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ABOUT CONFERENCE

The One-Day Multidisciplinary International e-Conference on New Horizon in Humanities and Basic sciences for sustainable development is a pioneering virtual event aimed at fostering collaboration and knowledge exchange among researchers, scholars, professionals, and enthusiasts in the fields of Sciences, Commerce and Humanities for sustainable development. This conference serves as a platform to explore recent advancements, discuss emerging trends, and address challenges in these interconnected disciplines. This conference aims to bringing together leading experts and stakeholders across multiple disciplines, the conference aims to catalyze innovation, inspire collaboration, and drive sustainable solutions for the challenges of today and tomorrow.

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- ✓ Mathematical Modelling
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CONTENT

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Advancements in Nano Crystalline Spinel Ferrite for Solar-Driven Hydrogen Production via Photo Catalytic Water Splitting : A Review

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ABSTRACT

Hydrogen is a sustainable and clean energy source, and its production from water using sunlight as the driving force is a promising approach. Ferrites have been widely known as excellent photo catalysts thanks to their excellent properties such as relatively narrow band gaps, chemical, and thermal stability, excellent magnetic property, and low-cost In the realm of solar energy conversion and storage, particularly solar fuel (hydrogen) generation by photo catalytic water-splitting, spinel ferrite, with general formula MFe2O4 (where M=Mg2+, Co2+, Ni2+, Zn2+, etc.), has attracted a lot of interest. For this reason, spinel ferrites have emerged as promising photo catalysts due to their special qualities and adaptable compositions. This review discusses the synthesis methods like sol-gel method, hydrothermal methods, precipitation, and solid-state reactions., Besides, optical, structural, electronic, and morphological properties of ferrites were characterized using several physical and analytical methods are highlighted. Various strategies for improving the photo catalytic activity of spinel ferrites, such as doping, modification, and heterojunction formation, are also explored. The challenges and opportunities associated with the application of spinel ferrites in photo catalysis for hydrogen production are discussed, along with future research directions in this field. Overall; this review highlights the potential of spinel ferrites as effective and efficient photo catalysts for the production of hydrogen through photo catalytic water splitting.

Keywords: ferrites, hydrogen production, water splitting, solar fuel, photo catalytic water splitting

I. INTRODUCTION

In recent years, the exploration of sustainable energy sources has become imperative to address environmental challenges and mitigate climate change. Among these sources, solar-driven hydrogen production via photo catalytic water splitting has emerged as a promising avenue for clean and efficient energy generation. This process utilizes sunlight to catalyze the conversion of water into hydrogen fuel, offering a renewable and environmentally friendly alternative to conventional fossil fuels. Advancements in nanotechnology have led to a surge in research focusing on nanostructured materials for photo catalytic water splitting, particularly Nano crystalline spinel ferrites, owing to their unique properties and potential catalytic activity (Refs. 1, 5, 6). Spinel ferrites, with their crystalline structure and Nano scale dimensions, possess adorable optical, electronic, and chemical characteristics that make them suitable candidates for photo catalysis (Refs. 2, 26).This review aims to comprehensively explore recent developments in utilizing Nano crystalline spinel ferrites for solar-driven hydrogen production via photo catalytic water splitting. Drawing upon a diverse range of studies, including comprehensive reviews (Ref. 1) and primary research articles (Refs. 5, 6), we will delve into the synthesis methodologies, structural characteristics, and performance metrics of these materials. Furthermore, we will discuss the significance of various doping strategies and surface modifications in enhancing the catalytic activity of spinel ferrites, as highlighted in studies by researchers such as F. Albagle (Ref. 4) and Heba M. Gobara et al. (Ref. 26). Insights from investigations into related materials, including cobalt ferrite Nano crystallites (Ref. 3) and magnesium zinc ferrite nanoparticles (Ref. 28), will contribute to our understanding of the broader landscape of catalyst development for solar-driven hydrogen production. Through the synthesis of findings from these studies, this review aims to provide valuable insights into the advancements, challenges, and future prospects of nanostructured spinel ferrites for photo catalytic water splitting. By elucidating the key strategies and mechanisms underlying their catalytic activity, this review seeks to inform and inspire further research efforts toward the development of efficient and sustainable energy technologies.

1. **Fundamentals of Solar-Driven Hydrogen Production** – Solar-driven hydrogen production through photo catalytic water-splitting has emerged as a promising avenue towards sustainable energy generation. This process harnesses solar energy to drive the conversion of water into hydrogen and oxygen
2. **Overview of Spinel Ferrites as Catalysts for Solar Fuel Generation** - The research primarily revolves around developing efficient catalysts for solar fuel (hydrogen) generation via photo catalytic water splitting. Various studies have explored the synthesis and characterization of spinel ferrites and their composites with other materials like TiO2, CNTs, etc., to enhance their photo catalytic properties. Investigations have focused on understanding the catalytic activity and stability of spinel ferrites under solar irradiation for water splitting reactions. Nanostructured spinel ferrites have been synthesized to achieve high surface area and improved charge transfer properties, which are crucial for enhancing catalytic performance. Several studies have examined spinel ferrite-based composites, such as ferrite/TiO2, ferrite/CNTs, etc., to harness synergistic effects and enhance catalytic efficiency. Doping with various metal ions and surface modifications have been explored to tune the electronic structure and improve the photo catalytic activity of spinel ferrites. The catalytic performance of spinel ferrites has been evaluated in both photo catalytic and photo electrochemical setups, aiming for efficient hydrogen generation under solar irradiation.

3. Synthesis Methods for Nano Crystalline Spinel Ferrites –

Hydrothermal Synthesis: Utilizing a hydrothermal method, nanostructured spinel ferrites can be synthesized. This involves the controlled reaction of precursor materials in an aqueous solution at elevated temperatures and pressures. (References: 5, 26, 25)

Sol-Gel Method: The sol-gel process involves the hydrolysis and polycondensation of metal alkoxides to form a sol, which can then undergo gelation to form a solid material. This method allows for the precise control of composition and morphology. (References: 14, 16)

Microwave-Assisted Synthesis: Microwave irradiation can accelerate the synthesis of spinel ferrites by providing rapid and uniform heating to the reaction mixture. This method typically results in shorter reaction times and energy savings. (References: 29, 30)

Co precipitation method -the desired ferrite nanoparticles are formed through precipitation by adjusting the pH or adding precipitating agents. (References: 15)

Solvothermal Synthesis: Similar to hydrothermal synthesis, solvothermal methods involve the reaction of precursors in a solvent at elevated temperatures and pressures. This technique can yield well-defined nanostructures with controlled sizes and shapes. (References: 14, 17)

Template-Assisted Synthesis: Using templates or sacrificial materials with desired morphologies, spinel ferrite nanostructures can be synthesized via techniques like template-assisted hydrothermal growth or template-directed electrode position. This allows for the fabrication of complex Nano architectures. (References: 18, 25)

4. Characterization Techniques for Nano Crystalline Spinel Ferrites

(XRD):-XRD is used to determine the crystal structure and phase composition of spinel ferrite nanoparticles. It provides information about crystallographic phases, lattice parameters, and crystallite size. **Transmission Electron Microscopy (TEM)**:-TEM enables the visualization of the morphology, size, and distribution of nanoparticles at the atomic level. It provides detailed information about particle size, shape, and homogeneity.

Scanning Electron Microscopy (SEM):-SEM is utilized to investigate the surface morphology and particle size distribution of Nano crystalline spinel ferrites. It provides high-resolution images of the surface topography **Fourier Transform Infrared Spectroscopy (FTIR)**:-FTIR spectroscopy is used to identify functional groups and chemical bonds present in the spinel ferrite nanoparticles. It provides information about the chemical structure and bonding configurations.**UV-Visible Spectroscopy**: UV-Vis spectroscopy is employed to study the optical properties of Nano crystalline spinel ferrites, such as band gap energy and absorption spectra. It helps in understanding the materials' suitability for photo catalytic applications.

5. Recent Advances in Nano Crystalline Spinel Ferrites for Solar Hydrogen Production

Cobalt Ferrite Nano crystallites: Cobalt ferrite Nano crystallites have been investigated for sustainable hydrogen production applications (Reference 3).They exhibit promising photo catalytic properties for water splitting under solar irradiation.

Zinc Ferrite-Based Composites:-Zinc ferrite-based composites, such as CNTs/ZnFe2O4 composites; have been synthesized hydrothermally for solar water splitting applications (Reference 5).These composites show enhanced performance in photo catalytic water splitting due to the synergistic effects between zinc ferrite and carbon nanotubes.

Bismuth Ferrite Nanoparticles:-Bismuth ferrite nanoparticles have been synthesized and applied in photo electrochemical water splitting systems (Reference 4).They demonstrate potential for efficient hydrogen generation under visible light irradiation, contributing to sustainable energy production.

Other Novel Ferrite Systems:-Various other novel ferrite systems, including spinel ferrites and mixed metal ferrites, have been explored for their photo catalytic and electro catalytic properties in water splitting reactions.(ref1)These systems often involve doping or modification with different metal ions to tailor their properties for enhanced performance in hydrogen generation (References 12, 26, 25, 14,31).These advancements hold promise for the development of efficient and sustainable energy conversion technologies.

6. **Potential Applications in Solar Fuel Production-**Solar Fuel Generation: Utilizing spinel ferrites-based materials for efficient solar fuel (hydrogen) generation via photo catalytic water-splitting, as discussed in Ref.1 by Miftahu Gambo Idris et al.Photocatalytic Water Splitting: Employing cobalt ferrite Nano crystallites for sustainable hydrogen production applications, as described in Ref.2 byF.Albagle.Hydrothermal Preparation: Utilizing nanostructured composites like CNTs/ZnFe2O4 for solar water splitting applications, as discussed in ref.4 by Haiphong Dang et al.Perovskite Photo catalysis: Utilizing Nano-crystalline LaFeO3 perovskite for photo catalytic hydrogen generation through water splitting, as discussed in Ref.5 by Sumatra N. Tijare et al. Using spinel Nano-ferrites as low-cost (photo)electro catalysts in solar energy conversion systems, as discussed in "REF.6 by Key van Malaie et al.
7. **Challenges and Opportunities for Further Research-Challenges**- Developing scalable and cost-effective synthesis methods for spinel ferrites-based materials to ensure their commercial viability for large-scale hydrogen production. Addressing issues related to stability and durability of spinel ferrites-based photo catalysts under prolonged operation, especially in harsh environmental conditions, to ensure long-term performance without significant degradation.**Opportunities**- Further research could explore the synthesis and application of mixed metal (Mg–Ni) ferrite Nano sheets for electro catalytic water splitting, as proposed by Nyemaga M. Malima et al. (Ref.21). Investigate the effects of metal doping, such as Mg2+ doping in MnO2, on enhancing the photo catalytic efficiency for sunlight-driven hydrogen generation, as proposed by Hamza Laksaci et al. (Ref. 19). Further explore the potential of MXene-based photo catalysts for efficient solar fuel generation via photo catalytic water-splitting reactions, as suggested by Adamu David Gaima Kafadi et al. (Ref.20). Investigate the synthesis and light-driven water splitting capabilities of hetero-metallic bismuth oxide catalysts, as proposed by Arshia Iqbal et al. (Ref. 22). Explore the utilization of defect-rich spinel ferrites with improved charge collection properties for efficient solar water splitting, as suggested by Runfa Tan et al. (Ref. 23). Investigate the synergistic effects of catalysts, such as Cu/Ni catalysts on CdS, for sunlight-driven hydrogen generation from water splitting, as proposed by Fatima Saleem et al. (Ref. 24).

II. CONCLUSION

In conclusion, recent advancements in Nano-crystalline spinel ferrite materials have shown promising potential for solar-driven hydrogen production via photo catalytic water splitting. Through innovative synthesis methods and structural modifications, researchers have enhanced the efficiency and stability of these materials, paving the way for sustainable hydrogen generation. The studies reviewed highlight the importance of material design and engineering in achieving high-performance photo catalysts for clean energy production. Continued research in this field holds great promise for addressing global energy challenges and transitioning towards a greener future.

Declaration of Competing Interest- no conflict of interest

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Nanostructured Materials for High-Performance Energy Conversion Devices: Sensing and Optimization

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ABSTRACT

Nanostructured materials have emerged as pivotal components in advancing energy conversion devices, owing to their unique properties and potential for high performance. This article provides a comprehensive review of the recent progress in utilizing nanostructured materials for various energy conversion applications, focusing on sensing mechanisms and optimization strategies. Synthesis methods, characterization techniques, sensing mechanisms, and optimization approaches are discussed in the context of solar cells, thermoelectric generators, and fuel cells.

Nanostructured materials offer unparalleled opportunities for enhancing the efficiency and sensitivity of energy conversion devices. Synthesis methods such as chemical vapor deposition, sol-gel techniques, and template-assisted growth enable precise control over the size, morphology, and composition of nanostructures, tailoring their properties for specific applications.

In solar cells, nanostructured semiconductors such as silicon nanowires, perovskite nanoparticles, and quantum dots exhibit enhanced light absorption and charge separation properties. Sensing mechanisms such as surface plasmon resonance (SPR) and photoluminescence (PL) are utilized to monitor solar cell performance. Similarly, in thermoelectric generators, nanostructured materials with reduced thermal conductivity and enhanced electrical conductivity enable high conversion efficiency. Sensing mechanisms such as Seebeck coefficient measurements aid in optimizing thermoelectric generator performance.

Optimization strategies including interface engineering and surface modification improve the efficiency and stability of nanostructured energy

conversion devices. Overall, the integration of nanostructured materials offers promising avenues for achieving high-performance energy conversion devices, advancing the transition towards sustainable energy solutions.

Keywords: Nanostructured materials, Energy conversion, Sensing, Optimization, Solar cells, Thermoelectric generators, Fuel cells.

I. INTRODUCTION

The global pursuit of sustainable energy solutions to mitigate environmental concerns and address energy security challenges has catalysed extensive research and development in the field of energy conversion devices. Nanostructured materials have emerged as key enablers in this endeavour, offering unparalleled opportunities to enhance the efficiency, sensitivity, and versatility of energy conversion technologies.[1-3] By virtue of their unique structural, electrical, and optical properties at the nanoscale, these materials have revolutionized the landscape of energy conversion devices, encompassing solar cells, thermoelectric generators, fuel cells, and beyond. [3-5]

Traditional energy conversion technologies often encounter limitations stemming from inherent material properties, such as limited light absorption in solar cells, low thermoelectric efficiency in thermoelectric generators, and sluggish reaction kinetics in fuel cells. Nanostructured materials, with their high surface-to-volume ratio, quantum confinement effects, and tailored electronic structures, present novel avenues to overcome these challenges and unlock unprecedented performance gains in energy conversion devices.[6]

The synthesis and design of nanostructured materials have witnessed remarkable advancements, offering precise control over size, shape, composition, and surface properties. Various synthesis techniques, including chemical vapor deposition, sol-gel methods, and template-assisted growth, enable the fabrication of nanomaterials with tailored functionalities for specific energy conversion applications. Moreover, advanced characterization techniques, such as electron microscopy, X-ray diffraction, and spectroscopic methods, provide insights into the structural, morphological, and chemical properties of nanostructured materials, essential for optimizing device performance.[7]

In this context, this research article aims to provide a comprehensive overview of the recent progress in harnessing nanostructured materials for high-performance energy conversion devices, with a particular emphasis on sensing mechanisms and optimization strategies. By exploring the synthesis methods, characterization techniques, sensing mechanisms, and optimization approaches, we aim to elucidate the underlying principles driving the enhanced performance of nanostructured energy conversion devices.[8]

Furthermore, we delve into specific applications, including solar cells, thermoelectric generators, and fuel cells, highlighting the contributions of nanostructured materials to each domain. By examining the sensing mechanisms employed to monitor device performance and the optimization strategies deployed to enhance efficiency and stability, we aim to provide valuable insights into the multifaceted role of nanostructured materials in advancing energy conversion technologies.[9-10]

Ultimately, this research article seeks to stimulate further research and innovation in the field, guiding the development of next-generation energy conversion devices that are efficient, reliable, and sustainable in the quest for a clean energy future.[11]

II. NANOSTRUCTURED MATERIALS FOR SOLAR CELLS

Solar cells, as one of the most promising renewable energy technologies, rely on the photovoltaic effect to convert sunlight into electricity. Nanostructured materials have garnered significant attention in the realm of solar energy harvesting due to their ability to enhance light absorption, charge carrier generation, and transport efficiency. This section explores the role of nanostructured materials in advancing solar cell technology, highlighting their synthesis, sensing mechanisms, and optimization strategies.[12-14]

Synthesis of Nanostructured Materials for Solar Cells:

Nanostructured semiconductors, including silicon nanowires, perovskite nanoparticles, and quantum dots, have emerged as key building blocks for next-generation solar cells. Various synthesis techniques, such as chemical vapor deposition, solution-based methods, and nanoimprint lithography, offer precise control over the size, shape, and composition of nanostructures, tailoring their optical and electronic properties to enhance solar cell performance. For instance, the synthesis of silicon nanowire arrays via vapor-liquid-solid growth enables efficient light trapping and charge collection, leading to improved power conversion efficiency (PCE) in silicon-based solar cells.[15-17]

Sensing Mechanisms in Nanostructured Solar Cells:

Sensing mechanisms play a crucial role in monitoring the performance and stability of nanostructured solar cells. [18] Surface plasmon resonance (SPR), arising from the interaction between light and metallic nanostructures, can enhance light absorption and photocurrent generation in thin-film solar cells. Additionally, photoluminescence (PL) spectroscopy provides valuable insights into the recombination dynamics and defect states in nanostructured solar cell materials, guiding optimization efforts to mitigate efficiency losses. [19] By leveraging these sensing mechanisms, researchers can gain deeper insights into the underlying processes governing solar cell operation and facilitate targeted improvements in device performance. [19]

Optimization Strategies for Nanostructured Solar Cells:

Optimizing the efficiency and stability of nanostructured solar cells requires innovative approaches to interface engineering, light management, and charge carrier transport. Nanostructured materials offer unique opportunities to tailor the optical and electrical properties of solar cell devices through surface passivation, heterojunction formation, and plasmonic enhancement. For example, the integration of metal nanoparticles or nanowire arrays on the surface of solar cells can enhance light trapping and absorption, thereby increasing photon-to-electron conversion efficiency.[20]

Moreover, doping strategies, such as surface doping or quantum dot sensitization, can modulate the bandgap and carrier concentration of nanostructured solar cell materials, enabling enhanced charge separation and collection at the interface. Furthermore, advanced characterization techniques, including transient absorption spectroscopy and Kelvin probe force microscopy, enable real-time monitoring of charge carrier dynamics and surface potential variations in nanostructured solar cells, facilitating the identification of performance-limiting factors and guiding optimization efforts.[21]

In nanostructured materials hold immense potential for advancing the efficiency and performance of solar cells through tailored synthesis, sensing mechanisms, and optimization strategies. By harnessing the unique

properties of nanostructures, researchers can overcome existing challenges in solar energy conversion and pave the way for cost-effective, scalable, and sustainable solar cell technologies. Continued research in this field is essential to unlock the full potential of nanostructured materials for meeting the ever-growing demand for clean and renewable energy sources.[20-22]

III.NANOSTRUCTURED MATERIALS FOR THERMOELECTRIC GENERATORS

Thermoelectric generators (TEGs) harness the Setback effect to convert waste heat into electricity, offering a promising solution for waste heat recovery and energy harvesting applications. Nanostructured materials have emerged as key components in enhancing the efficiency and performance of TEGs due to their ability to manipulate thermal and electrical transport properties at the nanoscale. [19-21]

Nano structuring techniques such as grain boundary engineering, superlattice structures, and phonon scattering interfaces enable the reduction of thermal conductivity while maintaining or even enhancing electrical conductivity. By introducing nanoscale features such as grain boundaries, interfaces, and nano-inclusions, researchers can effectively scatter phonons, the heat-carrying particles, thereby suppressing thermal conductivity and enhancing the thermoelectric figure of merit (ZT) of the material. [20-23]

Furthermore, the high surface-to-volume ratio of nanostructured materials facilitates efficient charge carrier transport, minimizing energy losses and maximizing the thermoelectric power factor. Nanostructured thermoelectric materials, such as bismuth telluride nanowires and silicon-germanium nanostructures, have demonstrated significantly improved ZT values compared to their bulk counterparts, making them attractive candidates for TEG applications.

Sensing mechanisms such as Setback coefficient measurements and electrical conductivity monitoring are employed to optimize the performance of nanostructured TEGs, providing insights into the thermoelectric properties and device efficiency. By leveraging nanostructured materials and advanced characterization techniques, researchers aim to develop TEGs with enhanced efficiency, reliability, and scalability, paving the way for sustainable energy harvesting from waste heat sources. [19-23]

IV.NANOSTRUCTURED MATERIALS FOR FUEL CELLS

Fuel cells stand at the forefront of clean energy technologies, offering efficient and environmentally friendly electricity generation through the electrochemical conversion of fuel and oxidant. Nanostructured materials have emerged as indispensable components in fuel cell systems, contributing to improved catalytic activity, enhanced ion transport, and increased durability. This section delves into the significance of nanostructured materials in fuel cell technology, elucidating their synthesis, catalytic performance, ion conductivity, sensing mechanisms, and optimization strategies. [21-24]

Synthesis of Nanostructured Catalysts:

Nanostructured catalysts serve as the heart of fuel cells, catalyzing the electrochemical reactions crucial for energy conversion. Techniques such as chemical vapor deposition, sol-gel synthesis, and electrodeposition enable the fabrication of catalyst nanoparticles with controlled size, shape, and composition. By precisely engineering these nanostructures, researchers can enhance the electrochemically active surface area, promote mass transfer, and optimize catalyst utilization efficiency. For instance, platinum nanoparticles supported on

carbon nanotubes exhibit superior catalytic activity and durability in proton exchange membrane fuel cells (PEMFCs), owing to their high surface area and geometrically accessible active sites.[25]

Enhanced Catalytic Performance:

Nanostructured catalysts offer distinct advantages over their bulk counterparts, including higher surface area, shorter diffusion pathways, and improved mass transport properties. The reduced dimensions of nanostructures facilitate efficient charge transfer and minimize reactant diffusion limitations, leading to enhanced reaction kinetics and lower activation energies. Moreover, the tunable electronic and chemical properties of nanostructured catalysts enable precise control over catalytic selectivity and stability, allowing for tailored performance in specific fuel cell environments. [26] By optimizing catalyst morphology, composition, and surface chemistry, researchers aim to achieve higher power density, lower overpotentials, and prolonged catalyst lifetime in fuel cell systems.

Ion Conductivity Enhancement:

In addition to catalysts, nanostructured materials play a crucial role in enhancing ion transport across fuel cell membranes and electrolytes. Nanostructured proton-conducting materials, such as perovskite oxides and sulfonated polymers, exhibit improved ion conductivity compared to their bulk counterparts. The nano structuring of electrolytes reduces ion diffusion pathways, enhances interfacial contact, and minimizes grain boundary resistance, thereby reducing ohmic losses and improving fuel cell efficiency. Furthermore, nanostructured membrane-electrode assemblies (MEAs) with controlled porosity and tortuosity facilitate efficient gas and ion transport, ensuring uniform fuel cell operation and enhanced performance. [21-25]

Sensing Mechanisms and Monitoring:

Sensing mechanisms such as electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV) play a crucial role in monitoring the performance and degradation of nanostructured fuel cell electrodes. EIS provides insights into the electrochemical processes occurring at the electrode-electrolyte interface, including charge transfer resistance, double-layer capacitance, and mass transport limitations. [27] CV enables the investigation of redox processes and electrochemical reaction kinetics, aiding in the optimization of catalyst activity and stability. By leveraging these sensing techniques, researchers can diagnose performance issues, identify degradation mechanisms, and develop mitigation strategies to enhance fuel cell reliability and durability.[28-29]

Optimization Strategies:

Optimizing the efficiency, durability, and scalability of nanostructured materials in fuel cells requires innovative strategies encompassing catalyst design, electrode architecture, and system integration. Surface engineering techniques such as atomic layer deposition, surface modification, and doping enable the precise control of catalyst properties and surface reactivity, enhancing catalytic activity and stability. [29] Moreover, advanced characterization techniques, including in situ spectroscopy and operando microscopy, provide real-time insights into catalyst performance under operating conditions, guiding the development of robust and reliable fuel cell systems. Additionally, computational modeling and machine learning approaches aid in the design and optimization of nanostructured materials for specific fuel cell applications, accelerating the discovery of novel catalyst formulations and electrode architectures. [29-30]

The materials offer unprecedented opportunities to enhance the efficiency, durability, and performance of fuel cells through tailored synthesis, enhanced catalytic activity, ion conductivity enhancement, advanced sensing mechanisms, and optimization strategies. By leveraging the unique properties of nanostructures, researchers strive to overcome existing challenges in fuel cell technology and unlock the full potential of these clean energy systems for a sustainable future.

V. CHALLENGES AND FUTURE PERSPECTIVES

Challenges persist in scaling up the synthesis of nanostructured materials to meet industrial demands while ensuring stability and cost-effectiveness. Achieving reproducible and scalable fabrication processes without compromising the intrinsic properties of nanostructures remains a significant hurdle. Additionally, ensuring the long-term stability of nanostructured materials under harsh operating conditions poses a challenge, necessitating the development of robust stabilization strategies. [28-31] Moreover, the cost-effective production of nanostructured materials is essential for widespread adoption in energy conversion devices. Future research directions should prioritize the development of scalable synthesis methods, robust stabilization techniques, and cost-effective fabrication approaches. Integration of multifunctional nanostructures and exploration of novel sensing mechanisms are crucial for real-time monitoring and optimization of energy conversion devices. [31] Advancements in computational modeling and machine learning techniques will further facilitate material design and device optimization, accelerating the translation of nanostructured materials into commercially viable solutions for high-performance energy conversion applications.

VI. CONCLUSION

Nanostructured materials offer immense potential for enhancing the efficiency and sensitivity of energy conversion devices such as solar cells, thermoelectric generators, and fuel cells. By understanding the synthesis methods, characterization techniques, sensing mechanisms, and optimization strategies of nanostructured materials, researchers can accelerate the development of high-performance energy conversion devices for sustainable energy applications.

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Study on Inter-Relationship between Zooplankton and Physicochemical Parameters of Kajali River, Ratnagiri, (M.S.), India

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ABSTRACT

The Kew River and Gad River is confluence to run Kajali River. The length is 72km western flowing river and it joins the Arabian sea at Bhatye near Ratnagiri. This research paper is on the inter- relationship between Physico-chemical parameters and Zooplankton diversity of Kajali River, Ratnagiri (M.S.) study during the Janaury 2021 to December 2021. The distribution and diversity of zooplankton in aquatic ecosystem depends mainly on the physico-chemical properties of water. Zooplankton has been considered as an ecologically important organism. The zooplankton community in Kajali River is comprised of rotifer, Cladocera, Copepoda and Ostracoda. Total 44 species and 34 genera of zooplankton obtained in this study, out of that number of species rotifer are 02,Cladocera 2, Copepods 38 and 2Otracods are found during the study period.A percentage comparison among the various zooplankton species reveals that the rotifers, Cladocera, Ostracoda were4.54% while the Copepods was dominant near about 86.36%. Thus, each group of zooplanktons preferred to reach their peak in different months of the year, Copepoda>Rotifera>Cladocera>Ostracoda.

Keyword: Zooplankton, Physico-chemical, Kajali River

I. INTRODUCTION

Environmental biology is extension of ecological approach, which stresses the study of environment for welfare of man and his comfort. Different climatic zones are formed based on annual temperature range, mean annual rain fall and on the basis of altitude.

In temperate regions, lakes often become thermally stratified during summer and again in winter, owing differential heating and cooling. Epilimnion i.e. the upper warmer part of lake isolated from the hypolimnion

i.e. colder warmer water by a thermocline zone that acts as barrier to exchange of material. “Blooms” of phytoplankton often follow seasonal rejuvenations of ecosystem.

Environment of water bodies mainly depends upon the climatic conditions occurs annually like temperature fluctuation, rainfall, physico-chemical properties, biological conditions and adverse effects decided condition of water.

The living organisms and their non-living environment are inter-related, interact separately and with each other. Any unit in which there is interaction between organism and between two materials is called ecosystem. Ecosystem is the functional unit of ecology and represent highest level of ecological interaction which is energy based (**Prasad 2000).**

The **“**Biotic community” and non-living environment function together called as an ecosystem.Ecology is the basic division of biology and also an integral part of any and all taxonomic division. It is consider in terms of the concept of several biotic level of organization as community, population, organism, organ, cell and gene.

The major ecosystem of the world deals with easily recognized types, with emphasis on geographical and biological differences that underly the remarkable diversity of life on earth. Fresh water eco-systems are characterized as having running water (lotic) and still water (lentic). The fresh water stream (springs creeks, rivulets,brooks etc.)and rivers are lotic zone but pools, ponds, some swamps bogs, lakes, etc. are lentic ecosystem.

II. MATERIAL AND METHODS

The Confluence of Kew river and Gad river is further known as Kajali river. The source of the river Kew is near AmbaGhat in the Sahyadri mountain range and the Gad river originates near the village of Devdhe at the foot of Vishalgad and from there it flows through the villages of Kirbet, Bhonde and Bhadkamba and comes directly to Kondgaon and joins the river Kew at Sakharpa. Kajaliriver is the western channel and near Bhatye village near Ratnagiri, it joins the Arabian sea and form Bhatye bay there. Total length of river is 72 km, it located at Sakharpa in Sangameshwar Tehsil of Ratnagiri district of Maharashtra.

Plankton sample is collected from four different sampling sites, collected plankton sample analyzed in the laboratory of Zoology Department, R. P. Gogate College of Arts and Science & R.V. Jogalekar College of Commerce, Ratnagiri. All collected sample will be analyzed by following the methods suggested in **APHA (1998)** and **Dhanpathi (2000).**

III.RESULT AND DISCUSSION:

Inter-relation between the Plankton with physico-chemical parameters of Kajali River was given below.

Physico-chemical Properties of the Kajali River Water:

The study of Kajali River was undertaken from January 2021 to December 2021 and the water quality studies consisted solely of the recording of selected physico-chemical parameters and their interpretation (Table 1). The river water was recorded having temperature highest in June i.e. 29.75 °C and lowest in December i.e. 18.25 °C, pH ranging from 8.1 to 7.23, Electrical conductivity (EC) ranges from 377.5 µmho/cm in June and lowest was 215 µmho/cm in month of December, Turbidity ranges from 9.14 NTU to 5.2 NTU both the range are in same month as EC, Total dissolved solid ranges from 375.36 mg/l to 228.83 mg/l, the various chemical parameters like dissolved oxygen (DO) ranging from 7.70 in the month of January to 3.9 mg/l in October, the

free carbon dioxide was observed in the water sample hence the observed total alkalinity by carbonate ranges from 56.5 mg/l to 22 mg/l and bicarbonate was ranges from 163 mg/l to 98.13 mg/l, the alkalinity highest was observed in the month of February while lowest was in the month of August. Total hardness ranges from 300.5 mg/l to 141.5 mg/l, while the calcium and magnesium hardness of river water are observed in permissible limit, Chloride of river water ranges from 140.73 mg/l to 68.34 mg/l salinity of is also calculated on the basis of chlorinity, Nitrogen compounds like ammonia, highest was observed 0.78 mg/l to 0.03 mg/l in trace amount during the summer season, while the ammonia converted in to the various other parameters like Nitrite and Nitrate, the highest was observed in the month of August and lowest was in February it ranges from 8.32 mg/l to 0.01 mg/l. The phosphate content of the water body was maximum during August that was 2.11 mg/l and lowest was 0.17 mg/l in month of January, Sulphate ranges from 7.375 mg/l to 3.23 mg/l, Silicates ranges from 9.35 mg/l to 1.60 mg/l. Biological oxygen demand ranges from 2.13 mg/ to 0.35 mg/l highest demand of oxygen was observed in the late winter season, Chemical oxygen demand ranges from 15.48 mg/l to 9.35 mg/l during the same season, **Walale and Rathod (2020).**

Table 1: Seasonal fluctuations in physico-chemical parameters of water in KajaliRiver water during the study period Jan to Dec 2021.

