type-III space-time. Mete *et al.* [13] have studied anisotropic, homogeneous two fluid

cosmological model using a plane symmetric metric. Two fluid FRW cosmological models have been investigated by Dagwal and Pawar [9] in the $f(T)$ theory of gravity. Coley and Dunn [8] have studied Bianchi type-VI_0 cosmological model with two fluid. Two fluid Bianchi type-II cosmological models have been investigated by Pant and Oli [16]. Samanta [22] investigated two fluid anisotropic Bianchi type-III cosmological model with variable gravitational constant G and cosmological constant $\wedge$ in the framework of general relativity.

With the motivation from above mentioned work, we have investigated LRS Bianchi type-I cosmological model with two fluid in $f(T)$ theory of gravity. The main aim of the present study is to apply the field equations of the $f(T)$ gravitational theory to a tetrad field having homogeneity and anisotropy and try to solve some problems that cannot be solved within the framework of GR. This paper is organized as follows: In Section 2, a brief review of the $f(T)$ gravitational theory is presented. In Section 3, field equations are derived for the given cosmological model. The resulting differential equations are solved in Section 4. In Section 5, we have studied different types of universe using EoS parameter and discuss some cosmological consequences. The final section is devoted to conclusions.

2. Preliminaries of $f(T)$ Gravity

The action of the $f(T)$ theory is defined by generalizing the action of Teleparallel theory of gravity given by

$$S = \int [f(T) + L_{matter}]\, e\, d^4x \ . \tag{1}$$

Here, $f(T)$ denotes the differentiable function of the torsion scalar T and L_{matter} is the matter Lagrangian, where $e = \sqrt{-g}$.

The torsion scalar is defined as

$$T = S_{\alpha}^{\ \mu\nu} T^{\alpha}_{\ \mu\nu} \ . \tag{2}$$

Here, components of the torsion tensor are defined as

$$T^{\alpha}_{\ \mu\nu} = \Gamma^{\alpha}_{\nu\mu} - \Gamma^{\alpha}_{\mu\nu} = h^{\alpha}_{i}(\partial_{\mu} h^{i}_{\nu} - \partial_{\nu} h^{i}_{\mu}) , \tag{3}$$

where h^{i}_{μ} are the components of the nontrivial tetrad field h_i in the coordinate basis and tetrad field is related to the metric tensor $g_{\mu\nu}$ by the following relation

$$g_{\mu\nu} = \eta_{ij} h^{i}_{\mu} h^{i}_{\nu} \text{, where } \eta_{ij} = diag(1, -1, -1, -1) \text{ is the Minkowski metric.} \tag{4}$$

The components of the contorsion tensor are defined as

$$K^{\mu\nu}{}_{\alpha} = -\frac{1}{2}(T^{\mu\nu}{}_{\alpha} - T^{\nu\mu}{}_{\alpha} - T_{\alpha}{}^{\mu\nu}) \ . \tag{5}$$

The skew symmetric tensor constructed from the components of the torsion and contorsion tensors is defined as

$$S_{\alpha}{}^{\mu\nu} = \frac{1}{2}(K^{\mu\nu}{}_{\alpha} + \delta^{\mu}_{\alpha}T^{\beta\nu}{}_{\beta} - \delta^{\nu}_{\alpha}T^{\beta\mu}{}_{\beta}) \ . \tag{6}$$

The field equations of the $f(T)$ theory of gravity is obtained by varying the action with respect to the tetrads in the following form

$$\left[e^{-1}\partial_{\mu}\left(eS_i^{\mu\nu}\right) - h_i^{\lambda}T^{\alpha}{}_{\mu\lambda}S_{\alpha}^{\nu\mu}\right]f_T + S_i^{\mu\nu}\partial_{\mu}Tf_{TT} + \frac{1}{4}h_i{}^{\nu}f = \frac{1}{2}h_i{}^{\alpha}T_{\alpha}^{\nu} \ , \tag{7}$$

where T_{α}^{ν} is the energy momentum tensor, $f_T = \dfrac{df}{dT}$ and $f_{TT} = \dfrac{d^2f}{dT^2}$.

3. Field Equations

The simplest anisotropic models usually used for describing the anisotropic effects is Bianchi type-I spatially homogeneous model. The advantages in using anisotropic models are that they have significant role in the description of the early stage of the universe and also are extremely useful in obtaining more general cosmological models that the isotropic FRW models. We focus our attention in this work to the Locally Rotationally Symmetric (LRS) Bianchi type-I model which is a special case of Bianchi type-I.

We consider LRS Bianchi type-I space-time in the form

$$ds^2 = dt^2 - A^2(t)dx^2 - B^2(t)\left[dy^2 + dz^2\right] . \tag{8}$$

Using (4) and (8), we obtain the tetrad components as follows

$$h^{i}_{\mu} = diag\,(1, A, B, B) \text{ and } h_i{}^{\mu} = diag(1, A^{-1}, B^{-1}, B^{-1}) \ . \tag{9}$$

The energy momentum tensor for the two fluid sources given by

$$T_{ij} = T_{ij}^{(m)} + T_{ij}^{(r)} \ , \tag{10}$$

where $T_{ij}^{(m)}$ is the energy–momentum tensor for matter field with the energy density ρ_m and pressure p_r, $T_{ij}^{(r)}$ is the energy–momentum tensor for radiation field having energy density ρ_r and pressure $p_r = (1/3)\ \rho_r$. The $T_{ij}^{(m)}$ and $T_{ij}^{(r)}$ are respectively given by [22]

$$T_{ij}^{(m)} = (p_m + \rho_m)u_i^{(m)}u_j^{(m)} - p_m g_{ij} \ , \tag{11}$$

$$T_{ij}^{(r)} = \frac{4}{3}\rho_r u_i^{(r)} u_j^{(r)} - \frac{1}{3}\rho_r g_{ij} \ . \tag{12}$$

The four-velocity vectors are given by

$$u_i^{(m)} = (0\ , 0, 0, 1) \text{ and } u_i^{r} = (0, 0, 0, 1) \text{ with } g^{ij} u_i^{(m)} u_j^{(m)} = 1 \text{ and } g^{ij} u_i^{(r)} u_j^{(r)} = 1. \tag{13}$$

The components of the torsion tensor (3) are

$$T_{41}^{1} = \frac{\dot{A}}{A},\ T_{42}^{2} = \frac{\dot{B}}{B},\ T_{43}^{3} = \frac{\dot{B}}{B} \ . \tag{14}$$

The components of the corresponding contorsion tensor (5) are

$$K^{41}{}_{1} = \frac{\dot{A}}{A}, T^{42}{}_{2} = \frac{\dot{B}}{B}, T^{43}{}_{3} = \frac{\dot{B}}{B} \ . \tag{15}$$

The components of the tensor $S_{\alpha}{}^{\mu\nu}$ in (6) are

$$S_{1}{}^{14} = \frac{\dot{B}}{B},\ S_{2}{}^{24} = \frac{1}{2}\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right),\ S_{3}{}^{34} = \frac{1}{2}\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right). \tag{16}$$

Using (14) and (16), we get torsion scalar (2) as

$$T = -2\left(2\frac{\dot{A}}{A}\frac{\dot{B}}{B} + \frac{\dot{B}^2}{B^2}\right). \tag{17}$$

The field equations (7) for the metric (8) for $i = \nu = 1$ and $i = \nu = 4$ becomes

$$f - 4f_T\left[\frac{\dot{B}^2}{B^2} + 2\frac{\dot{A}}{A}\frac{\dot{B}}{B}\right] = 2(\rho_m + \rho_r) \ , \tag{18}$$

$$4f_T\left[\frac{\dot{A}}{A}\frac{\dot{B}}{B} + \frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2}\right] - 16\frac{\dot{B}}{B}\left[\frac{\dot{B}}{B}\left(\frac{\ddot{A}}{A} - \frac{\dot{A}^2}{A^2}\right) + \left(\frac{\ddot{B}}{B} - \frac{\dot{B}^2}{B^2}\right)\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right)\right] f_{TT} - f = 2\left(p_m + \frac{\rho_r}{3}\right). \tag{19}$$

Here overhead dot denotes derivative with respect to cosmic time t.

The physical quantities which are important in cosmological investigation are listed below:

The average scale factor for metric (8) which indicate the rate of expansion is given by

$$a(t) = R = \left(AB^2\right)^{\frac{1}{3}} \ . \tag{20}$$

The spatial volume of the metric is $V = a^3(t) = R^3 = AB^2$. (21)

The directional Hubble parameters, which determine the universe expansion rates in the directions x, y and z axes are $H_1 = \frac{\dot{A}}{A}, H_2 = H_3 = \frac{\dot{B}}{B}$. (22)

The mean Hubble parameter, which expresses the volumetric expansion rate of the universe, is given as $H = \frac{1}{3}\left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right)$. (23)

The expression for the expansion scalar θ, which deals with the expansion of the universe, is given in form as, $\theta = \left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right)$. (24)

Shear scalar $\sigma^2 = \frac{1}{3}\left(\frac{\dot{A}}{A} - \frac{\dot{B}}{B}\right)^2$. (25)

The expansion rate is evaluated by anisotropy parameter given by $A_m = \frac{2}{9H^2}\left(\frac{\dot{A}}{A} - \frac{\dot{B}}{B}\right)^2$. (26)

The dimensionless quantity containing the third-order derivative of the average scale factor concerning the cosmic time which is used to describe models close to ΛCDM is termed as cosmic jerk parameter. It is defined as $j = \frac{1}{H^3}\left(\frac{\dddot{a}}{a}\right)$. (27)

Red shift $z = \frac{1}{a(t)} - 1$ (28)

The luminosity distance is described by the simple expression $d_L = r_1 a_0 (1+z)$. (29)

In order to determine r_1, we assume that a photon emitted by source with coordinate $r = r_0$ to $t = t_0$ and receive at a time t by an observer located at $r = 0$, then r_1 can be obtained from the relation $r_1 = \int_t^{t_0} \frac{1}{a(t)} dt$.

The distance modulas $D(Z) = 5Log\ d_L + 25$ (30)

The statefinder parameters are defined as $r = \frac{\dddot{a}}{aH^3}$, $s = \frac{r-1}{3\left(q-\frac{1}{2}\right)}$ (31)

4. Cosmological Solution

To solve the field equations (18), & (19), we need some additional constraints. One of the commonly used additional constraints is that the expansion scalar θ is proportional to shear scalar σ [22, 3, 26], which leads to:

$$A = B^m. \tag{32}$$

We consider constant deceleration parameter defined as

$$q = -\left(\frac{\dot{R}R}{\dot{R}^2}\right). \tag{33}$$

Solving (33) we get

$$R = (at+b)^{\frac{1}{1+q}}. \tag{34}$$

Using (20), (32) and (34), we get

$$B = (at+b)^{\frac{3}{(1+q)(m+2)}}. \tag{35}$$

Now, (32) gives

$$A = (at+b)^{\frac{3m}{(1+q)(m+2)}}. \tag{36}$$

Thus metric given in (8) reduces to

$$ds^2 = dt^2 - (at+b)^{\frac{6m}{(1+q)(m+2)}}dx^2 - (at+b)^{\frac{6}{(1+q)(m+2)}}\left[dy^2+dz^2\right]. \tag{37}$$

From (17), we get

$$T = -2\left[\frac{9a^2(1+2m)}{(1+q)^2(m+2)^2}(at+b)^{-2}\right]. \tag{38}$$

The torsion scalar is presented in Fig. 3, it tends to a constant value in large-cosmic time limit.

From (35) and (36), we get directional Hubble parameter as

$$H_1 = \frac{3ma}{(1+q)(m+2)}(at+b)^{-1}. \tag{39}$$

$$H_2 = H_3 = \frac{3a}{(1+q)(m+2)}(at+b)^{-1}, \tag{40}$$

Now, we take equation of state (EoS) which gives

$$p_m = (\gamma - 1)\rho_m, \quad 1 \le \gamma \le 2. \tag{41}$$

Conservation laws separated for radiation and matter field are

$$\dot{\rho}_m + [H_1 + 2H_2](\rho_m + p_m) = 0 , \tag{42}$$

$$\dot{\rho}_r + [H_1 + 2H_2]\left(\frac{4}{3}\rho_r\right) = 0. \tag{43}$$

Using (41) in (42) and using the values of H_1 and H_2, we get

$$\rho_m = c(at+b)^{-\frac{3}{1+q}\gamma}. \tag{44}$$

From (41) and (44), we have

$$p_m = c(\gamma - 1)(at+b)^{-\frac{3}{1+q}} . \tag{45}$$

Solving (43), we get

$$\rho_r = c_1(at+b)^{-\frac{4}{1+q}} . \tag{46}$$

Since $p_r = \frac{1}{3}\rho_r$, we get $p_r = \frac{1}{3}\rho_r = \frac{1}{3}c_1(at+b)^{-\frac{4}{1+q}}$. (47)

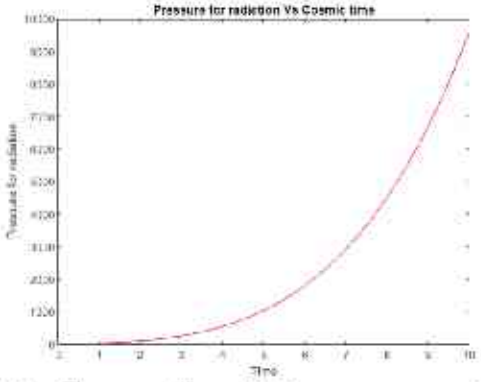

***Figure (1)**: Pressure for radiation versus cosmic time for* $c_1 = 1,\ a = 1,\ b = 1, q = -0.033.$

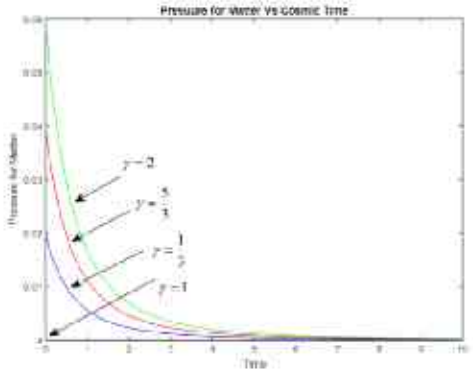

Figure (2): *Pressure for matter verses cosmic time for* $a=1, b=2, q=-0.033, c=0.5,\ \gamma=2, 5/3, 4/3, 1$

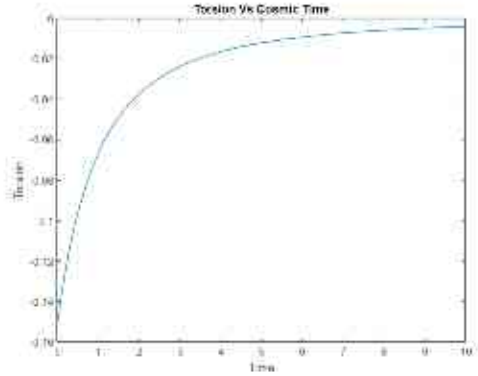

Figure (3): *Torsion scalar versus cosmic time for* $a=1, b=2, m=2, q=-0.033.$

Pressure for radiation field (47) is plotted in figure (1). It increases monotonically with respect to cosmic time. It approaches zero as t tends to ∞ and the diverges at $t=-b/a$. Pressure for matter (45) is presented in figure (2). It decreases monotonically with respect to cosmic time. It tends to zero for large value of cosmic time and diverges for small value of cosmic time. Variation of torsion scalar (38) versus cosmic time is plotted in figure (3). It tends to zero for large value of cosmic time and diverges for small value of cosmic time.

Using (17), (18), (36), (44) and (46), we get

$$f(T)=\frac{1}{T^{1/2}}\int\left[\frac{c}{(at+b)^{\frac{3}{1+q}\gamma}}+\frac{c_1}{(at+b)^{\frac{4}{1+q}}}\right]T^{-1/2}\,dT\ . \tag{48}$$

Using (20), we obtained average scale factor as $a(t) = (at+b)^{\frac{1}{(1+q)}}$. (49)

Using (21), we get the spatial volume of the metric as $V = (at+b)^{\frac{3}{(1+q)}}$. (50)

From (49) and (50), it is observe that scale factor and spatial volume approaches zero as t tends to zero and these parameters tends to infinity as t tends to infinity. Thus universe is expanding with time.

From (23) to (31), we get following:

- The mean Hubble parameter $H = \frac{1}{3}\left\{\frac{a}{1+q}(at+b)^{-1}\right\}$. (51)

Hubble parameter is a decreasing function of time and is always positive from the beginning of the cosmic evolution to the end.

- The scalar expansion $\theta = \left\{\frac{a}{1+q}(at+b)^{-1}\right\}$. (52)

It is observes that rate of expansion in the model is function of t. The expansion scalar decreases as t increases and the expansion in the model stops at $t = \infty$.

- Shear scalar $\sigma^2 = 3\left(\frac{m-1}{1+q}\right)^2 a^2(at+b)^{-2}$. (53)

It is observes that the parameter σ diverge at the beginning $t = 0$ and at $t = -b/a$. It is also observe that σ decreases as time increases.

- Anisotropy parameter $A_m = 2(m-1)^2$. (54)

The anisotropy parameter is constant and it depends on m. Since $\frac{\sigma^2}{\theta^2}$ = constant, the model does not approaches isotropy throughout the whole evolution of the universe.

- Jerk parameter $j = 27q(2q+1)$. (55)

In this model for $q < -1$ we have $j > 0$, which indicate that universe shifts from the early deceleration phase to the current acceleration phase.

- Luminosity distance $d_L = \frac{(1+q)}{aq}\frac{b^{\frac{1}{1+q}}}{(at+b)^{\frac{1}{1+q}}}\left[(at_0+b)^{\frac{q}{1+q}} - (at+b)^{\frac{q}{1+q}}\right]$, which gives

$$d_L = \frac{(1+q)}{aq} b^{\frac{1}{1+q}} (1+z) \left[(at_0 + b)^{\frac{q}{1+q}} - (at+b)^{\frac{q}{1+q}} \right]. \tag{56}$$

where, Red shift $z = \frac{1}{(at+b)^{\frac{1}{(1+q)}}} - 1$. (57)

It is observed that luminosity distance d_L increases with redshift.

- Distance modulas

$$D(z) = 5Log \left\{ \frac{(1+q)}{aq} \frac{b^{\frac{1}{1+q}}}{(at+b)^{\frac{1}{1+q}}} \left[(at_0 + b)^{\frac{q}{1+q}} - (at+b)^{\frac{q}{1+q}} \right] \right\} + 25 ,$$

$$D(z) = 5Log \left\{ \frac{(1+q)}{aq} b^{\frac{1}{1+q}} z \left[(at_0 + b)^{\frac{q}{1+q}} - (at+b)^{\frac{q}{1+q}} \right] \right\} + 25 \tag{58}$$

It is observed that distance modulas is also increasing function of redshift.

- Statefinder parameters $r = 27q(2q+1)$, $s = \frac{54q^2 + 27q - 1}{3(q - 1/2)}$. (59)

We observed that the statefinder parameters has values $\{r < 1, s > 0\}$ for $q < -1$. As a result, our model behaves like a quintessence model for $q < -1$.

- EoS parameter for matter field is given by $\omega_m = p_m / \rho_m = (\gamma - 1)$. (60)

The value of EoS parameter in different universe are: i) Dust universe $\omega_d = 0$, ii) Radiation universe $\omega_r = 1/3$, 3) Hard universe $\omega_h = 2/3$, 4) Zeldovich universe $\omega_z = 1$. (61)

5. Type of Universe

5.1 Dust universe: $\gamma = 1$

The energy density for matter and radiation is given by

$$\rho_m = \frac{c}{(at+b)^{\frac{3}{1+q}}} , \tag{62}$$

$$\rho_r = \frac{c_1}{(at+b)^{\frac{4}{1+q}}}. \tag{63}$$

The pressure for matter $p_m = 0.$ (64)

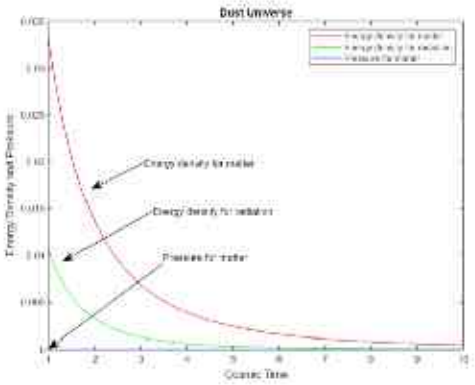

Figure (4): *Variation of energy density and pressure in dust universe versus cosmic time for* $q = -0.033, a = 1, b = 2, c = 1, c_1 = 1$

Energy density for matter and radiation decreases monotonically with respect to time and tends to a constant value in the large-time limit. The pressure for matter becomes zero.

The density parameters for matter and radiation are

$$\Omega_m = \frac{\rho_m}{3H^2} = \frac{c(1+q)^2}{a^2(at+b)^{\frac{1-2q}{1+q}}}. \tag{65}$$

$$\Omega_r = \frac{\rho_r}{3H^2} = \frac{c_1(1+q)^2}{a^2(at+b)^{\frac{2(1-q)}{1+q}}}. \tag{66}$$

The density parameter for matter and radiation increases monotonically with respect to time.

The value of $f(T)$ is given by

$$f(T) = \frac{1}{T^{1/2}}\int\left(c(at+b)^{-\frac{3}{1+q}} + c_1(at+b)^{\frac{4}{1+q}}\right)T^{-1/2}dT. \tag{67}$$

5.2 Radiation universe: $\gamma = \frac{4}{3}$

The energy density for matter and radiation is given by

$$\rho_m = \frac{c}{(at+b)^{\frac{4}{1+q}}}, \tag{68}$$

$$\rho_r = \frac{c_1}{(at+b)^{\frac{4}{1+q}}}. \tag{69}$$

The pressure for matter is

$$p_m = \frac{c}{3(at+b)^{\frac{3}{1+q}}}, \tag{70}$$

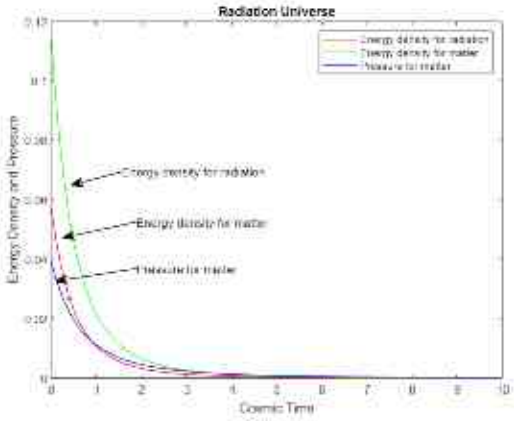

Figure (5): *Variation of energy density and pressure in radiation universe versus cosmic time for* $q = -0.033, a = 1, b = 2, c = 1, c_1 = 2.$

Energy density for radiation, energy density and pressure for matter decreases monotonically with respect to time and tends to a constant value in the large-time limit.

The density parameters for matter and radiation are

$$\Omega_m = \frac{\rho_m}{3H^2} = \frac{c(1+q)^2}{a^2(at+b)^{\frac{2-2q}{1+q}}}, \tag{71}$$

$$\Omega_r = \frac{\rho_r}{3H^2} = \frac{c_1(1+q)^2}{a^2(at+b)^{\frac{2-2q}{1+q}}}. \tag{72}$$

The density parameter for radiation and matter increases monotonically with respect to time

The value of $f(T)$ is given by

$$f(T)=\frac{1}{T^{1/2}}\int\left(c(at+b)^{-\frac{4}{1+q}}+c_1(at+b)^{-\frac{4}{1+q}}\right)T^{-1/2}dT\,. \tag{73}$$

5.3 Hard universe: $\gamma\in\left(\frac{4}{3},1\right)$, let $\gamma=\frac{5}{3}$

The energy density for matter and radiation is given by

$$\rho_m=\frac{c}{(at+b)^{\frac{5}{1+q}}}\,, \tag{74}$$

$$\rho_r=\frac{c_1}{(at+b)^{\frac{4}{1+q}}}\,. \tag{75}$$

The pressure for matter is

$$p_m=\frac{2c}{3(at+b)^{\frac{3}{1+q}}}\,. \tag{76}$$

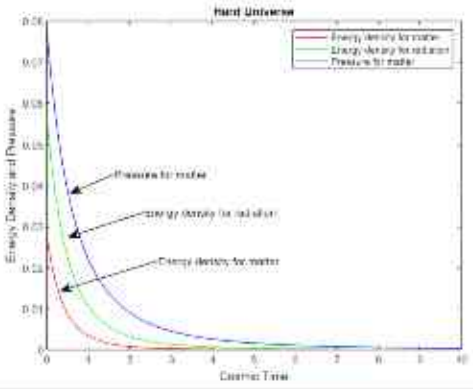

Figure 6: *Variation of energy density and pressure in hard universe versus cosmic time for* $q=-0.033, a=1, b=2, c=1, c_1=2.$

The energy density for radiation, energy density and pressure for matter decreases monotonically with respect to cosmic time and tend to constant value in the large-time limit.

The density parameters for matter and radiation are

$$\Omega_m=\frac{\rho_m}{3H^2}=\frac{c(1+q)^2}{a^2(at+b)^{\frac{3-2q}{1+q}}}\,, \tag{77}$$

$$\Omega_r = \frac{\rho_r}{3H^2} = \frac{c_1(1+q)^2}{a^2(at+b)^{\frac{2-2q}{1+q}}}\,. \tag{78}$$

The density parameter for radiation and matter increases monotonically with respect to time.

The value of $f(T)$ is given by

$$f(T) = \frac{1}{T^{1/2}}\int\left(c(at+b)^{-\frac{5}{1+q}} + c_1(at+b)^{-\frac{4}{1+q}} \right) T^{-1/2}dT\,. \tag{79}$$

5.4 Zeldovich universe: $\gamma = 2$

The energy density for matter and radiation is given by

$$\rho_m = \frac{c}{(at+b)^{\frac{6}{1+q}}}\,, \tag{80}$$

$$\rho_r = \frac{c_1}{(at+b)^{\frac{4}{1+q}}}\,. \tag{81}$$

$$p_m = \frac{c}{(at+b)^{\frac{3}{1+q}}}\,. \tag{82}$$

The pressure for matter is

The energy density for radiation, energy density and pressure for matter decreases monotonically with respect to cosmic time and tend to a constant value in the large-time limit.

The density parameters for matter and radiation are :

$$\Omega_m = \frac{\rho_m}{3H^2} = \frac{c(1+q)^2}{a^2(at+b)^{\frac{2(2-2q)}{1+q}}}\,, \tag{83}$$

$$\Omega_r = \frac{\rho_r}{3H^2} = \frac{c_1(1+q)^2}{a^2(at+b)^{\frac{2-2q}{1+q}}}\,. \tag{84}$$

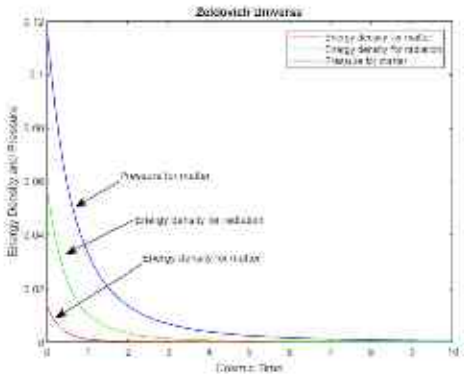

Figure (7): *Variation of energy density and pressure in zeldovich universe versus cosmic time for* $q=-0.033, a=1, b=2, c=1, c_1=1.$

The density parameter for radiation and matter increases monotonically with respect to time.

The value of $f(T)$ is given by

$$f(T)=\frac{1}{T^{1/2}}\int\left(c(at+b)^{-\frac{6}{1+q}}+c_1(at+b)^{-\frac{4}{1+q}}\right)T^{-1/2}dT\ . \tag{85}$$

6. Conclusion

In this paper, we have investigated LRS Bianchi type-I two fluid cosmological model in $f(T)$ gravity. We have following concluding remarks:

- From (49) and (50), we observe that scale factor and spatial volume approaches zero as t tends to zero and these parameters tends to infinity as t tends to infinity. Thus we conclude that the model obtained in (37) is expanding with time.
- From (51) and (52), we conclude that the parameters H and θ are infinite at the initial stage and at $t=-b/a$. It means that there is a singularity at $t=-b/a$.
- From (51), (52) and (53), we conclude that the Hubble parameter, scalar of expansion and shear scalar are vanishing for large value of cosmic time.
- From figures (1) and (2), we observe that pressure for radiation is an increasing function of time whereas pressure for matter is decreasing function of time.
- From figures (4), (5), (6) and (7), we conclude that the energy density for matter and radiation approaches toward zero for large value of cosmic time. From the same figures we conclude that the energy density for matter and radiation diverge initially and at $t=-b/a$ in all universes. These figures also indicate that energy density for radiation is same in all universes.

- From figures (4), (5), (6) and (7), we conclude that pressure for matter approaches toward zero as t tends to ∞. From the same figures we conclude that pressure for matter diverge at $t=0$ and at $t=-b/a$ except in dust universe, where pressure for matter is zero.
- From (65), (66), (71), (72), (77), (78), (83) and (84), we conclude that density parameters for radiation are same in all universes and when t approaches to ∞ the density parameters for matter and radiation vanishes in all universe.
- In this model for particular case $q<-1$ in (55), we have $j>0$, which indicate that universe shifts from the early deceleration phase to the current acceleration phase.
- From (56), it is observed that luminosity distance d_L increases with redshift.
- From (59), we observed that the statefinder parameters has values $\{r<1, s>0\}$ for $q<-1$. As a result, our model behaves like a quintessence model.

The two-fluid model of cosmic evolution seems superior to two sequences of a single-fluid model because both fluids are present throughout the cosmic evolution with one fluid dominating the other. Such models can be used to describe the transition from a radiation-dominated phase to a matter-dominated phase as the universe expands.

Acknowledgement: The authors are thankful to the Referee for valuable comments and suggestions.

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East European Journal of Physics. 1. 102–111 (2024)

DOI: 10.26565/2312-4334-2024-1-08 ISSN 2312-4334

PERFECT FLUID WITH HEAT FLOW IN $f(T)$ THEORY OF GRAVITY

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Received December 19, 2023; revised February 4, 2024; accepted February 10, 2024

Bianchi Type-I cosmological models have been a subject of extensive research in cosmology due to their simplicity and relevance in understanding the dynamics of the early Universe. In this study, we investigate the dynamics of such models within the framework of $f(T)$ gravity, an alternative theory of gravity that extends teleparallel gravity by introducing a general function of the torsion scalar, T. We focus on the presence of a perfect fluid with heat flow in the cosmic medium. By solving the field equations of $f(T)$ gravity, we obtain exact solutions for the Bianchi Type-I cosmological models. These solutions provide valuable insights into the evolution of the Universe and how it is influenced by the modified gravity theory. Furthermore, we derive cosmological parameters in terms of redshift, offering a convenient way to interpret observational data and connect theoretical predictions to empirical measurements. Our findings not only contribute to a deeper understanding of the dynamics of Bianchi Type-I cosmological models but also provide a foundation for comparing $f(T)$ gravity with standard general relativity in the context of observational cosmology. This research paves the way for further exploration of alternative gravity theories and their implications for the early Universe's evolution and structure.

Keywords: *$f(T)$ theory; Perfect fluid with heat flow; Bianchi type-I*

PACS: 98.80.-k,04.20.-q, 04.50.Kd

1. INTRODUCTION

The study of cosmological models has been instrumental in advancing our understanding of the evolution and structure of the Universe. In this context, Bianchi Type-I cosmological models have played a crucial role due to their inherent simplicity and applicability to various cosmological scenarios. These models assume a homogeneous and anisotropic distribution of matter and radiation in the early Universe, making them a valuable tool for investigating the dynamics of cosmic expansion.

Banerjee et.[1] al. conducted investigations on Bianchi I cosmological models that incorporate a fluid possessing both bulk and shear viscosity. These studies reveal the evolving significance of shear viscosity and fluid density dynamics throughout the cosmic evolution. Sharif and Rani [2] have studied spatially homogeneous and anisotropic Bianchi type I universe in the context of $F(T)$ gravity. Beesham and Aroonkumar [3] studied Bianchi type I cosmological models with variable gravitational constants (G) and cosmological constants (Λ). Jacobs and Kenneth [4] Explored cosmologies of Bianchi type I with a uniform magnetic field. Sahoo and Sivakumar [5] examined LRS (Locally Rotationally Symmetric) Bianchi type-I cosmological models in f(R, T) theory of gravity. Barrow [6] et al. analyzed the asymptotic stability of Bianchi type universes. Ashtekar[7] et al. Investigated loop quantum cosmology of Bianchi type I models. Akarsu [8] et al. explored LRS Bianchi type I models with anisotropic dark energy and constant deceleration parameters. Pawar [9] et al. investigated magnetized anisotropic dark energy by using Barber's self-creation theory. Saha [10] et al. investigated Bianchi type-I cosmology with scalar and spinor fields and they also Studied spinor fields in a Bianchi type-I universe, focusing on regular solutions. Jamil [11] et al. explored FRW and Bianchi type I cosmology of $f-$essence. Singh [12] et al. Explored Bianchi type-I cosmological models in Lyra's geometry. Singh [13] et al. analyzed Bianchi type-I cosmological models with variable G and Λ-term in general relativity. Arbab [14] has studied Bianchi type I viscous universe with variable G and Λ. Rodrigues [15] et al. have investigated Bianchi type-I, type-III, and Kantowski-Sachs solutions in $f(T)$ gravity. Shamir [16] has explored locally rotationally symmetric Bianchi type I cosmology in $f(R,T)$ gravity. Chirde [17] et al. Analyzed a Bianchi type I cosmological model with a perfect fluid and string in $f(T)$ theory of gravitation. Wanas [18] et al. have investigated Bianchi type I cosmological models in $f(T)$ gravitational theories. Fayaz [19] have studied f(T) theories from holographic dark energy models within a Bianchi type I universe. Rodrigues [20] have explored locally rotationally symmetric Bianchi type-I cosmological models in $f(T)$ gravity, spanning from early to dark energy-dominated universes. Aslam [21] et al. have investigated Noether gauge symmetry for the Bianchi type I model in $f(T)$ gravity. Qazi [22] et al. have explored conformal vector fields of Bianchi type-I perfect fluid solutions in $f(T)$ gravity. Hasmani

Cite as: D.D. Pawar, N.G. Ghungarwar, P.S. Gaikwad, East. Eur. J. Phys. 1, 102 (2024), https://doi.org/10.26565/2312-4334-2024-1-08

and Al-Haysah [23] have provided exact solutions for Bianchi type-I cosmological models in $f(R)$ Theory of Gravity. Shekh [24] et al. have explored an accelerating Bianchi type dark energy cosmological model with a cosmic string in $f(T)$ gravity. Koussour and Bennai [25] have conducted a stability analysis of anisotropic Bianchi type-I cosmological model in teleparallel gravity. Dawande [26] et al. have investigated LRS Bianchi Type-I Universe in $f(T)$ Theory of Gravity. Shukla [27] et al. have explored a Bianchi type-I cosmological model in a modified theory of gravity. Van den Hoogen [28] et al. investigated Bianchi type cosmological models in $f(T)$ tele-parallel gravity. Shamir [29] et al. have explored locally rotationally symmetric Bianchi type I cosmology in $f(R)$ gravity. Rodrigues [30] et al. analyzed anisotropic universe models in $f(T)$ gravity. Pawar [31] et al. have investigated LRS Bianchi type-I cosmological models in $f(Q,T)$ theory of gravity with observational constraints. Dagwal [32] has explored tilted two forms of dark energy in $f(T)$ theory of gravity. Solanke [33] et al. have studied an accelerating dark energy universe with LRS Bianchi type-I space-time. Pradhan [34] et al. have investigated Bianchi type I anisotropic magnetized cosmological models with varying Λ. General Relativity (GR), formulated by Albert Einstein, has long been the cornerstone of our understanding of gravitational interactions in the cosmos. However, in recent decades, alternative theories of gravity have gained attention, offering different perspectives on the gravitational field equations. One such alternative is $f(T)$ gravity [35], which extends the concept of teleparallel gravity by introducing a general function of the torsion scalar, T. Pawar et al.[36] have studied anisotropic behaviour of perfect fluid in fractal cosmology. $f(T)$ gravity has been explored as a viable alternative to GR, providing a framework to study the gravitational dynamics of the Universe beyond the confines of Einstein's theory.

In this research, we delve into the dynamics of Bianchi Type-I cosmological models within the framework of $f(T)$ gravity[37] . Our primary focus is on the inclusion of a perfect fluid with heat[38], which is crucial in understanding the thermodynamic aspects of the early Universe. By solving the field equations derived from $f(T)$ gravity, we aim to obtain exact solutions for the evolution of the Universe in the presence of these additional components. Pawar et al. [39]-[40] have studied several aspects of Bianchi Type-I with Two fluid axially symmetric cosmological models in $f(R,T)$ theory of gravitation and Tilted congruences with stiff fluid cosmological models.

Furthermore, one of the essential aspects of cosmological models is their ability to provide a connection between theoretical predictions and empirical observations. To facilitate this connection, we derive cosmological parameters that are expressed in terms of redshift, a key observational quantity. This approach enables us to relate our theoretical findings to astronomical data, enhancing the applicability and relevance of our research to the broader field of observational cosmology.

In summary, this research presents a comprehensive exploration of Bianchi Type-I cosmological models in $f(T)$ gravity, incorporating a perfect fluid with heat. The obtained solutions and derived cosmological parameters contribute to our understanding of the early Universe's dynamics and offer a bridge between theoretical predictions and observational data.

2. FIELD EQUATION

The line element for a flat, homogeneous and anisotropic LRS Bianchi type-I space time[41] is

$$ds^2 = dt^2 - A^2(t)dx^2 - B^2(t)\left[dy^2 + dz^2\right] \tag{1}$$

Here, t represents time, x is one spatial coordinate, and y and z are the other two spatial coordinates. The functions $A(t)$ and $B(t)$ are scale factors that describe the expansion or contraction of the space in the x and y-z directions, respectively.

We obtain the tetrad components as follows:

$$h_i^{\mu} = \mathrm{diag}(1, A^{-1}, B^{-1}, B^{-1}) \tag{2}$$

The torsion scalar, denoted as "T," is a scalar derived from the torsion tensor. It quantifies the deviation of the Weitzenböck connection from the Levi-Civita connection, which is used in general relativity. In simple terms, the torsion scalar reflects the inhomogeneity in the spacetime geometry due to torsion. The torsion scalar has the form

$$T = S_{\rho}^{\mu\omega} T_{\mu\omega}^{\rho} \tag{3}$$

The formulation of this theory's action involves extending and building upon the foundational principles of the Teleparallel Theory of Gravity.

$$I = \int e[f(T) + L_{matter}]d^4x \tag{4}$$

In this context, $f(T)$ signifies a function concerning with the torsion scalar T. Meanwhile, L_{matter} stands for the Lagrangian density associated with matter. Additionally, "e" corresponds to the determinant of the tetrad

field, which is intricately linked to the metric tensor through the relationship $e = \sqrt{-g}$. The non vanishing components of torsion tensor are defined as

$$T^{\rho}_{\mu\nu} = \Gamma^{\rho}_{\nu\mu} - \Gamma^{\rho}_{\mu\nu} = h^{\rho}_{i}(\partial_{\mu}h^{i}_{\nu} - \partial_{\nu}h^{i}_{\mu}) \tag{5}$$

The elements of the corresponding contorsion tensor are characterized by:

$$K^{\mu\nu}_{\rho} = -\frac{1}{2}(T^{\mu\nu}_{\rho} - T^{\nu\mu}_{\rho} - T^{\mu\nu}_{\rho}) \tag{6}$$

The determination of the elements of the tensor $S_{\rho}{}^{\mu\nu}$ is carried out in the following manner:

$$S_{\rho}{}^{\mu\nu} = \frac{1}{2}\left(K^{\mu\nu}{}_{\rho} + \delta^{\mu}_{\rho}T^{\theta\nu}{}_{\theta} - \delta^{\nu}_{\rho}T^{\theta\mu}{}_{\theta}\right) \tag{7}$$

By using above components we have computed the torsion scalar, "T," as follows:

$$T = -2\left(2\frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2}\right) \tag{8}$$

The derivation of the modified field equation in the teleparallel theory of gravity involves obtaining it through the variation of the action concerning the vierbein components, denoted as h^{i}_{μ}. This is expressed as:

$$S^{\nu\rho}_{\mu}\partial_{\rho}Tf_{TT} + \left[e^{-1}e^{i}_{\mu}\partial_{\rho}(ee^{\alpha}_{i}S^{\nu\rho}_{\alpha} + T^{\alpha}_{\lambda\nu}S^{\nu}_{\lambda\alpha}\right]f_{T} + \frac{1}{4}\delta^{\mu}_{\nu}f = 4\pi T^{\mu}_{\nu} \tag{9}$$

Where T^{ν}_{μ} is the energy momentum tensor, $f_T = \frac{df}{dT}$ and $f_{TT} = \frac{d^2f}{dT^2}$

The energy momentum tensor for perfect fluid with heat flow [42] is

$$T_{ij} = (\rho + p)u_iu_j + pg_{ij} + h_iu_j + h_ju_i \tag{10}$$

where ρ is the energy density, p is thermodynamic pressure, h_i is heat flow vector. The field equation corresponding to metric (1) are obtained by

$$f + 4f_T\left[\frac{\dot{B}^2}{B^2} + 2\frac{\dot{A}\dot{B}}{AB}\right] = -16\pi\rho \tag{11}$$

$$f + 4f_T\left[\frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + \frac{\dot{A}\dot{B}}{AB}\right] + 4\frac{\dot{B}}{B}\dot{T}f_{TT} = 16\pi p \tag{12}$$

$$f + 2f_T\left[\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + 3\frac{\dot{A}\dot{B}}{AB}\right] + 2\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\dot{T}f_{TT}\right) = 16\pi p \tag{13}$$

The crucial parameters in cosmological observations include the mean scale factor a, mean Hubble parameter H, scalar expansion θ, deceleration parameter q, shear scalar σ^2, and mean anisotropic parameter A_m. These quantities, derived from metric (1), are expressed as:

$$a = \left(AB^2\right)^{1/3} \tag{14}$$

$$H = \frac{1}{3}\left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right) \tag{15}$$

$$\theta = \frac{\dot{A}}{A} + 2\frac{\dot{B}}{B} \tag{16}$$

$$q = -\frac{a\ddot{a}}{\dot{a}^2} = \frac{d}{dt}\left(\frac{1}{H} - 1\right) \tag{17}$$

$$A_m = \frac{2}{9H^2}\left(\frac{\dot{A}}{A} - \frac{\dot{B}}{B}\right)^2 \tag{18}$$

3. SOLUTION OF FIELD EQUATION

Solving field equations (11), (12) and (13) we obtain

$$A(t) = \{(3+2m)(c_1 t + c_2)\}^{\frac{m}{3+2m}} \tag{19}$$

and

$$B(t) = \{(3+2m)(c_1 t + c_2)\}^{\frac{1}{3+2m}} \tag{20}$$

using equations (19) and (20) we get

$$T = \frac{-2(1+2m)}{(3+2m)^2 \cdot (c_1 t + c_2)^2} \tag{21}$$

$$f = -4K\frac{(1+2m)}{(5+3m)}(3+2m)^{\frac{2+m}{3+2m}} {c_1}^2 (c_1 t + c_2)^{-\frac{5+3m}{3+2m}} \tag{22}$$

$$\rho = \frac{K}{4\pi}\frac{(1+2m)(2+m)}{(5+3m)} {c_1}^2 ((3+2m)(c_1 t + c_2))^{-\frac{5+3m}{3+2m}} \tag{23}$$

$$p = \frac{K}{4\pi}\frac{(1+2m)}{(5+3m)}(3+2m)^{\frac{2+m}{3+m}} {c_1}^2 (c_1 t + c_2)^{-\frac{5+3m}{3+2m}} \tag{24}$$

The formulas for the Hubble parameter H, scalar expansion θ, shear scalar σ, and the mean anisotropic parameter A_m are obtained as follows:

$$\theta = 3H = c_1 \frac{2+m}{3+2m}(c_1 t + c_2)^{-1} \tag{25}$$

$$\sigma^2 = \frac{1}{3}\left(\frac{m-1}{3+2m}\right)^2 {c_1}^2 (c_1 t + c_2)^{-2} \tag{26}$$

$$A_m = \frac{2m^2 - 4m + 2}{(m+2)^2} \tag{27}$$

The value of the deceleration parameter is found to be

$$q = \frac{5m+7}{m+2} \tag{28}$$

which is constant.

By using $1 + z = \frac{a_0}{a}$ we get above physical parameters in terms of redshift z.

The torsion scalar is a geometric quantity associated with theories of gravity that incorporate torsion in addition to curvature. In the context of general relativity (which does not include torsion), the torsion tensor is assumed to be zero. However, in alternative theories of gravity, such as the Einstein-Cartan theory, torsion is considered. We have obtained torsion scalar in terms of redshift.

$$T = \frac{-2(1+2m)}{(3+2m)^2} c_1^3 \frac{(1+z)^{(\frac{3+2m}{m+2})}}{(3+2m)} \tag{29}$$

Figure 1 illustrates the correlation between the torsion scalar T and the redshift z across various constant m values in cosmological observations. The torsion scalar T, measuring spacetime geometry deviation from standard general relativity due to torsion, consistently exhibits negative values across all z and m, indicating a departure from general relativity. Redshift z, serving as a gauge of universe expansion and object distance, increases as the torsion scalar T decreases, suggesting a more pronounced deviation from general relativity in earlier cosmic epochs. Moreover, the value of m influences both the slope and magnitude of the torsion scalar T depicted in the figure, with higher m values corresponding to steeper slopes and smaller magnitudes of T.

$$f = \frac{-4K(1+2m)}{(5+3m)(3+2m)}(1+z)^{-3\frac{(5+3m)}{m+2}} \tag{30}$$

The relationship between pressure (P) and redshift (z) in cosmology is characterized by the equation of state parameter (ω). In the early universe dominated by radiation, ω is $\frac{1}{3}$, indicating positive pressure. As non-relativistic matter becomes dominant, ω for matter is 0, representing zero pressure. Dark energy, with a constant $\omega < 0$, contributes a negative pressure and is associated with the observed accelerated expansion of the universe.

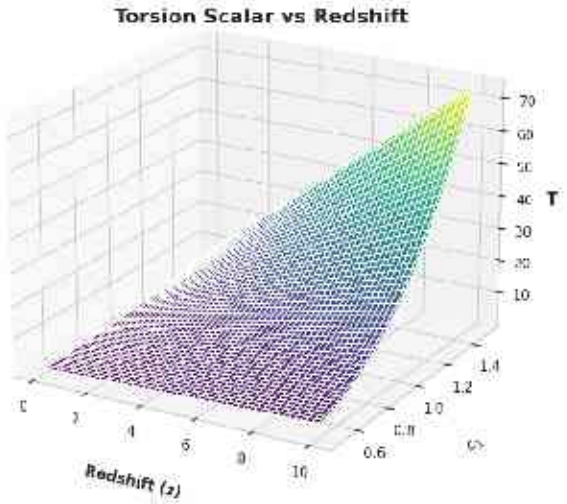
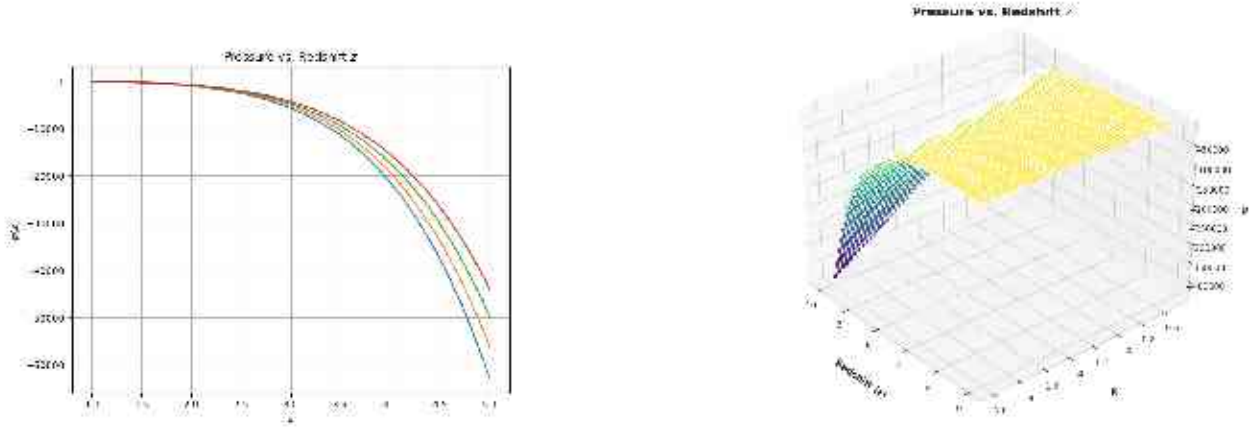


Figure 1. Torsion Scalar vs Redshift for $m = -1, 0.5 < c_1 < 1.5$



(a) 2D Plot **(b)** 3D Plot

Figure 2. The plot of pressure vs cosmic redshift z

The pressure is calculated as follows:

$$p = \frac{K}{4\pi}\frac{(1+2m)(2+m)}{(5+3m)}(3+2m)(1+z)^{\frac{3(5+3m)}{m+2}} \tag{31}$$

In Figure 2, pressure is plotted against cosmic redshift z for different values of m, a constant in the Bianchi type-I cosmological model relating the expansion scalar and shear scalar. Pressure consistently exhibits negativity across all m and z values, indicative of a tension-like effect associated with dark energy, presumed to fuel the universe's accelerated expansion. With increasing redshift, pressure diminishes, reflecting a rise in dark energy density over time and its eventual dominance over matter and radiation in the late universe. Notably, smaller values of m correspond to more negative pressure, suggesting a heightened repulsive gravitational effect, where the anisotropy of the Bianchi type-I model enhances the impact of dark energy.

The relationship between energy density and redshift is influenced by the contributions from radiation, matter, dark energy, and possibly other components, and it is described by the evolving scale factor in the Friedmann equations of cosmology. Here we have obtained the energy density in terms of redshift for perfect fluid.

$$\rho = \frac{K}{4\pi}\frac{(1+2m)(2+m)}{(5+3m)}(1+z)^{-\frac{3(5+3m)}{m+2}} \tag{32}$$

From Figure 3 we observed that the density of the universe is positive and decreases with increasing redshift. Additionally, the density of the universe is higher for lower values of m, indicating a stronger influence

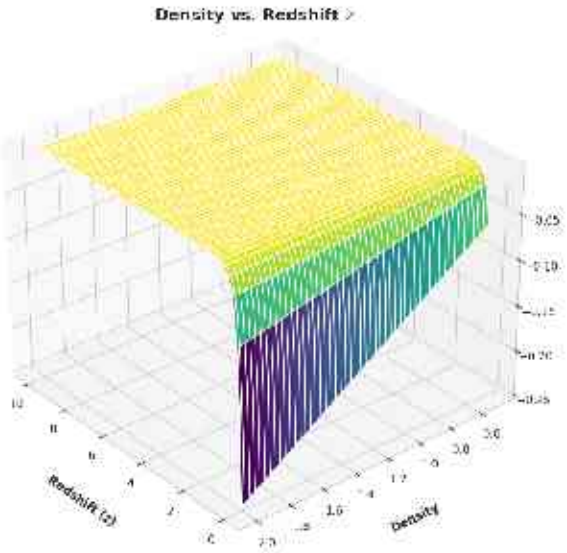


Figure 3. Density vs Redshift for $m = -1$

of matter on the cosmic expansion. Moreover, the density of the universe approaches zero as the redshift approaches infinity, implying a negligible contribution of matter in the early universe.

The equation of state parameter, typically denoted by ω, relates the pressure (p) to the energy density (ρ) of a substance. It's defined as $\omega = \frac{p}{\rho}$. The equation of state parameter (ω) characterizes the relationship between pressure and energy density in the universe. In the early universe, dominated by radiation, ω is 1/3. As non-relativistic matter becomes dominant, ω for matter is 0, and for dark energy, assumed constant, ω is $<$ 0. The evolution of ω with redshift reflects the changing contributions of different cosmic components to the energy density over cosmic time. We have calculated the equation of state parameter in terms of redshift as follows:

$$\omega = (3+2m)(1+z)^{\frac{6(3+3m)}{m+2}} \tag{33}$$

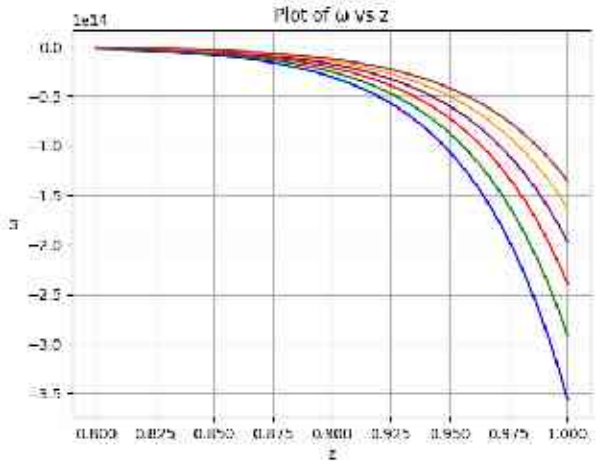


Figure 4. Equation of state parameter vs redshift

In Figure 4, we see how a parameter called the equation of state ω changes as the redshift z varies for different values of m. This parameter helps us understand the relationship between pressure and energy density in the universe. Some important points from Figure 4 include: all the curves have negative values for ω, indicating negative pressure, which is often associated with dark energy driving the universe's accelerated expansion; as the redshift increases, indicating earlier times in the universe, the negative pressure becomes stronger, suggesting that dark energy played a bigger role in the early universe; and the shape of the curves varies depending on the value of m, which reflects how the universe is structured (its anisotropy), indicating that the equation of state depends on the universe's structure.

The relationship between the Hubble parameter (H) and redshift (z) is often expressed in the context of the Friedmann-Lemaître-Robertson-Walker (FLRW) metric, which describes the expanding universe in cosmology. The Hubble parameter is related to the rate of expansion of the universe.