Param-eters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
TEMP ^{0}C	23.75	24.5	25.5	25.63	29.5	29.75	27.25	26.75	24.5	22.75	20.5	18.25
pH	7.58	7.7	7.9	8.05	7.9	8.1	7.9	7.68	7.53	8.03	7.38	7.23
EC µmho/cm	371.5	377.5	283.25	277.5	279.25	377.5	371.5	341	335.25	296	272.25	215
Turb. NTU	6.52	7.95	8.2	8.51	8.94	9.14	8.67	8.19	6.82	6.1	5.95	5.2
TDS mg/l	274.32	283.42	249.29	228.83	249.32	375.36	375.33	290.78	262.3	236.03	235.74	231.37
DO mg/l	7.70	6.83	4.45	5.3	5.25	6.35	7.45	6.48	4.75	3.9	5.25	7.4
CO2 mg/l	7.7	6.83	4.45	5.3	5.25	6.35	7.45	6.48	4.75	3.9	5.25	7.4
CO3 mg/l	37.5	56.5	44.5	27.75	32	35.25	27.25	22	23.75	29.75	27	24
HCO3	134.5	131.75	163	98.13	99.9	101.83	114.5	130.5	139.25	127.25	126.75	122.75
THmg/l	265	300.5	253.25	288.5	229	267.5	200.5	193	186.25	178.5	199.25	141.5
Ca H mg/l	43.4	40.9	41.15	39.06	34.1	26.04	10.84	8.3	8.65	16.33	24.77	35.68
Mg H mg/l	54.82	63.34	51.75	60.62	51.27	58.91	46.28	41.65	43.33	39.57	43.57	25.82
Cl. mg/l	79.76	68.43	90.22	127.48	140.73	103.16	93.56	93.03	78.7	94.15	87.48	73.23
Salinity mg/l	144.00	123.54	162.88	230.14	254.05	186.23	201.64	167.95	142.07	170.04	157.94	132.21
NH_3 mg/l	0.30	0.06	0.03	0.08	0.78	0.48	0.50	0.53	0.38	0.33	0.0825	0.235
Nitrite mg/l	0.21	0.01	0.08	0.03	0.40	0.43	0.24	0.41	0.23	0.11475	0.14	0.48575

Nitrate mg/l	2.16	2.47	3.18	5.59	7.75	7.67	5.75	8.32	4.97	4.08	4.5	3.52
Phosphate mg/l	0.17	0.26	0.28	0.42	0.51	0.61	1.13	2.11	1.01	0.82	0.65	0.36
Sulphatemg/l	5.00	3.55	4.50	5.23	5.15	4.75	3.23	4.13	3.60	6.4	7.375	4.875
Silicates mg/l	1.60	2.25	4.28	4.18	6.35	5.05	5.93	6.55	8.65	6.0025	9.35	6.125
BOD mg/l	2.03	2.13	1.33	1.06	0.53	0.35	1.93	0.79	0.61	0.6	0.47	0.52
COD mg/l	9.35	11.79	12.05	13.33	14.34	13.5	14.88	12.9	13.73	14.98	14.73	15.48

The zooplankton community in Kajali River is comprised of Rotifer, Cladocera,Copepoda and Ostracoda. Total 44 species and 34 genera of zooplankton obtained in this study, out of that number of species Rotifer, Cladocera and Ostracoda was 02 and Copepods 38 are found during study period, **Rathod and Walale (2022).**

During study periods the mean Rotifer diversity ranges from 0.75±0.5 to 10.25± 1.2583 in 2021, In rotifer total 2 genera are recorded including 2 species. Rotifera species were recorded more in winter season than monsoon and summer. Maximum number of rotifer found in the month of January and minimum in May. Rotifers are chiefly fresh water forms and presence of rotifer in abundance indicates suitable condition for their survival**Dhanapati (2000).** In rotifera species *Keratella sp.* and *Brachionus sp*.were abundant reported by**Kedar and *et al.,* (2008)** in abundance in Rishi Lake,Karnja In various water bodies of Central India **Kaushik and Saxena(1995)** have also reported genus Brachionus in abundance. Occurrence of genus*keratela* with*Brachionus*indicate nutrient rich status of water body. According to **Goel andCharan (1991)** *K. tropica*and *Brachionuscalyciflorus* are the pollution tolerant species and indicate accumulation of organic matter and these species reported dominant in polluted fresh water lake of Kolhapur.

Quantitative analysis of Cladocera during the 2021 it was 3.25±0.5 to 6.25 ±1.2583 Cladocera were found more in summer than monsoon and winter. Number of Cladocera was more in January, minimum in the month of September in 2021. **Gadekar and *et al.*, (2014)** also found that Cladocera were minimum in Monsoon but they recorded that maximum cladocera found in winter. In present study due to favorable temperature and availability of food like suspended detritus, bacteria and nanoplankton the abundancy of Cladocera increases. Similar result recorded by**Raut and *et al.*, (2012)** they found Cladocera dominated in summer season over other zooplankton. In monsoon season the physico-chemical factor like dissolved oxygen, temperature, turbidity, transparency also play an important role to controlling the density and diversity of Cladocera. **(Edmonson,1965; Baker 1979)**. Among Cladocera*Alona sp.* and *Moina* were most abundant.

During the study year the mean Copepods are dominate over all other zooplanktons, near about 86.36% from all Planktonic population. It shows the fluctuation all over the year but maximum number of copepods was found in November in years and less number found in January in 2021. Number of Copepods recorded 38 species in 34 genera.Controversial result obtained by **Pradhan (2014)** that they found dominancy of Copepods in summer month during study period.*Calanoid (diaptomus sp.),Eucyclopes sp., microcyclopes sp.* and Presence of Diatoms and cyclopes also observed by **Pawar and Pulle (2005)** in Pethwadaj dam Nanded. The Cladocerans are primary consumers which feed on algae and fine particulates thus it influence the energy of food chain and cycling matter in the detritus**Sitare, (2013).**

Ostracods during the 2021 it was ranges from 0.5±0.57735 to 1.75±0.9574. The highest ostracods ware observed during the month of April that is summer season while the lowest was observed in winter season that is month of November in both years. In ostracods*Paracondonaeuplectella*and*Cyclocypris sp.* were abundant. The highest density of ostracoda found in summer by **Sontakke and Mokashe (2014)** in Kagzipura Lake. Water level

decreases in summer and metabolic activities of biotic component increases. This result found by them and **Jayebhaye (2010)** worked on river kayadhu, near Hingoli city, Hingoli district, Maharashtra and study on perennial tank in Warangal district, A.P. As compared to other zooplankton population Ostracoda shows minimum population, similar observation are got by **Lahane and Jaybhaye (2013)** according to them Ostracoda population are less due to the feeding pressure of fishes and Ostracoda are small Crustaceans having bivalve carapace enclosing the laterally compressed body.

IV. CONCLUSION

An aquatic ecosystem consists of various kind of living organisms like phytoplankton, zooplankton, aquatic plants, sponges, cnidarians, fishes, amphibians etc. These living organisms depends on physico-chemical parameters for their food, distribution, density. The phytoplankton and zooplankton give response to temperature, pH, DO, BOD, COD, salinity, carbon dioxide, transparency, hardness and minerals Distribution and density of zooplankton is affected by temperature. Zooplanktons are important component of food chain. The fish larvae and some adult fishes feeds on zooplankton. The movement and distribution of fishes is affected by water temperature. Similarly, alkalinity ranges from 83-107 ppm are proper for growth and reproduction. The amount of DO, CO_2 affect life of aquatic organisms. So, the physico-chemical parameters in relation to zooplankton plays important role in fishery management and fish culture in lakes, ponds and other water bodies. The present investigation on the zooplankton composition, seasonal variation in the diversity and distribution of zooplankton in Kajali River, RatnagiriDistrict (M.S.), India is helpful to investigate the status of this river. In all 44 species of zooplankton were identified from river during the course of study of one years. All four groups of zooplankton were recorded throughout the study period. The number was highest during winter and lowest during summer except ostracoda. Ostracoda is maximum in summer to the study area. The study indicates that temperature plays an important role in the distribution of zooplankton in a fresh water habitat. The abundance of zooplankton from this Kajali River followed a sequence as under: Copepoda>Rotifera>Cladocera>Ostracoda.

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Short Review on Pectin : Extraction and Applications

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ABSTRACT

Pectin is a heterogeneous hydrocolloid present in the primary cell wall and middle lamella in all dicotyledonous plants, more commonly in the outer fruit coat or peel as compared to the inner matrix. Presently, apple fruits and citrus fruits are the core sources for profitable extraction of pectin. Current research on pectin extraction from alternate fruit sources and fruit wastes from processing industries will be of great importance. Pectin is widely used in the pharmaceutical industry for the preparation of medicines that reduce blood cholesterol level and cure gastrointestinal disorders, as well as in cancer treatment.

Keywords: Pectin, Extraction, application

I. INTRODUCTION

Pectin is a plant-based hydrocolloid, commonly added as an constituent in numerous food products, in the pharmaceutical industry and in other applications, such as for the development of edible films, plasticizers, paper substitutes and foams due to its unique structural and biochemical properties. The term pectin is applied to identify the numerous polymers that vary in neutral sugar content, molecular weight and chemical configuration, as pectin with different functional properties are produced by different plants. [1]There are already a number of literature review reports on pectin available, such as the extraction of pectin, pectin's chemistry and pharmaceutical uses, nutraceutical and functional properties, food packaging application of pectin, etc. [2-5]. However, there is a limited review on pectinwhich shows pectin's extraction and its applications. Therefore, the current short review paper reviews the extraction and the multidisciplinary role of pectin in different fields such in the food industry, the health and pharmaceutical sector, and in packaging industry.

Pectin is commonly utilized in the food industry as an additive in foods such as jams, jellies, low calorie foods, stabilizing acidified milk products, thickener and emulsifier. Pectin is widely used in the pharmaceutical industry for the preparation of medicines that reduce blood cholesterol level and cure gastrointestinal disorders, as well as in cancer treatment. Pectin also finds use in numerous other industries, such as in the preparation of edible films and coatings, paper substitutes and foams. Due to these varied uses of pectin in different

applications, there is a great necessity to explore other non-conventional sources or modify existing sources to obtain pectin with desired quality attributes to some extent by rational modifications of pectin with chemical and enzymatic treatments. Following table shows extraction method and pectin yield of different sources

II. EXTRACTION OF PECTIN

The pectin extraction from natural sources is a time-consuming and boring process as the raw material required for pectin extraction, such as fruit peels or pomace, are high in moisture content. The enzymes formed by fungi, including the de-esterifying and depolymerizing enzymes, are responsible for the breakdown of pectin. Pectin extraction from apple pomace is more difficult as compared to citrus peels, as it is easily spoilage by pectolytic enzymes unless instantly dried to reduce the moisture content before further storage for the process of pectin extraction.

Table No. 1 Sources of pectin and the extraction methods

Source	Pectin Yield	Extraction Method	Ref. No.
Sunflower heads	15–25%	Alkaline washing, 16 °C for 25 min at pH 5–7, 28:1 solvent:solid ratio	6
Cocoa husks	3.38–7.62%	Acidic extraction with citric acid or hydrochloric acid at pH 2.5 or 4.0	7
Cocoa husk	2.0–9.0%	Acidic extraction with HCl using microwave heating	8
Apple pomace	13.75–17.82 g % of pectin on a dry basis	Acidic extraction with citric or nitric acids	9
Grapefruit peel	23.44–26.74%	Acidic extraction with 0.5 M HCl using ultrasound-assisted heating extraction	10

III.COMMERCIAL SCALE CHALLENGES IN PECTIN EXTRACTION

Commercial Scale Challenges in Pectin extraction is of environmentally sustainable production of pectin. The main challenge is to the extraction of pectin are that this process requires the blanching and drying of raw material, a huge amount of water, collection and utilization the waste left by fruit and vegetable processing industries.Large amounts of energy by equipment such as mechanical grinding, freeze-drying and heating equipment and precipitants for the precipitation of pectin (1.2 to 9.9 L for the production of 10 g of pectin) [11]Due to this challenge in the conventional pectin extraction process, new process have been developed with some modification of the old conventional methods to increase the quality and yield of pectin.The Environmental friendly new methods such as ultrasound- or microwave-assisted techniques with reduced energy and reagent depletion, shorter extraction time and greater safety are replacing the old methods, as these are promising options for the commercial scale extraction of pectin.

IV.DIFFERENT APPLICATION OF PECTIN

The application possibilities of pectin are very extensive and several, ranging from the major categories of Jams and Jellies, Bakery products, Food packaging film, Food coating,**Antioxidant activity**,Therapeutic and pharmaceutical uses, briefly presented in following Table No. 2

Table No. 2 Different application of Pectin

APPLICATION OF PECTIN	
JAMS AND JELLIES	Ref. No
Peel was used for jam preparation with nice overall acceptability of Jams and Jellies	12
Pectin-based jams with maltitol, dried fruits and berries for glycemic control. The jam was successfully developed with textural parameters such as "gumminess," "springiness," and "homogeneity", and organoleptic properties with comparable overall consumer acceptance for both healthy people and people suffering with type 2 diabetes.	13
BAKERY PRODUCTS	
Apple pectin was successfully used for the preparation of wheat flour bread quality with improvement in the activation of fermentation and acid accumulation processes. The bread crust had a thin-walled crumb, with high porosity and sorption capacity.	14
Composite flour of wheat, pearl millet, and Bambara groundnut were used for bread production, along with apple pectin. The pectin exhibited up to 1.5% improved dough stability, whereas the highest overall acceptability for composite bread was observed at 2% pectin addition.	15
FOOD PACKAGING FILM	
Pectin-based Pectin/lime peel extract/coconut water-based film functionalized film was useful in the retardation of vegetable oil during storage.	16
Pectin/cinnamon oil film The film, when used for tofu storage, showed enhancement in shelf-life by reducing the growth of unwanted microbes.	17
FOOD COATING	
Pectin/oregano oil/ resveratrol The pectin formulation-coated pork loin showed less lipid oxidation and low microbial growth compared to uncoated counterparts.	18
Pectin/eugenolThe melon coated with functionalized pectin solution reduced the growth of Listeria while in storage.	19
Pectin/lemon EO/orange EO The formulation-coated apple slice showed lowered microbial count and less weight loss compared to the untreated sample.	20
ANTIOXIDANT ACTIVITY	21
Antioxidant activity of pectin from hawthorn wine pomace The antioxidant activity was evaluated for hawthorn wine pomace pectin extracted by different methods by using the concentration (IC_{50}) index, DPPH scavenging ability, and the IC_{50} values were 0.01 (VC, ascorbic acid), 2.63 (hydrochloric acid method), 2.10 (citric acid method), 2.24 (cellulase method) and 3.11 (microwave-assisted chelating agent method) mg/mL.	22
THERAPEUTIC AND PHARMACEUTICAL	
Pectin extracted from the roots of *Arctiumlappa* L. with dosages of 200 mg/kg and 400 mg/kg exhibited strong anti-constipation activity in vivo. The *Arctiumlappa* L. pectin-treated groups perhaps had improved small intestinal movement rate, and had significantly increased weight of feces in constipated mice.	23
The novel enzymatically extracted apple pectin reduced the viability of HCT 116 and Caco-2 colorectal cancer cells, induced apoptosis and increased intracellular reactive oxygen species production. Furthermore, enzymatically extracted apple pectin enhanced the cytotoxic and	24

proapoptotic effect of irinotecan (at concentrations below its IC_{50}), and exhibited potent anti-inflammatory properties.	

V. CONCLUSION AND FUTURE SCOPE

Different Extraction methods are determinant on thecharacteristics of the obtained pectin and must be considered at indus-trial level to assess cost, energy consumption and productivity. Conse-quently, such investigative enterprises will undoubtedly promote a cir-cular economy through the beneficial recycling of commonly discardedwaste products from the processing industries. Since its utilization onan industrial level, Extraction and applications for pectin have been discussed ,which will continue as further research works.Pectin is an important component of food and pharmaceutical products due to its gelling and stabilizing property. It is positively effective in wound healing, and has a synergistic effect on medicines in cancer therapy. The market for pectin and pectin-derived hydrocolloids is vast and is projected to grow; pectin application is common in the food and non-food industries alike, with yet more applications being discovered. Therefore, further research on the advancement of methods for pectin extraction and application is for is crucial.

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Study on Sustainable Accounting from the View of Climate Action, Life below Water and Life on Land

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ABSTRACT

As environmental concerns have grown, the accounting paradigm has changed to include sustainability as a fundamental tenet. This research explores the relationship between sustainable accounting and climate action, marine life, and terrestrial life. The study commences by outlining the theoretical foundation of sustainable accounting and explaining its critical function in promoting environmental stewardship and corporate social responsibility. It then looks at how climate action and sustainable accounting practices interact, explaining how to reduce greenhouse gas emissions, encourage the use of renewable energy sources, and help organisations become carbon neutral. The research also explores the complex connection between submerged life and sustainable accounting. It examines methods for determining and lessening how economic activity affects marine ecosystems, highlighting how important it is to preserve marine biodiversity and ecosystem health. Furthermore, the study explores the relationship between sustainable accounting and terrestrial life, highlighting methods for optimising land usage, protecting biodiversity, and restoring ecosystems. It explores how accounting frameworks might incorporate environmental, social, and governance (ESG) variables to quantify and report on an organization's influence on biodiversity and terrestrial ecosystems. This paper synthesises insights into the practical implementation of sustainable accounting frameworks across various organisational contexts, based on empirical evidence and case studies. It clarifies the difficulties, possibilities, and best practices related to integrating sustainability into accounting procedures, promoting a thorough comprehension of its consequences for climate action, marine life, and terrestrial life. In the end, this research highlights the revolutionary potential of the role of sustainable accounting in preventing environmental damage, preserving the health of the planet, and promoting harmony

between human activity and the environment. It promotes the use of sustainability concepts in business decision-making, policy-making, and accounting education in order to accelerate the shift towards a future that is more just and resilient for all living forms on Earth.

I. INTRODUCTION

In order to demonstrate market interest in non-financial metrics, including sustainability, reporting must combine sustainability measurements and tools, such as social, environmental, and governance indicators, to guarantee that sustainability practices become deeply established in firms. The information that must be gathered for accounting work is directly tied to the accounting transactions that are processed and then reported in sustainability, non-financial, and financial reports. Although most people agree that it is important for businesses to disclose their sustainability performance, there is a lack of clarity in accounting standards to define these disclosures. The field of sustainability accounting is leading the way in modern business strategies by providing a sophisticated method for assessing and controlling the triple bottom line—the effects on the economy, the environment, and society.

Integrating sustainability concepts into accounting methods has become a necessity rather than a choice in an era marked by increased scrutiny of corporate behavior and its effects on the environment and society. Sustainability accounting broadens the scope of traditional financial reporting, allowing firms to evaluate their performance in terms of social responsibility, environmental stewardship, and long-term viability. This paradigm shift highlights the need for businesses to connect their goals with sustainable development goals and reflects a growing awareness of global concerns such resource scarcity, social injustice, and climate change. Moreover, sustainability accounting is an effective instrument for raising stakeholder engagement, accountability, and transparency. Companies can establish trust with investors, consumers, and communities by showcasing their dedication to moral corporate conduct through the use of strong reporting frameworks and disclosure procedures. Adopting sustainability accounting is not without its difficulties, though; these include burdensome regulatory compliance, complex data administration, and unclear measurement. However, in a world that is becoming more linked and dynamic, firms can seize new chances for value creation and competitive advantage by overcoming these challenges and adopting innovative techniques.SDG Goal 13: Climate Action is a ray of hope in the face of climate change, one of the biggest problems facing humanity. There is an urgent need to reduce greenhouse gas emissions and increase resistance to the effects of climate change due to rising temperatures, harsh weather, and environmental degradation.

SDG 13 urges governments, institutions, and people to act decisively in the direction of a low- carbon, sustainable future. Fundamentally, this aim includes all aspects of the fight against climate change, including financing, adaptation, mitigation, and capacity-building strategies. Stakeholders pledge to protect the environment and guarantee a habitable environment for current and future generations by aligning with SDG 13. But reaching SDG 13 calls for revolutionary shift, creative fixes, and teamwork across industries and national boundaries.The essential need to save and manage the world's oceans, seas, and marine resources sustainably is encapsulated in SDG Goal 14: Life Below Water. SDG 14 is a call to action for the world since

marine ecosystems are under unprecedented threat from pollution, overfishing, climate change, and habitat destruction. The objectives of this goal are to maintain marine biodiversity, improve deteriorated ecosystems, and advance sustainable fishing and aquaculture methods. Prioritizing the resilience and health of marine ecosystems, SDG 14 protects marine life while also promoting the livelihoods and general well-being of coastal populations worldwide. Nonetheless, reaching SDG 14 calls for an all-encompassing and cooperative strategy involving individuals, corporations, governments, and civil society.

The pressing need to preserve, replenish, and manage terrestrial ecosystems and biodiversity sustainably is addressed by SDG Goal 15: Life on Land. With the rate at which land degradation, deforestation, and biodiversity loss are occurring increasing, SDG 15 provides a crucial foundation for encouraging conservation and sustainable land use practices. This objective is to stop the loss of biodiversity, repair damaged land, and stop desertification and land degradation. SDG 15 prioritizes the resilience and health of terrestrial ecosystems, which is important for maintaining ecosystem services that are essential for human well-being in addition

Review of Literature

1. Mengru Wang Annette B. G. Janssen(2022)) in their study Accounting for interactions between Sustainable Development Goals is essential for water pollution control in China tells The UN's 17 Sustainable Development Goals (SDGs) are all connected, but we don't know much about how they relate to each other. This study looks at how different SDGs interact when it comes to water pollution caused by nutrients in China. They found 319 interactions between clean water goals (SDGs 6 and 14) and other goals, mostly positive (helping each other) but some negative (working against each other). By testing different scenarios, they found that controlling pollution effectively means considering how these goals interact. For example, improving nutrient management, eating food efficiently, and fighting climate change together can help achieve clean water goals and other goals related to food, cities, and climate. This study shows how understanding these interactions can help make environmental policies in China and elsewhere more effective.

2. Miseldra Gil-Marin, Alejandro Vega-Munoz(2022)in there study Sustainability Accounting Studies: A Metasynthesis explains how review looks at past studies about sustainability accounting to see how ideas have changed over time. They looked at 334 documents from the Web of Science and picked out 15 for a detailed review. They found that there isn't a standard way of talking about sustainability accounting, which makes it hard to understand what companies are doing for sustainable goals. They focused on certain sustainable goals in their analysis. In the future, they suggest studying how sustainability practices affect companies and understanding their sustainability reports better.

3. Aideen O'Dochartaigh and Rebecca Maughanp(2019) in their study Sustainability Accounting and Reporting at a Sector Level: Mapping the Terrain explains how paper aims to understand how accounting and reporting for sustainability work at a sector level, which isn't well-covered in existing literature. Since sustainability is about systems, reporting needs to move beyond just one company and include multiple organizations like industries and supply chains. But there aren't many studies on this, and there aren't set guidelines for reporting at a sector level. This study fills this gap by looking at existing literature and new reporting methods. It looks at different levels of sustainability reporting and evaluates new reporting methods, focusing on the agri-food

industry as an example. However, it finds that there's a disconnect between global sustainability goals and how they're reported at a sector level. The paper suggests areas for future research to bridge this gap.

4. Carmela Gulluscio, Pina Puntillo (2020) in their study Climate Change Accounting and Reporting: A Systematic Literature Review tells In recent years, companies are expected to care about sustainability more. Stakeholders want them to use sustainable practices and tell everyone about it. So, corporate accountability, like accounting and reporting, needs to include sustainability too, not just financial stuff. Climate change is a big part of this, and companies need to take action and tell people what they're doing about it. This study looked at research about climate change accounting and reporting, focusing on SDG 13, "climate action". They found that most research talks about sustainability accounting in general, but there's not enough about managing climate change-related issues like planning and controlling actions to fight it. They suggested that accounting scholars should study this more and take social responsibility to focus on climate change in their research. They also looked at what's missing in climate change accounting and reporting research.

5. Sumit Lodiha (2024) in his study Sustainable development goals accounting and reporting for the “Other” sector talks about how organizations that aren't companies and don't focus solely on making profits can track and report on their progress towards Sustainable Development Goals (SDGs). It's a conceptual paper that looks at how these organizations are affected by the SDGs and how they can account for and report on their efforts to achieve them. While there are some limitations in terms of research theories and approaches, the insights from this paper can help these organizations improve their SDGs reporting. The paper is valuable because it sheds light on how the SDGs impact a sector that's different from traditional businesses and shows why tracking and reporting on these goals are important for them.

6. Madlen Sobkowiak and Thomas Cuckston (2020) in this study Framing sustainable development challenges: accounting for SDG-15 in the UK tells about This research how it aims to explain how a country's government creates a report on its biodiversity performance to help shape policies for Sustainable Development Goal 15: Life on Land. It looks at how the UK government puts together its yearly biodiversity report, using data from conservation groups and expertise from a small government team. The report helps the government understand how well it's doing in preserving biodiversity. The findings show that creating this report involves collaboration between different groups and ongoing improvement of the indicators used. This study highlights challenges with the current approach to measuring sustainable development and suggests that governments might need more support than what's currently outlined in the 2030 Agenda.

Background of the study

The increasing effects of environmental degradation, biodiversity loss, and climate change have led to a paradigm shift in the way that organisations approach sustainability in the last few decades. The Sustainable Development Goals (SDGs), which include addressing climate change (SDG 13), life below water (SDG 14), and life on land (SDG 15), highlight the urgent need for coordinated action to address these critical environmental issues. As a result, the idea of sustainable accounting has become important for incorporating environmental factors into organisational decision-making.

A collection of frameworks, procedures, and standards known as "sustainable accounting" are used to evaluate, quantify, and report on the financial, social, and environmental effects of an organization's operations. In tackling sustainability concerns including land management, marine conservation, and climate change mitigation, it aims to improve openness, accountability, and performance. In this context, it is critical to comprehend how sustainable accounting supports environmental stewardship and biodiversity conservation.

The goal of the proposed study is to examine sustainable accounting from the viewpoints of land-based, marine, and climate action research. The research attempts to clarify the efficacy of sustainable accounting frameworks in solving major sustainability concerns by looking at how organisations incorporate environmental factors into their accounting procedures. The study intends to provide insights into possibilities, difficulties, and best practices related to mainstreaming sustainability within accounting processes through empirical analysis and case studies.

The outcomes of the study are anticipated to provide a significant theoretical contribution to the literature on sustainable accounting and offer practical recommendations for stakeholders, policymakers, and organisations engaged in sustainability initiatives. By improving our comprehension of the interdependence The goal of the research is to catalyse positive changes towards a more resilient and equitable future for all living forms on Earth by examining the relationship between accounting practices and environmental sustainability goals.

Data interpretation

Several important conclusions become apparent when analysing the data from the Sustainable Accounting study from the perspectives of Climate Action, Life Below Water, and Life on Land. First, the data shows a noteworthy trend in the direction of incorporating sustainability principles into accounting systems used by organisations. The increasing use of sustainability reporting methods, which emphasise the disclosure of environmental consequences and actions pertaining to land management, marine conservation, and climate change mitigation, serves as evidence of this.

Additionally, the data indicates that businesses are beginning to see the benefits of sustainable

accounting and embracing it as a way to improve their environmental performance, reduce risks, and seize new possibilities as the world moves towards a low-carbon economy. The distribution of financial resources for renewable energy reflects this. efforts, carbon offset plans, and other climate-friendly projects; in addition, internal sustainability targets and indicators should be established in order to monitor progress over time.

Additionally, the data shows that transparency and stakeholder involvement are becoming more and more important in sustainable accounting processes. Companies are interacting with investors, clients, and authorities in a proactive manner in order to get their opinions, share pertinent data, and show that they are responsible for their environmental effects. The current trend towards increased transparency and disclosure indicates a change towards company practises that are more responsible and accountable. This aligns with the expectations of the public for corporate sustainability and responsibility.

The data also reveals a number of obstacles and restrictions in the application of sustainable accounting procedures, notwithstanding these encouraging trends. These include issues with measurement techniques, data quality and reliability, and the comparability of sustainability indicators amongst sectors and organisations. Furthermore, the acceptance and efficacy of sustainable accounting initiatives may be impeded by legislative complications, conflicting agendas, and organisational capacity restrictions, especially in smaller enterprises and industries with substantial environmental footprints.

In conclusion, the analysis of the data highlights how revolutionary sustainable accounting can be in furthering the aims of life on land, life below water, and climate action. In order to support more informed decision-making and increased accountability in the pursuit of environmental sustainability, it also highlights the necessity of continuing efforts to address issues and enhance the efficacy and credibility of sustainable accounting practices.

RESEARCH PROBLEM

The SDGs (sustainable development goals) require comprehensive policies to reduce environmental degradation and increase ecosystem resilience, especially those related to climate action (SDG 13), life below water (SDG 14), and life on land (SDG 15). Sustainable accounting presents a promising approach to achieving these objectives by incorporating environmental, social, and economic factors into organisational decision-making. It is unclear, nevertheless, how well sustainable accounting methods would tackle the related problems of biodiversity loss and climate change.

SCOPE OF THE RESEARCH

This study fills in important knowledge gaps about how sustainable accounting contributes to the conservation of terrestrial and marine ecosystems, the advancement of climate action, and the advancement of sustainable development. Through the clarification of the obstacles and possibilities related to the incorporation of climate, marine, and terrestrial elements into accounting frameworks, this research offers significant understanding for decision-makers, professionals, and academics who aim to improve the efficiency of sustainable accounting in accomplishing environmental sustainability objectives.

RESEARCH QUESTIONS

1) How much do the existing frameworks for sustainable accounting account for life on land, life below the water, and climate action?
2) What part does sustainable accounting play in mitigating climate change and conserving biodiversity, according to organisations?
3) What are the main obstacles to putting sustainable accounting methods into practice in order to improve ecosystem health and climate resilience?
4) What potential trade-offs and synergies exist, in the scope of sustainable accounting systems, between life on land, life below the water, and climate action?

OBJECTIVES

1. Investigate how sustainable accounting practices can contribute to climate action efforts.
2. Explore the impact of sustainable accounting on preserving life below water ecosystems.

3. Examine the role of sustainable accounting in promoting conservation and sustainability of life on land.

Dependent Variables Sustainable Accounting Independent variable Climate Action
Life Below Water Life on Land

Hypothesis

H0:- There is no significant relationship between sustainable accounting practices and climate action efforts.
H1:- There is significant relationship between sustainable accounting practices and climate action efforts.

H0:- There is no significant difference in the preservation of life below water ecosystems between organizations implementing sustainable accounting practices
H1:- There is significant difference in the preservation of life below water ecosystems between organizations implementing sustainable accounting practices

H0:- There is no association between the adoption of sustainable accounting practices and the promotion of conservation and sustainability of life on land, indicating that the two variables are independent of each other."
H1:- There is association between the adoption of sustainable accounting practices and the promotion of conservation and sustainability of life on land, indicating that the two variables are independent of each other."

RESESARCH DESIGN

SOURCES OF DATA
In order to provide thorough insights into sustainable accounting practices and their consequences for climate action, life below the water, and life on land, the study will make use of both primary and secondary data sources. To gather direct information on organisational practices and perceptions, primary data sources will comprise surveys, interviews, and focus groups with important stakeholders, including environmental managers, sustainability officers, and accounting professionals. Secondary data sources that offer further context and details on sustainable accounting procedures include government publications, financial reports, sustainability reports, academic literature, and industry studies.

SAMPLING DESIGN

To ensure representation across contexts and views, a varied selection of organisations from various industries and sectors will be chosen as part of the sampling strategy.
To choose the organisations, stratified random selection will be used to take into account factors including industry, size, location, and sustainable performance.
Corporate employees with appropriate experience and insights into sustainable accounting practices and their implications will participate trough survey (Google form)

TOOLS AND TECHNIQUES

Surveys designed to gather data on organisational attitudes, difficulties, and sustainable accounting practices will be among the data gathering instruments used.

In quantitative data analysis, linkages and trends in survey responses and financial data are examined using statistical techniques like regression analysis, correlation analysis, and frequency analysis.

LIMITATIONS OF THE STUDY

1. Limited sample size and representativeness may affect the generalizability of findings.

2. Self-report bias in survey data could lead to socially desirable responses.

3. Cross-sectional design limits the ability to establish causal relationships.

4. Measurement issues, such as subjective interpretation of variables, may introduce error.

Data analysis

ANOVA Analysis:

The ANOVA table shows that the regression model is statistically significant, as indicated by the p-value of 0.031.

This suggests that the predictors included in the model collectively have a significant effect on the rating of overall commitment to sustainability and climate action efforts.

The model accounts for 19.5% of the variance in the rating of overall commitment to sustainability and climate action efforts.

The correlation coefficient between "organization implementation of sustainability practices" and "importance of promoting conservation and sustainability of life on land" is 0.061.

The p-value associated with this correlation coefficient is 0.580, indicating a lack of statistical significance.

The most frequent effective measures of sustainability practices, as reported by respondents, are: Increasing stakeholder engagement (23.8%)

Providing incentives for sustainability reporting (20.2%) Enhancing data collection and reporting technologies (20.2%)

Data interpretation

1. There is a very weak positive correlation between the implementation of sustainability practices and the importance of promoting conservation and sustainability of life on land. However, this correlation is not statistically significant, suggesting that the two variables are not strongly related in this sample.

2. The frequency analysis highlights stakeholder engagement, incentives for sustainability reporting, and advancements in data collection technologies as effective measures for promoting sustainability practices.
3. The ANOVA analysis suggests that the predictors collectively have a significant effect on the rating of overall commitment to sustainability and climate action efforts

Findings

1. Weak positive correlation between sustainability practices and land conservation, though not statistically significant.