Hubble parameter H is calculated as:

$$H = \frac{2+m}{3}(1+z)^{\frac{3(1+2m)}{m+2}} \tag{34}$$

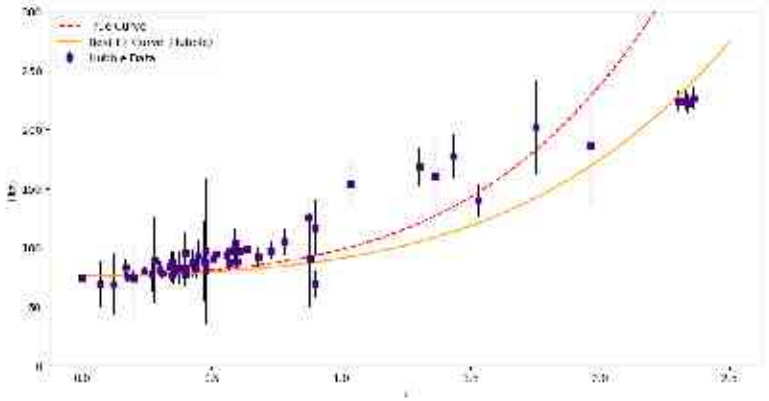


Figure 5. The plot of Hubbple parameter vs Redshift along with Hubble Data-Set

In Figure 5, we observe how the universe expands over time. It shows that as we look back in time, the universe expanded more slowly, measured by something called the Hubble parameter H at different redshifts z. The graph also indicates that the Hubble parameter is influenced by a constant called "m," which affects how the universe expands in a the model. Additionally, the graph compares theoretical expectations with real observations from telescopes like the Hubble Space Telescope and the Sloan Digital Sky Survey, and they seem to match up quite well, considering the uncertainties.

4. DISCUSSION AND CONCLUSION

Redshift in cosmology refers to the phenomenon where the light from distant galaxies or celestial objects appears to be shifted towards longer wavelengths, moving towards the red end of the electromagnetic spectrum. This is primarily due to the expansion of the universe.

As the universe expands, the space between galaxies also expands, causing the wavelengths of light emitted by these galaxies to stretch. This stretching of light results in a shift towards longer wavelengths, which is observed as a redshift. The greater the distance to a galaxy, the higher its redshift. Redshift is a crucial tool for astronomers in measuring the distances to and the velocities of objects in the universe.

In terms of redshift, as the universe expands, the effects of dark energy become more pronounced. If the pressure associated with dark energy remains negative, it can counteract the attractive force of gravity, leading to an accelerated expansion. This is consistent with the observations of distant supernovae and other cosmological data. The behavior of the universe is influenced when w is negative:

- **Accelerated Expansion:** The negative pressure associated with dark energy leads to an accelerated expansion of the universe. This is in contrast to matter, which has positive pressure and tends to slow down the expansion due to gravitational attraction.
- **Dominance at Late Times:** As the universe expands, the effects of dark energy become more pronounced over time. In the current epoch of the universe, dark energy is believed to be the dominant component, driving the observed acceleration.
- **Redshift of Distant Objects:** The acceleration of the universe affects the redshift of distant galaxies. Observationally, distant supernovae and other cosmological probes indicate that the rate of expansion is increasing with time.

The effect of the Hubble parameter on the universe can be summarized as follows:

- **Expansion Rate:** The Hubble parameter at a given redshift, $H(z)$, indicates the rate at which the universe is expanding at that particular cosmic time. A higher value of $H(z)$ implies a faster rate of expansion.

- **Historical Expansion:** Observing the Hubble parameter at different redshifts allows us to study the historical expansion of the universe. By looking at more distant objects, corresponding to higher redshifts, we are effectively looking back in time.
- **Cosmic Acceleration:** Changes in the Hubble parameter with redshift can provide insights into the cosmic acceleration. In a universe dominated by dark energy, the Hubble parameter may not decrease as much with increasing redshift as in a universe without dark energy.
- **Critical Density Determination:** The Hubble parameter is related to the critical density of the universe (ρ_{crit}). Understanding its behavior with redshift helps in determining the overall energy content and fate of the universe.

In this research, we explore the characteristics of the Bianchi type-I space-time within the framework of $f(T)$ gravity theory, where T represents the torsion scalar. The model is constructed based on specific assumptions. The first assumption posits a proportional relationship between the expansion scalar θ and the shear scalar σ, leading to the expression $A = B^m$, where A and B are metric coefficients, and m is a real constant. The second assumption sets equal pressure components in the x, y, and z directions, governed by an equation of state $p = \omega\rho$. Additionally, a power-law relation between F and the scale factor B is employed to derive the exact solution of the field equations.

Several key cosmological parameters, including the torsion scalar T pressure p, density ρ, equation of state parameter ω Hubble parameter Hin terms of cosmic time t and redshift z. The behaviour of the graph of the pressure vs redshift shows that the pressure is negative and constatly decreasing for the various values of $m = -1.03, -1.05, -1.07, -1.09$. If the pressure is negative (which corresponds to a situation where the substance has a tension-like effect rather than compressive), it can have significant implications for the evolution of the universe. A substance with negative pressure is often referred to as "exotic" or "dark energy."

The most well-known example of dark energy is the cosmological constant (Λ) associated with the vacuum of space. A negative pressure is a key component of dark energy because it's believed to be responsible for the observed accelerated expansion of the universe. The graph of density vs redshift we have plotted in 3D which shows that the density is positive. A positive density in terms of redshift typically refers to the energy density of matter in the universe. In cosmology, matter can have positive density, and its effects are often associated with the deceleration of the universe's expansion.

The pressure and density with the redshift shows the singularity at $m = -2$. Notably, the equation of state parameter ω shows the the negative behaviour and graph decreases rapidly for the values of $m = -2.201, -2.203, -2.205, -2.207, -2.209, -2.211$. When the equation of state parameter (w) in terms of redshift is negative, it implies that the substance in question has a negative pressure. This scenario is often associated with dark energy, which is believed to be responsible for the observed accelerated expansion of the universe.

The equation of state parameter is defined as $w = \frac{p}{\rho}$, where p is the pressure and ρ is the energy density. For dark energy, the negative pressure contributes to a repulsive gravitational effect, counteracting the attractive force of gravity caused by matter.

The Hubble parameter H plotted vs redshift z. The graph shows the values of Hubble parameter in the range of standard dataset wchich supports the current observational data.

The Hubble parameter in terms of redshift is a crucial observational quantity that informs us about the current state and past history of the universe's expansion. Studying its behavior with redshift provides valuable information about the underlying cosmological model and the influence of various components like matter, radiation, and dark energy on the evolution of the cosmos.

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ІДЕАЛЬНА РІДИНА З ТЕПЛОВИМ ПОТОКОМ У $f(T)$ ТЕОРІЇ ГРАВІТАЦІЇ

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Космологічні моделі Б'янкі типу I були предметом інтенсивних досліджень у космології через їхню простоту та актуальність для розуміння динаміки раннього Всесвіту. У цьому дослідженні ми досліджуємо динаміку таких моделей у рамках $f(T)$ гравітації, альтернативної теорії гравітації, яка розширює телепаралельну гравітацію шляхом введення загальної функції торсійного скаляра T. Ми акцентуємо увагу на наявності в космічному середовищі ідеальної рідини з тепловим потоком. Розв'язуючи рівняння поля гравітації $f(T)$, ми отримуємо точні розв'язки для космологічних моделей Б'янкі типу I. Ці рішення дають цінну інформацію про еволюцію Всесвіту та про те, як на неї впливає модифікована теорія гравітації. Крім того, ми виводимо космологічні параметри в термінах червоного зсуву, пропонуючи зручний спосіб інтерпретації даних спостережень і зв'язування теоретичних прогнозів з емпіричними вимірюваннями. Наші висновки не лише сприяють глибшому розумінню динаміки космологічних моделей Б'янкі типу I, але й створюють основу для порівняння $f(T)$ гравітації зі стандартною загальною теорією відносності в контексті спостережної космології. Це дослідження прокладає шлях для подальшого вивчення альтернативних теорій гравітації та їхнього впливу на еволюцію та структуру раннього Всесвіту.

Ключові слова: *теорія $f(T)$; ідеальна рідина з тепловим потоком; Б'янкі типу I*

IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

ISOLATION, IDENTIFICATION, AND MULTI-DRUG RESISTANCE PATTERN OF *ESCHERICHIA COLI* ISOLATED FROM SAMPLES OF URINARY TRACT INFECTED PATIENTS

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ABSTRACT: -

The most prevalent medical condition among hospitalized and outpatient patients is a urinary tract infection. Multi-drug resistance to antibacterial medications is a further issue that raises concerns among health professionals. The most frequent causative and etiologic agent for urinary tract infections is *Escherichia coli* (*E. coli*). *E. coli* was the most common bacteria, accounting for 27.38% (43/157) of the 157 isolated uropathogens. A large percentage was also seen in females, 62.42% (98/157).

These isolates were all further checked against 12 different antibiotics. *E. coli* showed tremendous resistance towards Amoxyclav 88.42% followed by Ampicillin, 81.79%, Ciprofloxacin, 79.32%, Nalidixic acid, 77.42%, Cefodoxime, 71.47%, Cephalothin, 69.62%, Tetracycline, 67.81%, Ceftazidime/clavulanic acid, 59.28%, Ceftriaxone, 53.80%, Cefepime, 32.75% and Cefoperazone/sulbactam, 23.70%. While Imipenem is the prominent drug of choice for urinary tract infections.

Key Words: *E. coli*, urinary tract infection, multi-drug resistance

INTRODUCTION: -

Due to anatomical differences, urinary tract infections (UTIs) are the most prevalent infection in humans, particularly in women. Due to the evolution of resistance to several antimicrobial drugs, managing urinary tract infections has recently become increasingly difficult (Steadman and Topley, 1998). The most frequent pathogen that can cause urinary tract infections (UTI) in both developed and developing nations is *Escherichia coli* (*E. coli*), more specifically known as Uropathogenic *Escherichia coli* (UPEC) (Samra et al., 2005). Bacterial resistance to various antimicrobial medications is a severe health risk for people all over the world. One of the main reasons for bacterial resistance to antimicrobial drugs is the unwarranted or constant use of certain antimicrobials.

According to Shames *et al*., (2009) and Ogura *et al*., (2009), *E. coli* is a common, diverse, and harmless commensal organism that only needs to acquire virulence factors to become a highly pathogenic organism with the ability to cause diseases like gastroenteritis, extra-intestinal infections, urinary tract infections, and bloodstream infections. In addition to these, it can survive in various environments, which makes it an excellent indicator organism to assess environmental samples and fecal contamination (Feng *et al*., 2002). It belongs to the gamma probacteria's *Enterobacteriaceae* family. According to Wagenlehner *et al*., (2008) and Kashef *et al*., (2010), it is the main infectious agent responsible for urinary tract infections. Additionally, the majority of diarrhea-related deaths in children under the age of five among people around the world are caused by *E. coli*

(Turner *et al.*, 2006).

Antimicrobial resistance in *E. coli* has been noted globally, and the rate of resistance has risen among *E. coli*, which is a serious issue (Kholy *et al.*, 2003; Bell *et al.*, 2002). Treatment of urinary tract infections becomes more challenging as antimicrobial medication resistance continues to rise. According to Dromigny *et al.*, (2005), the majority of people with severe urinary tract infection symptoms were likely treated without doing a bacteriological study in 95% of cases. According to Coque *et al.*, (2008), the first drug resistance was described in relation to ampicillin, amoxyclav, trimethoprim, erythromycin, third-generation cephalosporin antibiotics, and tetracycline.

The incidence and susceptibility profiles of *E. coli*, according to Erb *et al.*, (2007), show substantial topographical alterations as well as significant variations in different contexts and populations. Antibiotics should be used correctly to reduce the rate of antibiotic resistance (Islam *et al.*, 2010). This study's goal was to identify the prevalence and multidrug resistance profile of *E. coli* isolates from individuals with urinary tract infections in hospital settings.

MATERIALS & METHODS: -

In the current investigation, a total of 63 urine samples from individuals with infections of the urinary tract were obtained. Aseptically, in a sterile, clean catch container, fresh midstream urine samples were obtained. Within two hours of collection, urine samples were brought to the lab in sterilized Luria Broth (LB) broth. At 37°C, Luria broth was incubated for an entire night.

Then, using a calibrated loop that delivered 0.01ml of each sample, each sample was inoculated on plates of MacConkey agar, Cysteine Lactose Electrolyte Deficient (CLED) agar, and Eosin Methylene Blue (EMB) agar. Plates were then incubated for 24 hours at 37°C overnight. In addition, the E. coli isolates in which we are most interested were found through analysis of their morphological, cultural, and biochemical traits.

Using the single disc diffusion method recommended by Bauer-Kirby (1966), the antibiotic resistance pattern of E. coli isolates was examined. For this, 3 ml of sterile nutrient broth tubes were injected with a loop full of bacterial culture and incubated at 37°C for 4-6 hours. The nutritional broth tube was then used to moisten a clean cotton swab. The Mueller-Hinton agar plates' whole surface was inoculated with this swab. Mueller-Hinton agar was now covered with an antibiotic disc using sterile forceps, and the plates were then incubated at 37°C for an overnight period.

The following antibiotics were used in the current study, Amoxyclav (30µg), Ampicillin (20µg), Ciprofloxacin (5µg), Nalidixic acid (10µg), Imipenem (10µg), Tetracycline (10µg) and different generation cephalosporin viz, Cefepime (30µg), Cefodoxime (30µg), Cefperazone/sulbactum (20/10µg), Cephalothin (30µg), Ceftazidime/clavalunic acid (20/10µg) and Ceftriaxone (30µg). Every antibiotic was purchased from Hi Media Laboratory in India. A quality control strain that was obtained from MTCC (443) was used as a control strain in the present investigation.

RESULTS AND DISCUSSION: -

A total of 63 urine samples were obtained for the current study from the district civil hospital in Amravati, Maharashtra. These allowed for the isolation of 157 different varieties of Gram-positive and Gram-negative bacteria. *Escherichia coli* was the most frequent etiologic agent in our investigation, accounting for 68.25% (43/63) of all cases. The prevalence of several uropathogens isolated from urine samples is shown in Fig.1. From the isolates females (68.79%) accounted more as compared to males (31.21%). Gender-wise distribution of several uropathogens was shown in Fig.2. Figure 3 depicts the resistance pattern of *Escherichia coli* against 12 different antibiotics.

Using guidelines from the Clinical and Laboratory Standards Institute (CLSI), formerly known as the National Committee on Clinical Laboratory Standards (2006), the resistance pattern of *Escherichia coli* isolates was determined in the current investigation.

Table 1: The frequency of *Escherichia coli* and other bacteria that are isolated from urine samples			
Sr. No.	Bacteria	No. of bacterial isolate	Percentage of isolated bacteria
1	*Escherichia coli*	43	68.25%
2	*Klebsiella pneumoniae*	39	61.90%
3	*Staphylococcus aureus*	31	49.20%
4	*Pseudomonas aeruginosa*	23	36.50%
5	*Bacillus subtilis*	21	33.33%
	Total	157	-

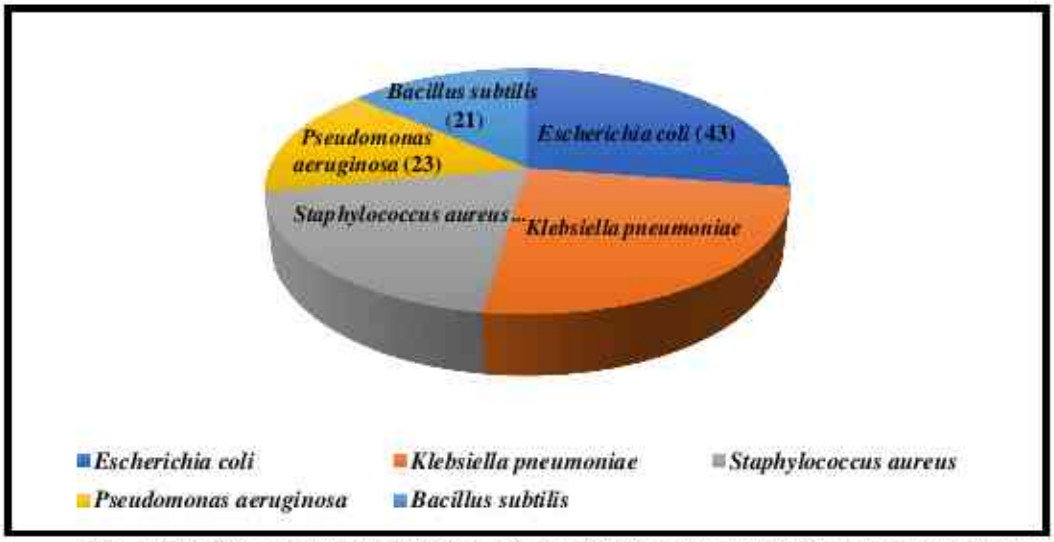

Fig. 1. The frequency of *Escherichia coli* & other bacteria that are isolated from urine samples

Table 2: Gender-specific distribution of several uropathogens in numbers					
Gender	**Uropathogens**				
	E. coli	***K. pneumoniae***	***S. aureus***	***P. aeruginosa***	***B. subtilis***
Male (%)	20	11	08	07	03
Female (%)	35	26	19	15	13
Total	55	37	27	22	16

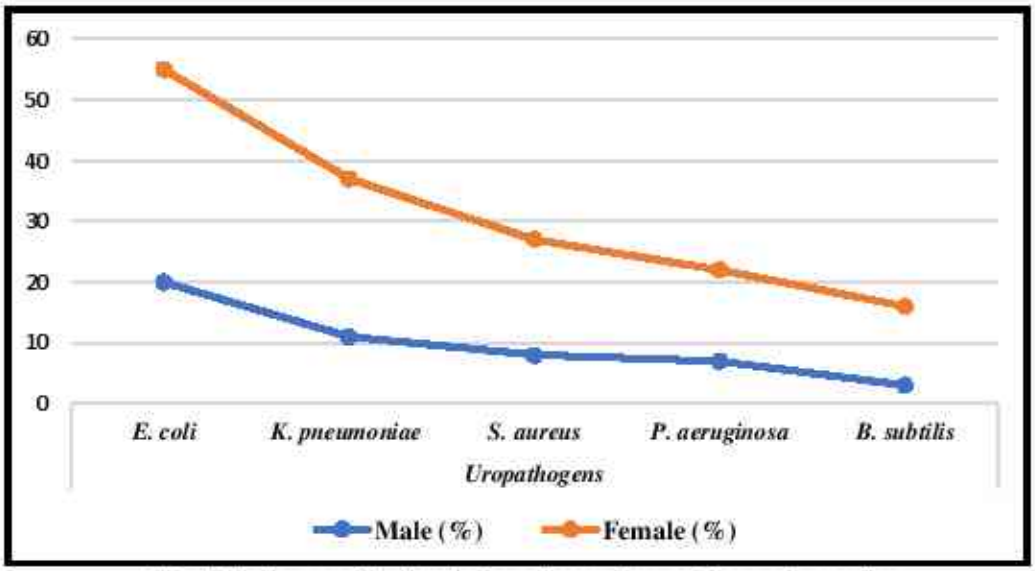

Fig. 2 Gender-specific distribution of several uropathogens in numbers

Table 3: ***Escherichia coli's*** **pattern of resistance towards 12 different antibiotics**			
Sr. No	**Antibiotics**	**No. of resistant isolates**	**% of resistant isolates (n=43)**
1	Amoxyclav (30µg)	39	90.70%
2	Ampicillin (20µg)	35	81.40%

3	Ciprofloxacin (5µg)	34	79.07%
4	Nalidixic acid (10µg)	37	86.05%
5	Cefodoxime (30µg)	32	74.42%
6	Cephalothin (30µg)	28	65.12%
7	Tetracycline (10µg)	27	62.79%
8	Ceftazidime/clavalunic acid (20/10µg)	22	51.16%
9	Ceftriaxone (30µg)	21	48.84%
10	Cefepime (30µg)	18	41.86%
11	Cefperazone/sulbactam (20/10µg)	16	37.21%
12	Imipenem (10µg)	00	00%

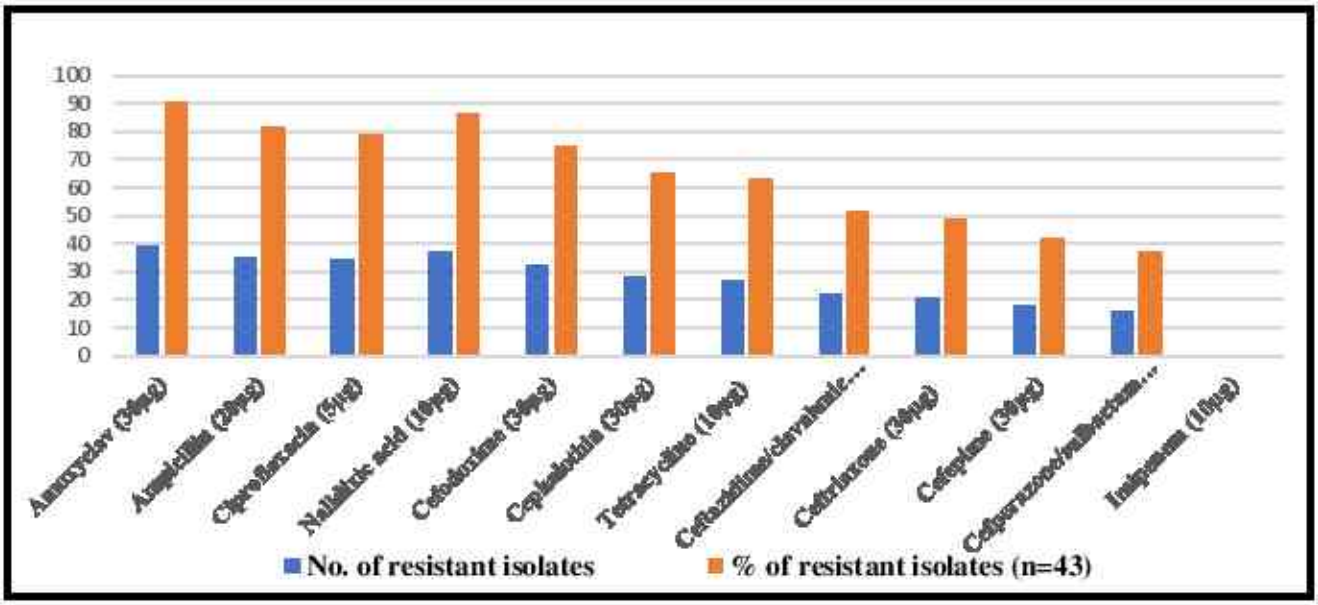

Fig. 3 *Escherichia coli* pattern of resistance towards 12 different antibiotics

The findings of the present study showed that a high proportion of resistance to eleven distinct antibiotics was seen. Amoxyclav (30µg) (90.70%), Ampicillin (20µg) (81.40%), Ciprofloxacin (5µg) (79.07%), Nalidixic acid (10µg) (86.05%), Cefodoxime (30µg) (74.42%), Cephalothin (30µg) (65.12%), Tetracycline (10µg) (62.79%), Ceftazidime/clavalunic acid (20/10µg) (51.16%), Ceftriaxone (30µg) (48.84%), Cefepime (30µg) (41.86%), Cefperazone/sulbactam (20/10µg) (37.21%), and Imipenem (10µg) (00%) are the antibiotics.

Since imipenem was extremely susceptible to all *Escherichia coli* isolates and no one strain was discovered to be resistant, imipenem was the most effective antibiotic and is now the medicine of choice for community-acquired urinary tract infections.

DISCUSSION: -

According to the research that is currently available, the most frequent pathogen found in urine tract infections recovered from patients was *Escherichia coli*. The majority of uropathogens were found in female samples. Akram *et al.* in 2007, conducted a similar investigation. According to Manges *et al.* (2006), the most common pathogen detected in patients with community-acquired urinary tract infections was *Escherichia coli*. Additionally, Zahera *et al.* (2011) demonstrated that the most frequent bacterial isolate discovered in urine samples was *Escherichia coli*.

The current investigation found that 81.40% of *Escherichia coli* strains were resistant to ampicillin, which is concerning. A near about similar set of results, showing 94.29% ampicillin resistance, was discovered by Rawat *et al.* (2010).

The level of fluoroquinolone resistance among the E. Coli isolates in this investigation, including ciprofloxacin, was likewise high. The percentage of E. Coli isolates resistant to ciprofloxacin was 79.07%. The findings of this study are consistent with earlier research, including 84% by Ahmad et al. (2009) and 90.28% by Rawat et al. (2010). The current results of our investigation, however, differ slightly. According to Kiffer et al. (2007), there was a lower-than-expected rate of ciprofloxacin resistance.

In our investigation, 62.79% of the *Escherichia coli* isolates showed high resistance to tetracycline. Yengkokpam *et al.* (2007) discovered a comparable kind of outcome, noting that 73.30% of isolates were found to be tetracycline resistant.

In our investigation, a remarkable 90.70% resistance rate towards amoxyclav was discovered. When this data was compared to findings from another researcher, Mulla *et al.* (2011) demonstrated that amoxyclav was an ineffective medication. The reason behind the resistance of bacteria like *Klebsiella pneumoniae* and *Escherichia coli* to this antibiotic is their synthesis of an enzyme called extended-spectrum β-lactamase, which is mediated by plasmids. In comparison to amoxyclav, 51.16% of the isolates of *Escherichia coli* that we studied showed reduced resistance to ceftazidime/clavulanic acid.

Only 41.86% of the isolates in this experiment were resistant to cefepime, indicating a slightly high susceptibility. Our data revealed almost identical results to those of Khadri *et al.* (2009), who discovered that the proportion of isolates resistant to this antibiotic was lower. As compared with the results of Rawat *et al.*,

According to the results of Rawat *et al.*, (2010) compared with our findings we observed that only 8.75% of *Escherichia coli isolates* were found to be resistant to this antibiotic. In the present investigation, the antibiotic ceftriaxone showed 48.84% resistance. George *et al.* (2012) conducted a similar kind of investigation because only 26.80% of the isolates of *Escherichia coli* were ceftriaxone-resistant.

Nalidixic acid and cephalothin, which account for 86.05% and 65.12% of the resistance rate, respectively, were shown to be highly resistant. Additionally, a high resistance rate of 74.42% against cefodoxime was noted. The current study found that the combination therapy of cefperazone and sulbactum reduced the rate of resistance to this antibiotic, with only 37.21% of *Escherichia coli* isolates resistant to it. Sulbactam is a potent inhibitor of extended-spectrum β-lactamase, so this combination may be used in the future to treat severe nosocomial infections.

Since no one *Escherichia coli* isolate was shown to be resistant in our investigation, imipenem may be the most popular medication of choice. Similarly, imipenem was found to be sensitive to every isolate of *Escherichia coli* by Farshad *et al.* (2010). Adwan *et al.* also noted a significant sensitivity to imipenem (2004).

CONCLUSION: -

The previously mentioned study proved that there is a considerable level of drug resistance to several different kinds of antibacterial drugs. An extremely alarming sign is that every isolation of *Escherichia coli* was resistant to most antibiotics. All of the isolates had extremely high rates of resistance to ciprofloxacin, amoxyclav, ampicillin, nalidixic acid, cefodoxime, cephalothin, and tetracycline. Given that it is effective against every isolate of *Escherichia coli*, imipenem is the drug of choice for treating bacterial infections.