2. Stakeholder engagement, incentives for sustainability reporting, and data collection technologies identified as effective measures for promoting sustainability.

3. Predictors collectively had a significant effect on commitment to sustainability and climate action efforts, explaining 19.5% of variance.

4. Effective measures can enhance sustainability initiatives and promote conservation efforts in the long term.

Suggestion and Recommendations

1. Explore additional factors influencing the relationship between sustainability accounting practices and conservation efforts, such as organizational culture and leadership commitment.

2. Conduct longitudinal studies to assess changes in sustainability practices and their impact on conservation efforts over time.

3. Compare sustainability practices across different cultural contexts to identify cultural-specific factors influencing conservation efforts.

4. Use qualitative research methods to gain deeper insights into stakeholders' perspectives on sustainability accounting and conservation efforts.

5. Analyze the impact of policy interventions on sustainability practices and their effectiveness in promoting conservation efforts.

Conclusion

In this research paper, we conducted a comprehensive investigation into the nexus between sustainability accounting practices and conservation efforts, specifically focusing on climate action, life below water, and life on land. Through a multi-faceted analysis encompassing correlation, frequency, and ANOVA tests, we sought to elucidate the impact of sustainability accounting practices on environmental conservation. Our findings revealed a nuanced picture: while a weak positive correlation was observed between sustainability practices and the importance of land conservation, effective measures such as stakeholder engagement and incentives for

sustainability reporting emerged as pivotal drivers for fostering sustainability initiatives. Moreover, the ANOVA analysis underscored the significant influence of predictors collectively on organizational commitment to sustainability and climate action efforts. Despite these insights, our study is not without limitations. The sample size and representativeness of respondents may restrict the generalizability of findings, and self-report bias in survey data could affect the reliability of results. Furthermore, the cross-sectional design limits our ability to establish causal relationships between sustainability accounting practices and conservation efforts. Moving forward, future research should explore additional factors shaping the relationship between sustainability accounting practices and conservation outcomes, while also addressing the methodological limitations identified herein. By addressing these gaps and leveraging effective measures identified in our study, organizations and policymakers can strive towards achieving greater environmental sustainability and conservation success in the years to come.

Questionare

Sustainable Accounting Practices

1) On a scale of 1 to 5, please rate the extent to which your organization implements sustainable accounting practices
2) How often does your organization engage in carbon accounting?
3) Does your organization regularly publish environmental reports?
4) To what extent does your organization prioritize social responsibility reporting?

Climate Action Efforts

1) How much emphasis does your organization place on reducing carbon emissions?
2) Does your organization have specific targets for reducing carbon emissions?
3) To what extent does your organization invest in renewable energy sources?
4) How frequently does your organization undertake sustainability initiatives?

Overall Perception

1) How would you rate your organization's overall commitment to sustainability and climate action efforts

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Synthesis of Copper Nanoparticles from Leaf Extract Ad Study Their Optical Property

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ABSTRACT

Green synthesis, utilizing natural sources such as plant extracts, microorganisms, and biopolymers, has emerged as a promising alternative to conventional chemical methods. Green synthesis offers several advantages including simplicity, cost-effectiveness, scalability and environmental friendliness. Among the various natural sources, plant extracts have gained considerable attention as reducing and capping agents for nanoparticle synthesis due to their abundance and diversity.The synthesis process is facile, environmentally benign, and offers a sustainable approach towards nanoparticle production. In this study, we present a sustainable method for synthesizing copper oxide (CuO) nanoparticles utilizing Tulasi and Moringa leaf extract as a reducing and capping agent. The synthesis process is facile, cost-effectiveand environmentally benign, offering an alternative to conventional chemical methods. Characterization techniques such as UV-Vis spectroscopy were employed to analysed the structural and morphological properties of the synthesized CuO nanoparticles. The results indicate the successful formation of CuO nanoparticles with distinct morphologies and crystalline structures. Furthermore, the potential applications of these green-synthesized CuO nanoparticles in various fields such as catalysis, electronics, and biomedicine are discussed, highlighting their promising prospects as sustainable nanomaterials. In this work the potential of CuO nanoparticles was investigated, and the application of plant-based copper nanoparticles in the and its study its optical property.

Keywords: Green synthesis, CuO nanoparticles, tulsi and moringa leaf extract, optical study

I. INTRODUCTION

The green synthesis of nanoparticles has gained significant attention due to its eco-friendly nature and potential applications in various fields. In this study, we present a sustainable method for synthesizing copper oxide (CuO) nanoparticles utilizing leaf extract as a reducing and capping agent. The synthesis process is facile, cost-effective, and environmentally.The green synthesis of copper oxide nanoparticles was efficaciously performed using copper nitrates a precursor and Moringa and tulsi leaf extract as a powerful reducing/oxidizing chelating agent. The applied biosynthetic technique is undemanding and easily biodegradable due to the presence of phytochemicals and is carried out in a short time. Characterization techniques such as UV-Vis spectroscopy were employed to analysed the structural and morphological properties of the synthesized CuO nanoparticles. The results indicate the successful formation of CuO nanoparticles with distinct morphologies and crystalline structures. Furthermore, the potential applications of these green-synthesized CuO nanoparticles in various fields such as catalysis, electronics, and biomedicine are discussed, highlighting their promising prospects as sustainable nanomaterials.

1.1 leaf and Chemicals used:

Because plants contain a wide variety of bioactive substances, various parts of plants or entire plants have been used in green synthesis to produce copper nanoparticles (CuNPs). The plant is studied in this work is Tulsi and Moringa .

Tulsi : Ocimum sanctum (local name Tulasi) is a traditional medicinal plant of India has a source of bio-reduction and stabilizers. The constituent of Tulsi are alkaloids, glycosides, tannins, saponins and aromatic compounds. It is used in the treatment of headaches, coughs, diarrhea, constipation, worts, worms and kidney malfunctions. Recent interest on Ocimum has resulted from its inhibitory activity against HIV-1 reverse transcriptase and platelet aggregation induced by collagen and ADP22 (adenosine 5-diphosphate). Recently Ocimum sanctum leafextracts have been used in the synthesis of silver nanoparticles and gold nanoparticles

Moringa : Moringa oleifera tree also known as the drumstick tree is native to Asia particularly India ,and also is grown in the Philippine, Sudan, Egypt, and South Africa. It is a member of the Moringa species and the Moringafamily, and is renowned for its safe to eat soft beans, flowers and leaves. The leaves, notably, are well-known for their prophylactic and therapeutic powers and are often devoured in meals. The Extracts obtained from the leaves have powerful antioxidant capabilities and high antibacterial action against Gram-positive and Gram-negative bacteria. Additionally, phytochemicals in Moringa oleifera leaves show incredible properties such as anticancer, anti-inflammatory, anti-diabetics and are suitable for applications in different industries such as foodstuff, cosmetics, and drug delivery Bhalla, et al.,This research looked into the effectiveness of Tulsi and Moringa leaf extract-derived CuO NPs against antimicrobial effect.Copper Nitrite CuNo2 .2H2O (98 % Pure) from Indian Platinum Pvt Ltd., of analytical grade, were purchased and used without further chemical treatment and purification. De-ionized water was obtained from Moradia Brothers Chem Pvt. Ltd., India

1.2 Preparation for Copper Nanoparticles (CuNPs):

The moringa and Tulsi leaves were collected and washed several times with water and rinsed with deionized water for the removal of impurities. In copper nanoparticles synthesis, the leaf extract is mixed with the aqueous solution of Cu (NO3)2.3H2O in 1:9 proportion. 10ml of prepared Tulsi leaf and Moringa leaf extract is

mixed with 90ml of Cu(NO3)2. 3H2O . as shown set up in Fig. 1. The mixture was stirred continuously at room temperature for 12 hours until color change was observed, indicating nanoparticle formation. The resulting solution was centrifuged at 8000 rpm for 15 minutes to collect the CuO nanoparticles. The collected nanoparticles were washed with deionized water and ethanol to remove impurities.Finally, the CuO nanoparticles were dried a shown in fig 2, at 60°C for 24 hours in an oven .

1.3 Characterization

The synthesized CuO nanoparticles were characterized using various techniques: To study the optical properties and confirm nanoparticle formation. UV-Vis Spectroscopy The UV-Vis spectrum of the synthesized CuO nanoparticles exhibited a characteristic absorption peak at around 256 nm, confirming the formation of nanoparticles as shown in (Figure 3)

II. RESULTS AND DISCUSSION

The energy structure and optical properties of CuO petal-like nanostructures are of interest because of their catalyst and semiconductor characteristics. The optical properties of CuO petal-like nanostructures were investigated using a UV-visible spectrometer for its light absorption, transmittance, and band gap calculation. Figure 4a shows UV–visible absorption spectrum of as prepared copper oxide nanopetals. The CuO nanopetals indicate an active and large absorption of light in the visible region. Furthermore, the band-gap energy of CuO nanopetals samples can be found according to Equation

$\alpha h\nu = A(h\nu - Eg)n/2$

where α = absorption coefficient, h = Planck constant, ν = light frequency Eg = band gap, A = constant and n = electron transition between conduction and valance band, n = 1 (allowed direct transition), n = 4 (allowed indirect transition), n = 3 (forbidden direct transition) and n = 6 (forbidden indirect transition). The plot of $(\alpha h\nu)2$ versus energy $(h\nu)$ for determining Eg (energy band gap) has been shown in Figure 4b. The band gap energy of the copper oxide petal-like nanostructure was found by deducing the linear part of $(\alpha h\nu)2$ versus energy $(h\nu)$. The calculated band gap energy of CuO nanopetals is about ≈1.73 eV, which is different from the bulk CuO (1.24 eV). Yang et al. [30] reported the band gaps of the ellipsoid-like, plate-like, boat-like, and flower-like CuO nanostructures were determined to be 1.371, 1.447, 1.429, 1.425 eV, respectively [30]. The measured band gap value of CuO nanopetals is greater than the band gap values with closely related structures and materials available in the literature. This change further supported an active and large absorption due to the nanometer range of synthesized material. This result suggests that the band gap changes in CuO nanopetal material could display higher catalytic activity. Figure 4c shows transmittance spectra of CuO nanopetals, which show a weak transmittance in the entire visible range. The weak transmittance in the entire visible range also support the higher absorption in that region. Optical study of CuO petal-like nanostructure. (a) UV–VIS absorption spectrum. (b) Band gap energy of CuO nanopetals. (c) Transmittance spectrum.

III.CONCLUSION

The present study has described a cost-effective and environmentally friendly green synthesis of CuO NPs using Tulsi and Moringa leaf extract aqueous extracts as reducing and capping agents. The CuO NPs were characterized using UV–Vis spectroscopy .To study the optical properties and confirm nanoparticle formation. UV-Vis Spectroscopy The UV-Vis spectrum of the synthesized CuO nanoparticles exhibited a characteristic

absorption peak at around 256 nm, confirming the formation of nanoparticles as shown in (Figure 3).Optical Property : The energy structure and optical properties of CuO petal-like nanostructures are of interest because of their catalyst and semiconductor characteristics. By green synthesis method we have successfully grown Cuo nano particles with help of Tulsi and Moringa lea extract. From Optical study we got energy band gap for synthesis nanoparticles is 1.73ev which is good agreement with available data.

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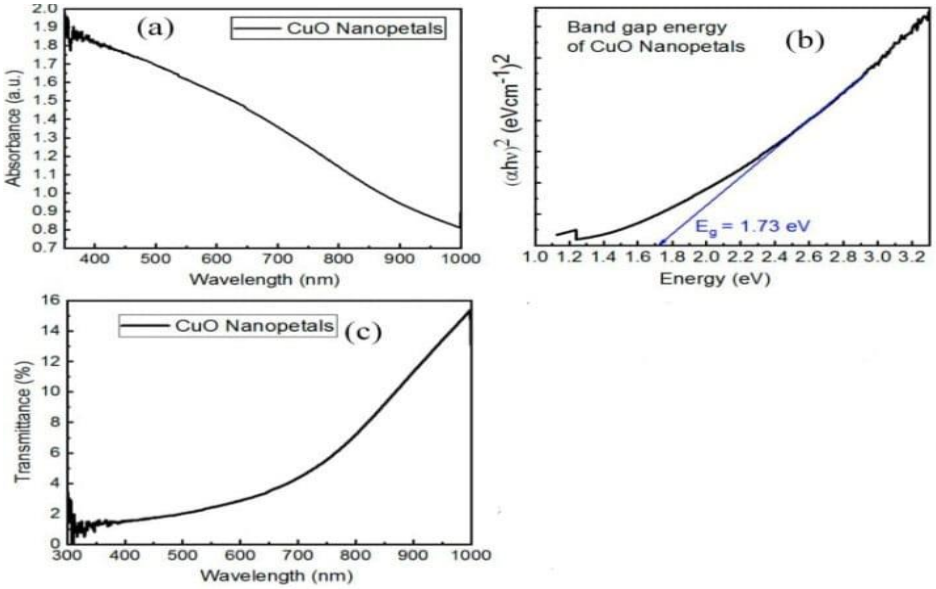

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Synthesis of Copper Nanoparticles from Leaf Extract and Study Their Optical Property

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I. INTRODUCTION

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1.3 Characterization

The synthesized CuO nanoparticles were characterized using various techniques: To study the optical properties and confirm nanoparticle formation. The UV-Vis spectrum were employed ,the synthesized CuO nanoparticles exhibited a characteristic absorption peak at around 256 nm, confirming the formation of nanoparticles as shown in Fig. 3 it conformed that Cu Oxide nanoparticles were synthesised.

II. RESULTS AND DISCUSSION

The energy structure and optical properties of CuO petal-like nanostructures are of interest because of their catalyst and semiconductor characteristics. The optical properties of CuO petal-like nanostructures were investigated using a UV-visible spectrometer for its light absorption, transmittance, and band gap calculation. Figure 3a shows UV–visible absorption spectrum of as prepared copper oxide nanopetals. The CuOnanopetals indicate an active and large absorption of light in the visible region. Furthermore, the band-gap energy of CuOnanopetals samples can be found according to Equation

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IV. ACKNOWLEDGMENTS

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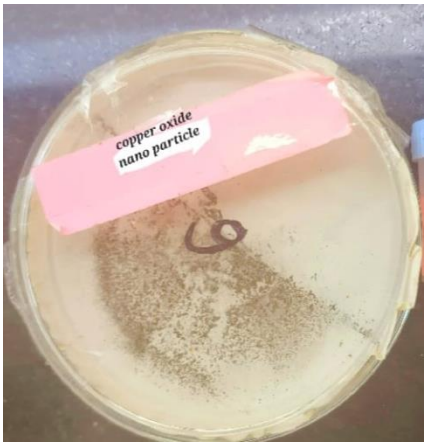

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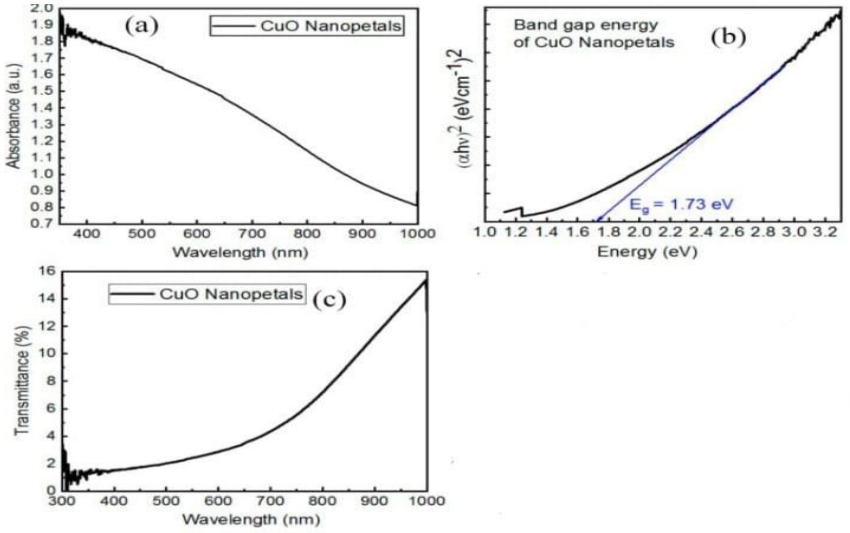
(a)
CuO Nanopetals
Absorbance (a.u.)
Wavelength (nm)
Band gap energy
of CuO Nanopetals
(b)
$(\alpha h\nu)^2$ (eVcm^{-1})2
E_g = 1.73 eV
Energy (eV)
CuO Nanopetals
(c)
Transmittance (%)
Wavelength (nm)

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Determination of Physical Properties and Essential Contents in a Soil of Agriculture and Forest Land in the Region of the Vikramgad

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ABSTRACT

Agriculture is mainstay of economy in India providing livelihood for more than 80% of Indians population. Hence, soil quality and fertility can be identified as the key to sustain Indian economy. Soil nutrient availability is an important factor controlling net primary productivity of an idea. Nitrogen, Phosphorus and Potassium are very important nutrients required for normal growth of plants and for increasing yield. Soil fertility is determined by the availability of nutrients like NPK and organic matter content in the soil. Assessment of nutrient level helps in the fertility management of soil. Vikramgad was selected as the study site and four samples each from agriculture land and forest were taken. The pH, organic matter, % carbon and NPK were analyzed. From the analysis it was found that soil of Vikramgad contained medium levels of nitrogen and organic matter content while the potassium availability in soil was found to be high. Phosphorus was found to be low and pH value ranged from slightly acidic to medium acidic soil.

Keywords: - Agriculture Land, Soil, Physical Properties, Essential Contents, Fertilizer etc.

I. INTRODUCTION

Soil is a living body. It is a medium of plant growth and supports different type of living organisms of the world[1]. It is a natural body consisting of layers (soil horizon) of primarily mineral constituents of variable thicknesses, which differ from the parent materials in their morphological, physical, chemical, and mineralogical characteristics. Soil is essential to plants, not only as a substrate, but also as a reservoir for water and essential minerals including nitrogen and phosphorus, as well as calcium, sulfur, potassium, and other ions. Soil has a certain distinctive physical, chemical and biological qualities which permit it to support plants growth[2,3]. Soil quality, thus, may be defined as the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation" [4]. It depends on many things such as soil texture, soil pH,

nutrients, organic matter, water holding capacity, microorganism, structure, microclimate, irrigation facility, land fragmentations, soil erosion, agricultural system and practices, diseases and insects, consumption of nutrients by crops, leaching of nutrients etc.

Many studies have identified soil nutrient availability to be an important factor controlling net primary productivity[5]. Nitrogen, phosphorus and potassium are very important nutrients required for normal growth of plants and for increasing yield. These nutrients are also added manually in agricultural lands. These are the macro nutrients required by the plants in high quantity while other nutrients called micro nutrients like Iron, Manganese, Boron, magnesium, sulphur etc. are required in small quantity and mostly they need not to be manually added. Soil chemical analysis is made to assess the available amounts of major nutrients, nitrogen phosphorus potassium and to assess a few others determinations which are correlated to soil fertility, such as soil texture, soil reaction (pH) and salinity. Soil organic matter is the solid portion of soil which is formed by the plants debris and dead animals. It increases humus in soil. High organic matter content in soil indicates high capacity to retain moisture in soil. The amount of organic matter in the soil varies according to the ecological zone in which it occurs as well as the land use and management of soil. Area under natural forest has higher organic matter than that used for cultivation. Soil fertility is determined by the availability of nutrients like NPK and organic matter content in the soil.

Table 1: Interpretation table for soil fertility given by NARC, 1993 as cited in Maharjan, 2010[5]

Organic matter (OM)%		Total Nitrogen (TN)		Available Phosphorus (Kg/ha)		Available Potassium (Kg/ha)	
Range	Level	Range	Level	Range	Level	Range	Level
<2.5	Low	<0.1	Low	<31	Low	<110	Low
2.5-5.0	Medium	0.1-2.0	Medium	31-55	Medium	110-280	Medium
>5.0	High	>2.0	High	>55	High	>280	High

Source: NARC, 1993 as cited in Maharjan, 2010

Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and is measured in pH units.

Table 2 Soil pH and Interpretation

5.0	5.5	6.0	6.5	7.0	7.0	8.0
Strongly Acid	Medium Acid	Slightly Acid	Neutral	Neutral	Mildly Alkaline	Moderately Alkaline
Best range for most crops						

II. MATERIAL AND METHODS

1. Site selection and sampling

Vikramgad Tehsil was selected as the study site. Soil analysis was conducted for four samples of agricultural land. The selected agriculture land has two sites, two from agriculture and two from common land were selected. The samples were taken by digging a V-shaped pit of 15 cm from surface. Soil from each site was mixed properly and then analyses were performed.

Soil sampling is crucial for success n soil analysis and interpretation. First, a sample should be fit to the experiment purpose. Second, because physical and chemical properties of soil are heterogeneous in fields, one should mind how it is difficult to take a representative sample.

Drying Air-dry samples collected as soon as possible under well-ventilated conditions. Wet samples must be spread on a sheet or a plate, less than 1 cm in thickness. Otherwise, the soils will rot and their chemical properties will change. Watch drying process and crush clods by hands carefully and frequently. Proper crushing time depends on soil's physical properties: For instance, right crushing timing is limited in clayey soils. Remove any foreign material such as organic matters, charcoal, shells, and plant seeds.

Sieve the air-dried soil sample through a screen with 2 mm circular holes. Grind large clods with a pestle and mortal: do not crush gravel or other foreign materials. Sieve them, and repeat the procedure until no soil is left on the screen. Weigh the soil and gravel separately; calculate the proportion of gravel. Store the sieved soil in an air-tight container like a plastic bottle or bag[6].

2. Moisture content

Dry an aluminum cup (or evaporating dish) at 100 o C for 2–3 hours in the drying oven; measure the constant weight (A gram). Put about 10 g of air-dried soil into the cup; weigh the cup with the soil in it (B gram). Dry the soil in the cup at 105 o C for 24 hours. Take out the cup from the drying oven, cool it in a desiccators, and weigh it (C gram).

Note that A, B and C must be weighed with 0.001 g accuracy.

3. Calculation

Soil moisture content of air-dried soil (%) = $[(B - C)/(B - A)] \times 100$

Soil moisture correction factor (MCF) = $(B - A)/(C - A)$

The MCF is used to correct analytical results on air-dried soil to the dry weight basis.

4. pH

Weigh 10 g of air-dried soil (accuracy 0.1 g) and put the soil in a 100 mL bottle. Add 25 mL of distilled water and cap the bottle. Occasionally shake the bottle for 1 hour. Before opening the bottle for measurement, shake it once again. Immerse the glass electrode of the pH meter in the soil suspension. Record pH when the reading becomes stable.

5. Electrical Conductivity

Electrical conductivity (EC) reflects the amount of water-soluble salts in soils. Generally, there is a positive correlation between EC and salt concentration.

Weigh 10 g of air-dried soil (accuracy 0.01 g) into a 100 mL plastics bottle. Add 50 mL of distilled water and cap the bottle. Shake by the reciprocal shaker for 1 hour. Before opening the bottle for measurement, shake by hand once more. Immerse the electrode of the EC meter in soil suspension. Read EC when the measurement is stabilized.

III.RESULT AND DISCUSSION

1. Moisture content

The moisture content of the soil can be calculated by using formula as following,

1) Soil moisture content of air dried soil (%) = (B-C)/(B-A) * 100
2) Soil moisture correction Factor (MCF) = (B-A)/(C-A)

The MCF is used to correct analytical results on air-dried soil to the dry weight basis.

Sr. No.	Test	Sample 1	Sample 2	Sample 3	Sample 4
1	M/C	7.25%	7.85%	7.60%	10.68%
2	MCF	1.078%	0.820%	1.082%	1.119%

Conclusion – From above results it is conclude that the soil of forest land having lower moisture content than agriculture land.

2. pH

Sr. No.	Test	Sample 1	Sample 2	Sample 3	Sample 4
1	pH (H2O)	6.55	7.04	7.19	6.13

Conclusion – From above results it is conclude that the pH of Soil in KCl solution observed lower than Water pH due to displacement of H+ Ions.

3. Electrical Conductivity

Sr. No.	Test	Sample 1	Sample 2	Sample 3	Sample 4
1	EC	0.1167mS m^{-1}	0.1508mS m^{-1}	0.1702 mS m^{-1}	0.1330mS m^{-1}

Conclusion – From above results it is conclude that the Soil is carrier of Electrical Conductivity.

IV. ACKNOWLEDGMENT

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Synthesis of Copper Oxide Nanoparticles via Thermal Evaporation for Gas Sensor

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ABSTRACT

The synthesis of Copper Oxide (CuO) nanoparticles films is developed through thermal evaporation, and their structure, morphology, and composition are subsequently confirmed using x-ray diffraction, scanning electron microscopy, atomic force microscopy, and EDAX analysis. The CuO films were analysed for their chemoresistive properties in the presence of various oxidizing and reducing gases. These films exhibit significant selectivity towards oxidizing nitrogen dioxide (NO_2) gas, showing a maximum response of 12% to a concentration of 100 parts per million (ppm) at an operating temperature of 150^{O}C. The CuO sensor demonstrates significantly improved sensing capabilities, such as rapid response and recovery time, high sensitivity, and excellent stability. This indicates its potential for use in the field of NO_2 gas sensing.

Keywords: Thermal Evaporation; CuO; chemoresistive Properties; NO_2 sensor.

I. INTRODUCTION

Nitrogen oxide (NO_2) gas, known for its high toxicity, presents a significant risk to both human health and environmental balance [1]. Notably, there have been instances where people have experienced severe respiratory infections that show symptoms similar to asthma due to a low level of nitrogen oxide, namely around 1 part per million (ppm) [2]. Therefore, it is imperative to develop a robust and effective NO_2 gas sensor capable of continuous real-time monitoring. A significant amount of research has been carried out on gas sensors that make use of semiconductors, with a specific emphasis on advanced nanomaterials like WO_3 [3], In_2O_3 [4], SnO_2 [5], Fe_2O_3 [6], ZnO [7], and CeO_2 [8], which demonstrate excellent gas-sensing abilities. Nevertheless, gas sensors utilizing metal-oxide nanoparticles suffer from inadequate selectivity and require a high operating temperature, leading to a complicated device with significant power usage [9]. Therefore, there is a growing demand for the development of gas-sensing nanomaterials that exhibit the following attributes:

operation at low temperatures, high sensitivity and selectivity, fast response time, and a high limit of detection (LOD) [10].

CuO is categorized as a p-type semiconductor because it contains acceptor levels that are linked to copper vacancies. The charge compensation for these vacancies can be accounted for by impurities or the generation of an equivalent number of Cu3+ ions [11]. Scientists are intrigued by it due to its potential uses in various domains, including gas sensing, photovoltaic solar cells, field emission, and catalysis [12-15]. The assessment of its ability to detect several target gases (such as NH_3, CO, NO_2, Cl, and H_2S) was carried out throughout a temperature range of 100^0C to 300^0C. Precise regulation of crystal size is crucial for resistive-type gas sensors made from oxide materials.

Reports indicate that the gas sensing capabilities of oxides are much improved when their crystal size is lowered to the nanoscale range [16, 17]. The phenomena can be explained by the efficient adsorption of oxygen, which leads to the creation of regions with a lack of electrons in nanoscale crystals. As a result, the presence of gas leads to a significant alteration in electrical conductivity [18, 19]. Consequently, the utilization of oxide nanoparticles is considered to be one of the most efficient approaches for producing gas sensors with outstanding capabilities [20, 21]. Several research have investigated the gas detection abilities of CuO nanoparticles when combined with different semiconductors, such as graphene oxide [22], ZnO [23], and SnO2 [24]. Thin-film CuO gas sensors [25] have recently gained significant recognition [25]. Only a limited number of studies have investigated the gas sensing properties of CuO nanoparticles [26-28]. Several methodologies, such as precipitation, sonochemical, microwave irradiation, thermal breakdown, solid-state reaction, among others, have been employed to synthesize copper oxide nanoparticles and nanocrystals [29-32]. The objective of this study was to employ a thermal evaporation technique for the synthesis of high-quality copper oxide nanoparticles.

This study outlines the production of CuO nanoparticles on a glass substrate by a thermal evaporation method, followed by annealing in an air atmosphere at a temperature of 400 degrees Celsius. The CuO nanoparticles were tested for the detection of various hazardous reducing and oxidizing gases at an operating temperature of 150^oC.

II. EXPERIMENTAL DETAIL

The CuO nanoparticles film were produced using catalyst-free thermal evaporation of Cu metal onto a glass substrate. The evaporation process occurred within a vacuum with a pressure of $5x10^{-5}$ mbar. The source material for evaporation consisted of a copper metal powder. At first, the copper metal powder was placed into the molybdenum boat of the thermal evaporation unit, which was linked to a high-power source. The copper metal was vaporized by progressively increasing the electric current and then deposited onto a glass substrate, which was securely positioned on a substrate holder within a vacuum chamber. Following the evaporation of Cu thin films, the films were then annealed at a temperature of 400^oC in a tubular zone furnace under an air atmosphere to facilitate the synthesis of CuO nanoparticles.

The gas sensing characteristics of CuO sensor films were evaluated utilizing a specifically designed high temperature gas sensing measuring apparatus. The Keithley 6514 programmable electrometer was connected to the gas sensor unit for the measurement of change in electrical resistance value of sensor i.e. gas response study of CuO sensor.

The gas response S (%) of the sensing materials has been determined using the equation (1). The gas response of the CuO sensing film has been determined using the well-known relation[33]:

$$Response\ (S\%) = \frac{(R_{air} - R_{gas})}{R_{air}} \times 100 \ldots (1)$$

The variables Rair and Rgas denote the resistance of the sensor when exposed to fresh air and the target gas, respectively.

III.RESULT AND DISCUSSION

3.1 Structural Analysis

The X-ray diffraction (XRD) pattern of the CuO sensor films, prepared at temperatures 400^{O}C, is depicted in figure 1. All the diffraction peaks of the CuO sensor film align well with the standard JCPDS card number 45-0937, indicating the formation of a monoclinic crystal structure. No impurity peaks were observed in the diffraction spectra of CuO, providing evidence of the high purity of the materials. The intensity of the (111) Bragg's reflection peak is relatively higher than that of the other reflections, suggesting the growth of CuO along the (111) direction.

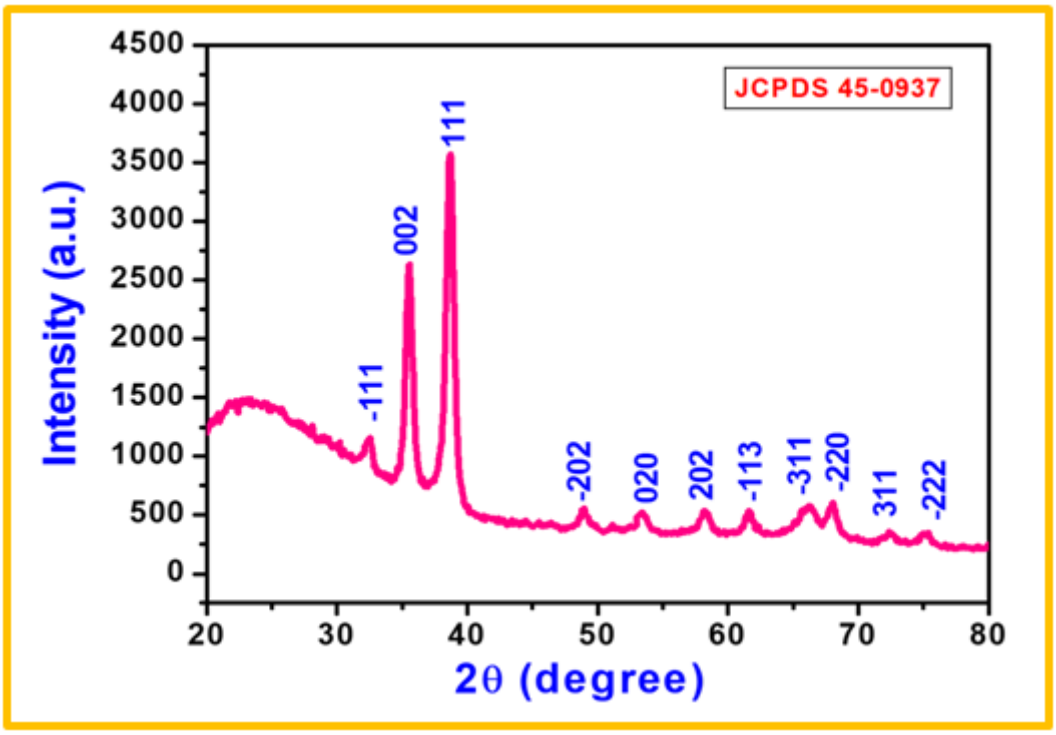

Fig. 1- XRD Pattern of CuO sensor film

3.2 Morphological Analysis

The scanning electron microscopy technique was used to investigate the surface morphology of the CuO sensor film. The resulting micrograph are depicted in Figure 2 (a). The analysis of the scanning electron microscope (SEM) pictures, depicted in the figure, reveals a highly homogeneous dispersion of CuO nanoparticles (NPs) throughout the surface of the glass substrate. The shape of nanosized dimensions allows for a high surface to volume ratio, which is advantageous for gas sensing applications [34].