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International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Volume 11, Issue 12, December-2023, Available online at: www.ijaresm.com

Antibiogram of Multi-Drug Resistant Klebsiella Pneumonia Isolated from Clinical Specimens

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ABSTRACT

Health professionals are also concerned about the issue of multi-drug resistance to antibacterial treatments. Due to the many resistance patterns that Enterobacteriaceae exhibit, treating different infections can be challenging. This problem arises from the abundant and broad usage of antibiotics. One major factor contributing to the emergence of bacterial resistance is the widespread use of antibiotics in medicine. Resistance to antimicrobial drugsis a global phenomenon that affects infections related to the urinary system, respiratory tract, hospital, and healthcare facilities, as well as diarrheal illnesses. Antimicrobial drug resistance is caused by several processes and is defined as resistance to at least one or more than two types of antibiotics. Klebsiella pneumoniae is the most common causative and pathogenic agent identified from urine samples. It was the most frequent bacteria found in urine samples that was isolated. Females likewise exhibited a high percentage, 72.27% (73/101). Thirteen distinct antibiotics were used to further examine each of these isolates. Amikacin (30µg) (91.08%), Amoxyclav (30µg) (86.13%), Ampicillin (10µg) (80.19%), Aztreonam (30µg) (82.17%), Cefepime (30µg) (78.21%), Cefixime (5µg) (67.32%), Cefodoxime (30µg) (62.37%), and Cephalexin (30µg) (58.41%), among other antibiotics, demonstrated remarkable resistance against these antibiotics. However, the widely recommended medication for UTIs is imipenem.

Keywords: K. Pneumoniae, Urine Specimen, Multiple-Drug resistance

INTRODUCTION

The family Enterobacteriaceae has a broad range of rapid aerobic, non-sporing, non-acid Gram-negative bacteria. The human large intestine is home to the majority of these family members. This huge family member has common morphological and biochemical characteristics.

This complex family has members that can be either non-or fully capsulated, motile by the use of flagella, or non-motile. Salmonella and Shigella are not lactose fermenters, however, the most prevalent member of this family is lactose-fermenting Escherichia coli, which is also present together with Klebsiella, Proteus, Enterobacter, Citrobacter, Serratia, Edwardsiella, etc. According to Ananthanarayan and Paniker (2009), the Enterobacteriaceae family exhibits heterogeneity in its antigenic structure as well as several distinct metabolic features.

Enterobacteriaceae infections are becoming a major clinical concern and are common all over the world (Sasirekha et al., 2010).

According to Paterson (2006), these organisms are the most significant opportunistic human pathogens that cause major infectious diseases, such as pneumonia linked to hospitals and healthcare facilities, septicemia, urinary tract infections, and different abdominal infections.

Due to the many resistance patterns that Enterobacteriaceae exhibit, treating different infections can be challenging. The root of this problem is the overuse and abuse of antibiotics. The extensive use of antibiotics in medicine is a significant contributor to the establishment of bacterial resistance. (Hemchandranet al., 2011).

Over the past twenty years, targeted drugs like cephalosporin and fluoroquinolone have made treating these infections relatively easy. The majority of the cephalosporin group of antibiotics includes antibiotics having β-lactam ring, which are frequently used to treat nosocomial infections. Antibiotics of this class have shown to be dependable workhorses up to the 20th century.

However, the widespread usage of antibiotics in the 21st century has led to a concerning scenario where resistance to these medications is developing (Denton, 2007).

While antibiotic therapy works well in most cases to control infections, there is currently a problem in the world with high-resistant bacteria that are resistant to life-saving medications; as a result, the effectiveness of antimicrobial agents is declining (Reid and Bruce, 1990).

Antimicrobial resistance is a global phenomenon that affects infections related to the urinary system, respiratory tract, hospital, healthcare facilities, and diarrheal illnesses. Antimicrobial drug resistance is caused by several processes and is defined as resistance to at least one or more than two groups of antibiotics (Engel, 2009).

Antibiotics known as β-lactams are frequently employed to address bacterial infections. Excessive usage of antibiotics, especially third-generation or extended-spectrum cephalosporins, causes bacterial resistance mediated by β-lactamases, which in turn causes the emergence of bacteria that produce extended-spectrum β-lactamases (ESBLs).

It was thus named expanded spectrum β-lactamases about these novel β-lactamases. Enzymes known as extended-spectrum antibiotics (ESBLs) cause resistance to both monobactams like aztreonam and extended-spectrum antibiotics like third-generation cephalosporins (CLSI, 2010). However, ESBLs are more common in Klebsiella species than in any other enterobacterial species; outbreaks of infection caused by ESBL-producing Klebsiella sp. have been widely reported. They have been found in Pseudomonas aeruginosa in addition to various genera of Enterobacteriaceae.

As per Sepehri et al., (2005), β-lactam antibiotics are the most often administered antibiotics for infections caused by Enterobacteriaceae family members.The production of extended range β-lactamases is the main mechanism of resistance in Enterobacteriaceae, particularly in Gram-negative bacteria. (Poole, 2004).

Extended-spectrum β-lactamases are a fast-growing class of plasmid-mediated enzymes that can hydrolyze and inactivating β-lactam antibiotics, including cephalosporin, penicillin, monobactams, and carbapenems. β-lactamase inhibitors, like clavulanate, sulbactam, and tazobactam, block these enzymes in vitro (Ndugulileet al., 2005; Spanuet al., 2006; Hosogluet al., 2007; Mansouri and Abbasi, 2010).

MATERIALS & METHODS

A total of 101 urine samples from both male and female subjects with urinary tract infections were collected from various laboratories for the current study. Fresh midstream urine samples were collected aseptically in a clean, sterile catch container. Urine samples were collected and brought to the lab in sterilized Luria Broth (LB) broth within two hours of collection. Luria broth was incubated for a whole night at 37°C.

Using the single disc diffusion method recommended by Bauer-Kirby (1966), the antibiotic resistance pattern of Klebsiella pneumoniaeisolates was examined. For this, 3 ml of sterile nutrient broth tubes were injected with a loop full of bacterial culture and incubated at 37°C for 4-6 hours. The nutritional broth tube was then used to moisten a clean cotton swab. The Mueller-Hinton agar plates' whole surface was inoculated with this swab. Mueller-Hinton agar was now covered with an antibiotic disc using sterile forceps, and the plates were then incubated at 37°C for an overnight period.

The following antibiotics were used in the present investigation,Amikacin (30µg), Amoxyclav(30µg), Ampicillin (10µg), Aztreonam (30 µg), Cefepime(30µg), Cefixime (5µg), Cefodoxime (30µg), Cephalexin (30µg), Cephalothin(30µg), Ceftazidime (30µg), Ceftriaxone(30µg), Imipenem(10µg), Tetracycline (10µg). All of the antibiotics were bought from Hi Media Laboratory, India. In the current investigation, a quality control strain was used to compare the outcomes.

RESULTS AND DISCUSSION

For the current investigation, urine samples from various hospitals and laboratories were obtained, and from those samples, 101 Klebsiella pneumoniae bacteria were isolated. The chromogenic medium Hi-chrome UTI agar was used in conjunction with a differential medium, such as MacConkey agar, and several selective media, such as Eosin Methylene Blue (EMB) agar and Cysteine Lactose Electrolyte Deficient (CLED) agar, to isolate Klebsiella pneumonia.

Bacterial isolates were identified using their morphological and biochemical features. Primary identification was carried out based on how the colony appeared in the relevant media. Klebsiella pneumoniae produces a mucoid or sticky colony on EMB agar.

The morphological and biochemical characteristics of Klebsiella pneumonia bacterial isolates which were isolated from urine samples were depicted in Table 1.

Table 1: Morphological and biochemical characteristics of Klebsiella pneumoniaeisolated from urine samples.

Sr. No.	Bacterial Isolate	Gram Character	Shape	Motility	Indole production	MR test	VP test	Citrate utilization	Oxidase	Catalase	Urea hydrolysis	H2S production	Glucose	Lactose	Mannitol	Sucrose
1	Klebsiella pneumoniae	-	Rod	Non-motile	-	-	+	+	-	+	-	-	+	+	+	+

Note: +: Positive; -: Negative; Gm-: Gram negative

The most common etiologic agent in our study, representing 60.47% (101/167) of all cases, was Klebsiella pneumoniae. The majority of the isolates were obtained from samples collected from females (72.27%) than males (27.72%). Figure 1 displays the distribution of Klebsiella pneumoniae by gender.

Table 1: Distribution of the Klebsiella pneumoniae isolates by gender in urine samples.

Sr. No.	Organism	Origin of the sample	Gender		Total
			Male	Female	
1	Klebsiella pneumoniae	Urine	28	73	101

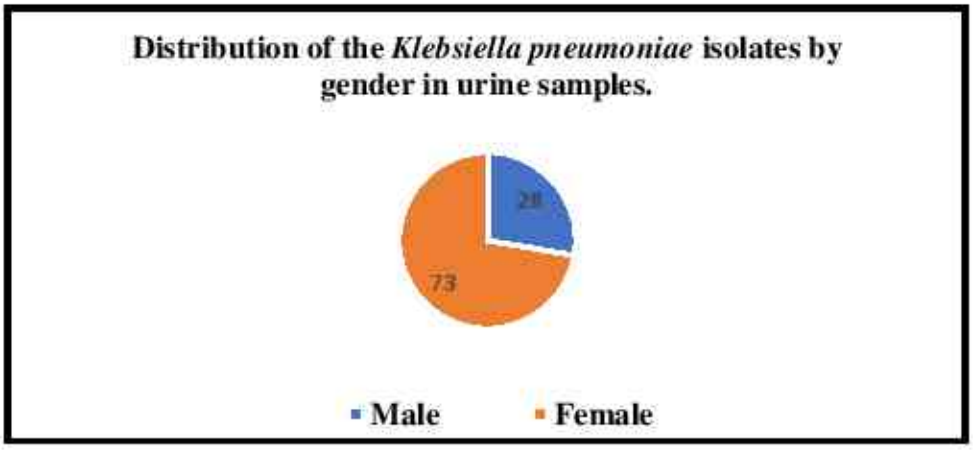

Fig. 1. Distribution of the Klebsiella pneumoniae isolates by gender in urine samples.

The resistance pattern of Klebsiella pneumoniae to 13 different antibiotics is shown in Figure 2. The resistance pattern of Klebsiella pneumoniae isolates was identified in the current study using the guidelines from the Clinical and Laboratory Standards Institute (CLSI), formerly known as the National Committee on Clinical Laboratory Standards (2006).

Table 2: Antibiogram of Klebsiella pneumoniaetowards 13 different antibiotics

Sr.No	Antibiotics	No.ofresistant isolates	%ofresistantisolates(n=101)
1	Amikacin (30µg)	92	91.08%
2	Amoxyclav(30µg)	87	86.13%
3	Ampicillin (10µg)	81	80.19%
4	Aztreonam (30µg)	83	82.17%
5	Cefepime(30µg)	79	78.21%
6	Cefixime (5µg)	68	67.32%
7	Cefodoxime (30µg)	63	62.37%
8	Cephalexin (30µg)	59	58.41%
9	Cephalothin(30µg)	53	52.47%
10	Ceftazidime (30µg)	48	47.52%
11	Ceftriaxone(30µg)	43	42.57%
12	Imipenem(10µg)	00	00%
13	Tetracycline (10µg)	65	64.35%

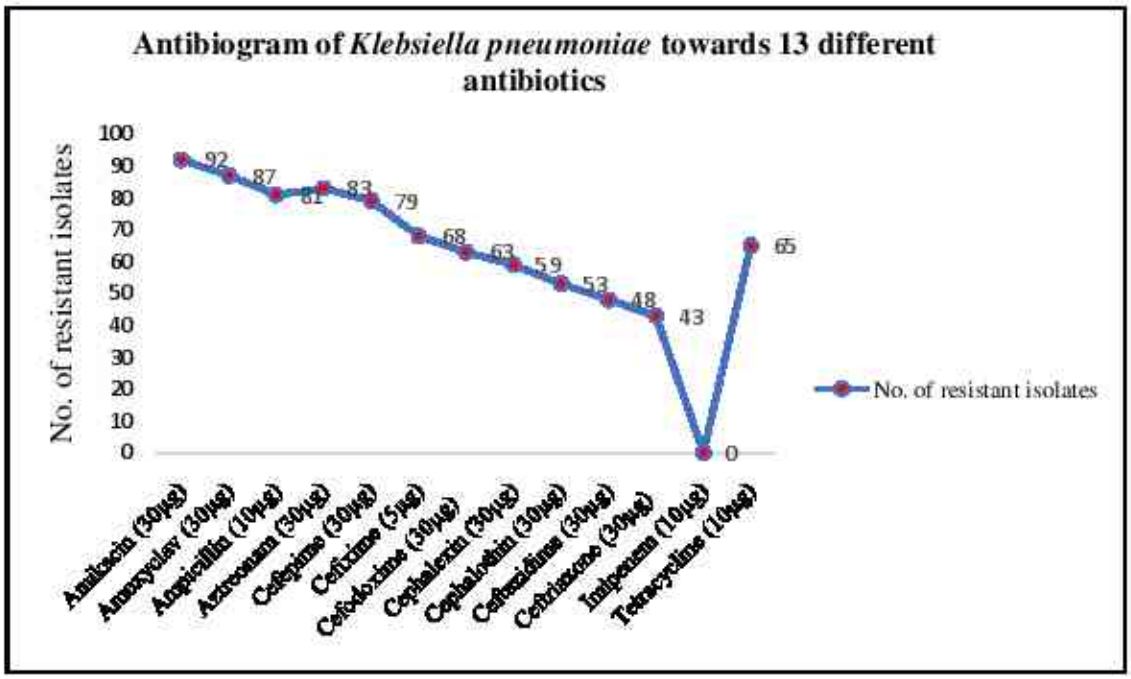

Fig 2. Antibiogram of Klebsiella pneumoniae towards 13 different antibiotics

The results of this investigation demonstrated a significant percentage of multidrug resistance i.e., resistance to twelve different drugs. Amikacin (30µg) (91.08%), Amoxyclav(30µg) (86.13%), Ampicillin (10µg) (80.19%), Aztreonam (30µg) (82.17%), Cefepime(30µg) (78.21%), Cefixime (5µg) (67.32%),Cefodoxime (30µg) (62.37%), Cephalexin (30µg) (58.41%), Cephalothin(30µg) (52.47%), Ceftazidime (30µg) (47.52%), Ceftriaxone(30µg) (42.57%), Imipenem(10µg) (00%), Tetracycline (10µg)(64.35%)are the antibiotics.Imipenem was the most effective antibiotic and is currently the drug of choice for community-acquired urinary tract infections since it was highly sensitive to all isolates of Klebsiella pneumoniae and no strain was found to be resistant.

DISCUSSION

From urine samples, it was found that a higher percentage of isolates in females than in males. This number is consistent with previous research, as Khadri and Alzohairy (2009) found that from urine samples, 68.4% of the bacterial isolates were isolated from female urine samples and 31.5% from male urine samples. Several researchers, including Maya et al. (2010) and Sharma et al. (2012), also reported similar findings.

Our study's results were in reasonable agreement with those of Melaku et al., (2012), who found that 50.5% of isolates were from samples belonging to women and 49.5% from samples belonging to men. These results were marginally less than the current study's findings.

Akram et al., (2007) conducted a similar study and stated that urine samples from females contained more K. pneumonoiae isolates than samples from males. According to a previous publication, there was a higher prevalence of this bacteria in various clinical specimens, including pus, blood, sputum, and fecal matter, particularly in females compared to males (Maya et al., 2010).

The current study's findings were somewhat consistent with those of Sharma et al. (2012), who isolated 37.82% of K. pneumoniae from several clinical samples. The prevalence rates of K. pneumoniae and E. coli, which are 28% and 20.3%, respectively, were lower than our results by Melaku et al., (2012), the other investigator.

The results of this investigation are consistent with those of Mshanaet al., (2009), who found that K. pneumoniae was the second most common isolate from a urine sample.K. pneumoniae isolates from urine and other clinical samples were reported to be 35.16%, 2.19%, 34.06%, and 28.57% by Mshanaet al., (2009).

The study carried out by Chaudhary, (2003) has been reported, 66% resistance against cefpirome, 72.7% to cefuroxime and towards cefotaxime 63.10% resistance was observed. The similar kind of results has been reported by Prakash et al., (2005) as 85.40% isolates of K. pneumoniae were resistant to cephalexin and 64.60% to cefpirome. Exactly similar result was observed by same investigator against cefotaxime 72.90% and ceftriaxone 70.80% isolates were resistant as compared with our results. Against ciprofloxacin high rate of resistance was observed 47.90% than our result, while

against amikacin 39.60% i.e., lower resistance rate was recorded than reported in the present study and slightly high resistance was seen against gentamicin 66.70% than our result.

The results of the present investigation suggest that imipenem was most sensitive drug which was exact harmony with results by Prakash et al., (2005) recorded that imipenem was completely sensitive. The findings of our study was quite similar or dissimilar to findings of Patil and Deshpande, (2010) who reported that K. pneumoniae was found to be 98% resistant to streptomycin, 54% to tobramycin, 18% and 14% to gentamicin and amikacin, while only 6% resistant to norfloxacin and ciprofloxacin.

Ampicillin was not found effective antibiotic against Klebsiella pneumoniae as high resistance rate was noted (70%). Even higher resistance was observed towards ampicillin. In the present study 60% resistance was observed against amoxyclav and co-trimaxozole. Nearly similar results were obtained by Sasirekha et al., (2010) who reported 40% and 37.14% isolates were resistant to these antibiotics. While in our study 50% isolates were resistant to tetracycline. Much higher rate of resistance (94.28%) was observed and also lower sensitivity was found against chloramphenicol by same investigator than our result. The result of the present study correlate with Jyothsna et al., (2011) who reported that higher resistance to cefotaxime (100%) was seen among K. pneumoniae compare to our result. Slightly lower resistance was observed against ceftazidime and ceftriaxone (50%) than our result. Mhsanaet al., (2011) studied the activity of cefepime against ESBL producing K. pneumoniae reported that 75.9% isolates were resistant which was lower as compared with our result.

CONCLUSION

The previously mentioned study proved that there is a considerable level of drug resistance to several different kinds of antibacterial drugs. An extremely alarming sign is that every bacterial isolate of Klebsiella pneumoniae was resistant to most antibiotics. All of the isolates had extremely high rates of resistance to Amikacin (30µg), Amoxyclav(30µg), Ampicillin (10µg), Aztreonam (30µg), Cefepime(30µg), Cefixime (5µg), Cefodoxime (30µg).Given that it is effective against every isolate of Klebsiella pneumoniae, imipenem is the drug of choice for treating bacterial infections.

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ISSN 2319 - 359X

AN INTERNATIONAL MULTIDISCIPLINARY
HALF YEARLY RESEARCH JOURNAL

IDEAL

Volume - XII Issue - II March - August - 2024

ENGLISH PART - VIII

Peer Reviewed Referred and
UGC Listed Journal No. 47026

Single Blind Review/Double Blind Review

ज्ञान-विज्ञान विमुक्तये

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Ajanta Prakashan
Aurangabad. (M.S.)

Printed by

Ajanta Computer, Near University Gate, Jaisingpura, Aurangabad. (M.S.)

Published by

Ajanta Prakashan, Near University Gate, Jaisingpura, Aurangabad. (M.S.)

Cell No. : 9579260877, 9822620877

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IDEAL - ISSN 2319 - 359X - Impact Factor - 7.537 (www.sjifactor.com)

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10. Isolation and Characterization of Bacterial Isolates from Agriculture Field Soil of Buldhana Region

Y. S. Patil
Shri. D. M. Burungale Science and Arts College, Shegaon.
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Abstract

Microorganisms present in soil plays a major role in enhancing the plant growth. In our present study soil sample was collected from the agriculture field of Buldhana District and organisms were isolated by serial dilution technique. Well defined isolated colonies were selected and pure cultured. The isolates were named as S1, S2, S3, S4 and S5. Biochemical characterization of the above mentioned isolates determined and metabolism of various sugars was done at a maximum rate by the isolates S4 and S5. Based on their biochemical characterization and carbohydrate fermentation the isolates were identified to be *Bacillus, Pseudomonas, Streptomycis, Azotobacter* and *Alcaligenes.*

Keywords: *Agriculture soil, isolates, carbohydrate fermentation.*

Introduction

Microorganisms are present in every part of biosphere, including soil, hot springs, inside rocks and 19 kilometres deep underground etc., Microorganisms present in soil play an important role in maintaining the biogeochemical cycle and biological balance in the life of our planet. All soils contain different types of microorganisms viz. bacteria, fungi, viruses etc. in varying amounts depending on soil conditions. The permitted degree of acidity and the types of residue added also determine the relative abundance of microbes. The fertility of soil and the accumulation of organic matter within a short time are dependent on the bacterial amount (Kummerer, 2004). The products and the by products of microorganism in soil are beneficial to increase the nutrient contents in soil, plant growth and also play an important role in nutritional chains (Paul and Clerk, 1966; Kumerer, 2004). Microorganisms in soil also play a major role in changing the nutrients into a form that can be used (Tugel and Lewandowski, 2010). Microorganisms in soil play a crucial role in biogeochemical cycles and in sustainable development of biosphere (Diaz, 2004). Microorganisms present in soil produces and consume

two or three major naturally occurring green house gases that distinctly influence agriculture (Levine *et al.*, 2011). In our present study we have collected the soil sample from the agriculture land of Buldhana District region. The organisms were isolated and characterized.

Materials and Methods

Collection of Soil Sample

The soil sample was collected from uprooted area of the plants without breaking the secondary and tertiary roots and placed in a sterile plastic bags and safely transferred to microbiology laboratory. The adhering soils from the root parts were separated carefully and stored at 4°C for further studies.

Determination of Pysiochemical Properties of Soil

Fresh soil samples were subjected to determine physiochemical properties. Soil pH was determined according to the procedure described by Martin *et al.* (2013). The moisture content of the sample was measured in hot air oven at 105°C to constant weight. The temperature and humidity was determined using thermometer and hydrometer (Pramer and Schmidt, 1964; Iyengar and Bhave, 2005).

Isolation of Bacterial Isolate

The soil microorganisms were isolated by serial dilution technique on nutrient agar medium (NAM). One gram of soil from sample were separately suspended in 10 ml of distilled water and mixed well for 15 minutes and vortexed. Each suspension was serially diluted from 10^{-1} to 10^{-6}. Spread plate technique was carried out to isolate the organism form the diluted sample. 0.1 ml was pipette out onto plates with nutrient agar and spreaded with a glass L shape rod and incubated at 37°C for 24 hours. The most prominent colonies were isolated and maintained at 4°C for further studies.

Identification and Characterization of Bacteria

The shape, size and arrangement of the isolates and their differentiation into gram negative or gram positive bacteria were found. The bacterial isolates were characterized biochemically by various tests like Indole, MR, VP, Citrate etc., including carbohydrate fermentation (Collins and Lyne, 1989; Harold, 2002; Zaved *et al.*, 2008).

Results and Discussion

The soil sample was collected from the rooted region of the plants in the agriculture area of Buldhana District. The soil sample was observed for its physiochemical properties. The soil had pH of about 6.5. Soil with such pH conditions enhances the nutrient availability. The temperature notified benefits the plant in availability of nutrients and the moisture content enhances the nutrient availability and enriches the growth of microorganisms which intern aids in plant growth.

Biochemical Analysis of Isolates

Soil sample from the agriculture field of Buldhana District were serially diluted and five well defined colonies (S1, S2, S3, S4, and S5) were selected and were pure cultured. The isolates were subjected to gram reactions and several biochemical characterizations. Among five isolates three isolates were found to be gram positive and two were gram negative. Almost all the isolates were rod shaped in which S1 was spore former and S2, S4 and S5 were found to be motile.

S2 and S5 were found to be gram negative and the remaining all other isolates identified namely S1 and S3 were found to be gram positive in reaction. The maximum fermentation of sugars was carried out by S4, whereas S5 did not undergo fermentation process. Based on biochemical characterization and fermentation of sugars the isolate S1 was identified as *Bacillus* sp, S2 was identified as *Pseudomonas* sp, S3 was identified as *Streptomycis* sp, S4 was identified to be *Azotobacter* sp and S5 was found to be *Alcaligenes* sp (Table 2).

Chitra Bhattacharya *et al.* (2014) in their research work has stated that from the agriculture soil microorganisms like *Micrococcus* sp, *Escherichia* sp, *and Staphylococcus* sp. have been isolated. Several bacteria and fungi were isolated from soil using serial dilution method (Nakuteshwar Dut Jasuja, 2013).

Conclusion

Soil contains billions of microorganisms in which some bacterial species are very fragile and may be killed by slight changes in the soil environment. Others are extremely tough, able to withstand severe heat, cold or drying. Some bacteria are dependent on specific plant species. Soil food web supports other soil organisms and the functions of a healthy soil. Diversified nature of soil bacteria can suppress root diseases. The current study establishes that the soil from agriculture field of Buldhana District has bacteria that might enhance the growth of plants and can be used as plant growth promoting bacteria.

Table 1: Morphological and Biochemical Characterization of

Bacterial Isolates from Soil

Test	S1	S2	S3	S4	S5
Gram Reaction	+	-	+	+	-
Spore former	+	-	-	-	-
Motility	-	+	-	+	+
Morphology	Rods	Rods	Ariel Mycelium	Rods (Diploid)	Rods
Indole		-	-		-
Methyl Red	-	-	-	-	-
VP	+	-	-	-	-
Citrate	-		-		
TSI	-	-	-	-	-
Urea	-	-	-	+	-

Table 2: Carbohydrate Fermentation of Bacterial Isolates from Soil

Carbohydrates	S1	S2	S3	S4	S5
Arabinose	-	-	–	+	-
Arabitol	-	-	-	-	-
Fructose	+	-/+	–	+	-
Fructose	+	-	-	+	-
Glucose	+	–	-	+	-
Lactose	-	-	-		-
Mannitol	-	–	–	-	-
Maltose	+	–	-	-	-
Starch		-	-	-	-
Sucrose	+	-	-	+	-
Xylose	-	-	-	+	-
Identified genus	***Bacillus sp***	***Psuedomonas sp***	***Streptomycis sp***	***Azotobacter sp***	***Alcaligenes sp***

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THE RUBRICS JOURNAL OF INTERDISCIPLINARY STUDIES
International, Indexed and Peer Reviewed e-Journal
ISSN 2454 1974

Synthesis Of Some Novel S-Arylisothiocarbamides

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INTRODUCTION

Thiolactosides constitute an important family of carbohydrate derivatives. These carbohydrate derivatives bearing *S*-linked functionalities at anomeric position are biologically and pharmacologically important[1]. Urea, thiourea and their derivatives are versatile reagent in organic synthesis and show strong antibacterial activity[2]. This type of compounds show antidiabetic and antituberculosis[3] significance. Lactosyl bromide[4] is an important reagent in the synthesis of *S*-lactosylated compounds. They were prepared by the interaction of hepta-*O*-benzoyl lactosyl bromide **(1)** and arylthiocarbamides[5] **(2a-g)**.