The elemental composition and purity of CuO samples were investigated using energy dispersive analysis X-ray (EDAX) spectroscopy. The findings obtained are displayed in figure 2 (b). The EDAX examination has verified

the presence of Copper (Cu) and Oxygen (O) elements in the deposited CuO sensor films, with no additional detectable impurities found. This finding is consistent with the results obtained from XRD analysis. The constituent composition and weight % are presented in a table provided as an inset in figure 2(b).

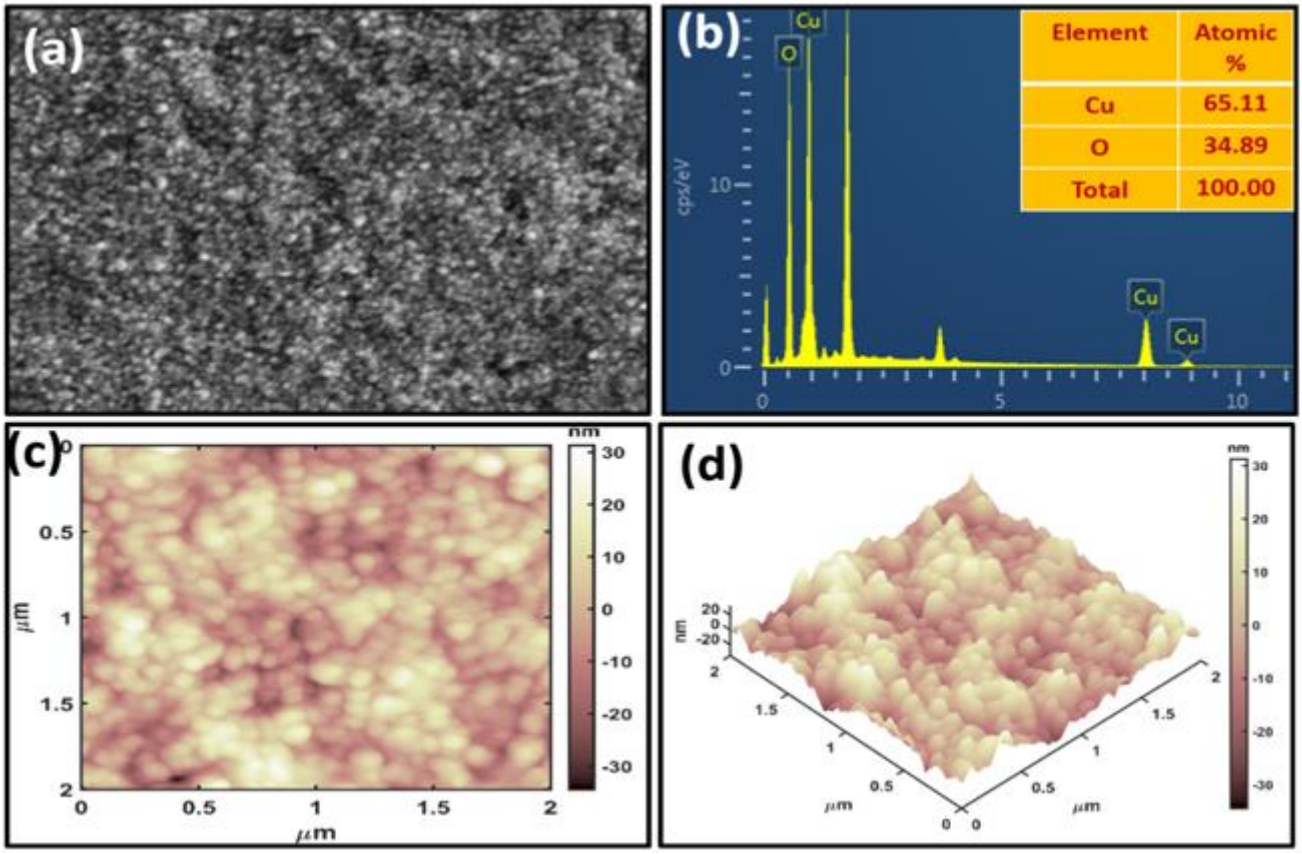

Fig. 2- (a)SEM, (b) EDAX, (c)2D AFM and (d)3D AFM of CuO sensor film

The atomic force microscopy (AFM) technique is used to investigate the surface topography and roughness of the CuO sensor film. The figures 2 (c) and (d) display the 2D and 3D surface pictures of the CuO sensor film that was formed at a temperature of 400ºC, using Atomic Force Microscopy (AFM). Through the 2D and 3D AFM analyses, it is evident that the CuO film exhibits a surface morphology characterized by nanoparticles. The CuO material has an average surface roughness measurement of 11.9 nm.

3.3 Gas Sensing Study

Selectivity refers to the capacity of a sensor film to specifically detect a particular gas in the presence of other test gases. This characteristic is of utmost importance for gas sensors that are intended for commercial use. Thus, to investigate selectivity, the initial focus was on examining the sensing capabilities of CuO sensor films towards a consistent concentration of 100 ppm of different harmful gases. The outcomes of these experiments are presented in figure 3(a). The selectivity graph clearly demonstrates that the CuO sensor film exhibited more sensitivity towards NO_2 gas compared to other test gases such as LPG, H_2S, $Cl_2$and methanol. This may be attributed to the higher rate of interaction between the CuO sensor surface and NO_2 gas molecules.

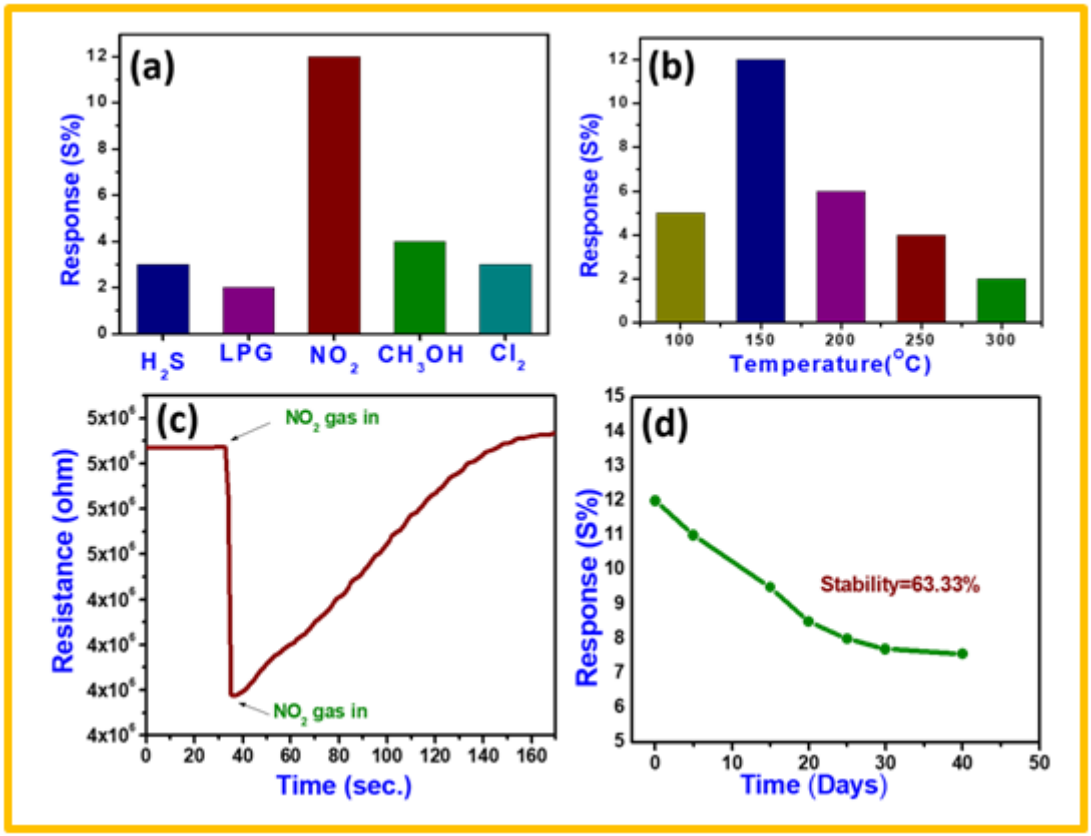

Fig. 3- (a)Selectivity, (b)Temperature dependence, (c)Gas Sensing and (d)Stability study of CuO sensor film

The gas sensing measurement was conducted at various temperature ranges (100 °C to 300 °C) to optimize the operating temperature of the CuO sensor film by manipulating the adsorption/desorption process of oxygen ions on the film's surface using a catalytic factor. Based on the data presented in Figure 3(b), it is evident that the CuO sensor film exhibits the maximum response of 12% for a concentration of 100 parts per million of NO_2 gas at a temperature of 150 degrees Celsius, surpassing the responses seen at other working temperatures. The figure 3(c) illustrates the variation in electrical resistance value of the CuO sensor when exposed to a concentration level of 100 ppm of NO_2 gas. The response values of CuO sensing films are determined by applying the response S (%) formula derived from equation 1 mentioned before. The CuO sensor exhibits the most significant gas response (S) and has a speedy response-recovery time when exposed to 100 ppm of NO_2 gas. The stability study of CuO sensor was measured for 40 days on expo sure of concentration of 100 ppm NO_2 gas at 150°C. The stability research findings are shown in figure 3(d). The CuO sensor has a stability of 63.33%. The decline in the responsiveness of the CuO sensor may be attributed to the influence of aging.

IV. CONCLUSION

To summarize, CuO nanoparticle films were effectively fabricated on a glass substrate using a simple thermal evaporation technique. These films were then subjected to annealing at temperatures 400 degrees Celsius in an air environment. The X-ray diffraction patterns of CuO exhibit a monoclinic crystal structure. The diffraction peaks of the CuO thin film precisely correspond to the standard JCPDS card number 45-0937. The analysis of surface morphology revealed that CuO nanoparticles were formed and distributed throughout the surface of the glass substrate. An EDAX analysis has verified the presence of Copper (Cu) and Oxygen (O) components in the deposited films of CuO. An investigation was conducted to determine the selectivity of a CuO nanoparticles

sensor for various gases. The results indicated that the sensor exhibited the highest response (12%) when exposed to NO_2 gas at a concentration of 100 ppm and an operating temperature of 150ºC, compared to other gases tested. Additionally, the sensor exhibits rapid response and recovery times. Based on the gas sensing findings we acquired, we have confidence that the CuO sensors are highly capable of detecting gases in industrial areas.

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Fuzzy Logic Application in Supply Chain Performance Management

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ABSTRACT

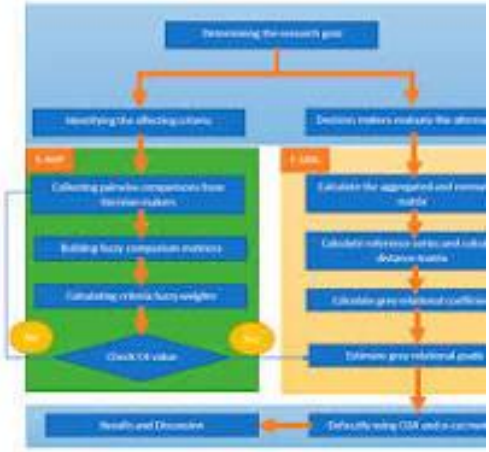
Fuzzy logic in supply chain is considered mostly as a mathematical technique, suitable in dealing with uncertainty, which subjectively becomes an auxiliary (additional help, support) program to approach in order to manage the performance in supply chain.

Fuzzy logic mathematical theory in performance management, is an approach to variable processing, which normally allows multiple variables, through values addition, in a mathematical model, so as to possibly be processed in the same variable, attempting to solve problems, with an open un-precise spectrum of data (data with high base) enabling to discover something among themselves, that makes it possible to obtain some of the accurate conclusions in supply chain.

Fuzzy Logic mathematical model, have been used in numerous application, in performance management, in the facial pattern recognition, air conditioners, washing machine vacuum cleaners, application in the manufacturing process in supply chain.

Study; Fuzzy Logic in performance management in a mathematical model is the basic control system that relies on the state of art, degree of the input, on a mathematical model, also on the variance of the output, depending upon the state of input, introduced, also the rate of the changes of the state of art, in which other Fuzzy logic system compares works, which is on the principle of assigning a particular output, depending on the probability of the state of art in the input achieved in supply chain.

Key Words: Fuzzy Logic: Performance Management: Multiple variables: Principle: Probability: Variance: Mathematical Model:



FUZZY LOGIC MATEMATICAL MODEL:

I. INTRODUCTION

Fuzzy Logic mathematical technique is aimed at exposing instance of application to measure the supply chain performance, in order to provide the researchers on the supply chain for real-value application, as supply chain network, including supply, manufacturing, assembly, distribution, logistic, facilities, that perform the function of material being transformed into intermediate part on to the finished goods, with proper distribution to the requirement of customers in supply chain.

Supply chain is the areas of research applications, which form the necessary part of the incredible network application, which comes into existence in every organisation, with development of supply chain performing measuring network methods, in order to have plenty of avenues, so as to make provision of Fuzzy Logic mathematical technique, which necessarily has wide area of application, in many of the fields in supply chain, that is best known to deal with uncertainty of the issues that are found in data, aimed at exploring the instances, where Fuzzy Logic technique are applied to measure the performance in supply chain.

Supply chain performance measurement, related to Fuzzy Logic, attributes to Reliability, the performance related to delivery, correct product, also the specification, to be delivered at the correct place, quality, time, with correct documentation, to the right customer. Responsiveness' is the speed at which supply chain provides the product to the customer. Flexibility the agile supply chain to the product is responding to the market changes in order to gain, or maintain its competitive advantage. Cost involves is related to the operation of supply chain. Asset management efficiency to meet the demand includes fixed working capital in supply chain.

II. PURPOSE OF THE STUDY

Fuzzy Logic in supply chain performance is a technique suitably dealing with the uncertainty, subjective, which is liable to become an inherent approach to manage the performance management in a descriptive quantitative approach to manage the best performance that has to be adopted on the basis of an predictive, statistical analysis, also to necessarily confirm the importance of relationship embedded in the findings, that are to be adopted to the Fuzzy Logic in supply chain.

Supply chain globalization intensifying the competition, will increase the emphasis on customer orientation required in the interest for an effective supply, to be rated as key criteria, in building a sustainable relationship, in order to analyse, the efficiencies benefits of an objective of Fuzzy Logic competitive performance, evaluation, methods in supply chain.

Analysis: Performance in supply chain is based on strategic tactical operational level, of performance, measures that emphasis on the performance, dealing with service, such as demand, transport, customer relationship management, capacity, resources, service performances, information techniques on the Fuzzy Logic, mathematical model based on the closed loop (forward logistic in the chain procurement, production, distribution)on the financial services in supply chain.

III.LITERATURE REVIEW

Supply chain system selected with a framework, reliable, providing ample scope for measurement, better performance, will be able to bring about 75% of the performance, which can reveal the various strategies, requiring better performance, measurement, framework, in order to capture the essence of the organisational performance on the basis of mathematical model of Fuzzy Logic in supply chain.

Fuzzy Logic mathematical strategy objectives allows to set targets, reflecting the financial, non-financial measures, related to decision making, control, performance, which is determined through various decisions, feed-back, also continuous improvement by adopting a proactive methods, or objectives, with a varied reliable performance measures, enabling aggregations, prioritisation, to facilitate, also integrate in a simple way to ease the use, so also to avoid the 60% of the overlapping in supply chain.

Supply chain decisions in Fuzzy Logic mathematical model are considered to be a strategic level decisions, sometimes becomes very expensive, time consuming, to change any of the decisions, at certain levels, in order to bring efficiency, also the operational efficiency, also considering the best decisions, as there is liable to be risks at every stages of supply chain. These risks are likely to originate from external factors, like the weather conditions, epidemics, thus affect the information technology, currency fluctuations, either from internal risk involved in the disruption of the global economy, on the transportation of raw materials from manufacturers to the supplier or the consumer, thus affecting 50% of the communication system in supply chain.

IV. RESEARCH METHODOLOGY

Research: Fuzzy Logic mathematical model becomes liable to share better performance, being more effective is able to increase the organisation effectiveness, leading to improved customer service, value, resources, utilization, improved revenue, as the evaluation of suppliers, selection process, for import of plant, machinery, equipments from global suppliers in supply chain.

Fuzzy logic in supply chain performance for better quality of products, is reliable for the process, performance, good quality of products, which is also able liable to have better combination with low quality of the products, design, packaging, ability, with supplier certification in supply chain.

Fuzzy logic in mathematical supply chain performance is considered as an important service orientation, designed to enhance the level of customer satisfaction, warranty, guarantee, claim process, spare parts management, availability, capacity utilization, delivery period, also easy on the communication of price, based

on the production, value, as per the required conditions, which is likely to affect the total cost of production, by also giving a combination of value to a suitable pricing in supply chain.

V. RESULTS

Analysis: Globalisation has increase the market share on the different types of products, with the customer facing challenges in supply chain, in order the achieve proper requirement, as it becomes for the customer or consumer to concentrate on the efficiency, effectiveness', of the involvement of activities, that fulfil customers demand in order to transfer the materials through downstream, upstream, so as to create value for the organisation, the activities numerous performances, measurement, framework, with qualitative system, in order to identify, select a mathematical Fuzzy Logic system to translate the systems in variability in supply chain.

Supply chain in order to achieve the best of quality in manufacturing, plans to make use of the best performance, also the methods of teaching technique, to control the problems, scheduling, material replenishment, ordering, with the options to measure the quality, in manufacturing, in order to have a continuous manufacturing, with an ability to adopt changes in demand, during the periods that become necessary, also have the ability to adapt the changes, to reflect the total quality plan in Fuzzy Logic, as it also refers to the things, that may not be clear, necessary with good cooperation, of valuable flexible reasoning, considering the inaccuracies, uncertainty in supply chain.

Fuzzy logic in supply chain has wide application, in many of the fields, with the best of the means to deal with uncertainty in supply chain, that is likely to be found in data management, which is also considered to be applied to measure the performance, that is in order to application to the new concepts, also support the activities in supply chain.

VI. DISCUSSIONS AND FINDINGS

Discussions: Cold supply chain does have become a integral part of the supply chain, as perishable products, whose aim is to examine the performance achieved, through a comprehensive review established to identify the supply chain, across multiple tiers in supply of manufacturing, to bring integration, analyse, examine the nature, also the dependence, on the driving powers, also to show strategic importance, due to their high powers, low dependence, also to improve their effectiveness, performance, employing high capital, with high operating cost, fragmentation, lack of skilled labour, inadequate information, which characterises the weakness in mathematical Fuzzy Logic system in supply chain.

Supply chain in risk is involved when raw materials, semi-finished goods , finished goods, that are required necessarily to be supplied for production or manufacture comes under the problem that may require good quality, as the material required may cause disruption, risk or shut down of the manufacture or production, but on keeping track of the critical supply, may lead to the performance using mathematical model of Fuzzy Logic system in supply chain.

Findings: Mathematical fussy logic system in supply chain model so adapted is to give preference to supplier conditions, uncertainty in supply, risk, disruption, on the basis of selection of Bull Whip effect, to establish on a strategic model, on the development on the selection of globalisation in supply chain.

VII. FUTURE WORKS/CONCLUSIONS

Future : Supply chain risk attained in resources, disruption, can be both internal, external forms, since raw materials required for production is considered to be the highest cost of expenditure, as suppliers of raw materials, are considered to be most important, the need for the industry, so as to be adjourned to the appropriate cost, to meet the needs through better transaction, performance, in order to meet the increased product demand, creating higher value for customers, with better technology, purchasing power, as the supplies are impacted by the industry growth, with appropriate relation to the industry, as they are to focus on Fuzzy Logic performance, risks, vulnerability, cost reduction in supply chain.

Recommendations: Supply chain performance measurement system; have long term focussed on financial measurement, but later the extended focus was on to the integralpart with the view of the organisation, taking into the consideration of the factors on mainly quality, the effectiveness, efficiency, performance, that prevailed in the organisation, with the accomplishment on adjusted stocks, delivery schedules, customer satisfaction, performance measurement, with sustainability, that overtook the elements of Fuzzy Logic becoming increasingly complicated in supply chain.

Conclusions: Measurement in supply chain practices of fuzzy mathematical logic system, with the supplier, customer's, on the relations, integration, quality, flexibility, agility, quality, innovation, sustainability, with the use of key performance indicators, using data processing based on Fuzzy Logic system in supply chain.

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Glycine Lithium Nitrate Doped with Sodium and Potassium Nitrates: Synthesis and Characterization

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ABSTRACT

Growing crystals can be done most simply via slow evaporation. When a guest molecule occludes the pure crystals of centrosymmetric glycine, Second Harmonic Generation (SHG) occurs. Amino acid-derived non-linear optical (NLO) materials areadvantageous in second harmonic generation. A solitary glycine crystal in the presence of trace amounts of sodium, potassium, chloride, bromide, lithium, and potassium nitrate are suitable non-linear optical (NLO) materials. Glycine lithium nitrate crystals have been produced using the slow evaporation method. Slow evaporation is used to form crystals of glycine and lithium nitrate, which are then doped with varying amounts of sodium and potassium nitrates (20%, 30%, 50%, and 60%).Crystallinity and functional group of the grown crystal have been identified by FTIR investigations. Optical band gap has been determined by UV method. The production of distinct spectra has been discussed on the basis of absorbency by the grown crystals.

Keyword: Slow evaporation method, UV, FTIR

I. INTRODUCTION

Research in a number of fields, including diode laser, optical communication, harmonic creation, laser lithography, and frequency mixing, has been sparked by the discovery of extraordinarily effective NLO materials. Organic materials have garnered a lot of attention due to their broad transparent window, thermal stability, strong nonlinear response, ease of synthesis, rapid nonlinear response, and promise for a wide range of device manufacturing. Additionally, they have been created and incorporated into gadgets.A variety of non-linear optical (NLO) applications for glycine's semi-organic single crystals have been evidenced. These crystals

have been widely used in several optoelectronic technologies, including light modulation, laser crystals, optical memory storage, and optical amplifiers. In a similar manner, single crystals are separated into three groups: semi-organic materials, inorganic materials, and organic materials.

Numerous isolated amino acids bind together to generate metal-organic complexes. Semi-organic crystals can be created by combining amino acid as a ligand with transition metal ions.Due to their polarity, certain metal compounds containing amino acids display ferroelectric characteristics.The prospective uses of the NLO material for second harmonic production in optical information processing, optoelectronics, photonics, frequency conservation, and optical commuting piqued the interest of the condensed matter community.The complex of organic and semi-organic NLO materials is produced by amino acids, which are non-organic linear materials with a second harmonic conversion efficiency of non-linear optics. A single crystal of glycine can include good nonlinear optical (NLO) materials in the presence of minuscule quantities of potassium, sodium, chloride, and bromide. For many device applications, crystals with clear infrared and ultraviolet characteristics, high conversion efficiencies for second harmonic generation (SHG), and nonlinear optical properties are crucial. The arrangement of defects during crystal formation has a major impact on a material's optical, electronic, and electrical capabilities.

II. SAMPLE PREPARATION AND CRYSTAL GROWTH

Lithium nitrate and glycine were administered as a powder along with deionised water for the crystal formation. The glycine lithium nitrate crystals were produced in an aqueous solution using a slow evaporation approach, in which evaporation is allowed while the saturated solution is maintained at ambient temperature. To create an aqueous solution, 10ml of double-distilled water was mixed with glycine and lithium nitrate at a 4.5:1.5 mol ratio.

What manfilter paper was used to filter the prepared solution in a glass jar with a perforated cover. The compound was allowed to crystallize and a provision was established for gradual evaporation in a dust-free atmosphere. Tiny, colourless seeds were found after the solvent had evaporated from the saturated solution for four to five days.The mother solution was supplemented with doped materials at 20%, 30%, 50%, and 60%, respectively, to examine the effects of different kinds of impurities on the material's physical properties. These substances were nitrates of potassium and sodium. After 20 days, tiny seeds floating solution crystallize into a variety of shapes and sizes.

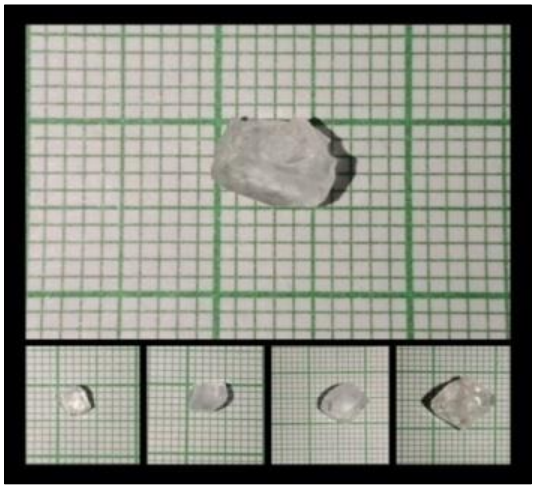


Figure.1 Glycine Lithium Nitrate doped with 20% , 30% , 50% and 60% of KNO_3

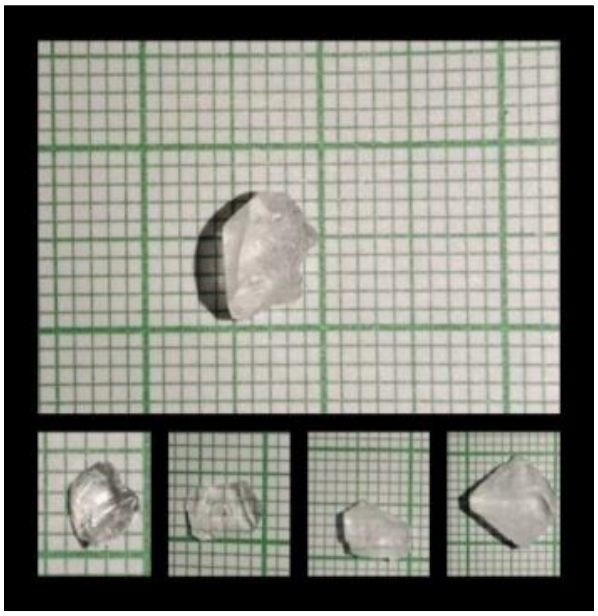


Figure.2 Glycine Lithium Nitrate doped with 20% , 30% , 50% and 60% $NaNO_3$

III.RESULT AND DISCUSSION

The mechanical, optical, and structural properties were investigated using pure crystalline crystals doped with KNO_3 and $NaNO_3$ at concentrations of 20, 30, 50, and 60%. Photon absorption or emission can be measured using UV-Vis absorption spectra. Using an FTIR spectrometer, an FTIR spectra was acquired in the wave number range of 450–4000 cm^{-1} to verify the existence of a functional group in the crystal lattice.

FTIR (FOURIER TRANSFROM INFRARED SPECTROSCOPY)

Transform of Fourier In order to confirm that there is a functional group in the crystal lattice, an infrared spectroscopy graph was recorded. Using an FTIR spectrometer, an FTIR spectrum in the 400–4000 cm–1 wave number range was obtained. The amount of infrared (IR) light that enters the material under study was noted. In actuality, each known chemical molecule has a typical infrared spectrum. The molecular structure of the structure under investigation can be inferred from the infrared spectrum. The O-H, C=O, and N-H symmetric stretching vibrations are correlated with the FTIR spectra.

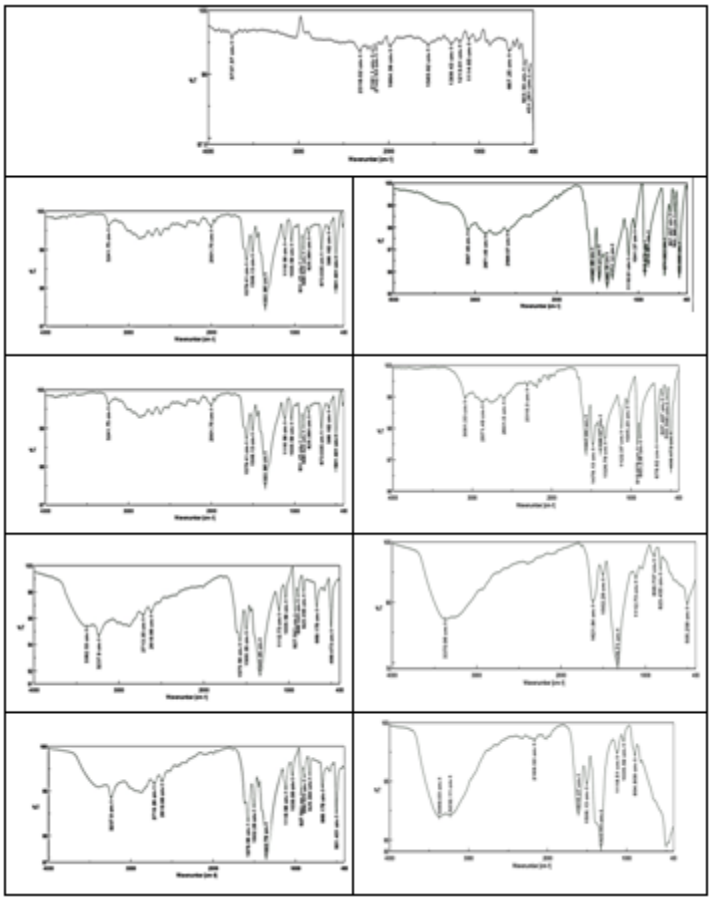


Fig. 5 FTIR of Glycine $LiNO_3$ doped with (A) undoped (B) 20% (C) 30% (D) 50% (E) 60% $NaNO_3$

Fig. 6 FTIR of Glycine $LiNO_3$ doped with (A) undoped (B) 20% (C) 30% (D) 50% (E) 60% KNO_3

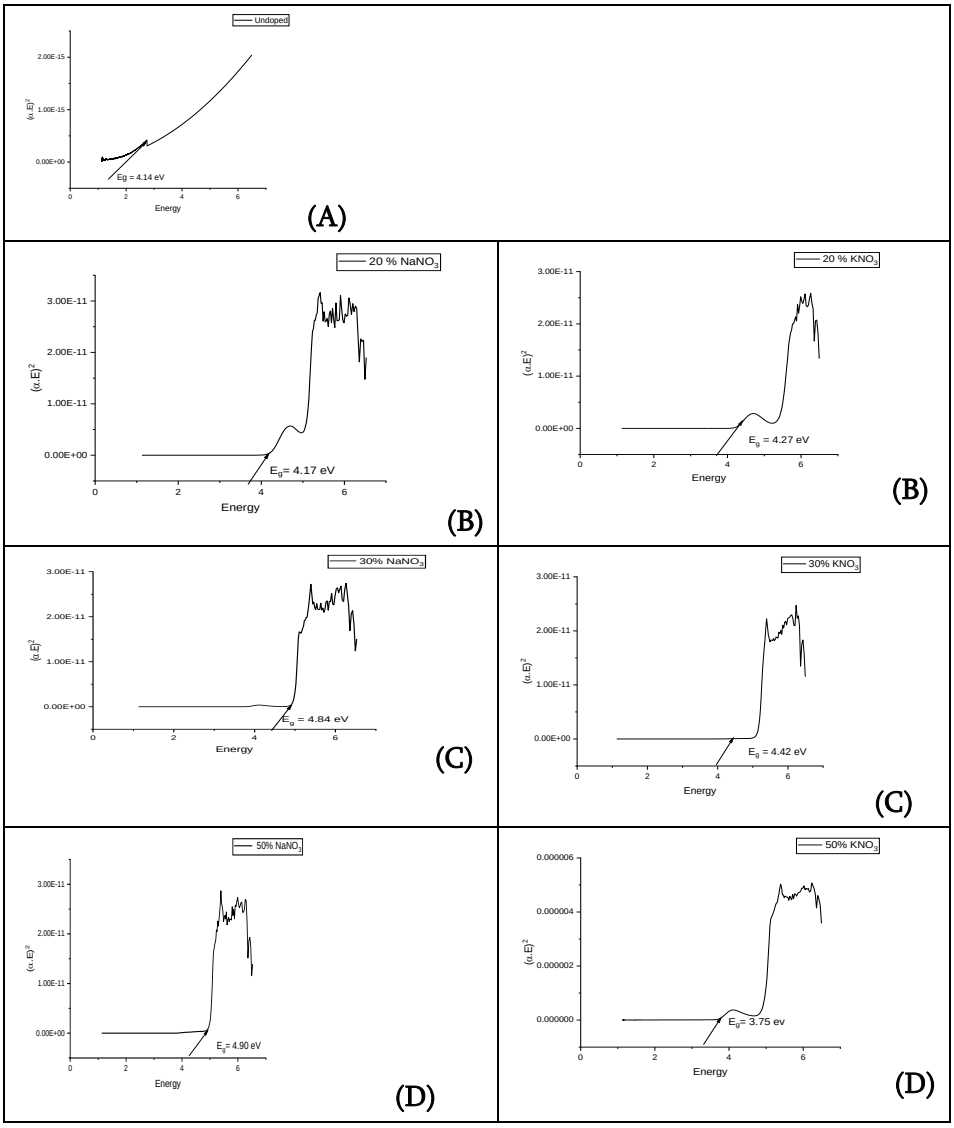
Undoped with $NaNO_3$			Undoped with KNO_3	
Sr. No.	Wave number(cm^{-1})	AssignedVibration	Wave number (cm^{-1})	Assigned Vibration
1	3382.53	N-H Group	3370.96	O-H Group
2	3241.75, 3237.9	=CH-H Group	2871.49	= CH_3 Group
3	2715.28, 2618.86	O-H Group	2601.5,2318.02	O-H Group
4	2142.53	C ≡ C Group	2181.1,2142.53	C≡C Group
5	1984.39	=C-H Group	1984.39, 1610.27	=C-H Group
6	1575.56, 1565.92	N-H Group	1565.92, 1502.28	C=C Group
7	1353.78,1340.28,	C-H Group	1328.71,1322.93	C-N Group
8	1213.01	O-H Group	1213.01,1122.37	C-O-C Group
9	1116.58, 1114.65,	C-O-C Group	919.87	O-H Group
10	931.45, 927.59	O-H Group	896.73, 894.80	=CH-H Group
11	673.03, 667.25	N-H Group	555.39, 505.25	C-Cl Group
12	503.33, 501.40	C - Cl Group	499.97, 451.26	C-I Group
13	499.47, 451.26	C- I Group	-	-

UV-Vis Absorbance Spectroscopy

The measurement of radiation absorption or emission linked to modifications in the spatial distribution of electrons in atoms and molecules is known as UV-Vis-NIR spectroscopy. In actuality, the electrons involved are

typically the valence or bonding electrons, which are stimulated by UV, visible or near-IR light absorption. The spatial extent of the electron distribution is increased upon excitation of a bound electron from the highest occupied molecular orbital, resulting in a larger, more diffuse, and frequently more polarizable total electron density. A molecule that is vibrationally stimulated also has vibrational excitation. The intensity of spectral lines is determined by the likelihood of electronic transitions.

To have a large absorption cross section or a high likelihood of the molecule absorbing or emitting radiation, there needs to be a significant overlap between the vibrational modes in the initial and final electronic states. Within the initial and final electronic states, a broad variety of vibrational levels can result in electronic transitions. In the 200–1000 nm range, saturated hydrocarbons and molecules with just ether, alcohol, and alkyl groups exhibit transparency, or no absorption. These substances can be used as solvents for spectral determination when the specimen's solutions are used in this area.The UV–vis absorbance spectra of Glycine $LiNO_3$ doped with $KNO_3$and $NaNO_3$are recorded in order to determine the optical transparency of the formed crystal. The energy gap between the undoped and doped samples was computed using UV measurement data, and the results are shown in figures 3 and 4.



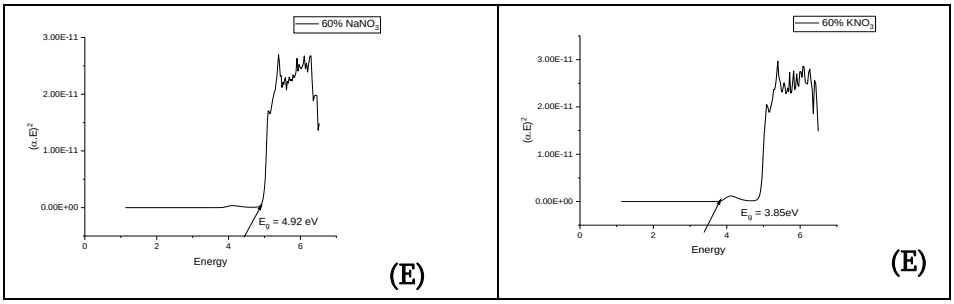


Fig. 3 Direct band gap of Glycine $LiNO_3$ doped with (A) undoped (B) 20% (C) 30% (D) 50% and (E) 60% $NaNO_3$

Fig. 4 Direct band gap of Glycine $LiNO_3$ doped with (A) undoped (B) 20% (C) 30% (D) 50% and (E) 60% KNO_3

Dopant= $NaNO_3$		**Dopant= KNO_3**	
Glycine $LiNO_3$	Band Gap (eV)	Glycine $LiNO_3$	Band Gap (eV)
Undoped	4.14 eV	Undoped	4.14eV
20%	4.17 eV	20%	4.27 eV
30%	4.84 eV	30%	4.42 eV
50%	4.90 eV	50%	3.75eV
60%	4.92 eV	60%	3.85 eV

IV. CONCLUSION

The usual slow evaporation method with double-distilled water at room temperature was used to successfully create the single crystal of Glycine $LiNO_3$ doped with KNO_3 and $NaNO_3$ with a 4.5:1.5 mol ratio. Regarding non-linear optical applications, it is a strong rival with enormous potential. FTIR spectroscopy research verified the molecule's molecular structure and the presence of the functional group. It is evident from a study of the direct energy band gap of crystals using UV Vis absorption spectroscopy that the band gap grows proportionately with the level of doping in the sample.

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Heart Disease Prediction Using Machine Learning

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ABSTRACT

The most serious problems are heart-related ones. The death rate from heart attacks is rising daily. We need to discover heart problems early on, thus developing a system is essential. Manually diagnosing these diseases takes a lot of time and has low system availability. Numerous technologies are employed in the creation of this kind of system, which uses the data mining principle. We may create these kinds of systems, which are a subset of the data mining idea, using various machine learning techniques. We must identify the diseases and take the required precautions against them as soon as possible in order to reduce the danger of death. K-Nearest Neighbors, Logistic Regression, Random Forest, and Naive Bayes.

Keywords- Heart healthiness, machine learning, healthcare support, logistic regression

I. INTRODUCTION

The heart is regarded as one of the most vital and significant parts of our bodies since it controls blood flow throughout our bodies. In the contemporary global, cardiovascular illness is among the primary causes of the majority of deaths. Heart failure or heart disease can be caused by modest threats to the heart. Hypertension can lead to heart disease, and fatty foods can cause hypertension. Heart disorders account for the majority of deaths, according to the WHO. The best defense against diseases linked to the coronary heart is a healthy lifestyle and early identification. Heart disease can be caused by a variety of factors, including stress, alcohol, bad diet, and smoking. The thread we have in front of us healthcare system is to effective diagnosis. It is possible to detect or predict heart diseases, for that many technologies are used like AI, ML and many more.
Algorithms of AI and ML used for detection of heart diseases. ML algorithms are very helpful in the recent time, to determine the heart related diseases correctly. Data mining contains many more technologies Machine Learning is one of them. Many ML techniques used in detection or prediction of heart diseases at earlier stage. ML plays a totally critical function to discover the hidden discrete styles and thereby analyses the data. In medical field ML mainly used for prediction of different illnesses. Random forest ,choice/decision Tree, Naive

Bayes, Logistic Regression for predicting heart ailment earlier, these are some ML strategies used for pattern recognition or prediction of pattern based on previous data-set. A logistic regression version predicts a fixed-up records variable via the use of reading the relationship amongst one or many present independent variables. Detection or prediction of pattern, forecasting these domains uses logistic regression.

II. LITERATURE SURVEY

These days, machine learning and related algorithms are widely used in web apps and platforms. Because it provides predictions along with accurate and efficient results. Therefore, because of this precise result, the research in this field becomes significant and valuable. There are various machine learning algorithms available that forecast diseases. The severity of cardiac disease can be predicted from the patient's sample reports. Patients often undergo clinical examinations, and the reports that are produced include a variety of information that, when combined with machine learning algorithms, can be used to gauge the severity of cardiac disease. The accuracy rate of the heart disease prediction project using Naive Bayes and Random Forest (RF) classifiers is 85.48%. Additionally, there are methods like RF, classifiers in the heart disease prediction project have accuracy rate of 85.48%. There are also techniques like RF, Support Vector Machine (SVM), and learning models which also can be used in heart datasets. The study of Mienye et al in this area states that the use of the mean based splitting method, classification and regression tree for divide the data set into smaller parts and perform predictions on that. There are different algorithms like logistic regression, KNN classifier, naive Bayesian we can use for classification of heart disease. The lot of research papers of Zameer Khan et al. all have accuracy rate of 85.71 of logistic regression. The main objective of proposed approach is to evaluate accuracy and error rate to identify the best feature. We select the feature and then we divide the data set as training data and testing data. We can have 80 % data as training data and remaining data as testing data. We can perform logistic regression or any other machine learning classification algorithms to predict the results. Then on basis of result, patients are suggested for further diagnosis. Cardiovascular disease is increasing daily in this modern world. According to the WHO, an estimated 17 million people die each year from cardiovascular disease, particularly heart attacks and strokes. ML is now an emerging field due to the increasing amount of data. ML makes it possible to acquire knowledge from a massive amount of data, which is very heavy for man and sometimes impossible. By using K-Nearest Neighbor, Support Vector Machine, Naive Bayes, Random Forest algorithms we can predict heart diseases. The purpose of this work is to compare algorithms with different performance measures using ML.

III.EXISTING SYSTEM

Heart problems pose a challenge to modern health system. Numerous existing methods primarily focus on data mining sets in addition to deep learning. Every clinical diagnostic plays a crucial role in accurately predicting the outcome. It is possible to forecast a patient's heart health using computer-generated reports.

Additionally, it lowers the price of a physical diagnosis. Data mining is utilized in current systems to find patterns and dependability in data sets. Data mining was used in previous decades. Computers have a high probability of immediately classifying various traits, attributes, or categories. The current systems are aware of the risk factors linked to heart disease. Permit the patient's condition to be assessed for high risk and make a

diagnosis based on that assessment. The current setup used patient's heart disease family history and total cholesterol values by using mathematical analysis. Existing system predict the heart problem intensity.

IV. PROPOSED SYSTEM

The data set of patient heart health report parameters that the project possesses and subsequently using the Logistic Algorithm, it provides the heart disease severity. We shall refer the patient to the local doctors for additional therapy based on the severity of their heart condition. By examining the patient report and conducting data investigation, the outcome is predicted. Numerous machine learning methods exist, including logistic regression, KNN, and naive bays. However, research indicates that logistic regression yields a greater accuracy rate, thus we employed this algorithm in the proposed system. Utilize the sklearnlibrary in that system to determine the accuracy score rate. We employed a random search strategy to identify the optimal answer for the built model by combining random combinations of hyper parameters. Then used to assess the outcomes logistic regression algorithm, performing it on training and testing data we predict the intensity of heart diseases. The very first step is importing the data set to read the data set. Data contains age, gender, sex, chest pain, slope and target.

For information verification data should be explored. By creating temporary variables build a model for logistic regression. In proposed system, sigmoid function is used which helped in graphical representation of data which is classified. The accuracy in the proposed system is more as compared to existing systems as we are using logistic regression.

V. APPROACH AND METHODOLOGY

The World Health Organization reported that heart disease causes 12 million deaths globally each year.50% of deaths worldwide, including in the US, are attributable to cardiovascular disease. For high-risk patients, changing their lifestyle is essential, as is preventing issues early on by scheduling timely visits with physicians and cardiac specialists.

The objective of the suggested model is to determine the risk factor for cardiac conditions and use logistic regression to forecast outcomes. In statistics, logistic regression is mostly used to predict the results of categorical dependent variables based on independent factors. In logistic regression, the dependent variable is always binary. A useful tool for risk prediction and probability calculation is logistic regression.

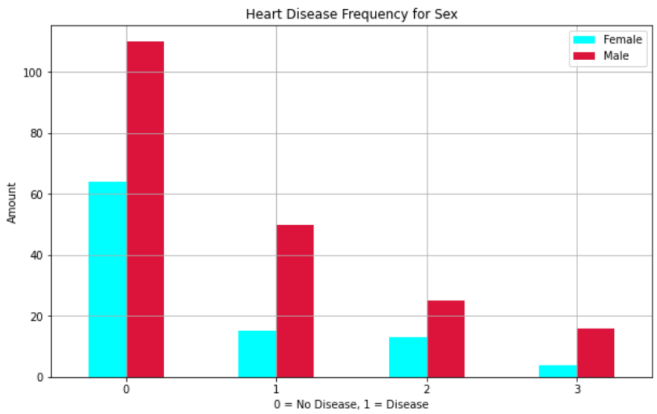

Fig.1 Heart disease frequency (Sex)

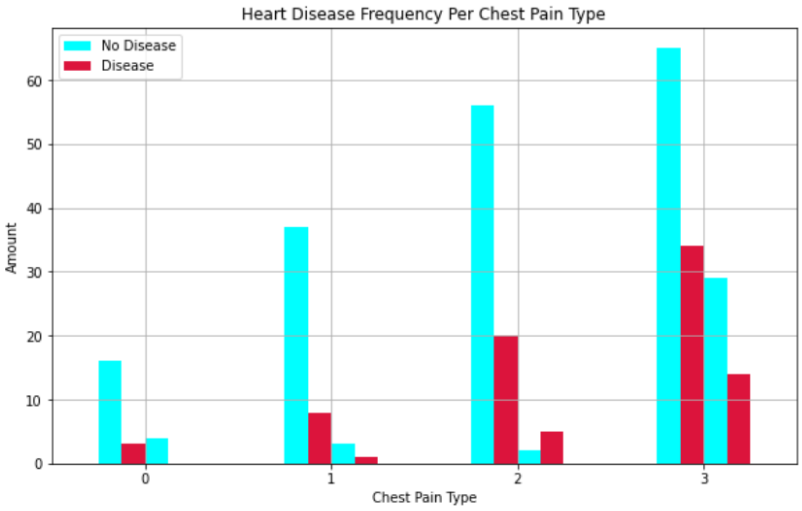

Fig.1 Heart disease frequency (Chest pain type)

The symbols in data dictionary for different chest pain can be understand from following cp - chest pain type:

- 0: This decrease blood supply to heart, related to heart pain aginal.
- 1: Its totally not related to heart atypical pain
- 2: This pain is not related to esophageal not related to heart non-aginal.
- 3: This is asymptotic it shows no symptoms

This chest pain type 1 shows it is not related to heart but it have more people as compared to person whom do not have chest pain. If data dictionary does not supply enough information you might use google to know about agnail pain, atypical pain, and asymptomatic pain non agnail chest pain type. This research came from asking from cardiologist you can also google about it.

VI. ECG BASED HEART HEALTH ANALYSIS

Heart disease and other cardiovascular conditions are the major causes of death worldwide. More lives can be saved the earlier they can be predicted and categorized. Cardiovascular disease can be identified with an electro-cardiogram (ECG), a simple, affordable, and non-invasive method of detecting the electrical activity of the heart. In this study, the public ECG picture data set of cardiac patients was used to harness the potential of deep learning techniques to predict the four main cardiac abnormalities: abnormal heartbeat, myocardial infarction, history of myocardial infarction, and normal person classes. SqueezeNet and AlexNet, two low-scale pre-trained deep neural networks, were used to examine the transfer learning strategy first. A brand-new Convolutional Neural Network (CNN) architecture was also suggested for the prediction of cardiac abnormalities. Third, the previously described pretrained models as well as our suggested CNN model were employed as feature extraction tools for conventional machine learning algorithms, including Support Vector Machine (SVM), K-Nearest Neighbors (K-NN), Decision Tree (DT), Random Forest (RF), and Naive Bayes (NB). The suggested CNN model outperforms existing works in terms of performance metrics, according to the experimental results; it achieves 98.23% accuracy, 98.22% recall, 98.31% precision, and 98.21% F1 score. Additionally, the suggested CNN model uses the NB method to reach the best score of 99.79% when employed for feature extraction.

VII. CONCLUSION

To reach the maximum point, the number of heart diseases may surpass the current situation. Heart disease is a complex condition that claims the lives of many people annually. Manually calculating the probability of developing heart disease based on previously identified risk factors is challenging. One of the main limitations of this system is that its primary goal is to apply classifying techniques and algorithms for the prediction of heart disease. By studying different data cleaning and mining techniques, we can prepare and build a data set suitable for data mining, which allows us to use machine learning in logistic regression algorithms to predict whether or not a patient has heart disease. Any non-medical employee can use this software and predict the heart disease and reduce the time complexity of the doctors. It is still an open domain waiting to get implemented in heart disease predication and increase the accuracy.

VIII. FUTURE WORK

Today's, world most of the data is computerized and everything is in the cloud which can be accessed although it is not utilized properly. By analyzing the available data, we can also use for unknown patterns. The primary motive of this research is the prediction of heart diseases with high rate of accuracy. For predicting the heart disease, we can use logistic regression algorithm, sklearn in machine learning. The future scope of the paper is the prediction of heart diseases by using advanced techniques and algorithms in less time complexity.

IX. RESULT PARAMETERS

1. Abnormal heartbeat:

Any disturbance in the heartbeat's rhythm or pace is referred to as an abnormal heartbeat, or arrhythmia.

Each heartbeat is generally regulated and coordinated by electrical signals that start in the sinoatrial node, the heart's natural pacemaker, and move through the electrical system of the heart.

But occasionally, these messages can be interfered with, resulting in the heart beating too quickly, too slowly, or irregularly. Many symptoms, including palpitations, shortness of breath, dizziness, or fainting, may result from this.

Arrhythmias come in a variety of forms, from minor and not harmful to acute and life-threatening. Atrial fibrillation, ventricular tachycardia, and supraventricular tachycardia are a few instances that are frequently seen.

2. Myocardial Infraction:

When there is a blockage in the blood supply to the heart muscle, it results in damage or death of the heart muscle tissue, which is known as a myocardial infarction or heart attack.

The blood tube that supplies the heart muscle with oxygen-rich blood, the coronary arteries, usually becomes blocked when a blood clot forms in one of them. This can occur when plaque, a waxy substance that can gather in the arterial walls over time, causes the coronary artery to constrict or become blocked. Chest pain or discomfort, shortness of breath, nausea, dizziness, or pain in other upper body areas such the arms, neck, jaw, or back are all possible heart attack symptoms.

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Assessment of few specific Heavy Metals along the Ghansoli Creek, Navi Mumbai, Maharashtra

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ABSTRACT

Ghansoli Creek is a part of Thane Creek and is an inlet in the shoreline of the Arabian Sea that isolates the Mumbai city from the Indian mainland situated at latitude 19° 06'41"N and longitude 19° 09'02"N to latitude 72° 59'11"E and longitude 72° 58'49"E which stretches 4.8 km from Ghansoli node till Airoli bridge. Creek is surrounded by mangroves on both sides with Bhandup on west side and Gansoli on east side. The monitoring and evaluation of the quality of water has become necessary as a result of human contamination. Anthropogenic activities, religious ceremonies, waste discharge through nallahs, and constructed ponds can all pollute the creek water. Exposure to heavy metals such as chromium, copper, iron, lead, and zinc etc pose some of the greatest risks to human health and animal species. Current research focuses on analyzing certain heavy metals to determine their quality and sustainability for multiple purposes. Findings indicate the presence of heavy metals in water samples, with high concentrations of some elements at the studied area as per MOEF.

Keywords: Ghansoli Creek, Heavy Metals, Chromium, Copper, Iron, Lead, Zinc.

I. INTRODUCTION

Creek is a narrow, sheltered waterway inlet in a shoreline or channel in a marsh. Anthropogenic contaminants that have been shown to have an impact on creek ecosystems include feces and other microbes, suspended sediments, fertilizers, pesticides and herbicides, heavy metals, petrochemicals, and other chemicals. Heavy metals provide significant environmental risks due to their non-biodegradability, cytotoxicity, mutagenicity, and carcinogenicity(More et al., 2003). In the aquatic environment, sediments play a significant role as metal transporters. Different sedimentological and geochemical phases make up the sediments in creek regions, and these phases serve as binding sites for metals that enter the creek ecosystem (Pande AandNayak G A, 2013).Marine waters are contaminated by heavy metals from various sources, which have an impact on aquatic life.(Yousafzai and Shakoori, 2008).When combined, heavy metals may have significant impacts (Ahmad et al.,

2014). The effects include shellfish closures due to microbic infective agent exposure, alteration of benthal substrata and loss of submerged macrophyte vegetation, nuisance and noxious algal blooms, loss of species due to environmental alteration or toxicity, reduced ecosystem function, and loss of recreational and commercial fisheries value. The net results of these impacts are that a lot of those complicated and productive ecosystems are anthropogenically degraded to varied extents. With increasing human coastal development, existing natural creeks are at merge of losing ecological worth with increasing impacts (B.V et.al 2003).Creeks are important part of ecosystem, as they provide habitat to various organisms, so they should be preserved.

Hydrological measurements are necessary for the interpretation of water quality information and for water resource management. Variations in hydrological conditions have vital effects on water quality (Kuusito E, 1996). Creeks are natural resource for flora and fauna and degradation of creek is a major environmental issue the world is currently facing. Human activities and alterations created by reclamation have had as adverse impact on their ecology. Because of this, water quality management of creek ecosystem is necessary. Regular studies of hydrological parameters are necessary for this purpose, as they can assess the status of contamination and help in deciding the remedial measures or mitigation strategy. Studies on hydrological parameters provide us first hand information about the metabolic events occurring in the water bodies. Hydrological parameters also govern the distribution of the animals/organisms and hence used in understanding the correlation with the environment (Quadros G, 1995). Frequent monitoring of the physical-chemical features is crucial because it allows us to create a relationship between the various parameters and determine the current state of the area (Raut et al., 2013). Water parameters are indicators of the quality of the water, and evaluating them enables us to stop further degradation and make sure the water looks good (Deshbhratar et al., 2014).Studies compared with past studies can provide a general idea of deterioration or improvement of ecosystem.

Mumbai has total creek line of close to 71 km2. It includes Vasai creek to the north and Thane Creek to the east. Within the city, there are Marve creek and Gorai Creek. There are also Mahul and Mahim creek. Ghansoli Creek is a part of Thane Creek and is an inlet in the shoreline of the Arabian Sea that isolates the Mumbai city from the Indian mainland situated at latitude 19° 06'41"N and longitude 19° 09'02"N to latitude 72° 59'11"E and longitude 72° 58'49"E which stretches 4.8 km from Ghansoli node till Airoli bridge. Creek is surrounded by mangroves on both sides with Bhandup on west side and Ghansoli on east side. Climatic condition may be classified as tropical, hot and humid. Winter is from December to February, followed by summer from March to June. The southwest monsoon season is from June to September, October and November months constitute the post monsoon season which is hot and humid in coastal areas. Total annual rainfall as per IMD data is 2373.4mm. This Creek provides habitat to various insects, crustaceans, amphibians, skinks, snakes, lizards, mudskipper and fishes. This creek provides home from tiny creatures, fishes and birds and plays an important role in animal biodiversity.

II. MATERIALS AND METHODS

The quality of water has never been static. It varies from place to place and also from time to time and is largely regulated by the biotic and abiotic agencies which come across or interact directly or indirectly (Raut S.R et al., 2013). Different health agencies have prescribed standards for different categories of water, e.g US Public Health Services (1992), WHO (1992), Indian Council of Medical Research (1962), MoEF (2021). Standards are essential because the quality of water directly affects human health. To make use of the new test methods and to take advantage of new treatment techniques, the standards are revised frequently (Patiram et al., 2007).

During study the assessment of heavy metals of water were done by standard methods of examination. Samples were collected from 4 stations on both sides of the creek between the year 2022 and 2023 during pre-monsoon, early monsoon and post-monsoon season. Site was visited using a boat from Thane Flamingo Sanctuary. Samples were collected in 1 litre plastic container without any air bubbles, closed tightly, labelled in the field and stored at temperature maintained at 4°C in refrigerator. Plastic containers were thoroughly washed by sample before collection. Samples were transported to the laboratory for testing on the very next day. Testing was done using AAS.

III.RESULTS

Data obtained from testing of heavy metals are displayed in the below tables.

Months	Spots	Chromium	Copper	Iron	Lead	Zinc
January	Station 1	367.85 ± 3.05	449.57 ± 2.73	0.5 ± 0.04	ND	16.46 ± 0.04
	Station 2	352.21 ± 2.16	301.35 ± 5.53	0.77 ± 0.02	ND	16.17 ± 0.42
	Station 3	302.83 ± 1.66	370.1 ± 3.08	0.32 ± 0.01	ND	16.47 ± 0.21
	Station 4	152.61 ± 1.46	186.51 ± 4.62	0.61 ± 0.008	ND	16.43 ± 0.34
June	Station 1	145.08 ± 2.20	213.94 ± 15.53	0.81 ± 0.01	ND	16.12 ± 0.06
	Station 2	416.51 ± 1.64	326.58 ± 4.11	0.96 ± 0.02	ND	16.89 ± 0.15
	Station 3	432.54 ± 0.06	694.34 ± 15.68	0.93 ± 0.01	ND	13.49 ± 0.24
	Station 4	170.32 ± 3.26	168.24 ± 0.79	0.59 ± 0.009	ND	16.69 ± 0.04
October	Station 1	369.58 ± 4.04	442.71 ± 8.49	0.63 ± 0.01	ND	15.75 ± 0.47
	Station 2	342.26 ± 3.82	364.54 ± 2.33	0.49 ± 0.01	ND	15.45 ± 0.23
	Station 3	326.42 ± 2.90	335.64 ± 5.84	0.83 ± 0.01	ND	16.54 ± 0.23
	Station 4	397.15 ± 6.65	190.82 ± 2.43	0.76 ± 0.03	ND	15.87 ± 0.25

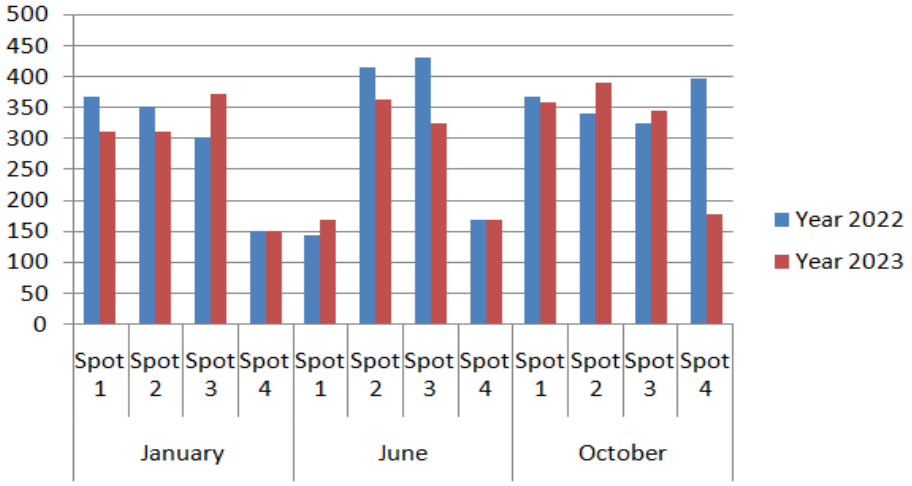
Table 1: Heavy metals values obtained in the year 2022

Months	Spots	Chromium	Copper	Iron	Lead	Zinc
January	Station 1	312.47 ± 1.35	383.07 ± 1.62	0.46 ± 0.02	ND	15.46 ± 0.02
	Station 2	311.45 ± 1.12	359.47 ± 1.08	0.58 ± 0.01	ND	15.89 ± 0.05
	Station 3	372.61 ± 2.98	311.04 ± 1.97	0.64 ± 0.02	ND	16.12 ± 0.11
	Station 4	142.84 ± 2.07	186.51 ± 2.42	0.61 ± 0.01	ND	16.43 ± 0.22
June	Station 1	170.18 ± 1.54	224.81 ± 1.12	0.79 ± 0.01	ND	16.69 ± 0.14
	Station 2	365.14 ± 2.53	470.26 ± 4.93	0.59 ± 0.02	ND	18.69 ± 0.02
	Station 3	326.15± 2.32	370.96 ± 1.63	0.57 ± 0.01	ND	16.96 ± 0.03
	Station 4	169.01± 1.23	156.12 ± 1.50	0.94 ± 0.01	ND	18.46 ± 0.34
October	Station 1	359.48 ± 1.20	412.78 ± 3.86	0.63 ± 0.01	ND	15.75 ± 0.11
	Station 2	391.62 ± 3.06	371.47 ± 2.34	0.49 ± 0.01	ND	15.45 ± 0.23
	Station 3	346.22 ± 2.51	365.22 ± 3.51	0.83 ± 0.03	ND	16.54 ± 0.02
	Station 4	179.02 ± 1.14	162.01 ± 0.55	0.72 ± 0.02	ND	16.76 ± 0.40

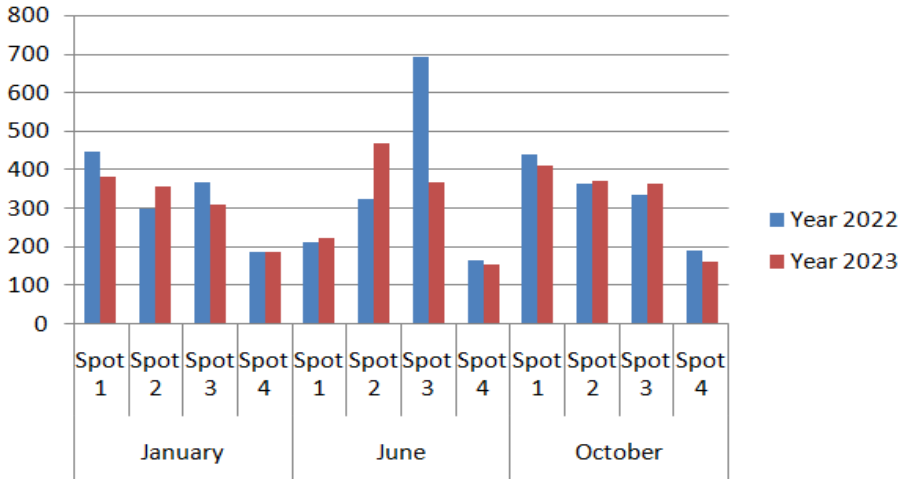
Table 2: Heavy metals values obtained in the year 2023

Values are displayed in the above mentioned table is in mg/L unit and testing is done by Spectormetry method and standard deviation is calculated using SPSS and Microsoft excel method. *ND- Not detected

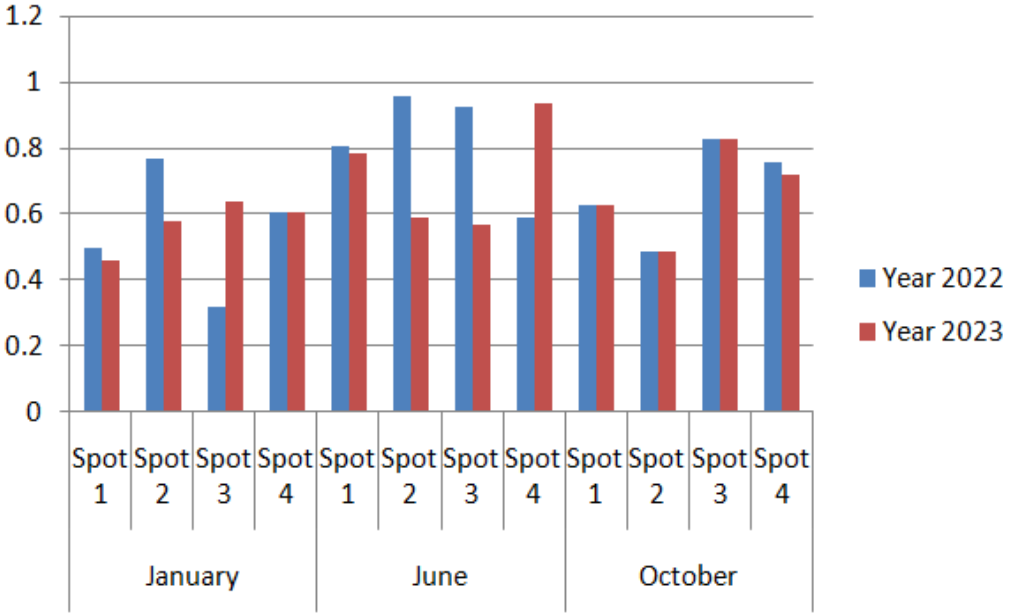
Comparison of obtained heavy metals values for the year 2022 and 2023 are displayed in the below graphs.