EXPERIMENTAL

All the melting points recorded are found uncorrected. IR Spectra were recorded on Perkin-Elmer spectrum RXI FTIR Spectrometer. ^{1}H NMR was obtained on Bruker DRX-300 NMR Spectrometer. Samples were prepared in $CDCl_3$ with TMS as an internal reference. The mass spectra were obtained on Thermo Fennigan LCQ Advantage max ion trap mass spectrometer. Optical rotations $[\alpha]_D^{31}$ were measured on the Equip-Tronics EQ-800 Digital Polarimeter at 31 ◦ C in $CHCl_3$.

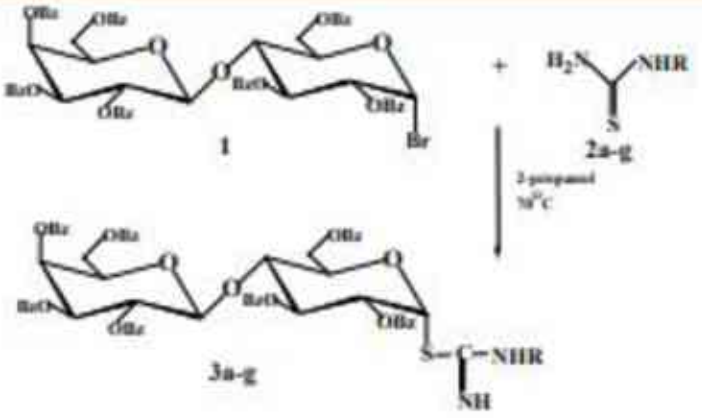
RESULT AND DISCUSSION

Isopropanolic (40 ml) suspension of hepta-O-benzoyl lactosyl bromide and phenyl thiocarbamide was heated on water bath at about 70◦C until the suspension gets cleared. The clear solution was kept at room temperature for 20 hours. It was mixed with 100 ml distilled water. This aqueous solution was acidic and non-desulphurisable when boiled with alkaline plumbite solution. The aqueous solution was basified with ammonium hydroxide afforded a sticky mass which was not solidified on standing for several hours. It was purified by ethanol and water. It gave charring test and was found to be non-desulphurisable. Its specific rotation was found $[\alpha]_D^{31}$ -30 (*c*, 0.980 in $CHCl_3$).

The IR, ^{1}H NMR and mass spectral analysis[6-11] and elemental analysis (Table 1) clearly indicated the product and was assigned the structure as *S*-hepta-*O*-benzoyl lactosyl-1-phenyl isothiocarbamide **(3a)**.

When the interaction of hepta-*O*-benzoyl lactosyl bromide was extended to other arylthiocarbamides the related *S*-hepta-*O*-benzoyl lactosyl-1-arylisothiocarbamides **(3b-g)** were isolated.

ISSN 2454-1974



Scheme 1

Where, Bz = COC_6H_5

R = a) phenyl, b) *o*-tolyl, c) *m*-tolyl, d) *p*-tolyl, e) *o*-Cl-phenyl, f) *m*-Cl-phenyl, g) *p*-Cl-phenyl.

General Procedure

Synthesis of S-hepta –O-benzoyl lactosyl -1-phenylisothiocarbamides (3a-g)

Isopropanolic (40 ml) suspension of S-hepta-*O*-benzoyl lactosyl bromide (0.01M, 11.32g) and phenyl thiourea (0.01M, 1.52g) was heated on water bath at about 70°C until the suspension gets cleared. The clear solution was kept at room temperature for 20 hours.

The aqueous solution when basified with ammonium hydroxide and afforded a sticky mass which was not solidified on standing for several hours. This sticky mass was purified by ethanol and water, the solid was obtained.

3a. IR (KBr) : ν 3460 cm^{-1} (N-H), 1728 cm^{-1} (C=O), 1655 cm^{-1} (C=N), 1454 cm^{-1} (C-N), 1271 cm^{-1} (C-O), 1026,858 (characteristic of lactose unit) and 709 cm^{-1} (C-S); ^{1}HNMR ($CDCl_3$): δ 8.14- 7.16 (40 H, m, Ar-H); δ 5.76 -5.39 (14 H, m, lactose ring protons); δ 5.75 (2H, s, 2N-H). MS (*m/z*): 1204 (M^+), 1083, 1053, 976, 948, 932, 918, 579. Anal. Found : C, 67.70; H, 4.70; N, 2.32 S, 2.74 Calcd. For $C_{68}H_{56}O_{17}N_2S$: C, 67.77; H, 4.65; N, 2.32; S, 2.26 %

3b. IR (KBr) : ν 3469 cm^{-1} (N-H), 1728 cm^{-1} (C=O), 1632 cm^{-1} (C=N), 1453 cm^{-1} (C-N), 1271 cm^{-1} (C-O), 1028 (characteristic of lactose unit) and 710 cm^{-1} (C-S); ^{1}HNMR ($CDCl_3$):δ 8.07- 7.18 (39 H, m, Ar-H); δ 5.74 -5.43 (14 H, m, lactose ring protons); δ 5.73 (1H, s, 2N-H), δ 6.1 (1H, s, N-H). MS (*m/z*): 1238 (M^+), 1203, 1133, 1103, 1053, 976, 932, 579. Anal. Found : C, 63.85.70; H, 4.25; N, 2.18 S, 2.77 Calcd. for $C_{68}H_{55}O_{17}N_2SCl$: C, 65.85; H, 4.43; N, 2.31; S, 2.88 %

3e IR (KBr) : ν3469 cm^{-1} (N-H), 1728 cm^{-1} (C=O), 1602 cm^{-1} (C=N), 1454 cm^{-1} (C-N), 1453 cm^{-1} (C-O), 1027, 855, (characteristic of lactose unit) and 710 cm^{-1} (C-S); ^{1}HNMR ($CDCl_3$):δ 8.03- 7.18 (39 H, m, Ar-H); δ 5.79 -5.39;(14 H, m, lactose ring protons); δ 2.9

ISSN 2454-1974

(3H, s, Ar-CH3), δ 6.8-6.7(2H, s, N-H). MS (m/z): 1218 (M^+), 1133, 1097, 1053, 932, 918, 579. Anal. Found : C, 66.78; H, 4.56; N, 2.4 S, 2.50 Calcd. For $C_{68}H_{74}O_{17}N_2S$: C, 67.98; H, 4.76; N, 2.2; S, 2.56 %

ANTIMICROBIAL ACTIVITIES

All the compounds have been screened for both antibacterial and antifungal activities using cup plate agar diffusion method by measuring the inhibition zone in mm. The compounds were taken at a concentration of 1µ/mL using dimethyl sulphoxide as solvent. Amikacin (100µg/ml) was used as a standard for antibacterial and antifungal activity and fluconazole (100µg/ml) as a standard for antifungal activity. The compounds were screened for antibacterial activity against *Escherichia coli, Staphylococcus aureus, Proteus vulgaris, Salmonella typhi, Klebsiella Pneumoniae, Pseudomonas aeruginosa, Bacillus subtilis* in nutrient agar medium and for antifungal activity against *Candida albicans* and *Aspergillus niger* in potato dextrose agar medium.It has been observed that all of these synthesized compounds showed nearly the same inhibitory activity as that of the standard Amikacin and Fluconazole. These sterilized agar media were poured into Petri dishes and allowed to solidify on the surface of the media, microbial suspensions were spread with the help of sterilized triangular loop. A stainless-steel cylinder of 8mm diameter (pre-sterilized) was used to bore the cavities. 0.1mL portions of the test compounds in solvent were added into these wells. The drug solution was allowed to diffuse for about an hour into the medium. The plates were incubated at 37°c for 24h and 30°c for 48h for antibacterial and antifungal activities respectively. The zone of inhibition observed around the cups after respective incubation was measured. The results are presented in (Table 1).

Table 1. Antimicrobial activities of S-Lactosides (3a-g).

Compd.	Antibacterial**							Antifungal**	
	E. coli	*S. aureus*	*P. vulgaris*	*S. typhi*	*K. Pneumonia*	*P. aeruginosa*	*B. Subtilis*	*C. albicance*	*A. niger*
3a	16	14	20	16	19	15	12	07	09
3b	23	13	13	12	15	17	22	10	07
3c	19	20	-	10	17	-	16	08	11
3d	-	17	22	-	13	13	17	07	-
3e	13	19	12	-	20	-	15	07	09
3f	16	15	17	14	-	14	-	07	08
3g	12	19	17	11	14	-	13	09	08
Amikacin	28	23	25	28	22	25	22	-	28

ISSN 2454-1974

Fluconazole	-	-	-	-	-	-	-	18	-

**zone of inhibition in mm (15 or less) resistance, (16-20mm) moderate and (more than 20mm) sensitive. *Escherichia coli, Staphalococcus aureus, Proteus vulgaris, Salmonella typhi Klebsiella Pneumoniae, Pseudomonas auriginosa, Bacillus subtilis, Candida albicans* and *Aspergillus niger.*

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JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

SMART LIBRARY TECHNOLOGY

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Abstract
The consequence of digitalization, Internet proliferation, and technology advancement, our way of teaching and learning has been changing. The role of library has to be converted into a place for discourse, peer collaboration, social learning, and exhibition concourse. Some scholars believed that the future Library is tied to the technological development of Web4.0 which is cha- rasterized by the terminology of Convergence, Remix ability, Standardization, Participation, Usability, Economy, and Design. This concept has been ex- tended to Campus. Some universities have started to adopt the latest technology to convert their Campus and Library into Smart ones for the interests of students. The findings of this paper support that the latest development of Smart Campus and library aligns with the new trend of education system, and creates positive impact on the competitiveness of a city. The applications in Smart Camus and Library in reality are also revealed.

Keywords- Smart library , Features, Technology.

Introduction:- The library is a crucial resource for learning and education, as it provides access to a vast collection of books and information resources. However, traditional library systems often face problems such as inefficient management of book records, slow processing times, and high-power consumption. Smart library is a system which is developed to maintain research and training activity. In digital environment smart libraries is just a library resolution to innovate library and information services. A library is built with smart technology is able to be open to library users without being personnel. The technology facilitates remote control of library building, includes well furnished furniture, automatics doors, lighting, self-service kiosks and open computers to all users. Create a new advance censor and networking is in a new ways for buildings to meet the needs of their users while reducing costs and increasing efficiency.

The concept of smart library

Began in 2000s with the advancement of the computer technology and digital interactions. Smart Library is also known as digital library, virtual library and also intellectual library. The concept of smart library emerge in various perspectives such as- the word 'smart' means elegant, flexible, stylish, acknowledging. According to their inquiries and requirements, smart library is a concept of the complexion hardware and software with a wide range of opportunities for searching and providing indispensable information to effective users. Smart library is a library offers all types of services which are innovative, interactive, informative, inventive, changing and so on. The major purpose of the smart library is to convince information requests of the user, using digital technology. To study an information need of a user is possible through implements of information technology.

FEATURES OF SMART LIBRARY

Following are the features of smart libraries which are as follows:

- Smart library providing skills and resources for the library society to confidently control cyber-issues and continue to hold the positive features of online achievement.
- For all types of libraries smart library is designed to be adjustable and flexible like regional, rural, educational, community, metropolitan, remote and mobile & it also providing useful direction to libraries.
- Smart library is an expansion of a verified model for the present scenario or the current period.
- To increase knowledge and skills of the users and staff, smart technology helps to reduce the digital divide in online world.
- The most appropriate resources and realistic tools in cyber-safety are assembled in single position.

Revolutionary Changes in Library Systems

Digital information storage technology and ICT together can revolutionize the concept of library system and can transform it into digital library. The conceptual model of Centralized National SL System is

prepared and implemented. In SL, the entire library functions are automated and a central library will digitize all the information and provide such service to all public and educational & research institutional libraries in e-form. A user can get access to any information through e-books, any newspapers, magazines, e-journals and their back volumes through search facility. This new model will also removes the constraint of unequal sharing of library resources between rural and urban institutions.

Promoting Target and Personalization of The Smart library Service in The big Data Era

- **Enhance the effect of improving reading promotion service**

At present, there are many problems in the library reading promotion, especially in the aspect of sustainability and effectiveness [7,8]. The library can through extensive data analysis, such as analysis of various types of books, publishing information, social network site data, identify and understand the specific period, knowledge needs of specific groups, reading focus on positive, innovation methods of reading promotion work. That can be carried out the reading promotion not only on the surface, but also point to the point. For example, through the collection and analysis of semi-structured and non-structured data about borrowing, life experience, work for readers and so on, a comprehensive grasp of the reader's reading habits and knowledge requirements, to carry out
targeted book recommendations, knowledge push work, improve the reading promotion effect.

- **Improve the efficiency of community library, mobile library and so on.**

Research shows that the important reason of the low utilization library in current is that the libraryis too far away from the user, when the library and the user to maintain appropriate distance, can effectively promote the use of public libraries. Community library, mobile library is the effective carrier of the library users, close to the user, is the library service "nerve endings", expand the scope
of the library radiation library are not based on the needs of users, targeted for the distribution of books, not in a timely manner to update the books. Big data of the era, it is through the data analysis, to grasp the specific regional population structure, accurately grasp the service time, content, form and place, greatly improve the utilization of books, play the role of the library.

- **Create a comfortable and friendly library physical space**

The function of library as a data storage has been gradually reduced, the library has become a "relaxed and pleasant space", in addition to the completion of the main purpose of information search, you can also learn, office, conference, friends visit, experience and appreciate, even date, and rest, it will become the main object of Library developmentIn the era of big data, improve the rationality of library information, on the line, reading books, data association, customs and other aspects of data mining, to let the readers into the library, dig out the potential value judgment, to optimize combine the distribution of books and data display mode, in order to improve the utilization rate of materials, readers can search etc.. On the space of layout, data collection with comfort, aesthetic, light and others, combination for furniture and equipment can be extended to optimization, mobility and experience, let the reader to enjoy the experience of art information.

6. Conclusions

The smart library service is the core value and significance of the library in the era of big data, which has injected new vitality and strength into the development of the society, which is the technical progress of library service. For many years, the library service can always catch the opportunity to develop and satisfied the growing cultural needs of users. The library in the era of big data should promote the application of big data in the library in order to maintain the development of the library, and with the rational thinking to strengthen the wisdom of library construction, to meet the opportunities and challenges bring about "big data to create a new world.

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International Journal of Advance and Innovative Research
Volume 11, Issue 1 (VI) January - March 2024
ISSN 2394 - 7780

RAJA RAMMOHAN ROY LIBRARY FOUNDATIONS ROLE IN THE DEVELOPMENT OF PUBLIC LIBRARIES IN INDIA

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ABSTRACT
This paper mainly focuses on the Role of Raja Rammohan Roy Library Foundations to development of public libraries in India. The paper also discusses public libraries are aware of their responsibility to satisfy information needs of all type of users in the society. State and Central governments have taken step to establish public libraries as valuable information resources for all types of users.

Keywords: RRRLF, Public Libraries, Financial Assistance, Training

INTRODUCTION
Raja Rammohan Roy Library Foundation (RRRLF) in India was set up in 1972 in the sweet memory of Raja Rammohan Roy of Bengal. Its head office is located in its own building. This foundation is on autonomous body running under the Department of Human Resources and Development of Government of India. Indian Governments provides full financial assistance to it for its handling. It helps State Central Libraries and District Central Libraries, which has helped many states and Union Territories develop rural public library services.

Organization of the Foundation
The president of this foundation is the minister of human Resources and Development Government of India, and there are other members of this foundation also. The members of it may be famous librarians, library science experts, and the representative of India Library Association. There is administrative committee for its administration. This foundation has on office also in which there is a director, one area officer, one executive officer, one accountant and so many other staff members.

Objectives of RRRLF
The objectives of this foundation are as follows

1. To promote the library movement with the assistance of state governments by making the planning of the progress of public libraries in the country.
2. To provide financial grants of public libraries through the state library planning committees constituted by various state governments,
3. To do efforts for enacting library acts in various states of the country.
4. To do efforts for the construction for national library police in the country.
5. Provide technical support to public libraries.
6. Establish a national library network by linking the National Library, State Central Library, District Library
7. Establishment of Regional Library Service Centre for the country
8. To advise the government in the library program
9. Promotion of research in problems of library development.
10. Periodic publication of reports on library development.

Activities and Programmes of the Foundation
This foundation plays a role by arranging following activities in the country to fulfill its aim and objectives.

1) Financial Assistance to Libraries
This foundation has started so many projects for the benefits of public libraries in the country. Out of them under some projects full matching grant and under some projects 50% matching grant is provided by this foundation.

2) Financial assistants to Library Association
This foundation also provides financial assistance at time to time to library associations of various states and other organization to organize seminars, conferences, workshop etc.

ISSN 2394 - 7780

3) Efforts for Library Legislation in the Country
This foundation always does efforts for promoting library acts in all the states of the country. For this it always writes letters and reminders to education ministers and other related officials to chief ministers of the states where library act has yet not been passed. The efforts done by this foundation in this regard are very much important in the country.

4) National Library Policy
This foundation set up a working group in 1981 to prepare a plan for national policy on libraries in the country. The group prepared its plan in 1983 and submitted it to central government. On the recommendations of this working group the Indian government constituted the committee for national policy on library and information system under the chairmanship prof. Chattopadhyaya. The committee submitted its report in May, 1986 to the minister of human Resources and development, Government of India which is being implemented in the country.

5) Public Programme
The foundation publish a journal called Granthana: Indian Journal Of Library Studies in English language. It also brings out a quarterly named Raja Rom Mohan Roy Library Foundation Newsletter to give publicity to its activities and to disseminate information on library services in different parts of the country.

6) Collection of Statistics
For effective planning and promotion of public library services, the foundation has taken up the task of collection of information on such libraries on a regular basis. It is also envisaged to help update the foundations Directory of Indian Public libraries.

7) Research work and Advisory Functions
The director of the foundation renders advisory and consultancy service to the department of culture, Government of India and different state Governments whenever necessary. In 1987-88, A Research committee was constituted for advising the foundation in matters of Research projects.

8) Library Establishment
In the year 1981-82 a special library on library and information was setup in the office of the foundation. This library has subscribed 20 journals and is being developed to function as an important resource center in library and information science discipline.

9) Assistance to Organize Seminars/ Workshops
The fact that library services must continuously evolve and improve in terms of both content and quality has been organized by the foundation. This objective has guided the adoption of this plan. All states are eligible for assistance under the programme, which comes from two sources: matching funds and foundation own funds (non-matching). Only organizations that have been approved by the corresponding state governments are eligible to receive this matching fund grant. Financial support from the non-matching fund is provided to all India library associations, including Indian Library Association.

10) Assistance to State Central Libraries and District libraries
The foundation distributes the books purchased by itself to state and district libraries in the country. The administrative committee of the foundation has laid down detailed guidelines for selection of titles of the books under this scheme.

11) Assistance to Voluntary Organization Providing Public Library Services
This is the voluntary organization outreach programme that the foundation is offering to promote public library services. Under this programme, the recipient organization is required to bear half of the project's expenses. The program's goal is to provide funding to nonprofit organizations that support public libraries so they can buy books. furnishings and equipment, as well as for the additions and modifications made to the library's structure.

12) Training Programmers
Under the government of India's Hindi Teaching Scheme, the foundation has taken action to install the official language implementation programmer and teach the personnel in using Hindi. As part of the celebration, the foundation also hosts an extempore elocution competition in Hindi for staff members who do not speak Hindi.

13) Inspection of Libraries
The Inspection and Monitoring unit of this foundation regularly conducts library inspections. The foundation inspects volunteer-run libraries and public libraries of all kinds to ensure that the funds it provides are used appropriately and for the intended purposes.

ISSN 2394 - 7780

14) Celebration of 21st Birthday Anniversary of Raja Rammohan Roy

On the occasion of 21st Birthday Anniversary of Raja Rammohan Roy the foundation organized a national seminar on secularism in India Rammohan to Nehru.

15) Public Libraries Database

The foundation decided to setup an Integrated Research Cell-Cum-Computer Unit with a view to developing a database of public libraries of the country.

CONCLUSION

Hence, In the end we see that the foundation not only pursued its regular activities of rendering assistance to libraries but also stepped up its promotional activities for qualitative improvement of public libraries in the country as a whole.

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ISSN No. 2319-992X, is indexed in ProQuest (LISA - Library and Information Science Abstracts) Impact Factor PIF 4.650 (2019) and 7.237 by Scientific Journal Impact Factor for the year (2021)

SCIENTOMETRIC STUDIES IN DOCTORAL RESEARCH OF LIBRARY AND INFORMATION SCIENCE IN INDIA: AN ANALYSIS

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Received for Publication – October 27, 2023 | Accepted for Publication – December 20, 2023

ABSTRACT:

This paper examines Scientometric studies in LIS doctoral research in India. The type of analysis and software used. A broad subject wise analysis was also carried out which helped to understand trends. Scope of scientometric studies is a very important aspect, and this paper also reviews the type of scope selected for various scientometric studies.

KEYWORDS :

Scientometric, Library & Information Science, Doctoral Research

Introduction :

Scientometric study gives us the opportunity to study the journal quantitatively. Helps us to understand productivity of authors, collaborative pattern, Year wise, Country wise, Subject wise and Institution wise productivity. We can prepare a rank list of subjects, journals and authors. We can apply Bradford's Law, Zips Law, Garfield Law of Concentration, Price Square Law of Scientific Productivity, The Law of Mandelbrot, Zipf-Pareto Law etc

Scientometric and Bibliometrics have been around for at least 50 years. In fact, the field's roots can be found in early 20th-century quantitative studies. It developed into the science of science in the 1930s. A crucial turning point was the publication of J.D. Bernal's Social Function of Science in 1939, but the field did not resume until after World War II, with the release of D.J.D. Price's books Science Since Babylon and Little Science, Big Science in 1961 and 1963, respectively. By using the HistCite software to depict his contribution as well as the following impact of the journal Scientometrics on the development of the subject, his role as the Father of Scientometrics is made abundantly clear. Both V.V. Nalimov, the creator of Naukometriya, and Tibor Braun, who customized the neologism for the journal, are responsible for the name Scientometrics. Bernal and Price were connected through Garfield's seminal study on citation indexing, which was first published in Science in 1955. (Garfield, 2009).

Objective:

1. To overview the Scientometric studies carried out in LIS doctoral research.
2. To study subject wise Scientometric studies carried out in LIS doctoral research.
3. To study scope wise Scientometric studies carried out in LIS doctoral research.

Methodology:

Researcher has taken 234 doctoral dissertations available on Shodhganga: Repository of Indian Ph.D. thesis. The word "Scientometric" was searched in Title field and results are listed. Subject wise and scope wise analysis was carried out to draw conclusions.

Scope and Limitation:

Scope of study was limited to only Indian Doctoral Thesis available on Shodhganga repository. The search was limited to those theses which have word "Scientometric" in their title field.

Literature Review:

Khorasani researches the citation counts for subject-related research metrics from the most well-liked scientometrics platforms. In order to identify the most active and dynamic research domains, quantitative assessments of the most- to least-cited subject areas have been conducted. (Khorasani, 2022).

Based on 15 criteria in four categories, Nadi-Ravandi compares scientific trends in the research performance of Iranian and Turkish scholarly outputs. Based on scientometrics indices and the SciVal Tool, this study is analytical and applied. (Nadi-Ravandi, 2022).

Cay, Wang Utilize bibliometric information from the publications of recent Physics PhD recipients to look into the impact of their advisers on the development of their academic network. (Wang, 2021).

Miyashita uses scientometric techniques to manage science because basic and academic scientific research need organizational and strategic management. (Miyashita, 2021).

Lackner presents a quantitative analysis of the development of events in computer science using the OpenResearch.org knowledge graph. We categorize these occurrences' shared traits, codify them, and then aggregate them as metrics. Potential authors can use these metrics to find high-quality events. (Lackner, 2021).

Vinkler calculated the frequency of articles in journals in the top publishing subsets (i.e., most often cited publications) of Price medallists using scientometrics. (Vinkler, 2019).

In addition to proposing a framework that reveals the multi-dimensional basis for citation behaviour and its epistemological consequences on the creation, transmission, and evolution of IS knowledge, Hassan's study contributes by elevating the discussion surrounding the significance of scientometric research in IS. (Hassan, 2017).

The creation of the International Society for Scientometrics and Informetric, according to Garfield, is yet another sign of the development of quantitative analyses of scientific output and a nearly universal acceptance of their value in determining the scientific significance of published research and guiding science-policy decisions. (GARFIELD, 1995).

Sengupta's conclusion is that the four measurement methodologies used in library and information science are bibliometrics, informetric, scientometrics, and librametrics. These concepts need to be clarified because they are comparable, or rather synonymous, with one another and have intertwined goals and objectives. In order to address numerous issues relating to library and information sciences, this study addresses their scope, application, development, and potential. (SENGUPTA, 1992)

Need of Study:

Scientometric study has following significance:

1. Measuring Research Impact: By assessing metrics such as citation counts, h-index and impact factors researchers can identify influential publications and researchers in the field. This information can guide decisions about funding, collaboration and future research directions.
2. Identifying Research Trends: This study can reveal emerging trends and areas of interest within emerging subjects.
3. Assessing Collaboration Patterns: It will help to uncover patterns of collaboration among researchers and institutions. This information can be used to identify potential collaborators, foster interdisciplinary research and strengthen research networks within the field.
4. Evaluating the Impact of Journals: This study can assess the influence of journals which helps researchers decide where to submit their work and where to seek relevant literature, enhancing the dissemination of knowledge.
5. Benchmarking and Evaluation: This study can provide a benchmark for evaluating the progress of rapidly evolving fields over the time.
6. Resource Allocation: Policy Makers and funding agencies can use Scientometric data to allocate resources efficiently. By identifying research area with high impact and potential for growth, they can make informed decisions about funding priorities and research investment.
7. Policy Formulation: Scientometric data analyses can inform the development of policies related to research, data sharing and technology adoption.
8. Educational Planning: Scientometric studies can guide the development of educational programs in emerging disciplines.
9. International Collaboration: Scientometric data can help identify opportunities for international collaboration. Researchers can identify regions or countries with similar research interest and expertise leading to collaborative projects that advances the field on a global scale.
10. Evidence Based Decision Making: Study helps healthcare providers and policy makers in making informed decisions.

This study helped to understand trends in Scientometric Studies carried out in LIS doctoral research in India.

Observations and Inferences:

Types of Scientometric Analysis Observed during Studies

Scientometric analysis involves the quantitative and qualitative evaluation of scientific publications, authors, journals and institutions to understand trends, impact, and the structure of scientific knowledge. Following are the types of Scientometric analysis,

Bibliometric Analysis: This is the most common type of scientimetrics analysis and involves the study of scientific publications, their citations, and their bibliographic informations. It includes metrics like the h-index, impact factor and citation analysis.

Citation Analysis: This type of analysis focuses on the citations that papers receive. It can help identify influential papers, authors, and journals. It's often used to assess the impact of a research paper or author in the field.

Co-authorship Analysis: This examines the collaboration patterns among researchers. It can help to identify productive authors in a research area and the strength of collaborative networks.

Journal Analysis: Journal level Scientometric assesses the impact and quality of scientific journals. Metrics like the impact factor and Eugine Factor are commonly used for this purpose.

Institutional Analysis: This type of analysis evaluates the research output and impact of academic institutions, universities, or research organizations. It helps in ranking institutions based on their research contributions.

Author Analysis: Author level scientometrics assess the research output and impact of individual researchers. Metrics like the h-index i10-index and g-index are often used.

Keyword Analysis: Analyzing the frequency and trends of keywords in scientific publications can help to identify emerging research topics and popular areas of study.

Collaboration Network Analysis: This involves visualizing and analyzing the network of collaborations between researchers or institutions. It can reveal key nodes and their influence in a scientific field.

Historical Analysis: This type of analysis focuses on the evolution of scientific research over time, identifying shifts in research trends and paradigms.

Altimetric: Altimetric go beyond traditional citation based analysis and include non-traditional metrics like social media mentions, downloads, and views of research outputs to measure the broader impact of research.

Collaboration and Interdisciplinary Analysis: This type of analysis assesses the degree of collaboration between researchers from different disciplines and can help identify emerging interdisciplinary fields.

Geospatial Analysis: Examines the geographic distribution of research institutions, authors, and collaborations, providing insights into regional and international research trends.

Software Used to carried out Scientometric Studies:

There are several software tools and platforms available for conducting Scientometric analysis. The choice of software depends on the specific needs and preferences of the researcher. Here are some commonly used software tools for Scientometric analysis.

VOSviewer: VOSviewer is a popular and user-friendly software for visualizing and exploring bibliometric networks. It can be used to create network maps, density maps, and various types of visualizations.

CiteSpace: CiteSpace is a tool designed for visualizing and analyzing trends and patterns in scientific literature. It can be used to detect emerging research areas and influential papers or authors.

Bibexcel: Bibexcel is a free tool for conducting bibliometric analysis. It can be used to extract and analyze bibliographic data from text files.

SciMAT: SciMAT (Scientific Mapping Analysis Tool) is a software tool for analyzing and visualizing research areas, trends, and emerging topics in scientific literature.

HistCite: HistCite is a software tool designed for citation based analysis, particularly for historical research on the development of scientific fields.

Tableau: Tableau is a data visualization and business intelligence software that can be used creating custom Scientometric visualizations and dashboards.

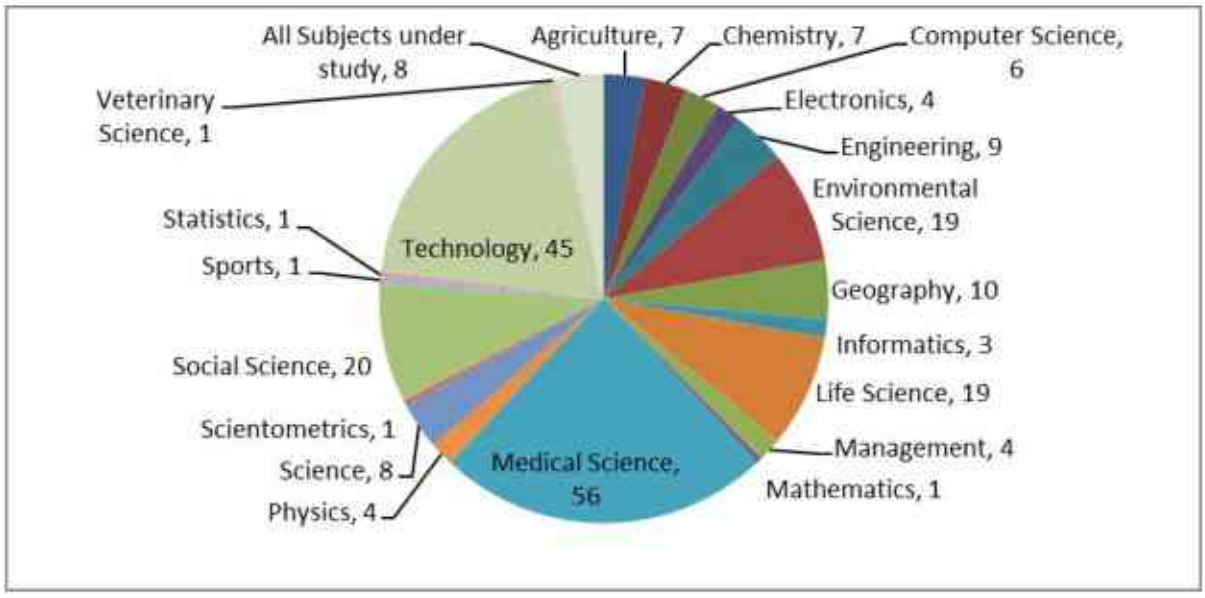
Bibliometrix: Bibliometrix is an R package for bibliometric and text analysis. It offers a range of functions for analyzing and visualizing bibliometric data in the R environment.

Dimensions: Dimensions is a research information platform that offers various bibliometric analysis features, including citation counts, co-authors networks and more.

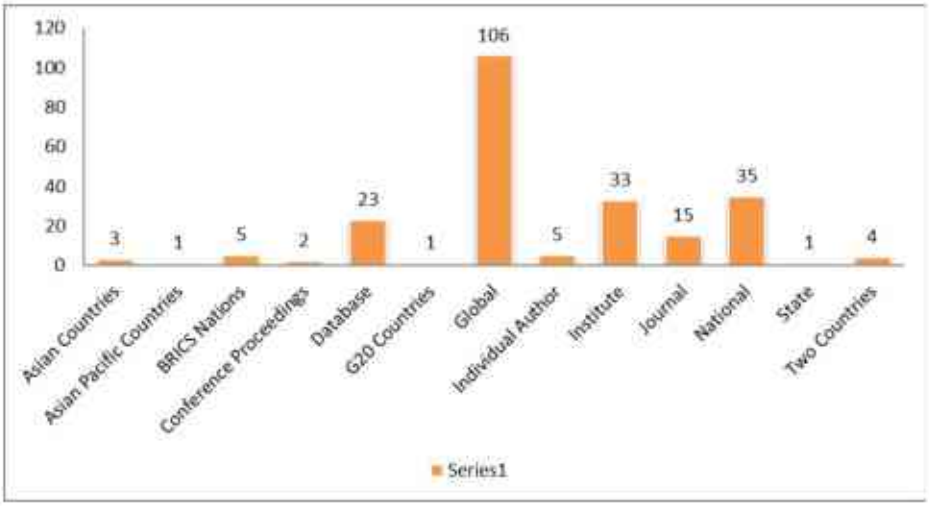
The choice of software depends on researchers' specific research goals, familiarity with tools and the scale of Scientometric analysis. Some software tools are open source and free while others may require a subscription or purchase. Researchers can use a combination of both for conducting comprehensive Scientometric analysis.

Data Analysis:

Graph No 1: Showing Number of Scientometric studies carried out on different disciplines during doctoral research in LIS.



Graph No.2: Showing the various scopes selected for Scientometric studies in LIS doctoral research in India



Conclusion:

Following conclusions can be drawn from above data analysis

1. Bibliometric, Citation, Co-Authorship, Journal, Collaboration, Institutional & Keywords Analysis are used in Scientometric studies.
2. VOSviewer, CiteSpace, Bibexcel, SciMAT, HistCite, Tableau, Bibliometrix and Dimensions are the software used to carry out Scientometric analysis.
3. Medical Science (56) is the popular field for scientometric studies in LIS doctoral research.
4. Technology (45) related subjects such as Nano technology, Information Technology are also favorite for scientometric studies.
5. The LIS community also studies environmental issues (19) scientometrically.
6. Social Science subjects such as economics, library science, gender studies also have a visible presence in scientometric studies.
7. Most of the Scientometric studies (106) have global scope while selecting subject literature.
8. Second most popular types of have limited scope such as Institute (33), Journal (15), National (35) and Specific Database (23).
9. Few Scientometric studies also have very narrow scope such as single author (5).
10. Scientometric studies have gained popularity among doctoral researchers in the Indian LIS community.

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SGPC's gnims Business School

ISSN No. 2319-992X, is indexed in ProQuest (LISA - Library and Information Science Abstracts) Impact Factor PIF 4.650 (2019) and 7.237 by Scientific Journal Impact Factor for the year (2021)

INFLIBNET: A LITERATURE REVIEW

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Received for Publication – October 26, 2023 | Accepted for Publication – January 10, 2024

ABSTRACT:

INFLIBNET is an autonomous IUC. The Present Paper aim to review the published research papers on the INFLIBNET and its projects, Programs like IRINS, INFEED, N-List, INFONET, E-PG Pathashala etc. Researcher has reviewed 12 papers in the article. researchers were searched articles in N-List Database, DELNET Database, ResearchGate, ACADEMIA, and in SCOPUS Database also. INFLIBNET and its projects title were used as a keyword while searching literature. Researcher has analysed the research articles on role, objectives, projects, services provide by INFLIBNET. Based on the reviewed articles researched has conclude that the libraries aware and using the INFLIBNET and its projects and using SOUL software for automation. Researcher also find some suggestions in the research articles, that the INFLIBNET should arrange more training programs for their users.

KEYWORDS :

INFLIBNET, N-List, IRINS, Shodhganga, INFEED, INFONET

Introduction :

INFLIBNET is an autonomous Inter University Centre established with the aim to modernise the Indian libraries. INFLIBNET has introduce more than 27 projectsto improve the quality in research, easy availability of study materials and e-resources for the students and researchers, quick and easy retrieved of Information, research and research profile of experts from India. N-List, Shodhsindhu are consortia-based Projects, which are beneficial for member libraries, Information Seeker and researchers to find the required information anywhere, anytime. IRINS is a project of INFLIBNET where research profile of all faculty members is curated on one portal. IRINS working as a free software for academic Institutions and research centres. E-PGpathashala make available Video and study materials for the Students. Shodhganga, Shodhgangotri, Shodhchakra these projects help researchers in their entire journey of research and help to avoid the duplications and plagiarised material. The article aims to review the selected published material on the INFLIBNET.

'RESEARCH JOURNEY' International E- Research Journal
Issue 336 : Multidisciplinary Issue
Impact Factor 6.625 Peer Reviewed Journal
E-ISSN : 2348-7143
February 2024

Content Analysis of Library Webpage of Maratha Vidya Prasark Samaj's Senior (Granted) Colleges

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Abstract:

This paper is mainly focused Content Analysis of Library Webpage of Maratha Vidya Prasark Samaj's Senior (Granted) Colleges. Through the library webpage library can introduced them and promoting the services for effective use. The evaluating the library webpage of Maratha Vidya Prasarak Samaj Senior (Granted) Colleges has been made more user friendly for accessing the information. Different library webpages studies were organized to evaluate different criterion, content, webpage design, accessibility, Updation etc.

The collected data was analyzed, tabulated, interpreted and presented in the form of this paper. The study concluded that users of Maratha Vidya Prasark Samaj Colleges extremely utilized electronic resources demonstrating shift to a digital platforms for academic research, easy convenience, accessibility and unlimited information availability in any format of resources. Hence one can say that most of the Colleges library services are effective and fasters regarding the use of online information.

Keywords: Content Analysis, Library Webpage, KTHM College, Online Services, E-journals, N-LIST, MVP Samaj

1. Introduction:-

Due to inventions of technologies, the routing basic works are changes. Libraries and Knowledge Resource Centers not only kept books and reference books but also various types of e-resources in the digital forms. Libraries are so updated in the collection development and information retrieval through online platform such as websites or webpages. Examination and assessment of web pages is a current field of study in a variety of disciplines. Libraries are no exception. Library webpages are a standard feature it is only logical to review them for utility and interactivity. The techniques for evaluating the authority and reliability of websites are similar to those that should be applied to print materials. The evaluation of website / webpage usage plays an important role in its maintenance and development.

Analyzing and exploring regularities in the user's behavior can be used to enhance the quality and facilitate delivery of information services, identify user's interests and improve the server's performance on the net, besides evaluation based on quality standards. As for libraries, their own websites can be effectively used for provisioning information services. With the help of library website or webpages, library professionals are able to provide information to the

library users in an efficient manner. The Librarians, one can simply say "content managers" in the web world rely on their Websites and on their Web catalogues to provide users with a variety of information, access to full-text resources, digital library services and to make library utilize simpler for the clients, information literary instruction can also be delivered through the library websites.

Earl Babbie defines content analysis as "the study of recorded human communications such as books, websites, paintings and laws." The website / webpage of each library are a mirror of that particular library & a guide for internet users. Through websites / webpages library can introduce them & their services. The evaluating the library webpage of Maratha Vidya Prasarak Samaj (MVP Samaj) Senior (Granted) Colleges has been made an attempts to enhance the effective use of library web sites to become more user friendly for accessing the information. Different library websites / webpages studies were organized to evaluate different criterion, content, webpage design, accessibility, date of update etc.

2. Origin of the research Problem:-

The library website might be able to function as sort of 'electronic signpost' to address a number of problems in the existing provision of information, by means of publicizing the library and its services beyond its historical user base and immediate geographical catchments area; providing considerably enhanced access to library services and other electronic sources from home for staff during their working day.

It's providing a window to selected, quality - filtered information geared to the specific needs and interests of practitioners working in mental health, and in community and primary care; offering an effective, customized means of access to the large variety of journals which the library provides; and making available internal resources and products. It is a greater responsibility on the part of library managers as web content in the internet world to be more meticulous in providing the information on their library websites keeping in view of the user community.

3. Significance of the study:-

Based on the findings of the study, in this section an attempt has been made to suggest a few recommendations, which will help to creator or designer of the website to make library website more interactive, attractive and workable. It will also be helpful to the user of the library website to evaluate its content, quality of information, design, structure and organization of information. During Social Problems or Critical Situations like Covid-19 such type of college Library Websites or Webpages are more effective for their users to access information & satisfies information needs.

4. Statement of the Problem:-

The Librarians as "content managers" in the web world rely on their Web sites and on their Web catalogues to provide users with a variety of information, access to full-text resources, digital library services and to make library utilize simpler for the users, information literary instruction can also be delivered through the library websites. Here the research problem is "Content analysis of Library Webpage of Maratha Vidya Prasark Samaj Senior (Granted) Colleges."

5. Review of Literature:-

"To improve the design of the library web page and facilitate user access, a web usage analysis was conducted as Texas A and M university libraries through examination of statistics

generated by web tracking software. The study examined the geographic distribution of users and usage patterns of the library web page, the peak usage times, and the computer environment information, which includes type of web browsers, operating systems, screen resolutions, and screen & colours. The findings concentrate on identifying web page design problems, thus allowing the establishment of recommendations to modify standards of library web page design and improve library web page promotion." (Li, X., 1999). Jange, S. and others (Feb., 2006) concluded that mere proclaiming as information officers and organizers of the information in the information in the internet world is not enough, it is a responsibility to show their information content to the world by creating comprehensive and pertinent library portal either by their own or assigning to web masters.

Gupta, R.C. (2002) attempts to described the status, methodology and organization involved, and some different ideas to be considered in designing a serviceable library website. Clausen, H. (1999) has studied "Danish university library web pages comparing them with websites in general and found that library web pages were above average." Still, J. M. (2001) concluded that "the prevalence of exam papers in some countries the interaction between universities and the for-profit sector such as the presence of links to bookstores, and the financial & technical concerns. While instruction in the use of the library and the 'always available' digital library are items frequently seen in the library literature and discussed at conferences, general instructional materials and information on remote access." The most popular suggestion made by McMullen, S. (2009) " based on usability study for improving the site was reduce the amount of text and links more significant since users do not want to spend the time and reading."

Babu, B. R. (2009) found that "the universities in Tamil Nadu studied have their own websites but they lacked standard design and structure." Cohen, L.B. and Still, J.M.A. (1999) found that "larger institutions made greater use of freely available internet resources and were more likely to create web version of paper documents." Osorio, N. L. (2001) studied "websites of science - engineering libraries of 45 universities using a prototyping model to access content and design. A list of 66 elements was developed consisting of design features such as navigation bar, library photograph or logo, screen lengths & colours and content features such as search this site, electronic resources, user education program, subject guides and electronic reference." McGills, L. & Toms, E. (2001) and Battleson B; Booth, A. & Weintrop, J. (2001) reported "on usability studies of academic library websites."

King, D. (1998) examined "the homepages of ARL libraries to compare design similarities. He categorized his findings in seven sections like background, document header, footer, document body, page length, number of steps to library homepage from parent institution website and domain name server." Islam, A. and Tsuji, K. (2011) examined " the usability aspects of these websites that can be improve the usability of these websites. Universities webmaster should pay more attention to the universities web design and content to make them more attractive to the user community."

Li, Si and R.A.A.S., Ranaweera (2016) are observed that "university libraries have enough capacities to utilization of innovative web based library service but proper planning and designing is lacking. Some libraries have used more text and some use unavailable links in the library website. Few libraries under study did not pay much attention to update the library website regularly."

Savitha, K.S. and Kenchakaller, P. (2016) concluded that library website is powerful tool to market the library sources and services. Library websites contain information about services,

sources, special collections etc. The study reveals that library websites are important tool to technical education institution and these are helping to provide traditional as well as electronic service to their users."

6. Objectives:-

The study aims to determine the information content on the library web pages of colleges' websites for better accessibility and use. More specifically, the study aims

1. To identify and compare the contents available on the library webpages.
2. To identify the library services offered to the users through the webpages.
3. To find the provisions for interactive use (e.g. searching Web OPAC, feedback, etc.) of library websites / webpages.
4. To know students awareness, opinions and expectations about the library's websites / webpages.
5. To suggest contents and format for an ideal college library webpages.
6. To identify social networking sites implemented in the websites / webpages.

7. Research Methodology:-

Content analysis is selected for this study in order to collect specific data from library webpages of MVP Samaj's Senior (Granted) Colleges. Content analysis is a methodology in social sciences for studying the content of communication. For the purpose of data collection checklist has prepared on the basis of earlier studies conducted by the various researchers. Information is given on each webpage was scanned thoroughly during January 2024 is used for content analysis. The collected data was presented in tabular format. This study has analyses contents of library webpages of MVP Samaj's Senior (Granted) Colleges. There are 15 colleges selected for this study from Nashik district's Eight Taluka's as Dindori, Igatpuri, Nandgaon, Nashik, Niphad, Satana, Sinnar and Trimbakeshwar. The fifteen colleges are categorized by Taluka's as follows given in the table form.

Table No.1:

It also evaluates user interface features of select library webpage of MVP Samaj's Senior

Taluka / **College**	**Dindori**	**Igatpuri**	**Nandgaon**	**Nashik**	**Niphad**	**Satana**	**Sinnar**	**Trimbakeshwar**
Education				√				
CIDCO				√				
Dindori	√							
Igatpuri		√						
KTHM				√				
Nandgaon			√					
Niphad					√			
Ozar					√			
Pimpalgaon					√			
Satana						√		
Saikheda					√			
Sinnar							√	
Deolali				√				
Trimbakeshwar								√
Vani	√							
Total	**2**	**1**	**1**	**4**	**4**	**1**	**1**	**1**

(Granted) colleges in Nashik uses a mixed method approach that combines both qualitative and

quantitative analysis. The qualitative analysis part of the checklist does not give any numerical values and are not considered for final ranking of evaluation. However, it is valuable to know the details of the website for browsing, History, About Us, Vision & Mission, Rules & Regulation etc. and contacting them for further details.

The quantitative part of checklist contains about questions to evaluate the websites based on a number of criteria's - library services, web 2.0 features, currency, accuracy, relevance, organization, structure, coverage, links etc. Also to consider evaluation of the user interface which is related to navigation, searching, advance search techniques features and informative feedback and support of study website to gather data.

8. Data Analysis and Interpretation:–

8.1 Year of Establishment of Colleges:–

Table No.2:

Sr. No.	Name of College	Year of Establihment	Sr. No.	Name of College	Year of Establihment
1	Education College	1965	9	Pimpalgaon Coll.	1968
2	CIDCO College	1993	10	Satana College	1961
3	Dindori College	2000	11	Saikheda Coll.	1998
4	Igatpuri College	1981	12	Sinnar College	1969
5	KTHM College	1969	13	Deolali College	1984
6	Nandgaon College	1972	14	Trimbakeshwar	1998
7	Niphad College	1971	15	Vani College	1972
8	Ozar College	1984			

The table no.2, mentioned 15 college library webpages are analysed for the study purpose. College of Education is the oldest college of MVP Samaj established in 1965 whereas Dindori College established in the year 2000. Remaining colleges are established in regular intervals to serving education for students in Nashik district.

8.2 Basic Information:–

Table No.3:

College	About	Lib. Committee	Library Timings	Lib. Rules	Lib. Plan	Lib. Staff	Contact	Total Score (Max.7)
Education	Y	Y	Y	Y	Y	Y	-	6 (85.71 %)
CIDCO	Y	Y	Y	Y	Y	Y	-	6 (85.71 %)
Dindori	Y	-	Y	-	-	-	-	2 (28.57 %)
Igatpuri	Y	-	Y	-	-	-	-	2 (28.57 %)
KTHM	Y	Y	Y	Y	Y	Y	Y	7 (100 %)
Nandgaon	Y	Y	Y	Y	-	Y	Y	6 (85.71 %)
Niphad	Y	-	Y	-	-	Y	-	2 (28.57 %)
Ozar	Y	Y	Y	Y	-	Y	-	5 (71.43 %)
Pimpalgaon	Y	-	Y	Y	-	Y	-	4 (57.14 %)
Satana	Y	Y	Y	Y	-		-	4 (57.14 %)
Saikheda	Y	Y	Y	Y	-	Y	Y	6 (85.71 %)
Sinnar	Y	Y	Y	Y	Y	Y	-	6 (85.71 %)
Deolali	Y	Y	Y	Y	Y	Y	-	6 (85.71 %)
Trimbak.	Y	Y	Y		Y	Y	-	5 (71.43 %)
Vani	Y	-	Y	Y	-	Y	-	4 (57.14 %)

From table no.3 observed that 7 college library webpages provides 85 to 100 % information on their libraries and Dindori, Igatpuri and Niphad college provide very less

information of their libraries. On the other hand remaining 5 colleges are providing 50 to 70 % basic information of the concerned libraries.

8.3 Library Collection: –

Table No.4:

College	Books	Printed Journals	Question Papers	CD's	Other Materials	List of Journals	Total Score (Max. 6)
Education	Y	Y	-	-	-	Y	3 (50 %)
CIDCO	Y	Y	Y	Y	Y	Y	6 (100 %)
Dindori	-	-	-	-	Y	-	1 (16.67 %)
KTHM	Y	Y	Y	Y	Y	Y	6 (100 %)
Nandgaon	Y	Y	-	Y	Y	Y	5 (83.33 %)
Ozar	Y	Y	-	Y	-	Y	4 (66.67 %)
Pimpalgaon	Y	Y	Y	Y	Y	-	5 (83.33 %)
Satana	Y	Y	-	-	Y	Y	4 (66.67 %)
Saikheda	Y	Y	-	Y	Y	Y	5 (83.33 %)
Sinnar	Y	Y	-	Y	Y	Y	5 (83.33 %)
Deolali	Y	Y	Y	Y	Y	Y	6 (100 %)
Trimbak.	Y	Y	-	-	Y	-	3 (50 %)
Vani	Y	Y	-	Y	Y	-	4 (66.67 %)

Table no.4 describes the library collection information in their college library webpages. KTHM and Deolali college provides 100 % information, followed by Nandgaon, Pimpalgaon, Saikheda and Sinnar college provides 83.33 % information, followed by ozar, Satana and Vani college gives 66.67 % information, followed by Education and Trimbakeshwar college provides 50 % information, while Dindori, college provide very less information of their library collection. Remaining Igatpuri and Niphad college does not providing any information about their library collection.

8.4 Library Online Services: –

Table No.5:

College	Insti. Repository	Lib. Downloads	Online Feedback Form	Web OPAC	Events & Program	Email Alerts	Total Score (Max. 6)
CIDCO	Y	Y	Y	Y	-	-	4 (66.67 %)
KTHM	Y	Y	Y	Y	Y	Y	6 (100%)
Nandgaon	-	Y	-	Y	-	-	2 (33.33 %)
Pimpalgaon	-	-	-	Y	-	-	1 (16.67 %)
Sinnar	Y	-	-	Y	-	-	2 (33.33 %)
Trimbak.	Y	Y	-	Y	-	-	3 (50 %)
Vani	-	-	-	Y	-	-	2 (33.33 %)

Table no.5 provides the library online services information in their college library webpages. KTHM college provides 100 % information about library online services, followed by CIDCO college provides 66.67 % information about library online services, followed by Trimbakeshwar college provides 50 % information about library online services, followed by Nandgaon, Sinnar and Vani college gives 33.33 % information about library online services, followed by Pimpalgaon college provides 16.67 % information about library online services. Remaining 7 college does not providing any information about library online services.

8.5 Electronic Resources: –

Table No.6:

College	E-Books	E-Journals	Links of e-Newspaper	Links of Govt.	Links of Database	Links to OER	Link to N-LIST	Total Score (Max.7)
Education	_	Y	Y	Y	Y	_	Y	5 (71.43 %)
CIDCO	Y	Y	Y	Y	Y	_	Y	6 (85.71 %)
Dindori	_	_	_	_	_	_	_	0
Igatpuri	_	_	_	_	_	_	_	0
KTHM	Y	Y	Y	Y	Y	Y	Y	7 (100 %)
Nandgaon	Y	Y	Y		Y	Y	_	5 (71.43 %)
Niphad	Y	Y	_	_	_	_	Y	3 (42.86 %)
Ozar	Y	Y	Y	Y	_	_	_	4 (57.14 %)
Pimpalgaon	Y	Y	_	_	Y	_	Y	4 (57.14 %)
Satana	_	_	_	_	_	_	Y	1 (14.29 %)
Saikheda	Y	Y	Y	Y	_	_	_	4 (57.14 %)
Sinnar	Y	Y	_	Y	Y	Y	_	5 (71.43 %)
Deolali	Y	Y	Y	Y	_	_	_	4 (57.14 %)
Trimbak.	Y	Y	Y	_	Y	Y	Y	6 (85.71 %)
Vani	Y	Y	Y	_	_	_	_	3 (42.86 %)

Table no.6 reports the accessibility of electronic resources available linkages on the college library webpages. KTHM college provides 100 % linkages, followed by CIDCO and Trimbakeshwar college provides 85.71% linkages, followed by Education, Nandgaon and Sinnar college gives 71.43 % linkages, followed by Ozar, Pimpalgaon, Saikheda and Deolali college gives 57.14 % linkages, followed by Niphad and Vani college gives 42.86 % linkages, followed by Statana college gives 14.29 % linkages. Remaining 2 colleges as Dindori and Igatpuri does not providing any linkages of electronic resources.