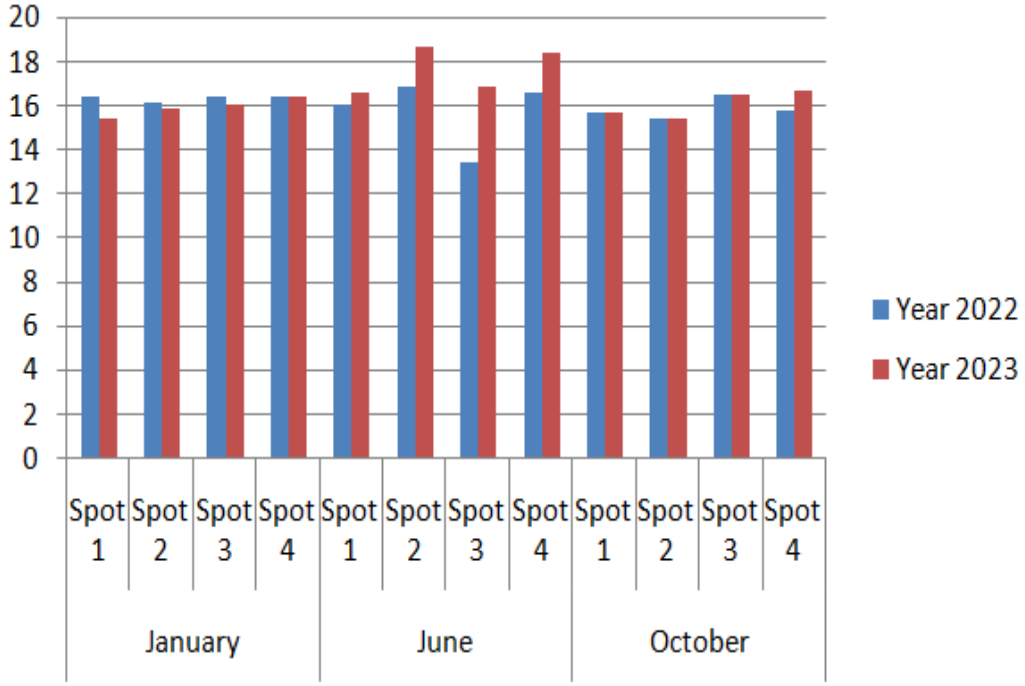
Graph 1: Comparison of Chromium values in the year 2022 and 2023.



Graph 2: Comparison of Copper values in the year 2022 and 2023.



Graph 3: Comparison of Iron values in the year 2022 and 2023.



Graph 4: Comparison of Zinc values in the year 2022 and 2023.

Chromium: The metal chromium can be found in natural deposits as chromates and dichromates, which are soluble in water. The two main industries that release chromium into the atmosphere are those that manufacture chemicals and those that burn coal, oil, and natural gas for a variety of uses. Chrome is mostly used in metalalloys like stainless steel, magnetic tapes, protective coatings for metal, paints, cement, paper, rubber, and composition floor coverings, among other things. Its soluble forms are also used in wood preservatives. Exposure to chromium for long-term can cause harm to the kidney, liver, heart, and nerve tissues of the organisms (Dayan et al., 2001). Average value of chromium obtained during study was 301.305 mg/L which is very high than standard value of 2 mg/L by MoEF (1993) for marine and coastal areas. Highest value of chromium was recorded during early monsoon which is 432.54 mg/L at station 3 and lowest was recorded 142.84 at station 4 mg/L during pre-monsoon.

Copper: Antifouling paints, which are applied to ship hulls, buoys, and underwater surfaces as well as decks, pilings, and other maritime structures made of lumber coated with chromated copper arsenate (CCA), are a significant source of copper in the marine environment. An excessive amount of copper build up in an animal's body is harmful (Parsad et al., 2006). Copper is extremely toxic to fishes, which can have an impact on their development, ability to reproduce, activity of their enzymes, etc (Gharedaashi et al., 2013). Average value of copper obtained during study was 325.752 mg/L which is very high than standard value of 3 mg/L by MoEF (1993) for marine and coastal areas. Highest value of copper was recorded during early monsoon which is 694.34 mg/L at station 3 and lowest was recorded 156.12 mg/L at station 4 during early monsoon.

Iron: Since the iron ions Fe2+ and Fe3+ easily interact with molecules containing oxygen and sulphur to create oxides, hydroxides, carbonates, and sulfurides, elemental iron is rarely seen in nature. For the metabolism of plants and animals, iron is required. The most prevalent forms of iron in nature are its oxides (Elinder 1986). Average value of Iron obtained during study was 0.66 mg/L which is less than standard value of 3 mg/L by MoEF (1993) for marine and coastal areas. Highest value of iron was recorded during early monsoon which is 0.96 mg/L at station 2 and lowest was recorded 0.32 mg/L at station 3 during pre-monsoon.

Lead: Lead is found in the environment as a result of both anthropogenic and natural causes. Lead has a 20-year biological half-life and accumulates in the teeth and bones (Frances, 2008).Lead was below detectable limit during the study. Standard value of lead is 2 mg/L by MoEF (1993) for marine and coastal areas.

Zinc: Animal growth and survival depend on zinc (Shankar and Parsad, 1998), however excessive zinc exposure can have negative health effects (Azizullah et al., 2011). Average value of zinc obtained during study was 16.31 mg/L which is around standard value of 15 mg/L by MoEF (1993) for marine and coastal areas. Highest value of zinc was recorded during early monsoon which is 18.69 mg/L at station 2 and lowest was recorded 13.49 mg/L at station 3 during early monsoon.

IV. DISCUSSION

The concentration sequence of heavy metals in the water samples of the study area can be arranged in order Copper> Chromium> Zinc> Iron> Lead. Copper and chromium concentration is very high as per the standards. Concentration of high level of metal can also be due to evaporation and low influx of fresh water (Oribhabor B J and Ogbeibu A E, 2009).Concentration of Chromium and Copper is high because of industrial discharge from the presence of petrochemical industries and refineries located in MIDC Ghansoli, which releases waste material in the Creek through Nallahs.Concentration of Iron is low because Iron is not present in soluble form and is dominantly present in Fe2+ and Fe3+ ion forms.There are no nearby industries or sources which releases Lead into the creek.

V. CONCLUSION

Urbanised parts of India generates extent amount of waste material which are often released into water bodies without proper treatment (Central Pollution Control Board, 2018a, 2018b). Continuous monitoring of the water quality and awareness program among the people can help in maintaining good health of the creek and decrease water pollution. The information obtained from this study can help decision maker in proper management and protection of the creek.These metal concentrations in Ghansoli Creek are therefore extremely concerning, necessitating the need for regular water and resource sampling and analysis in nearby areas of the creeks to track the pollution and productivity status of the marine ecosystem and compare the results with global norms.Continuous monitoring of the water quality and awareness program among the people can help in maintaining good health of the creek and decrease water pollution. This study will broaden the scope of information obtained in the field of environmental research by other scientists. The study makes a strong argument for more research on this creek to evaluate metal bioaccumulation and potential risks resulting from the high concentration of metals in the water. The information obtained from this study can help decision maker in proper management and protection of the creek.

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Design of R.C.C. Slab by Optimization Techniques

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ABSTRACT

This paper presents an experimental investigation into the behavior of a bubble deck slab with varying thickness, variation in hollow plastic balls and optimization of materials. Test was conducted on two slab specimens to evaluate the effect of the slab thickness on flexural capacity. Slab thickness was varied from 120 to 150mm. All specimens will be a cast with a normal concrete of approximately 30MPa. A compressive strength results. Show that the flexural capacity of slab increases with an increase in slab thickness. The reduction of the dead load is about 35%. The principle of this slab is to connect hollow plastic balls (bubbles) of 65mm and 55mm with reinforcing elements in an industrial prefabrication phase, which leads to more efficient method of construction.

Keywords: Bubble deck slab thickness deflection behavior, flexural capability, prefabrication

I. INTRODUCTION

In building constructions, the slab is a very important structural member to make a space. And the slab is one of the largest member consuming concrete. In a general way, the slab was designed only to resist vertical load. As people are getting more interested of residential environment, noise and vibration of slab are getting more importance. In addition, as the span is increased, the deflection of the slab is also increased. Increasing the slab thickness makes the slabs heavier, and will increased column and foundations size. Thus, it makes buildings consuming more materials such as concrete and steel reinforcement. To avoid these disadvantages which were caused by increasing of self-weight of slabs, the Bubble Deck slab system, also known as void slab, was suggested. This system consists of hollow plastic spheres putting into the concrete to create a grid of void forms inside the slab.

Saurabh Sumana [1] demonstrates that bubble voided-slabs are cost-effective, reducing concrete consumption by 30-40% without compromising load capacity, though strength diminishes beyond permissible void percentages. Neeraj Tiwari [2] found Bubble Deck slabs outperform conventional slabs in stress criteria and

weight, while Chung J.H [3] highlight the benefits of Bubble Deck frameworks in reducing concrete quantity using HDPE spheres. Anusha M [4] showcase the innovative application of bubble deck slab technology, reducing dead weight in floor slabs with recycled plastic balls, suitable for multi-storey constructions. N. Tiwari [5] suggest that although voided specimens exhibit slightly higher deflections, they offer concrete volume savings and recommend the future adoption of bubble deck slabs in construction.

II. EXPERIMENTAL PROGRAM

2.1 Problem statement: Design of two bubble deck slab of varying thickness. Polyvinyl plastic ball with varying diameter of ball are arranged in Bubble Deck Slab having arrangement is z-shape respectively. All sizes and thickness of Conventional Slab and Bubble Deck Slab are given in following table.

Slab	Size (mm)	Thickness (mm)	Arrangement Of Plastic Ball
Conventional Slab 1	750x750x150	150	-
Bubble Deck slab 1	750x750x150	150	Z-shape (dia 65mm)
Conventional Slab	750x750x120	120	-
Bubble Deck slab 1	750x750x120	120	Z-Shape (dia 55mm)

Table 1: Representing dimensions of all slabs

2.2 Objectives

1. To study experimental behavior of conventional and bubble deck slab.
2. To compare the load carrying capacity of bubble deck slab with conventional slab by varying thickness.
3. To estimate the amount of concrete reduced as result of plastic balls introduction into conventional slab.
4. Cost effective analysis for the partial replacement of concrete in slab by plastic balls.

2.3 Materials:

1. Cement : Cement is a binder, a chemical substance used for construction that sets, hardens, and adheres to other materials to bind them together.

- Properties of Good Cement
- Provides strength to masonry.
- Stiffens or hardens early.
- Possesses good plasticity.
- An excellent building material.
- Easily workable.

Company: Hyderabad Packaging Size 50kg
Color: Grey Cement Bags Used 2
Grade: OPC 53 Grade

2. Coarse Aggregate: Aggregates are inert granular materials such as sand, gravel, or crushed stone that, along with water and Portland cement, are an essential ingredient in concrete. Aggregates strongly influence concrete's freshly mixed and hardened properties, mixture proportions, and economy. Aggregate having size of 20mm used. Quantity of aggregate for 120mm slab as 35kg and for 150mm as 45kg is used. Slab consequently, selection of aggregates is an important process. Although some variation in aggregate properties is expected.

3. Fine aggregate: Fine aggregate is a granular material composed of finely divided mineral particles. Sand has various compositions but is defined by its grain size. Sand grains are smaller than gravel and coarser than silt. We have used crushed sand for preparing concrete of slab.20 kg of sand is used for 120 mm slab thickness and 25 kg of sand is used for 150 mm slab thickness.

4. Steel : Steel is an alloy of iron and carbon with improved strength and fracture resistance compared to other forms of iron. Fe 415 grade of steel is used. 10 mm diameter of 20 bars are used for two slab. Size of steel bar in length is 2 feet used for preparing reinforcement of slab.

5. Binding wire : Binding Wire is used for the purpose of tying applications in the field of construction. It is used extensively in the construction sector for tying the rebar at the junctions/joints so as to keep the structure intact. Binding wire is made of mild steel.

6. Plastic hollow balls : Hollow balls manufactured from polypropylene are extremely versatile and have a variety of uses in various sizes. Balls manufactured from PVC (polyvinyl chloride) are lightweight, resistant to bacterial growth and surface corrosion, nontoxic, and resistant to radiation. PVC plastic balls also boast a high hardness and a good resistance to oils. We have used 55 mm and 65mm diameter size of hollow plastic ball in number of 32 balls.

III.METHODOLOGY

3.1 Collection of data

We collect data about bubble deck slab with help to teachers and from different research papers.Fromthatdatawehavestudyaboutthedifferencebetweenthebubbledeckslabandconventional slab. From that study we make a model on it by step by step i.e. (design of steel forconventional slab, mix design of conventional slab, design of steel for bubble deck slab, mixdesignof bubbledeck,etc.)

3.2 ConstructionMethodology(BubbleDeckSlab)

3.2.1 SelectionofMaterials: These materials use for the research where obtained within College. Ordinary Portland cement(OPC) Was used for the project, the fine aggregate (sharp sand) use was obtained from a flowingriver it was dried for some days in the laboratory and then sieved to be free from deleteriousmaterial. Coarse aggregate was available. And instead of bubble we used plastic balls. Ordinarycline tap water free for drinking was used for the experiment. We used steel having 10mmdiameterfor theproject

3.2.2 Locationofballs: The balls are placed in concrete. Bottom reinforcement and diagonal girders keep the bubbles inposition. During the final positioning of the slab elements it is checked if the displaying of thespheres is according to the plans. Also, it is checked the reinforcement in the over concretingareas.

3.2.3 Mixproportionsofconventionalandbubbledeckslab:

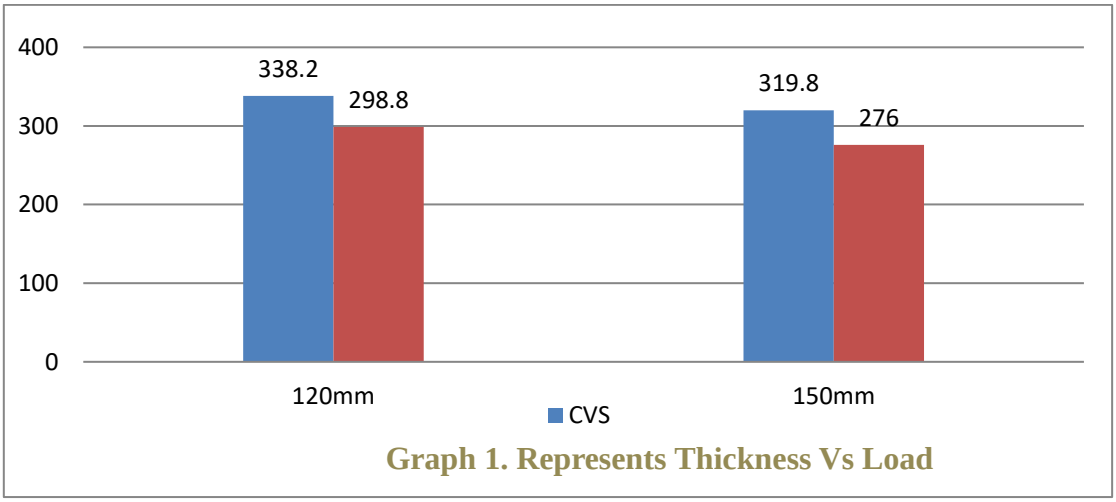
Batchingoperationbyweightapproacheswasadoptedinthestudy.Preliminarymixesof1:1:2(cement:fine sand:coarseaggregate)wereinvestigatedwithwater/cementratioof0.4 and 0.5 respectively so as to obtained the required w/c ratio for the actual mixes

IV. RESULT

1. Comparison of load carrying capacity with varying thickness of conventional and bubble deck slab

Sr. No.	Structural Element	Load (KN)
1	Conventional Slab (120mm)	338.2
2	Bubble Deck (120mm)	298.8
3	Conventional Slab (150mm)	319.8
4	Bubble Deck (150mm)	276

Table 2: Showing load carrying capacity

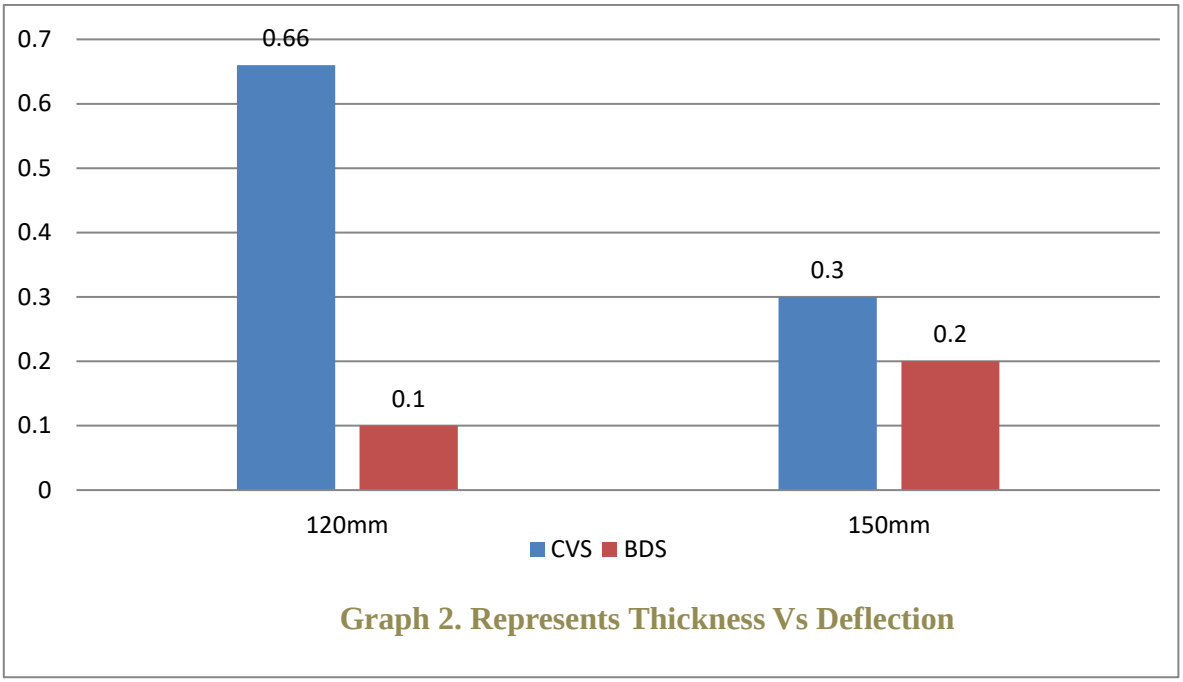


Graph 1. Represents Thickness Vs Load

2. Comparison of Deflection with varying thickness of conventional and bubble deck slab

Sr.no	Structural Element	Deflection (mm)
1	Conventional Slab (120mm)	0.66
2	Bubble Deck (120mm)	0.1
3	Conventional Slab (150mm)	0.3
4	Bubble Deck (150mm)	0.2

Table 3: Showing deflection in mm



Graph 2. Represents Thickness Vs Deflection

V. CONCLUSION

1. In the experiment we found that the bubble deck (continuous) with much reduced the volume of concrete has much lower self-weight. Simultaneously the load carrying capacity is carried by Bubble Deck Slab equal to the Conventional Slab.
2. But the arrangement of the bubbles does have an effect on the load carrying capacity of the slab, in the case of alternative arrangements of bubbles there is an increase in the load carrying capacity when compared with the conventional slab, but the load carrying capacity is lower than the continuous bubble deck slab.
3. Simultaneously, bubble deck slab also has improved elasticity property compared to the conventional slab which causes the conventional slab to deflect less than the bubble deck slab, the number of bubbles in the slab also has an effect on the this elasticity property.
4. The results are shown in table when a bubble deck slab is compared with a conventional slab for varying thickness, varying size of hallow balls, load carrying capacity and deflection.

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A Study of Laplace Transform and It's Application to Solving Ordinary Differential Equations

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ABSTRACT

In mathematics, the Laplace transform technique is one of the powerful tools for solving physical problems involving ordinary differential equations (ODE), particularly initial value problems. This method has a particular advantage in finding the solution of an initial value problem, without first finding the general solution and then arbitrary constants using the given initial conditions. However, there are other areas where the properties of the Laplace transform are very useful, such as evaluation of certain integrals and electric circuit analysis. In this paper we will briefly discuss applications of the Laplace transform in solution of initial value problems.

Keywords: Laplace transform, Properties of Laplace transform, Inverse Laplace transform, Differential equation.

I. INTRODUCTION

Laplace transform is essentially a mathematical tool which can be used to solve several problems in science and engineering. This transform was first introduced by Laplace, a French mathematician, in the year 1790 in his work on probability theorem. This technique became popular when Heaviside applied it to the solution of an ordinary differential equation The Laplace transformation replaces a given function $f(t)$ by another function $F(s)$. Then Laplace transformation converts an ordinary differential equation with some given initial conditions into an algebraic equation in terms of $F(s)$. Finally, using inverse Laplace transformation we recover the original function $f(t)$.Thus, the method of Laplace transformation is especially useful for initial value problems, as it enables us to solve the problem without the trouble of finding the general solution first and then evaluating the arbitrary constants. This paper will also discuss the properties and applications of Laplace transforms.

II. DEFINITION OF LAPLACE TRANSFORMATION

Let $f(t)$ be a piecewise continuous and single-valued function of the real variable t defined for all t, $0 < t < \infty$ and is of exponential order. Then the Laplace transform of $f(t)$ is defined as a function $F(s)$ denoted by the integral

$$\mathcal{L}\big(f(t)\big) = \int_0^{\infty} e^{-st} f(t)dt = F(s) \quad Re(s) > 0. \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$F(s)$ is called Laplace Transform of $f(t)$ and $f(t)$ is known as Inverse Laplace Transform of $F(s)$ and denoted as $\mathcal{L}^{-1}(\big(F(s)\big) = f(t)$.

III.LAPLACE AND INVERSE LAPLACE TRANSFORMATION OF SOME ELEMENTARY FUNCTIONS

1.1. If $f(t) = 1$ then $\mathcal{L}(1) = \frac{1}{s}$ and hence $\mathcal{L}^{-1}\left(\frac{1}{s}\right) = 1$

1.2. If $f(t) = e^{at}, a \in \mathbb{R}$ then $\mathcal{L}(e^{at}) = \frac{1}{s-a}$ and hence $\mathcal{L}^{-1}\left(\frac{1}{s-a}\right) = e^{at}$

1.3. If $f(t) = \sin at$ then $\mathcal{L}(\sin at) = \frac{a}{s^2+a^2}$ and hence $\mathcal{L}^{-1}\left(\frac{1}{s^2+a^2}\right) = \frac{1}{a}\sin at$

1.4. If $f(t) = \cos at$ then $\mathcal{L}(\cos at) = \frac{s}{s^2+a^2}$ and hence $\mathcal{L}^{-1}\left(\frac{s}{s^2+a^2}\right) = \cos at$

1.5. If $f(t) = t^n$ then $\mathcal{L}(t^n) = \frac{n!}{s^{n+1}}$ and hence $\mathcal{L}^{-1}\left(\frac{1}{s^n}\right) = \frac{t^{n-1}}{(n-1)!}$

IV. PROPERTIES OF LAPLACE AND INVERSE LAPLACE TRANSFORMATION

3.1 Linearity Property :

If $\mathcal{L}\big(f(t)\big) = F(s)$ and $\mathcal{L}\big(g(t)\big) = G(s)$ then for any arbitrary constant a and b

$\mathcal{L}(af(t) \pm bg(t)) = aF(s) \pm bG(s)$

Similarly, If $\mathcal{L}^{-1}(F(s)) = f(t)$ and $\mathcal{L}^{-1}(G(s)) = g(t)$ then

$\mathcal{L}^{-1}(aF(s) \pm bG(s)) = af(t) \pm bg(t)$

3.2 Scaling Property :

If $\mathcal{L}\big(f(t)\big) = F(s)$ then $\mathcal{L}\big(f(at)\big) = \frac{1}{a}F\left(\frac{s}{a}\right)$, $a > 0$

Similarly, If $\mathcal{L}^{-1}(F(s)) = f(t)$ then $\mathcal{L}^{-1}\left(F\left(\frac{s}{a}\right)\right) = af(at)$

3.3 First Shift Property :

If $\mathcal{L}\big(f(t)\big) = F(s)$ then $\mathcal{L}\big(e^{at}f(t)\big) = F(s-a)$, $a > 0$

Similarly, If $\mathcal{L}^{-1}(F(s)) = f(t)$ then $\mathcal{L}^{-1}(F(s-a)) = e^{at}\mathcal{L}^{-1}(F(s))$

Hence we get, $\mathcal{L}^{-1}\left[\frac{1}{(s+a)^n}\right] = e^{-at}\frac{t^{n-1}}{(n-1)!}, n \in \mathbb{N}$

3.4 Second Shift Property :

If $\mathcal{L}\big(f(t)\big) = F(s)$ then $\mathcal{L}\big(f(t-a)H(t-a)\big) = e^{-as}F(s)$

Similarly, If $\mathcal{L}^{-1}(F(s)) = f(t)$ then $\mathcal{L}^{-1}(e^{-as}F(s)) = f(t-a)H(t-a)$.

V. SOME STANDARD RESULTS

4.1 The Laplace transform of a Periodic function:

If $f(t)$ is a periodic function of period T, and if $\mathcal{L}\big(f(t)\big)$ exists then

$$\mathcal{L}\big(f(t)\big) = \frac{1}{1-e^{-sT}} \int_0^T e^{-st} f(t)dt$$

4.2 Multiplication by t^n:

If $\mathcal{L}\big(f(t)\big) = F(s)$ then $\mathcal{L}\big(t^n f(t)\big) = (-1)^n \frac{d^n}{ds^n} F(s)$, $n \in \mathbb{N}$.

In particular $\mathcal{L}\big(tf(t)\big) = -F'(s)$ and $\mathcal{L}\big(t^2 f(t)\big) = F''(s)$.

4.3 Division by t:

If $\mathcal{L}\big(f(t)\big) = F(s)$ then $\mathcal{L}\left(\frac{1}{t} f(t)\right) = \int_s^\infty F(s)ds$

4.4 Laplace Transformation of Derivatives :

If $\mathcal{L}\big(f(t)\big) = F(s)$ then

(i) $\mathcal{L}\left(f'(t)\right) = s\mathcal{L}\big(f(t)\big) - f(0)$

(ii) $\mathcal{L}\left(f''(t)\right) = s^2\mathcal{L}\big(f(t)\big) - sf(0) - f'(0)$

(iii) $\mathcal{L}\left(f'''(t)\right) = s^3\mathcal{L}\big(f(t)\big) - s^2 f(0) - sf'(0) - f''(0)$ and so on.

4.5 Laplace Transformation of Integral :

If $\mathcal{L}\big(f(t)\big) = F(s)$ then $\mathcal{L}\left(\int_0^t f(u)du\right) = \frac{1}{s} F(s)$

VI. APPLICATION

5.1 Solution of Ordinary Differential equation :

Consider a second order linear differential equation $y'' + \alpha y' + \beta y = f(t)$ ..... (2)

with initial conditions $y(0) = a$ and $y'(0) = b$ ..... (3)

Where α and β are constants, apply Laplace Transform on both sides of equation (2)

$\mathcal{L}\big[y''(t) + \alpha y'(t) + \beta y(t)\big] = \mathcal{L}(f(t))$

$\mathcal{L}\big(y''(t)\big) + \alpha\mathcal{L}\big(y'(t)\big) + \beta\mathcal{L}(y(t)) = \mathcal{L}(f(t))$ .....using linearity property

$\big[s^2\mathcal{L}(y(t)) - sy(0) - y'(0)\big] + \alpha[s\mathcal{L}(y(t)) - y(0)\,] + \beta\mathcal{L}(y(t)) = \mathcal{L}(f(t))$ .....using 4.4

Put $y(0) = a$ and $y'(0) = b$ and simplify to get,

$(s^2 + \alpha s + \beta)\mathcal{L}(y(t)) - (s+\alpha)a - b = F(s)$ where $F(s) = \mathcal{L}\big(f(t)\big)$ and $Y(s) = \mathcal{L}\big(y(t)\big)$

Therefore, $(s^2 + \alpha s + \beta)Y(s) = F(s) + (s+\alpha)a + b$

Hence, $\mathcal{L}\big(y(t)\big) = Y(s) = \frac{F(s)+(s+\alpha)a+b}{(s^2+\alpha s+\beta)} = \frac{(s+\alpha)a+b}{s^2+\alpha s+\beta} + \frac{F(s)}{s^2+\alpha s+\beta}$

Taking the inverse Laplace transform on both sides, we get the solution in the form

$$y(t) = \mathcal{L}^{-1}\left(\frac{(s+\alpha)a+b}{s^2 + \alpha s + \beta}\right) + \mathcal{L}^{-1}\left(\frac{F(s)}{s^2 + \alpha s + \beta}\right)$$

5.1.1 Using Laplace Transform solve the differential equation $y'' - 3y' + 2y = e^{3t}$ with initial conditions, $y(0) = 0$ and $y'(0) = 0$.

Solution : Given that $y'' - 3y' + 2y = e^{3t}$ …….. (4)

Apply Laplace Transform on both sides of equation (4) and using linearity property, we get

$\mathcal{L}(y''(t)) - 3\mathcal{L}(y'(t)) + 2\mathcal{L}(y(t)) = \mathcal{L}(e^{3t})$

$[s^2\mathcal{L}(y(t)) - sy(0) - y'(0)] + \alpha[s\mathcal{L}(y(t)) - y(0)] + \beta\mathcal{L}(y(t)) = \frac{1}{s-3}$…. using 4.4 & 2.2

Put $y(0) = 0$ and $y'(0) = 0$ and simplify to get,

$(s^2 - 3s + 2)\mathcal{L}(y(t)) = \frac{1}{s-3} \quad \Rightarrow \quad \mathcal{L}(y(t)) = \frac{1}{(s-3)(s^2-3s+2)} = \frac{1}{(s-3)(s-1)(s-2)}$

Using partial fraction method at RHS we get,

$\mathcal{L}(y(t)) = \frac{1}{2(s-3)} - \frac{1}{s-2} + \frac{1}{2(s-1)}$ …….. (5)

Taking the inverse Laplace transform on both sides of equation (5) and apply linearity property, we have

$y(t) = \frac{1}{2}\mathcal{L}^{-1}\left(\frac{1}{s-3}\right) - \mathcal{L}^{-1}\left(\frac{1}{s-2}\right) + \frac{1}{2}\mathcal{L}^{-1}\left(\frac{1}{s-1}\right)$ …….. Apply 2.2

Therefore $y(t) = \frac{1}{2}\,e^{3t} - e^{2t} + \frac{1}{2}\,e^{t}$ is the solution of given differential equation.

5.2 Population Growth Problem :

It is known that a number of population of a city or town increase with time. It means there is growth in the population. If the population P increases at time t then the rate of change of P is proportional to the population present at that time. Then the corresponding first order linear differential equation is,

$\frac{dP}{dt} = kP$ …….. (6)

With $P(t_0) = P_0$, where P_0 is initial population at time t_0 and $k \in \mathbb{R}$.

Apply Laplace Transform on both sides of equation (6), we have

$\mathcal{L}\left[\frac{dP}{dt}\right] = \mathcal{L}(kP) = k\,\mathcal{L}(P(t)) \quad \Rightarrow \quad s\mathcal{L}(P(t)) - P(0) = k\,\mathcal{L}(P(t))$ using 4.4 (i)

On simplification, we get $\mathcal{L}(P(t)) = \frac{P(0)}{s-k}$ …….. (7)

Apply Inverse Laplace Transform on both sides of (7), we get

$P(t) = \mathcal{L}^{-1}\left(\frac{P(0)}{s-k}\right) = P(0)\,\mathcal{L}^{-1}\left(\frac{1}{s-k}\right)$

$P(t) = P(0)\,e^{kt}$ ……..…….. (8)

Equation (8) gives population at any time t.

5.2.1 The population of a town increasing at a rate proportional to the population at that time. If the population increases from 40000 to 60000 in 40 years, what will be the population in another 20 years?

Solution : Let P be the population at time t. Since rate of increase of P is a proportional to P.

We have, $\frac{dP}{dt} = kP$

Using above procedure, the population at any time t is given as,

$P(t) = P(0)\,e^{kt}$ …….. (9)

It is given that initially at time $t = 0$ the population is 40000.

That is $P(0) = 40000$

We get $P(t) = 40000\,e^{kt}$ …….. (10)

Further the population $P = 60000$ when $t = 40$, from equation (10), we get

$60000 = 40000\,e^{40k} \quad \Rightarrow e^{40k} = 1.5$ …….. (11)

Now to find P after $t = 40 + 20 = 60$ years, using equation (10)

$P = 40000\, e^{60k} = 40000\left(e^{40k}\right)^{1.5} = 40000(1.5)^{1.5}$ using equation (11)

Therefore $P = 73484$.

After 60 years the population of a town will be 73484.

5.3 Newton's law of Cooling :

Newton's law of cooling states that the rate of change of cooling heated body at any time is proportional to the difference between the temperature of a body and temperature of its surrounding medium.

Let θ be the temperature of a body at time t and θ_m be the temperature of the medium then,

$\frac{d\theta}{dt} \propto (\theta - \theta_m)$

$\frac{d\theta}{dt} = -k(\theta - \theta_m)$ …….. (12)

Where k is constant of proportionality and negative sign indicates that difference of temperature is decreasing.