8.6 Library Services: –

Table No.7:

College	Circulation	ILL	CAS / SDI	Open Access	Book Bank	Reading Rooms	Xerox	Total Score (Max.7)
Education	Y	Y	_	Y	_	Y	Y	5 (71.43 %)
CIDCO	Y	Y	_	Y	Y	Y	Y	6 (85.71 %)
Dindori	_	_	_	_	_	_	_	0
Igatpuri	Y	_	_	Y	_	Y	_	3 (42.86 %)
KTHM	Y	Y	Y	Y	Y	Y	Y	7 (100 %)
Nandgaon	Y	Y	Y	Y	_	Y	_	5 (71.43 %)
Niphad	_	_	_	_	_	_	_	0
Ozar	_	Y	_	Y	Y	_	_	3 (42.86 %)
Pimpalgaon	Y	Y	_	Y	_	Y	_	4 (57.14 %)
Satana	Y	_	_	_	_	Y	_	2 (28.57 %)
Saikheda	Y	Y	_	Y	_	Y	Y	5 (71.43 %)
Sinnar	Y	Y	_	_	_	Y	_	3 (42.86 %)
Deolali	Y	Y	Y	Y	Y	Y	_	6 (85.71 %)
Trimbak.	Y	_	Y	Y	Y	Y	_	5 (71.43 %)
Vani	Y	_	_	Y	Y	Y	_	4 (57.14 %)

Table no.7 describes the library routine services information given on the library webpages. Majority of college provide more than 50 % information on the webpage. Igatpuri, Ozar, Sinnar and Satana college gives less than 45% information regarding library services.

Whereas Dindori and Niphad does not providing any information about their routine library services.

8.7 Social Media: –

Table No.8:

College	Youtube Channel	Whatsapp Group	Educational Videos	Library Blog.	Twitter	Instagram	Total Score (Max. 6)
CIDCO	Y	Y	_	_	_	_	2 (33 %)
KTHM	Y	Y	Y	_	_	_	3(50 %)
Trimbak	Y	_	Y	Y	_	_	3(50 %)

Table no.8 observes that KTHM and Trimbakeshwar College gives 50 % access or information through Social Media, followed by CIDCO college giving only 33 %. Other Remaining 12 Colleges as College of Education, Dindori, Igatpuri, Nandgaon, Niphad, Ozar, Pimpalgaon, Satana, Saikheda, Sinnar and Vani college does not access any type information's or services through the social media.

8.8 Value Added Services: –

Table No.9:

College	Web Research Guide	Web Counter	Website Update Date	Citation Style	Total Score (Max. 4)
CIDCO	Y	_	_	Y	2 (50 %)
Trimbak.	_	_	_	Y	1 (25 %)

Table no.9 mentioned that CIDCO College gives 50 % Value added services on the library webpages, followed by Trimbakeshwar College giving only 25 %. Other Remaining 13 Colleges as College of Education, Dindori, Igatpuri, KTHM, Nandgaon, Niphad, Ozar, Pimpalgaon, Satana, Saikheda, Sinnar and Vani college does not give information about value added services.

8.9 Ranking of College Library Webpage: –

Table No.10:

College	Basic Info.	Lib. Coll.	Lib. Online Service	E-Resources	Lib. Services	Social Media	Value Added Service	Total Score (Max. 43)	Rank of Lib. Webpages
Education	6	3	0	5	5	0	0	19	8
CIDCO	6	6	4	6	6	2	2	32	2
Dindori	2	1	0	0	0	0	0	3	15
Igatpuri	2	0	0	0	3	0	0	5	14
KTHM	7	6	6	7	7	3	0	36	1
Nandgaon	6	5	2	5	5	0	0	23	4
Niphad	3	0	0	3	0	0	0	6	13
Ozar	5	4	0	4	3	0	0	16	11
Pimpalgaon	4	5	1	4	4	0	0	18	9
Satana	4	4	0	1	2	0	0	11	12
Saikheda	6	5	0	4	5	0	0	20	7
Sinnar	6	5	2	5	3	0	0	21	6
Deolali	6	6	0	4	6	0	0	22	5
Trimbak.	5	3	3	6	5	3	1	26	3
Vani	4	4	2	3	4	0	0	17	10
Total	72	57	20	57	58	8	3	275	

Table no.10 mentioned that KTHM College provided detailed information regarding library activities, facilities, services, linkages to e-resources, institutional repository link, online services and library collection is on the library webpages. Hence it has score 36 and stood 1st rank among MVP Samaj's Senior (Granted) colleges comparatively other colleges. CIDCO college 2nd rank and Trimbakeshwar college having 3rd rank.

8.10 Ranking Study of MVP Samaj's Colleges Library Webpages: –
Table No.11:

College	Total Score (Max. 43)	Rank
KTHM College and CIDCO College	**Between 30 to 39**	**Above Average**
Trimbakeshwar, Nandgaon, Deolali, Sinnar and Saikheda	**Between 20 to 29**	**Average**
College of Education, Pimpalgaon, Vani, Ozar, Satana	**Between 10 to 19**	**Below Average**
Niphad, Igatpuri and Dindori	**Between 01 to 09**	**Need to Improvement**

A quantitative five-point rating scale was designed to determine the evaluation checklist whether or not it effectively served its intended dual purpose i.e. to provide a meaningful numerical rating for each individual feature of the college library webpage and to aid in distinguish quality among the college library webpages. Its purpose is best served when comparing and ranking the MVP Senior (Granted) colleges' library webpages with similar purpose, scope, and content to rank from "excellent" to "needs improvement". Table no. 11 describes the five points rating scale was fixed equally based on the maximum score of 43 quantitative evaluation points. The range for the rating scale was as: The range for the rating scale is as follows: P 40–49: Excellent, P 30–39: Above Average, P 20–29: Average, P 10–19: Below Average, P 01–09: Needs Improvement.

9. Findings:

1. Out of fifteen colleges libraries none of the college library webpage had ranked "Excellent".
2. KTHM College provided detailed information regarding library activities, facilities, services, linkages to e-resources, institutional repository link, online services and library collection is on the library webpages. Hence it has score 36 and stood 1st rank among MVP Samaj's Senior (Granted) colleges.
3. Basic information about library, library committee, findings, library rules, library staff and contact us provided by majority of libraries. on the other hand Dindori, Igatpuri and Niphad college provide less basic information.
4. Majority of libraries fails to providing library online services as institutional repository, library downloads, online feedback form, WebOPAC, events & programs, email alerts etc.
5. Rregarding social media application and value added services only three libraries CIDCO, KTHM and Trimbakeshwar College provided links effectively for their services users.
6. Some libraries highlights library best practices as Book Exhibitions, Vachaan Aani Prerna Din, Librarian Day, Marathi Bhasha Din etc. These libraries celebrates such

occasions and held quiz competitions, book reviews, debates, guest lectures and most important photographs of all activities uploaded to the webpage with caption to photographs.

7. All college libraries not given update date on their library webpages.

10. Suggestions:

1. Library webpages must give user oriented services, linkages, downloads, study materials, open educational resources, citation style manual etc. rather than more generic and theoretical information.
2. Librarians are totally depending on website developers or computer science teachers for updating information on library webpages. Librarians should do or attend some programming courses, website development training or any workshop regarding website development.
3. Library webpage should have certain fixed captions on a tab, that tab reflects to the web page which provide links or information of resources to download, print or to be share.
4. Collages authorities should be appoint a committee for updating library webpages on regular intervals.
5. For marketing and promotion of library services, it should have dynamic in nature for managing the content of libraries services, e-resources, library rules etc.

11. Conclusion:

The content analysis of library webpages provides valuable insights into the information architecture, user-centric focus and overall effectiveness of these online platforms. By examining structure and features we gain a deeper understanding of how library present information, engage users and facilitate access to resources.

User feedback and comparison of library websites with other websites is very necessary for the continuous development of the effective library websites (Hugar, 2019). Additionally integration of multimedia, social media links and responsive designs enhances accessibility. This analysis underscores the importance of continual adaptation to technological advancement and user preferences in maintaining the relevance and effectiveness of library webpages.

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USE OF E-RESOURCES BY THE RESEARCH SCHOLARS OF KTHM COLLEGE: A SURVEY

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Abstract: *This paper is mainly focused on use of e-resources by research students of KTHM College, Nashik. It is discuss importance of introducing about e-resources, various types e-resources and improving and optimising the e-resources utilization and delivering efficient services to the users. Questionnaire method was adopted according to a structured through Google platform i.e. Google forms keeping in mind the objectives of the study. Google form links sharing to the email addresses and WhatsApp groups of research students.*

The collected data was analysed, tabulated, interpreted and presented in the form of this paper. The study concluded that research scholar extremely utilised electronic resources demonstrating shift to a digital platforms for academic research, easy convenience, accessibility and unlimited information availability in any format of resources. Hence one can say that KTHM College library services are effective and fasters regarding the use of electronic resources.

Keywords: *E-resources, KTHM College, Research Scholars, E-journals, E-books*

Introduction:

Due to changing information and communication technology has affects on every sectors of life. Old forms of documents like books, journals, thesis, dissertations, reports etc. are currently available in the electronic formats. Hence library and information centre also affected by these online environments. These technologies are adaptable or adapted by libraries for providing effective and fastest services to users. Now a day's libraries are transformed in electronic libraries, virtual libraries and digital libraries. These three terms are equal or similar to each others. In simple words electronic library refers to a library system in which information is stored electronically and made accessible through electronic devices and networks. Electronic Resources have access from anywhere and anytime without geographical limitation and time limitation. As per user's convenience and demands, it's used that particular electronic resource.

Definition of Electronic Resources:

Dass and Jayaraman (2014) explained the concept of Electronic Resources as "Electronic Resources are any information sources that the library provides access to in an electronic format the library has purchased subscriptions to many electronic information resources in order to provide access to free of charge." These E-resources include lot of things full text e-journals, e-newspapers e-books, digital images, e-dictionaries, e-encyclopaedias, research information regarding any subject etc.

According to Library of Congress (2003) an "electronic resource" is defined as any work encoded and made available for access available by 1) Remote access and 2) Direct access (fixed media). In other words: Remote access (electronic resources) refers to use of electronic resources via computer networks. Direct access (electronic resources) refers to the use of electronic resources via carriers (e.g. discs / disks, cassettes, cartridges) designed to be inserted into a computerised device or its auxiliary equipments.

In this information era electronic resources are have crucial role in research. Electronic resources refer to those materials that require computer access, whether through a personal computer mainframe or handheld mobile device. They may either be accesses remotely via the internet or locally. Some of the most frequently encountered types are e-journals, e-books, full text (aggregated) databases, indexing and abstracting databases, Reference databases (Biographies, Dictionaries, Directories, encyclopaedias etc.), Numeric and statistical databases, e-images, e-audio / visual resources (International Federation of Library Association (IFLA Website)).

KTHM College: An Overview:

KTHM College: The College established in 1969. That time library having one room stack, now library having separate building which occupies an area of 882.57 Sq. Mts. consisting of a spacious reading hall, stacking section, text book section, periodical section, reference section, administrative wing, librarian's cabin, Asst. librarian cabin, issuing counters etc. library budget is near about 8,00,000/- every year and UGC also provides funds for library development.

The library is enriched with a huge collection of reference books, text books, CD's, Audio books, Braille books, periodicals and research journals. KTHM College offers Ph.D. in 14 subjects as Botany, Chemistry, Microbiology, Physics, Electronics, Economics, Marathi, Hindi, English, Commerce, Environmental Science, Mathematics, Zoology & Geography. College Admissions are near about 17000 students every year to various courses and total collection of library is 1,80,000. Amongst 17000, there are 339 students enrolled as research scholar in respective subjects.

Objectives of the Study:

The objectives of the present study are as:

1. To identify how many research scholars access the e-resources.
2. To study the purpose and utilisation of e-resources.
3. To find out the frequency of using e-resources.
4. To identify to study the preferred format for using resources.
5. To identify the problem faced by the respondent while accessing the e-resources.
6. To suggest suitable recommendations to improve facility and services related to the use of e-resources.

Research Methodology:

For the proposed study, questionnaire method was adopted according to a structured through Google platform i.e. Google forms keeping in mind the objectives of the study. Google form links sharing to the email addresses and WhatsApp groups of research students. The collected data was analysed, tabulated, interpreted and presented in the form of this paper.

Scope and Limitation of the study:

The present study covered the research scholars from KTHM college Ph.D. centre in 14 subjects only. KTHM College offers Ph.D. in 14 subjects as Botany, Chemistry, Microbiology, Physics, Electronics, Economics, Marathi, Hindi, English, Commerce, Environmental Science, Mathematics, Geography and Zoology.

Literature Review:

Madhusudan (2008) conducted a study on the use of electronic resources by teachers, students and research scholars of universities and research organisations. 78% of the respondents feel that the use of the UGC - Infonet has created high deficiency value on their research work and they demanded for current awareness service and electronic documents supply services.

Mulimani (2008) presented the result of the study on usage of internet by students and research scholars of Karnataka University library. It is revealed that majority of respondent use internet to keep up-to-date for research and academic purposes.

Satpathy (2010) has examined the use of resources by the faculty members who is special reference to CVRCE Bhubaneswar, indicating that the faculty members are heavily dependants on e-resources for their required information and keep themselves up-to-date in their subject areas.

Maharana (2010) conducted a study on the use of the internet and e-resources by the students of business management: survey of P.G. students of business administration Sambalpur University, India. Majority of respondents are used internet that it is time saving, legs expensive, more information, highly useful and inventional for management education as well as research proposes

Thamuskodi and Amsan (2013) conducted study to determine the usage of electronic resources among the students of J J College of engineering and technology the findings of the studies are electronic publishing is treated as the speedy, accurate and effective way of communication among the engineer professionals.

Chohda (2015) presented a study on the use of e-resources in Punjab University Library, Chandigar. It examines the preferences, importance, purpose and problems of electronic resources in Punjab University Library. Chohda make recommendations as providing the user training and new techniques to handle new technology to handle new technology.

Imsong and Kharbudn (2016) examined a study on information literacy on usage of electronic resources in academic libraries and author's opinion on study is that how to inform users regarding electronic resources and how to provide accurate information to the correct users from the collection of e-resources.

Data Analysis:

Analysis of data is the ultimate step in the research process. It is the link between raw data to significant results leading to the conclusion. This process of analysis has to be results oriented and suggested in recommendations. There are 339 students enrolled in Ph.D. Center as research scholar in respective subjects out of that 320 responded to Google forms.

1. Gender wise Respondents:

Table No.1

Sr. No.	Gender	Respondents	Percentages
1	Male	140	43.75 %
2	Female	180	56.25 %
Total		**320**	**100 %**

As shown in Table No. 1, the gender of the respondents is quite clear: out of the 320 respondents investigated for this study, the overwhelming majority 180 (56.25 %), were Females. In contrast, about 140 (43.75 %) were Males. Surprisingly, most of the students are females, which is higher than their male counterparts.

2. Opinion regarding frequency of access e-resources:

Table No.2

Sr. No.	Category	Respondents	Percentages
1	Always	118	36.88 %

2	Often	129	40.31 %
3	Occasionally	47	14.69 %
4	Rarely	23	7.19 %
5	Never	3	0.93 %
Total		**320**	**100 %**

Table No.2, Shows respondents give opinion regarding frequency of access e-resources. The result indicates out of 320 respondents 129 (40.31 %) are often access e-resources while 118 (36.88 %) are access e-resources always. Accessing e-resources occasionally and rarely is 47 (14.69 %) and 23 (7.19 %) respectively. In other hand, access e-resources never are below 1 % respondents. Hence it indicates usage of e-resources is effectively done by respondents.

3. Purpose and utilisation of e-resources:

Table No.3

Sr. No.	Category	Respondents	Percentages
1	Studying a coursework	55	17.19 %
2	Dissertations or project	62	19.38 %
3	Writing a research paper	30	9.37 %
4	Research work	108	33.75 %
5	For Teaching	8	2.5 %
6	Seminar / conferences / presentations	45	14.06 %
7	Up-to-date knowledge	8	2.5 %
8	General information	4	1.25 %
Total		**320**	**100 %**

As shown in Table No. 3, the purpose and utilisation of e-resources indicates that majority of respondents 108 (33.75 %), used e-resources for their research work. Research related activities like coursework, dissertations, writing research paper etc. used e-resources effectively as compare to Seminar / conferences / presentations, up-to-date knowledge, teaching etc. are self developing activities used less access e-resources. For general information research scholars used rare e-resources only 1.25% i.e. 4 respondents only.

4. Formats of e-resources:

Table No.4

Sr. No.	Category	Respondents	Percentages
1	E-books	65	20.31 %
2	E-journals	148	46.25 %
3	Electronic reference resources	50	15.63 %
4	E-Thesis	25	7.81 %
5	Web OPAC	15	4.69 %
6	Open access resources	10	3.13 %
7	Question Banks	3	0.93 %
8	NLIST Consortia	2	0.625 %
9	NPTEL Platform	2	0.625 %
Total		**320**	**100 %**

Table No.4, Shows respondents responded for formats of e-resources which they access most frequently. The result indicates out of 320 respondents 148 (46.25 %) are access e-resources as e-journal format while 65 (20.31 %) used e-books and 50 (15.63 %) used Electronic Reference resources. On other hand, E-thesis, Web OPAC, Open Access resources, question banks, NLIST Consortia & NPTEL Platform are used less number of respondents.

5. Problem facing by respondents while using the e-resources:

Table No.5

Sr. No.	Category	Respondents	Percentages
1	Insufficient e-resources	75	23.44 %
2	Less coverage of e-resources in subject field	85	26.56 %
3	Lack of proper assistance by library staff	40	12.50 %
4	Poor knowledge for searching skills	35	10.94 %
5	Less number of computer terminals	12	3.75 %

6	Lower internet connectivity or speed	62	19.38 %
7	Time Consuming	5	1.56 %
8	Electricity failures	4	1.25 %
9	Unorganised information content	2	0.62 %
Total		**320**	**100 %**

As shown in Table No. 5, Problem facing by respondents while using the e-resources indicates that majority of respondents 85 (26.56 %) & 75 (23.44 %) are arguing for Insufficient e-resources their subject field and overall very less e-resources are provided by the Library. 62 (19.38 %) respondents are faced internet connectively problem for accessing e-resources. While 40 (12.50%) & 35 (10.94 %) respondents are facing problems as less cooperation by library staff & Poor knowledge for searching skills of library staff for accessing the e-resources. Remaining respondents are facing fewer problems which are negligible as less number of computer terminals, time consuming, electricity failures and unorganised information content.

6. Recommendations:

On the Basis of problems facing by respondents while using the e-resources, some recommendations are suggested for effective usage of e-resources as:

- Development of infrastructure facilities for accessing the E-Resources by the respondents.
- User training is essential for the better use of electronic resources.
- E-resources users should be taught about advanced search strategies.
- Remedies for negotiation with the publishers / consortia regarding the speed of host to website.
- More personalised service required to users by the library staff in accessing E-Resources.
- Electronic document delivery service should be introduced in the library.

Conclusion:

Due to fast growth of information and communication technology especially internet & electronic resources; Hence change traditional methods of research; Purchases / Subscribes, Collects, Storage and Dissemination of scholarly information. The study concluded that research scholar extremely utilised electronic resources demonstrating shift to a digital platforms for academic research. The convenience accessibility and unlimited information availability in any format of resources. Some nominal changes are made for infrastructure and training programs for students are allotted in regular frequencies and modems are used for high speed internet which helps to students access information easily.

Hence one can say that KTHM College library services are effective and fasters regarding the use of electronic resources.

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International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Influence of Annealing Temperature on the Optical Properties of Cu Doped Zinc Oxide Films

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Abstract: ***In this work, Cu-doped zinc oxide films were deposited using the sol-gel method. The impact of annealing temperature on optical properties was examined. The transmission spectra confirm that all the samples had a percent transmission >90 in the visible wavelength range. The refractive index was found to be ~1.8 from the oscillating pattern of the transmittance spectra. It was noted that the annealing temperature has less effect on the bandgap energy, which was determined to be ~3.2 eV. SEM images and recorded EDAX spectra confirm the distribution of grains and the successful incorporation of Cu atoms in ZnO.***

Keywords: CuZnO, transmittance spectra, refractive index, II-VI Semiconductor, P-type

1. Introduction

Zinc oxide (ZnO) is a versatile material that has attracted considerable attention in recent years due to its unique optical, electrical, and structural properties. ZnO has a wide bandgap of 3.37 eV and a large exciton binding energy of 60 mV, making it suitable for various optoelectronic and solar applications [1–3]. The structural, optical, and electrical properties of ZnO films were significantly affected by deposition parameters and dopants. ZnO is a semiconductor material of the intrinsic n-type due to native donor defects such as oxygen vacancies (Vo) or interstitial zinc (Zni) [4]. When ZnO was doped with the IIIrd group, it was observed that the conductivity got enhanced and it remained n-type ZnO [4]. However, it is difficult to fabricate p-type ZnO with sufficient electrical conductivity. When ZnO was doped with Ist and Vth group elements, it formed p-type ZnO. However, the low solubility of dopants, low thermal excitations into the energy level of acceptor impurities, and the introduction of point defects acting as compensators are the main obstacles during the fabrication of P-type ZnO [5]. Recently, several research groups have been trying to improve p-type conduction using dopants from the Ist and Vth groups, like lithium, sodium, nitrogen, phosphorus, silver, and copper [6–9]. As discussed earlier, the addition of different types of impurities can change the properties of ZnO, which are useful in various applications. When copper is doped into ZnO, it enhances its ferromagnetic and photoluminescence properties, as observed by Xu et al. [10]. During this work, it was noted that very little work was carried out using cost-effective methods for depositing p-type ZnO thin films. Therefore, through this work, an attempt has been made to fabricate high-quality cost-effective Cu-doped ZnO films using sol-gel deposition technique. Moreover, since the ferroelectric and photoluminescence properties are examined by others, we aimed to investigate the optical properties of Cu-doped ZnO thin films through this work.

2. Experimental Process

The sol-gel spin coating method, which was earlier used to deposit doped and undoped ZnO, is used in this work for the deposition of Cu-doped ZnO [11–12]. The solution was prepared using zinc acetate dihydrate and copper acetate as sources of zinc and copper, respectively. 2-Methoxyethanol was used as a solvent, while ethanolamine was used as a reagent. A transparent solution was obtained by dissolving zinc acetate dihydrate and copper acetate in 2-methylethanol, and simultaneously, 5 to 7 drops of ethanolamine were added to the solution, which helped to increase the rate of reaction and maintain stability. Then the solution was continuously stirred on the hot plate at 80°C for an hour, and a transparent and clear solution was obtained. The obtained solution was cooled to room temperature, followed by the deposition of films on microscopic glass with a homemade spin coating system. Each time after the deposition process, films were preheated in the open air at 300°C for 10 minutes for the evaporation of organic elements present in the films. After cooling the substrate to room temperature, the next layer was deposited. Finally, samples were post-annealed at 375 °C for an hour in the open air. For the investigation of the optical property, multilayered (10 coatings) films were deposited at various dopant concentrations. Similarly, the film of undoped ZnO was prepared using zinc acetate as a source of zinc, and 2-methyloxyethanol and ethanolamine were used as solvents and reagents, respectively.

Shimadzu UV spectrophotometry was used to record the transmittance spectra of the sample to study its optical properties like refractive index and bandgap energy. In addition to this, the thickness of the films deposited on the glass substrate was determined from transmission spectra using the envelope method, also known as the swapnoel method. The optical band gap was further determined using a tauc plot. The surface morphology and chemical composition were investigated using SEM and EDAX spectra, respectively.

3. Result and Discussion

In the present work, the primary investigation of Cu-doped ZnO films is discussed. To study the effect of post-annealing temperature on optical properties, the post-annealing temperature was varied between 350°C to 425°C for 4 at% Cu doped ZnO film in a controlled environment for an hour.

3.1 UV-Vis Transmission Spectra

The UV-visible transmission spectra of Cu-doped ZnO films deposited on a microscopic glass substrate are shown in Figure 1 as a function of wavelength. The transmission spectra showed that deposited films are highly transparent, and the oscillating nature of the spectra indicates the optimum thickness of the films, which was useful in determining sufficient data for deducing optical properties like refractive index. It is confirmed from the transmittance spectra that the as-deposited films are mostly transparent from the 400 nm wavelength up to most of the visible wavelength range. However, below this range of wavelength, the maximum absorbance occurs and is fully absorbed at approximately a wavelength of ~380 nm. This also indicated that the deposition process does not introduce any significant defects or impurities that could affect the optical properties of the samples.

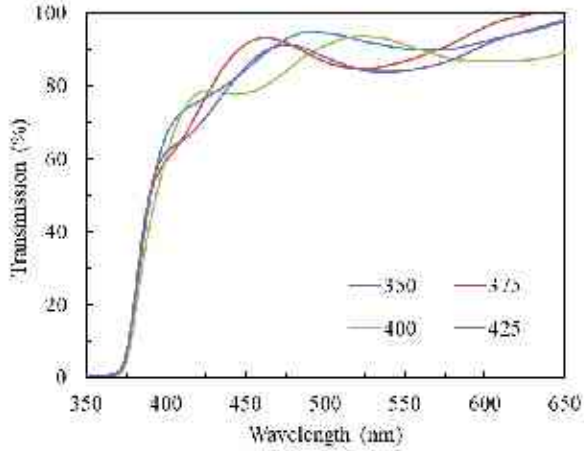

Figure 1: Transmission spectra of Cu doped ZnO, annealed at different temperatures (in ^{0}C)

3.2 Refractive Index and ThicknessCalculation

Since ZnO-based materials are highly under investigation for realizing optoelectronic devices, their refractive index was calculated for the 450nm wavelength using the swanepoel method [13]. This method uses the transmittance percentage of the recorded spectra to calculate the refractive index and thickness of the film. In this work, the refractive index (n) was calculated using the following equation:

$$n = [N + (N^2 - s^2)^{1/2}]^{1/2} \quad (1)$$

Where,

$$N = 2s\frac{T_M - T_m}{T_M T_m} + \frac{s^2+1}{2} \quad (2)$$

Here, T_M and T_m are the maximum and minimum transmittance at wavelength. The refractive index of each deposited Cu-doped ZnO films is found to be ~1.88, which is in very good agreement with the refractive index reported by others [14–16]. This work indicates that a dopant concentration of 4 at% has not changed the refractive index of ZnO material. The distribution of the refractive index of Cu-doped ZnO at various annealing temperatures is shown in Figure 2. However, negligible variation is noted in the refractive index of Cu-doped ZnO as compared to ZnO annealed at 400 °C.

Similarly, the thickness of the deposited transparent films were calculated using following equation,

$$d = \frac{\lambda_1\lambda_2}{2(\lambda_1 n_2 - \lambda_2 n_1)} \quad (3)$$

The details of the parameters in the above equation and determination of thickness are given in the work by swanpoel et al [13]. The thickness of the as-deposited films is mentioned in Table 1. Since an equal number of ten coatings were applied on the surface of the slides annealed at various post annealing temperatures, the thickness was found to be very much same.

Table 1: Calculated refractive index and thickness of Cu doped ZnO thin films

Post annealing temperature	Refractive Index (at 450nm wavelength)	Thickness (nm)
350	~1.8	447
375	~1.8	432
400	~1.88	447
425	~1.8	441

3.3 Direct Bandgap Energy

Bandgap energy is another important factor that was investigated for the Cu-doped ZnO thin film in this work. We used the Tauc plot method to determine the optical band gap energy of the films from the absorption coefficient, as shown in figure 3. The absorption coefficient was calculated from the following equation:

$$\propto = (h\vartheta - Eg)^{1/2} \quad (4)$$

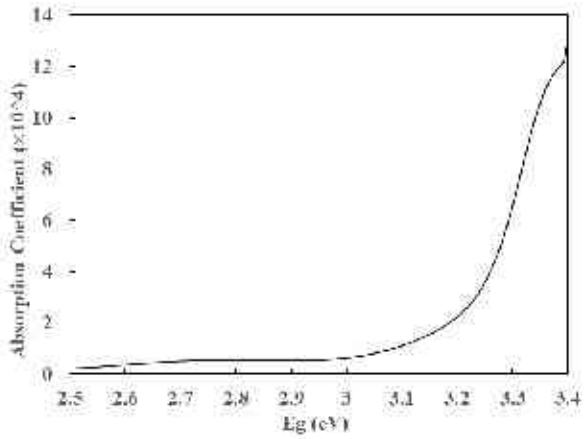

Figure 3: Plot of absorption coefficient versus band gap energy of Cu doped ZnO annealed at 400^{0}C.