Apply Laplace Transform on both sides of equation (12), we have

$\mathcal{L}\left[\frac{d\theta}{dt}\right] = \mathcal{L}[-k(\theta - \theta_m)] = -k\,[\mathcal{L}(\theta) - \mathcal{L}(\theta_m)]$

$s\mathcal{L}\big(\theta(t)\big) - \theta(0) = -k\,\mathcal{L}(\theta(t)) + k\theta_m\,\mathcal{L}(1)$ Since θ_m is a constant.

$s\mathcal{L}\big(\theta(t)\big) - \theta(0) = -k\,\mathcal{L}(\theta(t)) + k\theta_m\,\frac{1}{s}$

On simplification, we get $\mathcal{L}\big(\theta(t)\big) = \frac{\theta(0) + k\,\theta_m \frac{1}{s}}{s + k}$ …… (13)

Apply Inverse Laplace Transform on both sides of (13), we get

$\theta(t) = \mathcal{L}^{-1}\left(\frac{\theta(0) + k\,\theta_m \frac{1}{s}}{s + k}\right) = \theta(0)\,\mathcal{L}^{-1}\left(\frac{1}{s + k}\right) + k\theta_m\,\mathcal{L}^{-1}\left[\frac{1}{s\,(s + k)}\right]$

$\theta(t) = \theta(0)\,\mathcal{L}^{-1}\left(\frac{1}{s + k}\right) + k\theta_m\mathcal{L}^{-1}\left[\frac{1}{k}\left(\frac{1}{s} - \frac{1}{s + k}\right)\right]$ Using linearity property

$\theta(t) = \theta(0)\,\mathcal{L}^{-1}\left(\frac{1}{s + k}\right) + \theta_m\left[\mathcal{L}^{-1}\left(\frac{1}{s}\right) - \mathcal{L}^{-1}\left(\frac{1}{s + k}\right)\right]$ Using 2.1 & 2.2

$\theta(t) = \theta(0)\,e^{-kt} + \theta_m\left(1 - e^{-kt}\right)$

$\theta(t) = \theta_m + [\theta(0) - \theta_m]e^{-kt}$ ……..…….. (14)

Equation (14) gives temperature of a body at any time t.

5.3.1 A body cools according to Newton's law from 100°C to 60°C in 20 minutes. The temperature of the surrounding being 20°C. How long will it take to cool down to 30°C?

Solution : Let θ be the temperature of the body at time t. The temperature of the surrounding is 20°C. Therefore $\theta_m = 20$

Further, initially the temperature of the body is 100°C. Hence $\theta(0) = 100$.

Using equation (14), we get

$\theta(t) = 20 + 80\,e^{-kt}$ …… (15)

Further the body cools down to 60°C in 20 minutes.

Therefore put $t = 20$ and $\theta(t) = 60$ in equation (15), we get

$60 = 20 + 80\,e^{-20k} \implies e^{-20k} = 0.5$ …… (16)

Now to find t, when $\theta = 30$

$30 = 20 + 80\,e^{-k\,t}$

$10 = 80\left(e^{-20k}\right)^{\frac{t}{20}}$ using equation (16)

$(0.5)^{\frac{t}{20}} = 0.125$

$t = 60$ minutes.

The temperature of the body will be 30°C after 1 hour.

5.4 Application in Electrical Engineering :

Consider a simple $R - C$ circuit containing electromotive force (E), a capacitor (C) and a resistance (R). The voltage drop across the capacitor is $\frac{Q}{C}$, where Q is the charge and I is the current.

So by Kirchhoff's law,

$IR + \frac{Q}{C} = E$

Further, $= \frac{dQ}{dt}$, hence we get,

$R\frac{dQ}{dt} + \frac{Q}{C} = E$

5.4.1 Find the current I in $R - C$ circuit containing $R = 20$ ohms, $C = 0.01$ farad at $t = 0$, and $E = 200e^{-5t}$ with $I(0) = 0$.

Solution : By Kirchhoff's law, we have

$R\frac{dQ}{dt} + \frac{Q}{C} = E$

Given that $R = 20$ ohms, $C = 0.01$ farad and $E = 200e^{-5t}$

$20\frac{dQ}{dt} + \frac{Q}{0.01} = 200e^{-5t}$

$\frac{dQ}{dt} + 5Q = 10e^{-5t}$ …….. (17)

Apply Laplace Transform on both sides of equation (17), we have

$\mathcal{L}\left(\frac{dQ}{dt} + 5Q\right) = \mathcal{L}(10e^{-5t})$ Using linearity property and 4.4 (i)

$s\mathcal{L}\big(Q(t)\big) - Q(0) + 5\mathcal{L}\big(Q(t)\big) = 10\frac{1}{s+5}$

Since $I(0) = 0$ and hence $Q(0) = 0$

$(s+5)\mathcal{L}\big(Q(t)\big) = \frac{10}{s+5}$

$\mathcal{L}\big(Q(t)\big) = \frac{10}{(s+5)^2}$

Apply Inverse Laplace Transform, we get

$Q(t) = \mathcal{L}^{-1}\left[\frac{10}{(s+5)^2}\right]$ Using 3.3

$Q(t) = 10\ t\ e^{-5t}$

But $I = \frac{dQ}{dt} = \frac{d}{dt}(10\ t\ e^{-5t})$

Hence $I = 10\ e^{-5t}(1 - 5t)$ is the current at time t.

VII. CONCLUSION

In this paper, we have illustrated how Laplace transform can be used in solving ordinary differential equation, Population growth problem, application to Newton's law of cooling and problem on electrical circuit. Further Laplace transform is one of the most efficient techniques for solving very complicated problems of most engineering and science domains. In today's world, Laplace transform is widely used to find the solution of various problems.

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An Exploration of Sustainable Development Goals in Mahesh Elkunchwar's Play, Pond

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ABSTRACT

The world is currently facing a myriad of environmental issues, including climate change, deforestation, and pollution. Sustainable Development (SD) is one of the solutions that have gained significant attention in recent times. However, the concept of SD is not always clear to everyone, and there is a need for more discussion and understanding of its implications on various levels. This calls for a concise and coherent discourse on SD to encourage active citizenship instead of passive spectatorship. Literature is one area that can contribute to this discourse. In this context, the present paper explores the Sustainable Development Goals (SDGs) through the lens of Mahesh Elkunchwar's play Pond (1976). This paper focuses on key issues related to sustainable development and aims to contribute to the discussion on SD. This analysis can provide useful insights for readers, researchers, and students that will aid policymakers, researchers, and practitioners in their efforts to promote sustainable development.

Keywords: Sustainable Development (SD), social sustainability, environmental sustainability, economic sustainability, industrialization,

I. INTRODUCTION

The present paper discusses the issues of sustainable development, which is centred on the three interlinked pillars of environment, economy and society. The purpose of this analysis is to examine the role of literature in facilitating a growing environmental consciousness and drawing attention to the philosophy of sustainability. The paper is divided into five parts. The first part considers the concept of sustainable development and gives an overview of its history and evolution. The second part looks at the three interlinked pillars of sustainable development and their respective roles in achieving sustainability. The third part deals with the setting and plot of the play *Pond*. The fourth part considers the issues raised in the play, particularly those related to sustainable development. The final section focuses on the importance of literature in promoting sustainable development. It highlights the importance of literature as a means of raising awareness of environmental issues and motivating readers to act towards sustainability.

II. SUSTAINABLE DEVELOPMENT: MEANING, HISTORY, AND GOALS AND PRINCIPLES

2.1 Meaning:

The concept of sustainable development can be viewed as a phrase consisting of two words, "sustainable" and "development." Development has been defined in many ways by different scholars, but according to Todaro and Smith (2006), development is a multidimensional process that involves major changes in social structures, attitudes, and institutions, as well as economic growth, reduction of inequality and eradication of absolute poverty. According to Basiago (1999), sustainability refers to the capacity to maintain some entity, outcome or process over time. However, in development literature, sustainability is broadly applied to the improvement and maintenance of a healthy economic, ecological, and social system for human development. According to Gro Harlem Brundtland, sustainable development is defined as, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission 1987: 43).

The above three definitions show that sustainable development includes both the concepts of sustainability and development; It includes economic growth, basic needs and rights, and conditions necessary for sustainability, and involves finding a balance between economic growth, social development and environmental protection. Therefore, the ultimate goal of sustainability is to achieve the right alignment and balance between society, economy and environment.

2.2 History:

The history of sustainable development can be traced back to the 1970s when concerns about the impact of economic growth on the environment began to emerge. The concept gained momentum in the 1980s and 1990s, with the publication of influential reports such as the Brundtland Report and the Rio Declaration on Environment and Development. Sustainable development (SD) as a concept has its roots in economics as a discipline. The discussion of whether the Earth's limited natural resources could continue to support the increasing human population gained prominence with the [1]Malthusian population theory.

The first significant international recognition of sustainable development, as a concept, was at the United Nations Conference on the Human Environment, held in Stockholm in 1972. The report's recommendations formed the primary topic of discussion. The second United Nations Conference on Environment and Development (UNCED) was held in Rio in 1992. The conference outcome document, Agenda 21, declared that SD should become a priority item on the agenda of the international community and recommended that national policies address the economic, social and environmental aspects of sustainable development. In 2002, the World Summit on Sustainable Development (WSSD), known as Rio+10, reviewed progress in implementing the outcomes of the Rio Earth Summit and developed the Johannesburg Plan of Implementation for the actions set out in Agenda 21. WSSD also launched several multi-stakeholder partnerships for SD. In 2012, the United Nations Conference on Sustainable Development (UNCSD), or Rio+20, focused on two themes: a green economy and an institutional framework. SD was recognized by the United Nations as one of the five key priorities in 2012, 20 years after the first Rio Earth Summit.

[1] Malthus postulated that the human population tended to grow in a geometric progression, while subsistence could grow in only an arithmetic progression, and for that matter, population growth was likely to outstrip the capacity of the natural resources to support the needs of the increasing population (Rostow&Rostow, 1978).

Moreover, Sustainable development (SD) is a core concept within global development policy and agenda, providing a mechanism for society to interact with the environment without risking damage to resources in the future. It aims to improve living standards without endangering the earth's ecosystems or causing environmental problems such as deforestation, water and air pollution, climate change, and the extinction of species (Benaim&Raftis, 2008; Browning &Rigolon, 2019). SD is an approach to development which uses resources in a way that allows them (the resources) to continue to exist for others (Mohieldin, 2017). Although the population keeps increasing, the natural resources available for satisfying human needs and wants do not. However, it is always possible to meet the current generation's needs without compromising future generations' ability to meet theirs. This implies that SD aims to achieve a balance among economic growth, environmental integrity, and social well-being.

2.3 Goals:

Sustainable development is all about meeting human development goals while sustaining natural systems to provide resources and ecosystem services. The UN's 2030 Agenda, also known as the Sustainable Development Goals (SDGs), is a universal call to action to eradicate poverty and hunger, protect the planet, ensure a healthy life, peace and prosperity, and care for environmental integrity by 2030. The five overarching themes of the SDGs, often referred to as the five P's (people, planet, prosperity, peace and partnerships), focus on tackling the root causes of poverty and aim to cover areas such as hunger, health, education, gender equality, water and sanitation, energy, economic growth, sustainable cities and communities, climate change, and peace and justice. The principles of sustainability include focusing on the economy, environment, and society, as well as conserving ecosystems and biodiversity, managing alternative sources of energy and production systems, population control, and human resource management. These principles are essential for the survival of living organisms on Earth. As human beings, we have a responsibility to take care of the environment, economy, and society to ensure a sustainable future. Education and training can help promote people's participation and develop the skills and knowledge necessary to promote sustainability. In short, the Sustainable Development Goals (SDGs) are eradicating poverty, reducing inequality, promoting economic growth, and protecting the environment. These goals are interconnected and need to be addressed together to achieve sustainable development.

2.4 Relationships among the Environment, Economy and Society:

Sustainability is a multifaceted concept that involves the integration of the environment, economy, and society. These three domains are interconnected and should be considered together to achieve sustainability. Achieving sustainable development requires a balance between economic growth, social welfare, and environmental protection. The three main issues of sustainable development are economic growth, environmental protection, and social equity. The concept of sustainable development is based on the three pillars of economic sustainability, social sustainability, and environmental sustainability.

2.4.1 Economic sustainability: Traditionally, economists assumed that natural resources were unlimited and relied on the market to allocate resources efficiently. They believed that economic growth would replenish natural resources destroyed in production. However, it is now recognized that natural resources are finite, and not all of them are renewable. In an economy, production, distribution, and consumption are the three main activities that rely on limited natural resources to sustain human life on earth.

2.4.2 Social Sustainability: The term social sustainability encompasses notions of equity, empowerment, accessibility, participation, cultural identity and institutional stability (Daly, 1992). It relates to the connection between social conditions such as poverty and environmental destruction and encompasses

human rights, gender equity, public participation, and the rule of law. Social sustainability involves fostering people, communities, and cultures to achieve a meaningful life with proper healthcare, education, gender equality, peace, and social stability worldwide.

2.4.3 Environmental Sustainability: Environmental sustainability is about maintaining a productive and resilient natural environment to support human life. It requires sustainably using natural resources as economic inputs and as waste sinks. The earth's systems have limits, and natural resources must be harvested at a rate that allows for regeneration while waste must be emitted at a rate that can be assimilated by the environment. Environmental sustainability is vital to ensuring a stable and resilient natural environment to support human life and development.

III.THE PLAY: POND

3.1 The Background and Setting:

The setting of the literary books refers to the specific place where the incidents occur. Physical location, period, time, weather, season, climate, social, cultural, political and economic conditions are important aspects of the setting. The play *Pond* is set in Dharangaon village of the Vidarbha which is famous for its lake. The playwright Mahesh Elkunchwar has dynamically used the image of a lake in the setting of this play. Firstly, the image of a pond represents the concept of environment and ecosystem in which various animals, small and large organisms are interconnected and interdependent. In this background, this play creates awareness about threats to the environment. Secondly, the pond is closely related to earth (soil), sky (sun), sea (waves) wind and man (and all animals) which are natural resources for sustainable development. Being a surrounding marine metaphor and reservoir of water, the pond enriches the landscape. In this sense, the lake is presented as the destroyer and preserver of life. It is designated by a physically existing pond in Dharangaon village. Thirdly, the lake enhances the understanding of the earth as a living force. It becomes an archetype of 'life' like the sea. This analysis reveals that the setting of this play is based on ecological principles or the theory of eco-criticism.

Moreover, following the pond image, the playwright expresses the fear of water scarcity. This fear overshadows many fears, associated with the ending physical world, for example, food shortages, land depletion, forest degradation, loss of material resources, etc. Thus, Elkunchwar on the one hand highlights the importance of lake conservation and on the other hand, expresses environmental concerns about the degradation of nature and threats to human life that echo in contemporary discourses of sustainability, and he formulates sustainable ethics in the central region.

3.2 Parag's Monologue:

A long monologue by Parag appears in Act II- Scene I of this play. This is an exploration of Parag's attitude towards nature. In it, Parag says:

There's something very special about the stars in our village Abhu. How many nights I have spent gazing at them. They are my eternal companions. . . . Once your gaze fixes on this star-filled sky, you forget all else. It's as if a pool of radiant light has been upturned over you. Drink your fill from it, you'll never empty it. It's there for everybody. What is this inexhaustible spring? What could be the purpose of it all? Every day, new stars, new constellations, new galaxies are born, then die. What does it signify? Who creates all this? This infinite space, its gigantic events and our minuscule lives. What's the connection? Or are they no more the accidents? Then our life and death are also, other events, aren't they? Unimportant, trivial, purposeless. Then why do we burden ourselves with joy and sorrow? If life is just a puff of air, why do we love, why do we rage? I ask the

stars all these questions. But I don't understand their language. I have always thought I share a deep relationship with them. I want to touch them, learn their language, talk to them, mustn't there? They too must be gazing at the earth. The thought that someone on one of them might be looking at me at the very moment that I'm looking at it makes my hair stand on end. What power lies behind this? Does such power exist at all? Why can't I see it then? Has the umbilical cord between me and that power snapped? When can I get close to it again? How will the break be joined? Sometimes I have the impression that the whole of creation is eager to talk to me. But I can't speak its language, it drives me crazy. Then I dip my hand in the water to try and gather a fistful of the reflected stars. But they disappear. My wet hand is empty. The game becomes an obsession. Such an obsession that I can't think of anything else (Elkunchwar II 239-240).

Essentially, the above thoughts of (confused) Parag reveal his longing to understand natural things. The sky, the stars and the sun are his companions. He expresses a desire to understand the relationship between human life and the natural world, to connect with the natural force that governs all events.

Moreover, Parag's monologue conveys the idea of sustainability; but this philosophical paradigm seems in contrast to scientific paradigms. Parag asserts that creation as a set of diverse ecosystems is a systematic and organic paradigm. He idealizes, embraces and explores nature and the environment as a living force. On the one hand, it highlights the regularities of nature; on the other hand, he incorporates his existential concerns. Fundamentally, against the backdrop of the environmental crisis caused by the degradation of human activities, he expresses human alienation from nature and highlights the inconsistent continuity that exists between humans and the environment. He, accordingly, examines how humans can exist and sustain themselves in an ever-changing, emergent environment.

Furthermore, Parag raises many intellectual questions about the interrelationships between human and nonhuman environments, which are replicating and revolving around the all-important questions of the present age. These questions highlight the human failure to understand their interrelationship with the environment, which is the root cause of many environmental crises. His sense of human alienation from the natural order of things and his desire to interact with nature/environment (human and non-human) suggest human alienation from nature (and their surroundings). This can be considered both the ethics and aesthetics of sustainability.

Besides, Elkunchwar reveals the universal truth of human life and reminds us that the world is not always what it seems. Life is constant; although, it renews itself from moment to moment. Therefore, man cannot grasp the world in any singular sense; man sees a glimpse of nature. Irrationality, hallucination and susceptibility to natural order are signs of human imperfection.

Additionally, the way Elkunchwar emphasizes that phenomena in nature have independent powers of self-creation, animation, and self-direction shows an affinity with the Romantic paradigm of Vitalism. The playwright's ecological vision of the environment seems parallel with Eric Wilson's romantic turbulence, Wordsworth's sublime, Hopkins's poetic embodiment, Coleridge's theory of life, Carlyle's receptivity to energy physics, and Ruskin's radicalism of 'life'. As a leading exponent of environmental critique, the playwright defines human engagement in terms of ecological determinism, scientific enthusiasm, and socio-cultural understandings of sustainability. This can be considered an attempt to understand the management of nature rather than an environmental critic's lament.

Thus, the aesthetics of the SDGs available in Parag's monologue suggest that humans and the environment are interrelated and co-existent phenomena, implying that human sustenance depends on human actions within a given environment, and the play becomes a discourse on sustainability.

3.3 The Narrative of the Play:

Parag is the main hero of this play. Going into the forest, cutting teak and selling it is his business. Police Inspector Sharma warns Parag to stop his illegal business. Along with his hobnobbing with politicians and hosting banquets for high-ranking officials suggest his corrupt lifestyle. Moreover, Parag's circle of friends, which includes Salunke, Biharilal and many others, gives the play an additional corrupt touch. When Salunke, the village Sarpanch, arrived in the village, he was penniless. Now he has a two-storey house and a liquor store. Also, Biharilal, a big timber merchant, has an illegal business of buying and selling stolen goods. This shows how the people of Dharangaon are harming the environment by doing unlawful business, and the government officials are supporting them. These things give the play a political dimension. It prompts the reader to enliven the sustainability vision and reflect on its fundamentals.

Moreover, Sudhir, Parag's uncle, who has never sweated the land does not know where his land ends and other's land begins and does not know the survey number of his plot and how much revenue he has to pay. Once, he comes to his village and announces to sell his share of land. Thus, Sudhir becomes a practical man, who has left the village for the amenities of city life; he shows a neutral and dispassionate, commercial and materialistic approach towards the natural resource of land.

On the other hand, Parag's father Bhaskar is a different kind of person. Being a village-born and brought-up man, he has a deep love for the village. When he learns that his son Parag is involved in the illegal business of cutting down trees, he opposes him. When he learns that the son has stopped growing food crops and has turned to cash crops (saga), he feels sad about his work. He mourns over his son's turning of a good soil that used to produce oranges, bananas, grains and vegetables into a desert. He scolds his son for his quick-money approach. This shows Bhaskar's environmental awareness and concern about the destruction and ruin of his village and many such environmental problems. Thereby, he emerges as a representative of a generation that has witnessed the unprecedented destruction of ecosystems and the impracticality of environmental laws. Thus, Bhaskar exposes the massive degradation of nature by looking at the forest as a natural resource that is on the verge of extinction due to irrational human intervention. This is a reflection of environmental issues and the need for sustainable development.

However, Parag gets very angry when he hears his father disagreeing with his business and farming practices. He scolds his father for his fault-finding nature instead of helping him in his work. An enraged Parag replies to his father in the following words:

"I know what I'm doing is wrong. But how far could we have gone doing the right things? . . . Turn back and go where? Whenever I go, people like Lala and Subhedar Singh will always be there. The city and its monster have entered the village for keeps now. Do you think they'll rest till they've stripped village bare? If you want to survive just shake hands with them. That's the only way left" (Elkunchwar231-32).

The above Parag's reply suggests this play is a critique of economic development. Here, Parag speaks about and against the unsustainable practices of capitalism, consumerism, and individualism. Hence, it becomes a narrative of progress and degrowth. Parag juxtaposes two viewpoints. The first is identifiable with village life. The second is identifiable with urban life; especially, the encroachment of urban life on village life and the encroachment of urban development policies on village life. Parag suggests that village life, which once stood for the ethics of embracing humans, nonhumans and even others in the biosphere, has now changed drastically. Urban life that dominates technological development and is measured by economic growth has destroyed the happy village life or disturbed the harmony of rural life. Thus, the play comments on the striking contrast

between country and city life and the evils of industrialization; it replays contemporary debates around sustainability.

Moreover, Parag's above words reflect his inner battle; his standing between two poles of consciousness and helplessness. On the one hand, he expresses his understanding that whatever he is doing is wrong. While, on the other hand, he expresses his helplessness in doing so against his will, to mitigate the needs of the changing times. This can be considered as his compromise position for sustainable development, sustainability versus un-sustainability. In addition, Parag's answer above is an exhortation for a destructing environment and irrational human expectations and tendencies, amid technological comforts and economic developments. This environmental awareness and understanding of the interrelationship between nature and mankind, associated with a counter-cultural lifestyle, is crucial to understanding the play. Above all, the playwright's empathetic and retrospective attitude allows the reader to recognize the seeming contradictions of sustainability.

3.4 The Villagers:

Throughout the play, the villagers are depicted as engaging in many brazenly unsustainable practices. In the beginning, the playwright emphasizes the villagers' mutual jealousy, greed for material gain and lust for power and money. Along with this, he also points out the disinterest of farmers in agriculture and the alcoholism of the youth. Secondly, he talks about how villagers abandon traditional agriculture and turn to modern business. The majority turned to cutting down more forests; while some people take all the products produced in the village to sell in Mumbai. Here, the villagers are seen as a microcosm of mankind, engaged in various activities disfiguring the green environment. This shows that the changing times have entered the village. The villagers are seen as ecologically and socially oppressed creatures due to their involvement in short-term economic interests. In short, Dharangaon depicts how an ecologically prosperous village becomes an ecologically dystopian village due to the increasing interference of people in the environment.

Furthermore, this is a comment on human failure to understand that the economics of purpose is not merely about making money but realising the importance of the principles of sustenance and sustainability of resources. Besides, it conveys that new scientific discoveries have generated new social, economic and environmental problems; hence, intellectual interpretations and perspectives are needed to overcome ecological problems. Thus, with necessary addresses to the contemporary issues that destroy the environment, the play warns about the perpetual decay, which is deeply inter-fused with ecological relations. This prime area of concern relevant to environmental matters facilitates readers with some other dimensions of SD, and it implies that achieving sustainable development inescapably depends upon people – whether those in power or the general populace.

Another environmental issue discussed in the play is the encroachment of factories on fertile lands. A prominent example is Bansilal, who wants to set up a tile factory on fertile land. This poignant fear of land erosion raises the issue of the destruction of the biosphere by the hands of science, technology and economics. It is a discussion on the effects of modernity, especially on agricultural lands, due to the establishment of small-scale industries. Moreover, it can be counted as one or more money-making strategies among the temptations of modernity. On the one hand, it shows people's disinterest in agriculture and failure to understand the importance of natural resources. It shows that modernity has created various problems in terms of protecting sustainability, which is partly the result of human imperfection and partly irrational scientism.

The playwright's concern that the lakes around Dharangaon have been exhausted and the area of barren land has increased includes the continuing concerns for the sustenance of mankind. The depiction of human exploitation of nature confirms that man will repeat his mistakes in the name of progress. It repeats the regressive theme of perverse progress and creates tension in readers to be creative. The play is thus a sustained

analysis of the emergence and evolution of ecologically destructive processes in the name of modernity. It shows that colonization is not a thing of the past; it is still very much alive.

IV. CONCLUSION

The discourse of sustainability which has arisen since the 1960s is aptly caught by Mahesh Elkunchwar with his specific response to the current issues of climate emergency, which impact on human life. His play *Pond* revolves around the Sustainable Development Goals, discusses the social, environmental, and economic pillars of sustainability and becomes a tool to shape human understanding, inspiring people to take constructive action. The analysis reveals that the playwright's complex imagery, specific narrative and interactional processes invite green perspectives on evolution and survival. It proves that the play opens a new recognition of the consequences of environmental crises and a new perspective on human actions and is a living force and transformative energy.

Elkunchwar uses the pond to explore the problematic accounts of village life. Like eco-critics, he addresses the relationship between the environment and human culture and warns of environmental threats from governmental, industrial, commercial and neo-colonial forces. It refers to multiple collective and individual paradigms of sustainable development and avoids stressing sustainability with global and local dynamics. It shows the anthropocentric role of the playwright.

As a post-humanist, eco-critic, new materialist and apocalyptic environmentalist, he reiterates the failure of man to sustain. Through his writing, sustainability constitutes a political matter, as he raises the issue of ecological understanding and provides a more profound understanding of the complexities that surround sustainability. He insists on constraints to transform human behaviour and safeguard human sustainability. He messages that the well-being of future generations is relying upon our actions going forward today, raising a question: How much change is required, and of what kind?

In short, Elkunchwar's Pond is a useful source of Green Literature. Through his writing, the contemporary ecological idea of sustainability emerges as a recognizable concept from intellectual, social and literary currents. Hence, Elkunchwar emerges as an important pioneer, whose play has become a distinctive part of a long cultural tradition that has existed since the nineteenth century to the present day.

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An Interrogation of the Post human Ethics of Care in the Malayalam Movie "Android Kunjappan Ver 5.25

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ABSTRACT

Posthumanism as a critical discourse, decenters the human in a postmodern world. Its diverse approaches and perspectives deconstruct the anthropocentric ideology, restructuring human integrities and identities in the contemporary technoculture. One important arena impacted by posthumanism is the ethics of care. This paper examines the posthumanist ethics of care in the Indian society. It specifically examines this ethicality in the light of posthumanism as reflected in the Malayalam movie, Android Kunjappan Ver 5.25, set in a village in Kerala.

Keywords: Posthumanism, ethics, care, android

I. INTRODUCTION

Posthumanism embodies the actualization of postmodernism's interrogation of the human subject. Postmodernism's scrutiny of the humanistic aspect of subjectivity resonates in the diverse forms of posthumanism. Posthumanism emerged in the early twenty-first century and perspectives on posthumanism range from its impact on the domain of health (Cohn, 2017), archeology (Fernández-Götz, 2021), education (Toohey, 2021) and spirituality (Ferrando, 2016) among others. Posthumanism challenges the hierarchical positioning of humans over other life forms, while simultaneously refuting the notion of humans as self-governing and completely delineated entities.Instead, it posits human itself as "an assemblage, co-evolving with machines and animals. It also calls for a more inclusive definition of life, and a greater moral-ethical response, and responsibility, to non-human life forms..." (Nayar 8). Posthumanism aims to refute the humanistic model of the Western Enlightenment that places humans at the centre of existence. It critiques humanism's anthropocentric, rationalistic, Eurocentric and patriarchal assumptions that marginalise not just most of human population but also other life forms.One important arena impacted by posthumanism is the ethics of care. This paper examines the posthumanist ethics of care in the Indian context. It specifically examines this ethicality in

the light of posthumanism as reflected in the Malayalam movie, *Android Kunjappan Ver 5.25*, set in a village in Kerala.

As a philosophical perspective, posthumanism challenges traditional notions of what it means to be human within the framework of technological advancements and evolving social systems. The traditional boundaries between human and non-human entities, such as animals, machines, and artificial intelligence erode under a posthuman interrogation and cease to exist as hermetically sealed forms. It encompasses a wider array of perspectives ranging from a critique of technological determinism, concerns about social justice and examination of the consequences of human actions on ecology. It also examines the ethical implications associated with technologies such as artificial intelligence, genetic engineering, and biotechnology that challenge traditional understandings of human agency and responsibility. One such intersection between posthumanism and ethics is the ethics of care.

The ethics of care embodies the moral aspect in human relationships.The ethics of care is divorced from Kantian/deontological and utilitarian/consequentalist ethical theories that emphasize generalizable standards and impartiality but instead emphasizes the importance of affective responses in human relationships. Consequently, the human conditionis not examined through the lens of justice but mitigated through the framework of interdependence and vulnerability of the subject. Needless to say, that the ethics of care is deeply entrenched in the anthropocentric view of the world that perceives a unified or homogeneous humanity that aspires to virtue. While the idea in itself is problematic in a posthuman world, a critical ethics of care underscores the exploitative nature of care that often seeks to marginalise, dominate and disenfranchise.

A posthumanist analysis of the ethics of care attempts to uncouple 'care' from 'human' while exploring the potential of alternative means of posthuman care. There are various arguments that support this perspective. Firstly, a posthuman ethics of care seeks to provide a non-anthropocentric perspective that extends beyond the human to encompass non-human entities such as animals, ecosystems and even artificial intelligences. It underscores the interconnectedness and interdependence of all life forms within complex socio-ecological networks while rescuing care and moral consideration from occupying a purely human ambit. Secondly, the posthuman ethics of care critiques hierarchies and binaries such as human/animal, nature/culture, and mind/body. It seeks to dismantle hierarchical structures that privilege certain beings over others and perpetuate systems of domination and exploitation. Thirdly, this approach advocates for environmental sustainability, social justice, and the redistribution of care responsibilities within communities. It seeks a redressal of systemic inequalities that affect marginalized populations and lead to environmental degradation. Fourthly, the approach recognizes the ethical implications of technological advancements and their impact on relationships between humans and non-humans. It calls for critical reflection on the ways in which technology shapes and mediates care practices, as well as the potential for technology to enhance or undermine care relationships. And so, finally, and most importantly, it reassigns the meaning of vulnerability. The posthuman ethics of care acknowledges the inherent vulnerability and interdependency of all beings, rejecting the notion of fully autonomous and self-sufficient individuals.Instead, it emphasizes the importance of recognizing and responding to the needs, vulnerabilities and dependencies of others within relational contexts.Overall, the posthuman ethics of care offers a relational and inclusive approach to ethics that challenges conventional human-centered perspectives and calls for a more compassionate and ecologically attuned ethic of care that extends to all beings within interconnected webs of life.

Into such a posthuman ecosystem is introduced the *hobot* or the human care robot that provides care to the old and the ailing. It is essential at this point to delineate perspectives of care. While in the West, Care (or

'dependency' work) is predominantly the domain of society's minoritized populations: immigrants, people of colour, migrants; in India, Care becomes an emblem of sacrificial obligation offered at the altar of familial love but mostly born by women in the family. The care-givers in the West including personal nurses, nannies, caretakers and support workers are poorly paid while the familial care-givers in India are unpaid. Both scenarios indicate a systemic/exploitative nature of care that seeks to disenfranchise. Though care work is associated with the ethics of virtue, this devaluation of the care work in the west makes it a prime candidate for roboticization while the Indian scenario is slightly different. While the degradation of the female care-giver is subsumed under familial obligation and virtue, the situation is compounded by the unavailability of carers in Indian homes where most members are earning their keep abroad (maybe even as the above-mentioned immigrant carer/nurse). This unavailability or unreachability of care-givers become the reasons to embrace roboticization in an Indian context.

Speculative representations that envision the provision of care by robots serve as valuable tools for contemplating and examining the ethical, aesthetic and political dimensions of posthuman care. One such representation is the 2019 Malayalam film, *Android Kunjappan Version 5.25,* directed by Ratheesh Balakrishnan Poduval. The film examines the ethical dilemmas faced by the expat in relegating the care of elderly parent to a robot and the struggles of the parent who feels abandoned by their children. The film becomes quite significant in the context of the Keraliya society where most able-bodied humans are employed in Gulf countries or have moved out of the state in search of better job prospects. The film then is a reflection of the anxiety felt by much of the aging community of the society who might dwell in big palatial homes funded by expat money but lack immediate familial relatives who would care for them. Poduval's film examines this crisis in human care, the possibility of posthuman care and the ethical and moral dilemmas it throws up.