From the plot, it was confirmed that the deposited cu-doped ZnO films are direct band gap semiconductor material. Furthermore, with the help of the extrapolation method, the energy band gap is found to be ~3.2 eV, which is in

agreement with the CuZnO thin films deposited using several other techniques [17–19].

3.4 Microstructure Analysis using SEM

From the SEM image depicted in Figure 4a, the film morphology of Cu-doped ZnO film annealed at 400^{0}C was determined. The image of the film was recorded for 1 µm with a resolution of x10,000. It shows the distribution of doped ZnO grains across the surface. The surface appears to be the repeating pattern which is indicative of the crystalline structure of Cu doped ZnO.

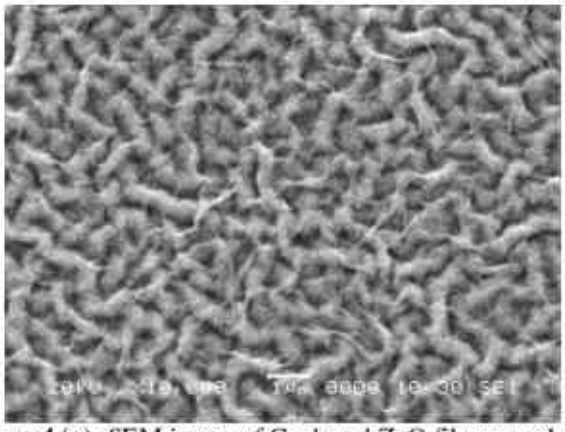

Figure 4 (a): SEM image of Cu doped ZnO film annealed at 400^{0}C.

Moreover, the SEM images revealed that the films exhibited a uniform and dense grain distribution across the surface, and the grain boundaries are visible, suggesting a good interconnection between the grains.

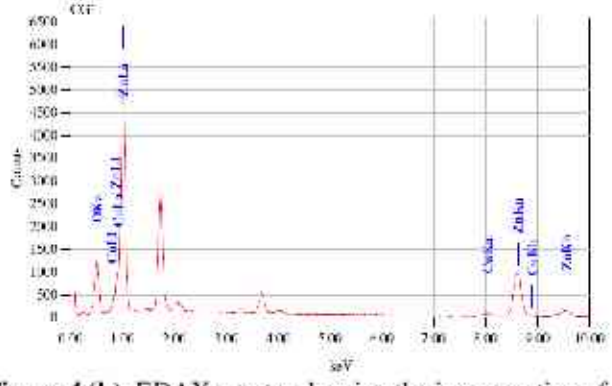

Figure 4 (b): EDAX spectra showing the incorporation of Cu in ZnO film annealed 400^{0}C.

The presence of Cu in ZnO films was verified by EDAX analysis, as shown in figure 4b. The EDAX spectra showed peaks corresponding to Cu, Zn, and O elements, indicating that Cu was successfully incorporated into the ZnO lattice by the sol-gel method.

4. Conclusion

We used the sol-gel method to produce Cu-doped ZnO films with transparent conducting properties. This work is motivated by the possible applications of P-type ZnO as a transparent conductor in optoelectronics and photonic devices. We report on the optical and structural characteristics of the 4 at% Cu-doped ZnO films prepared at various annealing temperatures. The transparency of the deposited samples was measured using a spectrophotometer. The results showed that the samples had a high degree of transparency, with values above 90% in the visible range. The refractive index of 1.8 was successfully attained during the fabrication of CU-doped ZnO. The band gap value for the doping level (4%) was 3.2 eV. The surface morphology and the Cu incorporation on ZnO were examined by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDAX). The EDAX spectra confirmed the presence of Cu in the ZnO films. With the results obtained in this work, we intent to investigate further the effect of doping concentration of Cu in ZnO at various annealing temperatures.In conclusion, highly transparent cu-doped ZnO films were successfully prepared and characterized through this work.

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Deposition of Ag doped Zinc Oxide Thin Films for p-type semiconductor

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Abstract – This paper aims to optimize and fabricate high-quality Ag doped zinc oxide (ZnO) thin films using a low-cost sol gel deposition method. The study demonstrates the successful implantation of single crystalline ZnO on a glass substrate as well as Ag doped ZnO at 1at%, to 5 at% using the sol gel-method. The XRD spectra show the formation Ag embedded ZnO films on glass. The embedding of Ag in ZnO was confirmed from the SEM image. The UV-Vis transmission spectra show high transparency and uniform deposition of doped ZnO at different doping levels. The energy band gap of the deposited sample is ~3.2eV. The surface morphology of the Ag-doped ZnO is also studied using SEM characterization.

Index Terms – Ag doped ZnO, solgel deposition, XRD spectra, UV-VIS spectra, SEM

I. INTRODUCTION

Ag-ZnO thin film is one of the important semiconductors materials used in optical electronics, sensors, solar cells, and antibacterial coatings[1-5], and has attracted considerable attention for its unique properties. ZnO has been already a widely accepted semiconducting material in the applications of photodetectors, sensors, light emitting devices etc [6]. The epitaxial growth of ZnO has led to the development of quantum wells and other heterostructures for excellent ultraviolet and blue light emitters [7]. The success of zinc oxide based devices would not have been possible without the dopant materials like Cu [8], Al [9] and Sb [10], N [11] for fabrication of n-type and p-type ZnO semiconductor from III and V group atoms. The fabrication of undoped and doped ZnO material has been reported using various chemical assisted deposition and physical vapor deposition techniques previously [12]. Several attempts have been made to fabricate the stable p-type ZnO semiconducting material and doping of silver can also assist in the fabrication of stable p-type ZnO [13-15]. The Ag doping can improve the conductivity, transparency and photocatalytic activity of ZnO thin films by introducing extra electrons and scattering centers in the film.

However, one of the problems that arise in Ag doped ZnO thin films is to control the stable electrical and optical properties by adjusting several parameters. These parameters could be the deposition method, the substrate temperature, the doping concentration, and the post-deposition treatment etc. These parameters affect the structure, morphology and composition of the films, which in turn influence their electrical and optical properties. In this paper, an attempt has been made to optimize and fabricate stable high-quality Ag doped ZnO thin films of desired properties with a very low cost sol gel deposition method. This method is not only simple and cost effective, but also, it also provides various parameters to control the doping concentration and annealing temperatures. Further the deposited samples were characterized for its distinctiveness using XRD, UV-Vis spectrophotometer and SEM.

II. EXPERIMENTAL PROCEDURE

The sol-gel spin coating approach, which was previously utilized to deposit doped and undoped ZnO [16-17], is used in this study to deposit Ag-doped ZnO. The solution was made with zinc acetate dihydrate and silver acetate as zinc and Ag sources respectively. 2-Methoxyethanol was employed as a solvent, while ethanolamine was used as a reagent. By dissolving zinc acetate dihydrate and silver acetate in 2-methoxyethanol, a clear solution was formed, and 5 to 7 drops of ethanolamine were added to the solution at the same time, which served to improve the rate of reaction and preserve stability. The solution was then continually stirred on a hot plate at 80°C for an hour, yielding a translucent and clear solution. The obtained solution was cooled at room temperature followed by the deposition of films on microscopic glass and silicon substrate with a homemade spin coating system. Each time after the deposition process, films were preheated in the open air at 300°C for 10 minutes for evaporation of any organic elements present in the films. After cooling the substrate to room temperature, the next layer was deposited. Finally, all the samples were post-annealed at 375°C for an hour in the open air. For the investigation of the optical property, multiple coated films of undoped and doped ZnO were deposited for 1 at% to 5 at% silver doping concentrations.

The deposited Ag doped and undoped films on glass substrate were characterized to study percentage of transparency and energy bandgap using transmittance spectra, recorded by Shimadzu UV spectrophotometry. Structural property of undoped and doped films were investigated by XRD pattern recorded using Bruker AXS-D8 X-ray diffractometer. The X-ray diffractometer was equipped with a Cu-kα x-ray source having wavelength 1.54059 Å. Samples deposited in silicon substrate were used to measure the refractive index on silicon substrate.

III. Result and Discussion

Structural Properties

As recorded XRD spectra of undoped and 4 at% silver doped ZnO thin film on glass substrate using the sol gel method are shown in Figure 1 and Figure 2 respectively. In Figure 1, the peak at 34.8° corresponds to (002) plane orientation of the wurtzite hexagonal structure whereas no other significant peaks were observed [18]. It indicates that a c-axis oriented single crystalline ZnO was successfully deposited on the glass using the sol gel deposition method at optimum conditions.

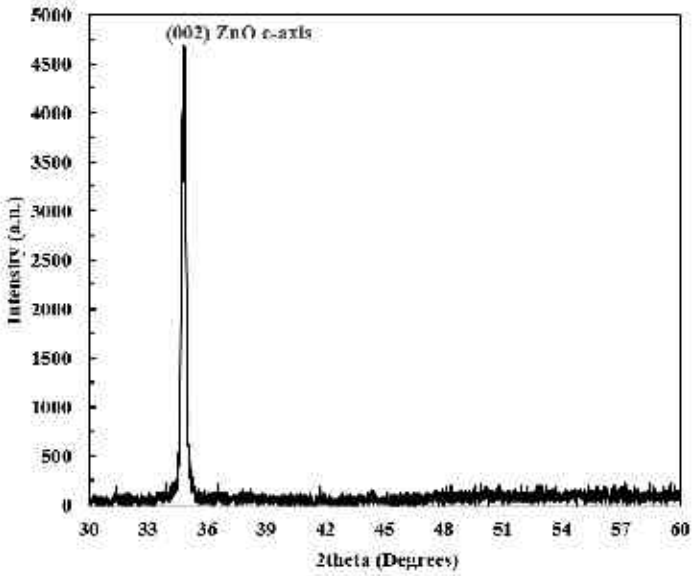


Figure 1 XRD spectra of ZnO film deposited using solgel

The recorded spectra of Ag doped ZnO are shown in Figure 2. The peak at 38.2° and 44.46° are associated with the (111) and (002) plane respectively of silver crystal [19]. The same peaks were reported for the formation of face centered cubic structure silver crystal elsewhere [20-22]. The increased intensity of peaks of silver crystal may be attributed to the 4 at% dopant value of silver acetate in the solution. However, for lower atomic concentrations the negligible height of the peak was reported [23]. It became evident from the XRD results that the Ag was successfully incorporated in ZnO with low cost solgel technique.

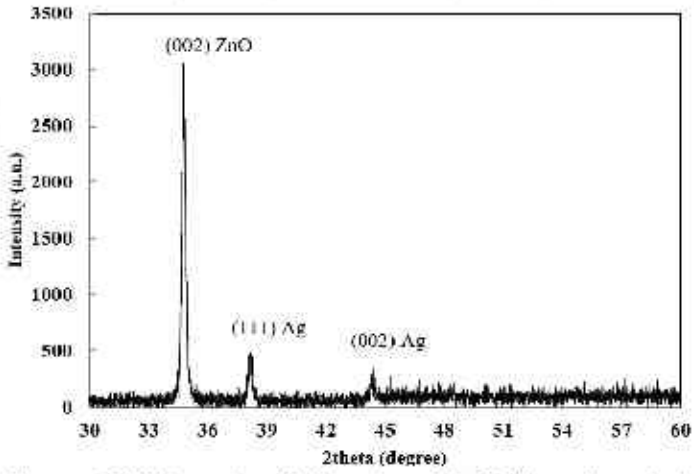


FIGURE 2 XRD spectra of silver doped ZnO film using solgel

Optical properties

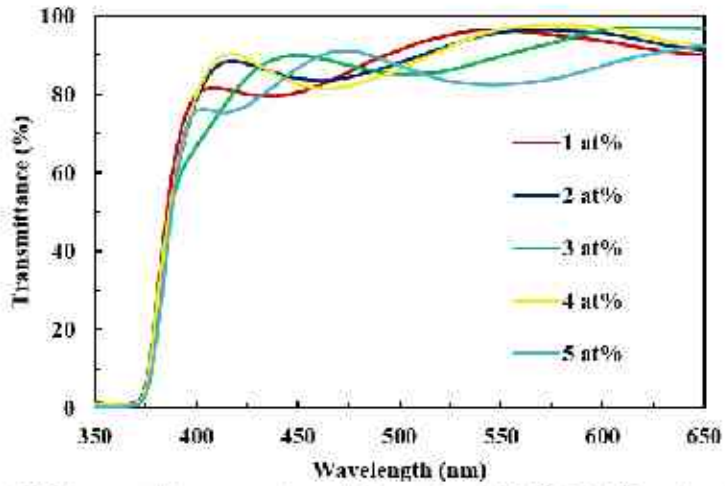


Figure 3. UV-VIS transmittance spectra of silver doped ZnO thin film at various at%

The UV–visible transmission spectra of Ag-doped ZnO films deposited on a microscopic glass substrate are shown in figure 3 as a function of wavelength. The transmission spectra show that deposited films were highly transparent and the oscillating nature of the spectra indicates uniform deposition of doped ZnO at various at% doping of silver. From these transmission spectra, various parameters like thickness and energy band gap were determined as calculated previously [24]. Since an equal number of coatings were applied under optimum deposition parameters on the glass surface, it was expected to get the equal thickness of the sample in this study. The thickness of sample, determined using well known swapnoel method, was calculated to be ~489 nm.

The bandgap energy of the deposited 4at% silver doped ZnO film was determined using a plot of absorption coefficient versus energy bandgap as shown in Figure 4. From the plot, it was observed that Ag doped ZnO showed a direct bandgap nature. With the help of extrapolation taken on the absorption coefficient curve, the energy bandgap was found to be ~3.2eV. The transmittance spectra and absorption coefficient of the deposited film also indicated that the higher transparency could be maintained even after ZnO was doped with silver atoms.

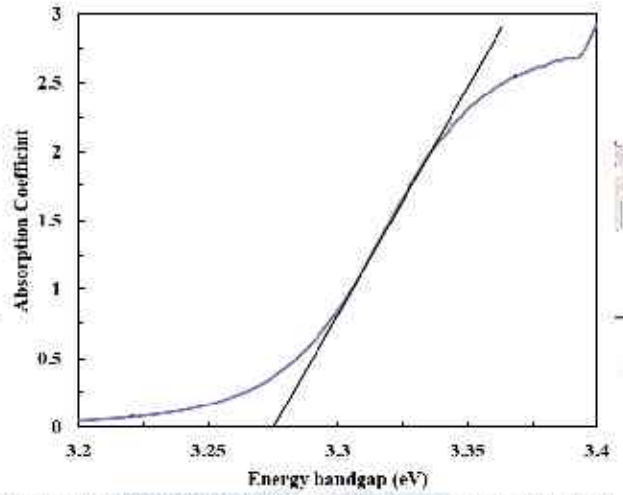
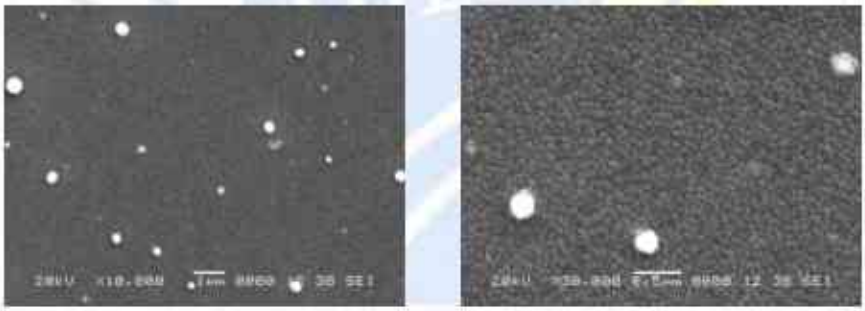


Figure 4. Plot of absorption coefficient versus energy bandgap of 4 at% Ag doped ZnO

Surface Morphology

The surface morphology of the silver doped ZnO was studied using SEM characterization. The white spots appearing in the image are attributed to the formation of silver crystals embedded in ZnO. The appearance of these crystal in Ag doped ZnO in SEM image indicates the formation of metallic silver nanoparticles. The SEM image shows that the silver crystal has a spherical shape and a uniform size distribution, with an average diameter of about 10 to 20 nm. Such type of silver embedded in ZnO may enhance the optical and electrical properties of the material. It is reported that such silver nanocrystals were helping in the increase in the conductivity of the doped ZnO material [25].



(a) (b)

Figure 5 (a) and (b) SEM images of silver doped ZnO thin film at 1µm and 0.5µm respectivaly

IV. Conclusion

Ag doped ZnO thin films of various concentrations were grown on the microscopic glass with the sol gel method. Out of them, the effect of 4at% doped ZnO thin film was investigated for structural and optical properties. The XRD spectra of undoped and 4 at% silver doped ZnO thin films on a glass substrate show the formation of wurtzite hexagonal structure and the formation of face centered cubic structure silver crystal. The large peaks of silver crystal may be due to the 4 at% dopant value of silver acetate in the solution. The UV-visible transmission spectra of Ag-doped ZnO films deposited on a microscopic glass substrate showed uniform deposition of doped ZnO at various at% doping of silver. The thickness of the samples was determined to be 489 nm. SEM characterization of silver doped ZnO revealed the formation of silver crystals embedded in ZnO, with a spherical shape and uniform size distribution. These silver nanocrystals may enhance the optical and electrical properties of the material. Further research work will be carried out to measure the impact of the Ag doping in ZnO on electrical, optical and structural properties for detailed investigation.

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International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Comparative Analysis of Cu and Ag doped ZnO: Influence of Doping Concentration and Annealing Temperature on Optical and Electrical Properties

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Abstract: ***In this work, Cu-doped and Ag-doped zinc oxide films were deposited using the sol-gel method. The impact of annealing temperature and doping concentration on optical and electrical properties were examined. It was noted that the annealing temperature has less effect on both the Cu-doped and Ag-doped zinc oxide films optical band gap energy. The minimum resistivity for Ag doped ZnO was From the study it was understood that Ag doped ZnO has lower resistivity as compared to Cu doped ZnO both at different doping concentrations and annealing temperatures.***

Keywords: Solgel method, Ag doped ZnO, Cu doped ZnO , Annealing temperature, Electrical resistivity

1. Introduction

Zinc oxide, abbreviated ZnO, is an inorganic substance possessing semiconductor properties. As an element of the II-VI semiconductor group, it is composed of the two group VI elements (oxygen) and group II elements (zinc). Given its large band gap of approximately 3.3 eV, ZnO finds use in transparent electronics, optoelectronics, and sensors. ZnO can have its electrical and optical properties changed by simply doping it with various impurities. However, as a result of intrinsic flaws like oxygen vacancies or zinc interstitials, zinc oxide usually has the n-type, indicating that it has more electrons than holes [1].

Therefore, various dopants such as trivalent (Al, Ga, In) [2-4], pentavalent (N, P, As) [5-7], or rare earth (Er, Gd) [8-9] elements have been used to achieve different types of doping in ZnO. Doping can affect the structural, optical, and magnetic properties of ZnO depending on the dopant concentration, ionic radius, electronegativity, and valence state [10].

One of the challenges in ZnO-based devices is to achieve p-type doping, which is essential for creating p-n junctions. N-type ZnO has an excess of electrons, while p-type ZnO has a deficiency of electrons. One of the methods to achieve p-type doping in ZnO is to use copper (Cu) as a dopant [11]. Cu has one less valence electron than Zn, so it can substitute Zn atoms in the ZnO lattice and create acceptor levels. The Cu-doped ZnO can be synthesized by various techniques, such as sol-gel, hydrothermal, spray pyrolysis, and sputtering [10]. The electrical and optical properties of Cu-doped ZnO depend on the Cu concentration, annealing temperature, and ambient atmosphere. Cu-doped ZnO can exhibit enhanced photoluminescence, photocatalytic activity, and gas sensing performance compared to undoped ZnO.

One way to enhance the electrical properties of ZnO is to introduce dopants, such as silver (Ag), that can create free carriers and modify the band structure. Silver (Ag) is an attractive candidate because of its high conductivity, antibacterial activity, and plasmonic properties [12]. Ag doped ZnO (Ag-ZnO) can exhibit enhanced electrical, optical, and catalytic performance compared to pure ZnO.

Therefore, it is important to optimize the synthesis conditions and characterization methods of silver-doped ZnO for achieving high-quality p-type material. In this study, doped ZnO films with different concentrations were annealed at different temperatures to study optical and electrical properties.

2. Experimental Process

The sol-gel spin coating method, which was earlier used to deposit doped and undoped ZnO, is used in this work for the deposition of Cu and Ag doped ZnO [13-14]. Since this study involves study of two different dopants in ZnO, copper acetate and silver acetate were used for synthesis of Cu doped ZnO and Ag doped ZnO respectively. The solution was prepared by dissolving zinc acetate dihydrate in 2-Methoxyethanol used as a solvent, while ethanolamine was used as a reagent with the appropriate amount of copper acetate and indium acetate for depositing Cu doped and In doped ZnO respectively. Then the solution was continuously stirred on the hot plate at 80°C for an hour, and a transparent and clear solution was obtained. The obtained solution was cooled to room temperature, followed by the deposition of films on glass substrate and silicon substrate with a homemade spin coating system for optical and electrical measurements respectively. Each time after the deposition process, films were preheated in the open air at 300°C for 10 minutes for the evaporation of organic elements present in the films. After cooling the substrate to room temperature, the next layer was deposited. Finally, samples were post-annealed at 375°C for an hour in the open air. For the investigation of the optical property, multilayered (10 coatings) films were deposited at various dopant concentrations.

Shimadzu UV spectrophotometry was used to record the

transmittance spectra of the sample to study its optical properties. The optical band gap was further determined using a tauc plot. The resistivity of the samples were measured using four probe methods. The surface morphology was investigated using SEM.

3. Result and Discussion

Figure 1 depicts the graph of a square of the absorption coefficient versus photon energy for copper and silver doped ZnO films. The optical band gap energy was estimated using the linear extrapolation method from the absorption coefficient. It was noted that the optical band gaps of copper and silver doped ZnO were found to be lower than those of pure ZnO. A band gap of 3.08 eV was observed for copper-doped ZnO, whereas it was found to be 3.18 eV for silver doped ZnO. Reddy et al. found a similar type of reduction in band gap after copper doping [15].

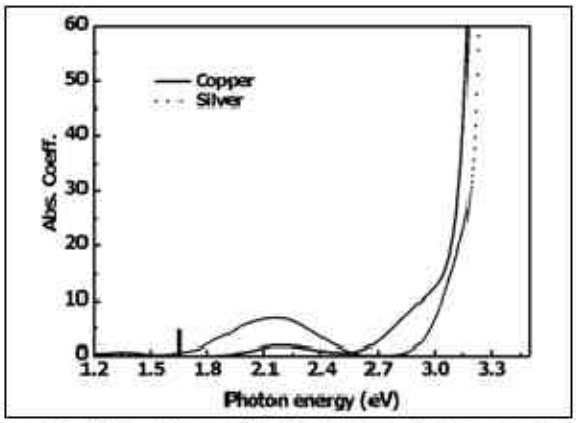

Figure 1: Absorption coefficient versus photon energy for copper and silver doped ZnO films

To study the effect of copper and silver impurities in ZnO, the resistivity of the films was calculated using the following equation:.

$$\rho = Rs \times t \quad (1)$$

Where *Rs* is sheet resistance, ρ is the resistivity, and *t* is the thickness of the film.

Figure 2 depicts the effect of dopant concentration on the resistivity of silver and copper doped ZnO films deposited on a silicon substrate. For both the dopants (silver and copper) at lower doping concentrations, resistivity was noted to be large. As the doping concentrations increased, resistivity gradually decreased and attained a minimum value of 4 at%. The minimum resistivity of ~4.5106 Ω-cm and ~1.7105 Ω-cm are measured for Cu and Ag doped ZnO, respectively, at 4 at%. The measured resistivity values are in good agreement with values reported by Wang et al. [16].

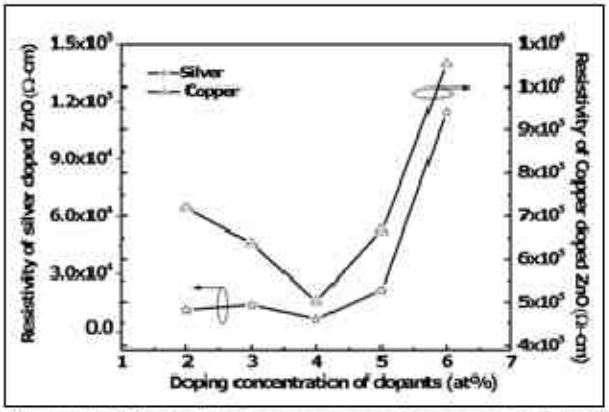

Figure 2: Effect of doping concentration on resistivity of copper and silver doped ZnO films deposited on silicon substrate

Figure 3 illustrates the effect of post annealing temperature on the resistivity of copper and silver doped ZnO films deposited on silicon substrates. Initially, a reduction in resistivity was observed when the temperature was varied from 350°C to 375°C. This may be due to the improvement in crystallinity after annealing at 375°C. Above 375°C, resistivity was found to be increased due to the scattering effect or may be due to the reduction in carrier concentration. From the results of resistivity, it has been concluded that silver doping is a better choice to achieve lower resistivity.

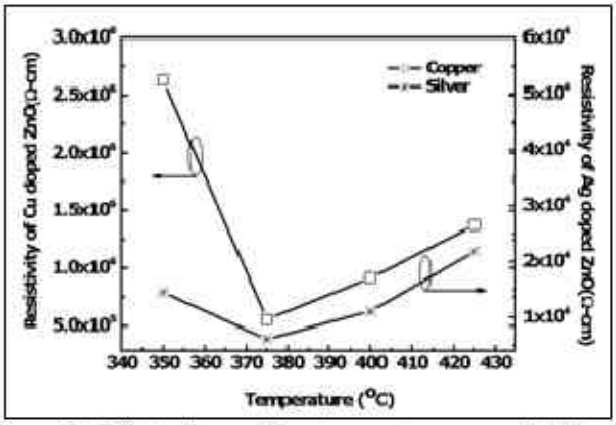

Figure 3: Effect of annealing temperature on resistivity of copper and silver doped films deposited on silicon substrate

4. Conclusion

Cu and Ag doped ZnO films are successfully deposited using a low cost sol gel technique for different molar concentration dopings and annealing temperatures. From the absorption coefficient plot, it is deduced that the optical band gap of ZnO remains approximately the same even after Cu and Ag doping. With the help of a probe method, deposited samples are successfully investigated for electrical properties. For both 4 at% Cu and Ag doped ZnO, the resistivity is found to be minimum, whereas at 375°C annealing temperature, the minimum resistivity is noted due to an improvement in the crystallinity.

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