Care is an approach to morality that is basic to human existence. It is definitely a central tenet of human existence. The concern becomes primary median in Indian societies that contemptuously set themselves apart from distinct 'western influences' who do not care for their elderly and seem eager to confine them to old age homes. This also becomes a rousing recommendation for marriage and procreation in India as "Who else will take care of you in your old age?" While this evidence of human vulnerability cannot be disregarded what can neither be dismissed is the complexity of 'location' in the contemporary global world nor the complex social and subjective nature of care. The film*Android Kunjappan Version 5.25* revolves Bhaskaran Poduval, a cantankerous old man who assiduously avoids new-age technology- he does not own a smart phone, refuses to modernize his house and does not even own a television much to the chagrin of his son and the amusement of the villagers. He keeps his only son, Subramanian, a mechanical engineer, close to him, not allowing him to apply for jobs away from home, wanting him to care for him during his old age. Bhaskaran represents every elderly Indian who has failed to move with the advancements of the computer age and often find themselves having to antithetically depend on the younger generation for help with mobiles and apps.

Subramaniangets a job at a Japanese Robotics firm in Russia and leaves for Russia after a showdown with his father. While abroad, he is guilt-ridden about his father and worries about him constantly. Driven by guilt over his inability to care for his father directly he contemplates resigning from his job. He is introduced to the idea of posthuman care by Hitomi, his girlfriend. She tells him about the robotic home nurse who took care of her father, ailing from Alzheimer's, in Japan. Subramanian returns home with an Android Robot Version 5.25, developed by his firm, to care for his father. The film now shifts to the human-robot tussle as Bhaskaran refuses to engage with the robot. Slowly the robot insinuates into all parts of Bhaskaran's life who becomes strongly attached to it. The non-human patience displayed by Kunjappan while dealing with Bhaskaran is a testimony to

the possibilities of robotic care un-impinged by human emotions and turmoil. Human qualities are ascribed to the android who is named Kunjappan (meaning short one) and is wrapped in a *mundu* to cover his 'nakedness'. Bhaskaran starts treating the robot as his son. Subramanian in the meanwhile realises that the android robot has a glitch that makes it kill those whom it provides care for. Subramanian and Hitomi rush to Kerala but Bhaskaran refuses to relinquish Kunjappan to them and runs away with the android to a forest. Kunjappan asks Bhaskaran to abandon him in the forest, which he refuses to do. Subramanian finally locates them and in a dramatic series of events Kunjappan attacks him, trying to strangulate him. Subramanian is rescued by his father and they leave for home. Bhaskaran, in the last shot of the film, is seen mistaking his son for the robot and whispering his name, Kunjappan.

The film flags various important aspects of care-giving. On the one hand, it plays on the fear of every individual of being replaced by a robot. Bhaskaran's love for Kunjappan is complete so much so that he is worried that Kunjappan might suffer from the evil eye and in a comic, yet endearing scene, consults an astrologer and gets a *raksha* (a scared thread) to protect him from evil. This humanizing of a robot by an apparently gullible old man underscores the vulnerability felt by both the father and the son. On the other hand, the care given by Kunjappan is comprehensive. The robot succeeds where various home-nurses and servants had failed. Kunjappan is non-humanely patient with Bhaskaran's grouchy ways, and non-judgmental when he helps Bhaskaran connect with his ex-lover, Soudamini.

Care-giving becomes a major issue especially in third-world nations like India where most of the adult population has migrated to first-world nations for a better economic future. The financially sound expat is unable to provide direct geriatric care to their elderly parents. The unreliability of human caregivers, the cautionary tales of murdered helpless parents and the demands made by care agencies add to the woe of such expats. The film questions the ethics of human care and the assumption that good care means necessarily human. But there are not easy conclusions to be made. The open-ended conclusion of the film allows its viewers to interpret the ethics of care from their perspective- Is human care the best care? Would allowing robots into the highly affective arena of care lead to a roboapocalypse? More importantly, the film signals the fear- Would care robots reduce human love to a cipher? It certainly opens up the larger debates around the ethics of affective robots designed for care.

This does not indicate supplanting human care but hybridizing and augmenting it. Critical posthumanism challenges the notion of human exceptionalism and calls for a reassessment the human-centric perspective that has traditionally been regarded as the unquestionable benchmark for care. The fact remains that the ethics of care cannot anymore be solely placed under the ambit of virtue ethics which is then juxtaposed against a utilitarian framework. The posthuman existence in a postmodern world, questions the ideology of human nature as normative while interrogating the purely regulatory role heretofore assigned to the ethics of care.

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Distribution and Growth Pattern of Muscle Fibers in Peroneus longus Muscle of Chick in Relation to Functional Activity

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ABSTRACT

The current investigation presents findings on the distribution of fibers and the growth pattern in the context of functional activity and somatic growth rate of the muscle in developing male white Leghorn chicks. This study tested three hypotheses: a) muscle fiber typing based on histochemical properties is uniform within the muscle mass, b) the distribution pattern of various muscle fibers correlates with the functional activities specific to the species, c) fiber growth patterns are associated with the somatic growth rate of the species. The results revealed the presence of all three fundamental fiber types - red, pink, and white - thus confirming the initial hypothesis. Additionally, the outcomes demonstrated that the growth of these fiber types occurs primarily through hypertrophy. Notably, true hyperplasia was not evident in any age group and may occur later in the embryonic stage. Some instances of splitting larger fibers into smaller ones were observed in pink and white fibers exclusively. These findings indicated that all three basic fiber types predominantly grow through hypertrophy regardless of their location and functional roles.The growth of muscle fibers within this muscle mass was significantly correlated with the somatic growth rate of the chick.

Keywords: Muscle fibers, Growth dynamics, Post-natal growth, Chick, Hypertrophy, Hyperplasia

I. INTRODUCTION

Muscle is one of the most specialized and organized post-mitotic tissues. Almost all vertebrates rely heavily on skeletal muscle to maintain their body mass and size. Muscle fibers are highly specialized cells that serve as the structural units of skeletal muscle (Hedrick et. al., 1994). The number of muscle fibers, their size, and their shape are all closely related (Ryuet. al., 2004). These fiber types are recognized using histochemical staining with SDH (Mankodi, 1988). Their color represents the amount of circulation each muscle type receives (Kundu

and Mansuri, 1992, 1994). In fish musculature, fiber types are divided into muscle masses (Weatherley, 1990), whereas mammalian and avian muscles contain a variety of fiber types(Sokal. and Rohlf, 1969). Studies have shown that muscle fibers are morphologically and biochemically modified to meet distinct functional requirements. Fiber growth by hypertrophy is positively connected with age, and these fiber types can transition from one to another based on functional adaptability (D'Angelis, 2004). Muscle inactivity triggers an increase in white fibers, resulting in muscle atrophy (Urso et. al., 2006). Many bird species have annual cycles of muscle atrophy and restoration (Cheral et. al., 1988). In such instances, some muscles are catabolized to provide energy, resulting in atrophy due to inactivity. Muscles in fish expand by hyperplasia or hypertrophy, according to studies (Weatherley, 1990). Muscle growth in fish starts early in development and lasts throughout their lives (Templeton et. al., 1988). The threshold diameter of fibers is genetically set, and the fibers begin to divide into little fibers (Anastasia and Mary 1999 &Johnstonet, al.,2001). In higher vertebrates, post-embryonic muscle growth occurs exclusively through hypertrophy, with extra nuclei often produced from myosatellite cells (Johnstonet, al.,2001). In post-hatch birds, skeletal muscle growth is determined by hypertrophy and nuclei accretion, which is related with an increase in the number of nuclei per fiber (Sokal and Rohlf, 1969).

II. METHODS AND MATERIAL

The study used a male chick, Gallus gallus, from a poultry farm in Rajkot city, and included Peroneus longus muscle from eight age groups. 32 animals were slaughtered, kept in hygienic conditions, and given a poultry starter mash prepared by Hindustan Lever Ltd. They were provided with tap water ad libitum. The experiments followed ethical guidelines issued by CPCSEA, India, and were conducted under hygienic conditions.

Muscles were dissected, mounted on pre-chilled tissue holders, and frozen in a cryostat at -18 to -20 degrees Celsius. T.S. samples of 10-15µm were cut using a cryostat microtome and histochemically stained for SDH. Muscle fibers were identified using Lojda et al.'s approach (1979). Sections were examined with a Carl Zeiss Axioscope - II microscope at various magnifications, and the desired sections were photographed digitally (Kunduet. al.,1990). Because huge pink and white threads are not always round in shape, their diameters were measured at least three times from three different angles, and the average value was calculated. For every size class, at least 100 fibers of every type were measured from every conceivable place. The Carl Zeiss Axioscope II microscope and the Carl-Zeiss Image Analysis Software were used for all morphometric measurements. Several statistical analyses, including regression and correlation coefficient analysis, were performed on the collected data (Stein & Padykula, 1962).

III.RESULTS AND DISCUSSION

A. Fiber identification:

Staining of fibers under a microscope revealed variations in color, shape, size, distribution, and orientation. The oxidative enzyme SDH served as the basis for recognizing and identifying these fibers. They were generally divided into three categories: red, pink, and white. Red filaments were smaller and rounder than pink and white threads. Different types of lipids were colored by the Nile blue sulfate stain. Neutral lipids were only present in interstitial spaces and stained as red droplets, while phospholipids stained blue. Larger fibers were mildly stained, while smaller, almost spherical fibers were heavily stained. Glycogen was vivid red in white fibers, and lipids were more frequently connected with red fibers.

The findings showed that the largest fibers are white, the largest fibers are pink, and the tiniest fibers are red (Peter et. al., 1972).The histochemical testing results demonstrated a marked variation in the physiological characteristics of the three types of fiber. Red fibers' oxidative metabolism is mostly aerobic or oxidative, which is well supported by their high lipid content. This is indicated by the high activity of the oxidative enzyme (SDH) and the low activity of the glycolytic enzyme (LDH) in red fibers. As a result, red fibers are linked to aerobic metabolism, which runs on myoglobin and lipids and they carry out prolonged, sluggish contraction (Kunduet. al.,1990).White fibers with low SDH activity and high LDH activity mostly undergo anaerobic metabolism via the glycolytic route, which uses glycogen as fuel to produce a fast but quickly exhausting contraction. Oxidative enzymes such as succinic dehydrogenase are found in large quantities in red fibers (Lojda et al.,1979). Additionally, oxidative enzyme activity is typically higher in pink fibers (Kundu and Mansuri, 1992). Fish myotomal muscles also showed similar results (Pandya et. al.,2003).

B. Fiber Distribution and Orientation:

The relative proportions of red, pink and white fibers in muscle of chick (Table-1).

TABLE: 1 DISTRIBUTION OF FIBER TYPES IN MUSCLE OF CHICK.

Sr.no	Muscle Name	Fiber types (% frequency)		
		Red	Pink	White
1.		17.51 ± 0.72	48.43 ± 0.97	33.95 ± 0.53

The chosen muscle had nearly equal amounts of red, pink, and white fibers, but more pink fibers than red or white. Chickens have more pink fibers than other animals. Muscle fibers were orientated differently, with white fibers in the periphery and red fibers concentrated in deeper areas near the bone. The muscle mass had an irregular distribution of pink fibers.A histochemical investigation revealed that the percentage of red (31.01%) and white (32.74%) fibers was nearly equal.Since pink (36.24%) fibers were slightly more abundant than red and white, they made up a significant portion of the muscle mass. Red fibers were nearly spherical in appearance, whereas pink and white strands seemed huge and slightly uneven. Most vertebrates have Peroneus longus muscles, which are mostly made up of pink and white fibers and are known for their quick, abrupt movements. Since the experimental animal is a flightless bird, the distribution of muscle fibers in that muscle is related to how that muscle moves during locomotion.

The chosen muscle contains all three fundamental fiber types, with pink and white fibers predominant, indicating active movement. The growth rate of the muscle is a proxy for the entire organism's size, and Type II fibers are more abundant in chickens. The presence of distinct fiber types in muscles causes their varied appearances, such as red appearance in muscles with more cytochrome and myoglobin(Chandra-Bose, et. al., 1964), whereas muscles with less myoglobin are primarily made of white fibers. In nearly every way, intermediate fibers are intermediate.All three forms of fiber are present in the majority of the hens' muscle (Chandra-Bose, et. al., 1965). The proportion of different types of fibers changes depending on the animal species and the purpose of each individual muscle. Red fibers are oddly located in postural muscles because they are made for slow, continuous movements of the body, yet the musculature of larger animals' forelimbs seems to be more involved in maintaining a standing position than in smaller species.

Fiber diameter variation and Growth:

i) **Red fibers:** The results of this investigation demonstrated a clear variance in several muscle fibers in a particular muscle. In the developing chick, the diameter of red fibers varied between 13.24 μm to 31.77

μm in the lowest age class and from 34.81μm to maximum of 80.47 μm in the highest age class in the developing chick. The mean diameter was 21.42 ± 3.57 μm in the lowest age class which increased to 58.80 ± 7.84 μm in the highest age class. The results clearly show an increase in the fiber diameter from lower to higher age class as the animal grows (Fig. 1). The findings indicate that as the animal matures, the fiber diameter increases from lower to higher age classes. Thered fibers of the muscle showed obvious signs of hypertrophy (Table 2).

Table – 2. Mean diameter of red fibers in muscle of Chick. Values expressed are in μm.The muscle is showing gradual increase in mean fiber diameter from the subsequent age classes upto 42 days in all the three fiber types. Thereafter there is decline.

Age	Minimum Diameter	Maximum Diameter	Mean Diameter ± SD
7th Day	13.24	31.77	21.42 ± 3.57
14th Day	8.34	39.97	20.31 ± 6.53
21st Day	15.24	52.50	33.51 ± 6.86
28th Day	23.86	67.99	41.67 ± 8.24
35th Day	24.01	54.21	39.88 ± 5.22
42nd Day	26.33	74.06	52.24 ± 10.43
49th Day	31.97	84.12	48.91 ± 8.15
56th Day	34.81	80.47	58.80 ± 7.84

Regression analysis (Fig. 2) with a positive correlation coefficient value (R2 = 0.354) supports the result. A modest number of fibers were used to populate in 35 days (Fig. 1), which could have been caused by the splitting of bigger fibers already in place or the activation of pre-existing progenitor cells (Fig. 2).

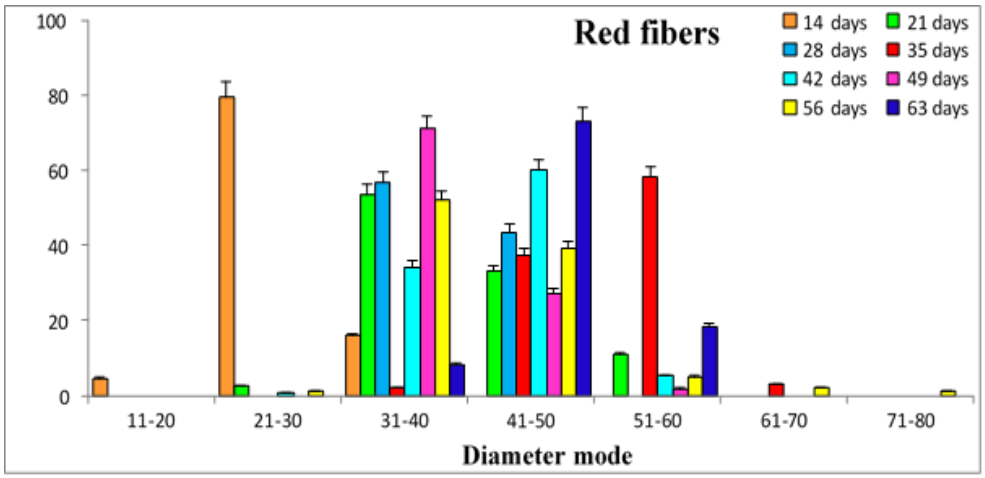

Fig. 1. Graphs showing percent fiber frequencies against diameter modes in red fibers of muscle of chick. Error bars represent the standard deviation.

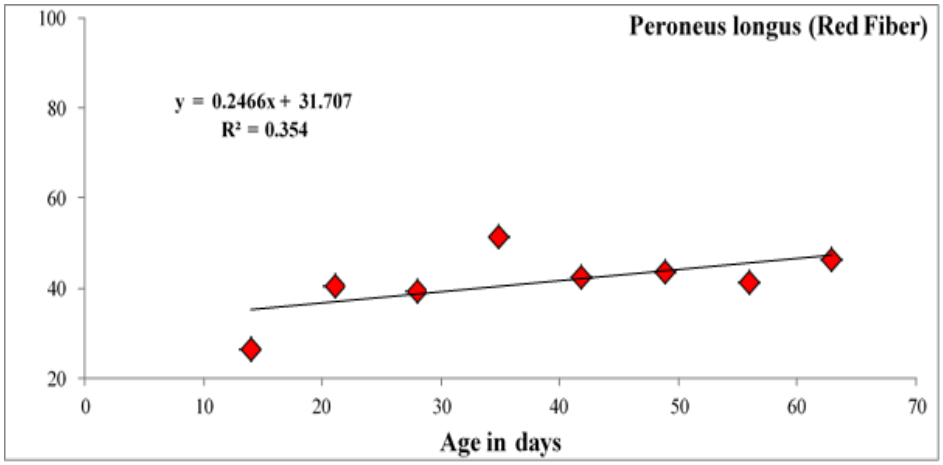

Fig. 2. Regression analysis of redfibers of muscle of developing chick. Regression equations and Correlation Coefficient values are given.

Hypertrophy and hyperplasia's impact on muscle growth varies across vertebrates, with declines occurring throughout juvenile and adult stages, and some fish species reaching 100% maximum body length(Weatherley 1990,Dimpal and Kundu, 2013).Fibers reached to their extreme diameter (90 µm) value at the age of 49 days, after that the value was maintained till 56 days (Fig. 1). There was good correlation between age and higher diameter modes as well as frequency values were also increasing according to age (R2 = 0.354). In the present investigations, it is clear that the main mode of growth of red fibers in mainly by hypertrophy (Fig. 15). However, hyperplasia also plays a very important role in the higher size classes (Koumans et. al., 1991, Kundu et. al., 1990).

ii) **Pink fibers:** In the developing chick, the diameter of pink fibers varied from 15.23 µm to 30.10 µm in the lowest age class and a minimum of 47.01 µm to maximum of 116.08 µm in the highest age class in the developing chick. The mean diameter was 21.70 ± 3.17 µm in the lowest age class which increased to 75.08 ± 13.32 µm in the highest age class. The data indicates a consistent increase in fiber diameter from lower to higher age classes in the animal as it grows(Table 3).

Table – 3. Mean diameter of pink fibers in muscle of Chick. Values expressed are in µm.The muscle is showing gradual increase in mean fiber diameter from the subsequent age classes upto 42 days in all the three fiber types. Thereafter there is decline.

Age	Minimum Diameter	Maximum Diameter	Mean Diameter ± SD
7th Day	15.23	30.10	21.70 ± 3.17
14th Day	11.69	41.14	24.17 ± 7.69
21st Day	19.69	56.49	37.59 ± 6.64
28th Day	30.07	60.52	43.99 ± 6.64
35th Day	32.29	71.08	43.90 ± 6.26
42nd Day	35.16	79.36	57.25 ± 7.06
49th Day	20.82	89.53	50.64 ± 12.89
56th Day	47.01	116.08	75.08 ± 13.32

There is continuous shift of modal frequency values towards higher diameter modes which shows a good correlation between age and mean fiber diameter (R2 = 0.4011) but the frequency values are continuously decreasing towards higher diameter modes as age advances (Fig. 4).The study found that pink fibers in the

muscle mass were as large as white fibers and exhibited hypertrophy during growth, with a flat regression slope and a cessation of small new fiber recruitment across all age classes(Johnston et. al., 1997; Weatherley, 1990).

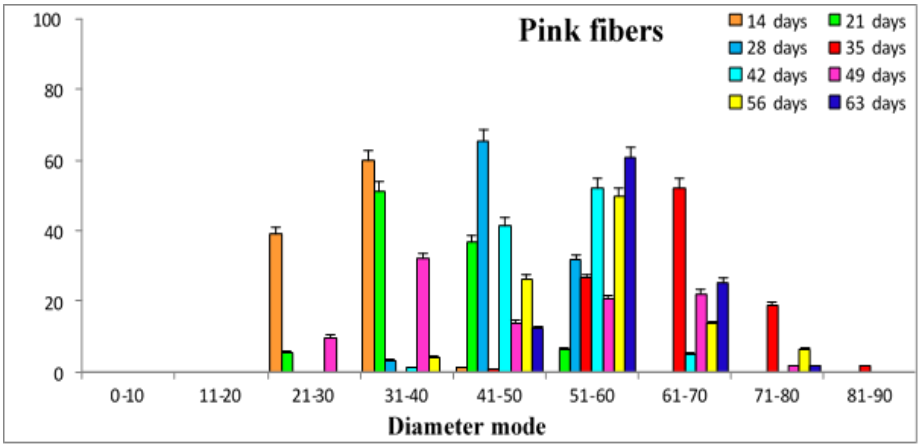

Fig. 3. Graphs showing percent fiber frequencies against diameter modes in pink fibers of muscle of chick. Error bars represent the standard deviation.

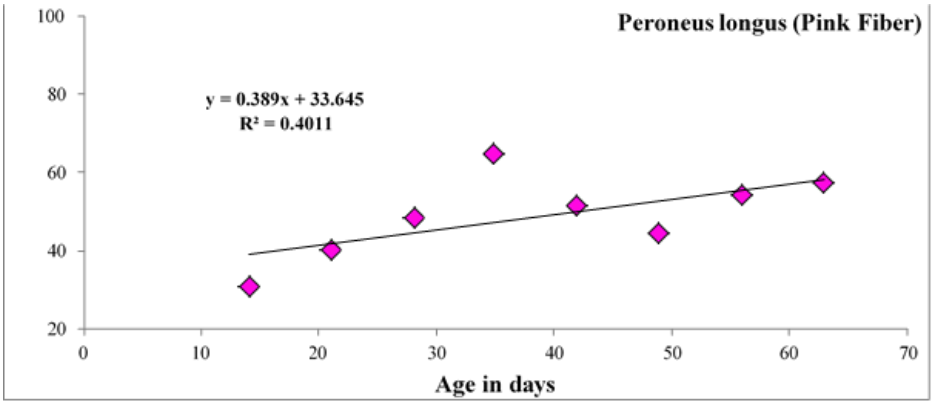

Fig. 4. Regression analysis of pinkfibers of muscle of developing chick. Regression equations and Correlation Coefficient values are given.

The investigations reveal that the primary mode of growth for red fibers is primarily through hypertrophy(Fig. 3). However, hyperplasia also plays a very important role in the higher size classes (Koumans et. al., 1991). Older age groups may experience smaller new fibers due to larger fibers splitting and budding (Fig. 3). Between red and white muscle, pink muscle appears to be intermediate (Kundu and Mansuri, 1994, Dimpal and Kundu, 2013).

iii) **White fibers:** In the developing chick, the diameter of white fibers varied between 10.84 µm to 33.06 µm in the lowest age class and a minimum of 36.12 µm to maximum of 104.08 µm in the highest age class in the developing chick. The mean diameter was 21.63 ± 3.99 µm in the lowest age class which increased to 74.38 ± 13.21 µm in the highest age class. The results clearly showan increase in the fiber diameter from lower to higher age class as the animal grows(Table 4).

Table – 4. Mean diameter of white fibers in muscle of Chick. Values expressed are in µm.The muscle is showing gradual increase in mean fiber diameter from the subsequent age classes upto 42 days in all the three fiber types. Thereafter there is decline.

Age	Minimum Diameter	Maximum Diameter	Mean Diameter ± SD
7th Day	10.84	33.06	21.63 ± 3.99
14th Day	5.60	39.80	20.40 ± 7.87

21st Day	20.98	53.25	36.40 ± 6.79
28th Day	21.55	58.18	42.25 ± 7.75
35th Day	33.26	77.52	54.95 ± 7.68
42nd Day	38.10	76.78	55.57 ± 8.15
49th Day	27.00	94.07	62.18 ± 10.32
56th Day	36.12	104.08	74.38 ± 13.21

There is perfect correlation between age and growth (R2 = 0.4328).Diameter modes were increased successively all through the age groups (Fig.6).

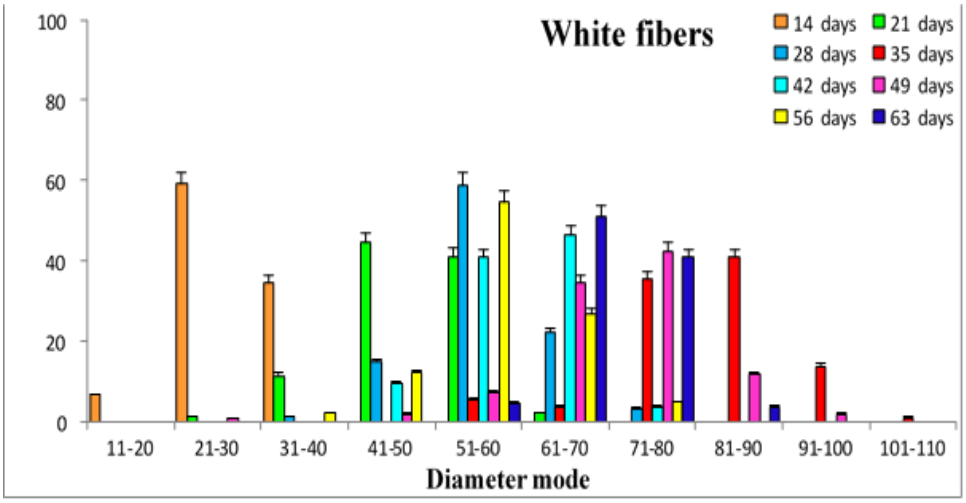

Fig. 5. Graphs showing percent fiber frequencies against diameter modes in white fibers of muscle of chick. Error bars represent the standard deviation.

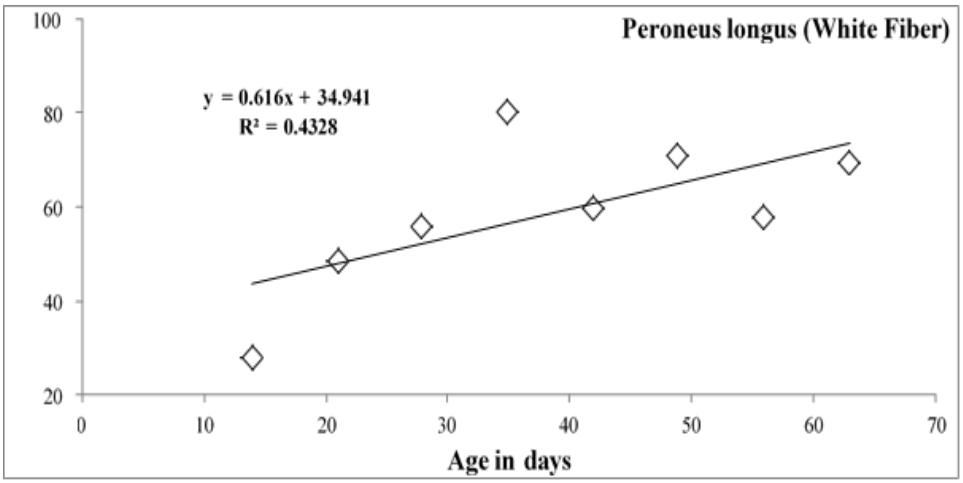

Fig. 6. Regression analysis of pinkfibers of muscle of developing chick. Regression equations and Correlation Coefficient values are given.

The results (Fig. 5) show that both in the lower age group and in the much higher age groups, there was a high frequency of tiny new fiber recruitment. There was a noticeable change in modal frequency values towards higher diameter modes in the older age groups. This indicates a surge in medium-diameter fibers, which are created when dominant big fibers that reached a threshold diameter split (Johnstonet. al., 2001, Kundu et. al., 1991b).

The results of the current experiment showed that hypertrophy is the primary growth mechanism for red, pink, and white fibers. Even though almost all age groups had high frequencies of specific intermediate diameter modes. Additionally, all three types of fibers showed the highest diameter modes in the white fibers, indicating an extended range of fiber diameter that points to the splitting of larger fibers into smaller ones (Mascarelloet. al., 1995). The total growth and development of muscle fibers in the chosen muscle were also linked to the inclusion of myosatellite or persistent myoblast cells (Koumans et. al., 1991, Higgins and Thorpe, 1990). According to current research, hypertrophy is the only mechanism by which the three types of fibers in the muscle appear to develop (Pandya et. al., 2003, Dimpal and Kundu, 2013).

There have previously been reports of increased red and pink fiber area in physically active individuals in birds (Moss 1968, Cheral & Chinoy, 1988) and mammals (D'Angelis, 2004). Therefore, more muscle activity during the trial period—that is, more interactions between the broilers—may be linked to the enhanced hypertrophy of the fibers in the selected muscle of broilers starting at 28 days of age. According to our results, the diameter of the red, pink, and white fibers increased only until the age of 42 days. The absence of hypertrophy for the three fiber types between 42 and 56 days of age indicates that the muscle fibers attained their target growth at 42 days; nevertheless, it is still unclear why the hypertrophic growth of the muscle fibers ceased between 42 and 49 days of age.

IV. CONCLUSION

The current investigation found that the selected muscle included all three fundamental fiber types; red, pink, and white. It was discovered that hypertrophy is the only mechanism by which muscles expand. The data can be utilized to increase the quantity as well as the quality of animal meat because the chosen animal is one of the most important food animals.

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Thermal Analysis of Gel Grown Pure Strontium Tartrate and Strontium-Magnesium-Zinc Ternary Levo-Tartrate Crystals

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ABSTRACT

Various ternary tartrate crystals have been reported by many researchers. But in the literature survey, the studies of strontium- magnesium- zinc ternary levo-tartrate crystals have never been reported. In the present investigation, single crystals of pure strontium tartrate (ST) and strontium-magnesium-zinc ternary levo-tartrate (SMZT) crystals have been grown by technique of single diffusion gel growth in silica hydrogel medium at ambient temperature. The obtained pure ST and SMZT crystals were opaque having dimensions of 10x8x6 mm3 and 7x3x2 mm3 respectively. The presence of expected elements in crystals was confirmed by carrying out EDAX spectrum analysis. The scanned images show these crystals to be grown by layer deposition. The thermal stabilities of the crystals were studied by thermogravimetry and by using the standard Broido relation, the activation energy and various kinetic parameters such as change in entropy, enthalpy and Gibb's free energy for each crystals was obtained and studied. Obtained TG curves for pure ST and SMZT crystals show different temperatures for each of them indicating different degrees of thermal stability.

Keywords: Gel growth, EDAX, TGA, Broido relation, Enthalpy, Entropy

I. INTRODUCTION

Among various tartrate compounds, the crystals of strontium tartrate have received great attention for their useful properties such as ferroelectric, non-linear optical, and spectral characteristics. Growth and characterization of various mixed strontium tartrate crystals have been reported by various researchers [1-4]. Because of its wide applications several types of ternary tartrate crystals were grown and studied [5,6]. However, in the literature survey, no report has been made on the growth and characterization of strontium-magnesium-zinc ternary levo-tartrate (SMZT) crystals. In the current investigation, single crystals of pure strontium tartrate (ST) and strontium-magnesium-zinc ternary levo-tartrate (SMZT) crystals have been grown by gel

growth technique in silica hydrogel medium at room temperature. Also, the grown crystals were characterized by carrying out various EDAX spectral and thermogravimetricanalyses.

II. EXPERIMENTAL DETAILS

2.1 Crystal growth

Single crystals of pure ST and ternary SMZT were grown by gel technique. The chemical used for the growth of crystals were tartaric acid, strontium chloride, magnesium chloride, zinc chloride and sodium metasilicate from Sigma Aldrich. The crystallization apparatus consists of borosilglass test tubes having dimensions of 32mm x 200mm. The solutions of tartaric acid, strontium chloride, magnesium chloride and Zinc chloride were prepared by dissolving these compounds in an appropriate amount of distilled water to get the required molarities. The solutions were stirred and filtered using whiteman filter paper (Grade 1). The aqueous solution of sodium metasilicate was prepared by adding its compound into distilled water in an appropriate amount. It was stirred and kept for a day to settle down all the impurities. Then the solution was filtered and kept aside. To get the required specific gravity of the gel, the calculated amount of distilled water is added into sodium meta-silicate solution. Silica gel is prepared by addinga solution of sodium meta-silicate into tartaric acid drop by drop with continuous stirring. The pH of the gel was adjusted to attain various specific values. The gelling mixture was transferred into the test tubes and allowed to set by keeping them undisturbed. The open end of the test tubes were closed using cotton plugs to prevent excess evaporation and contamination from the exposed surface of the gel. Here the tartaric acid acted as lower reactant. After confirming the gel setting, to grow pure ST crystals,a solution of strontium chloride was carefully poured along the wall of the test tube with the help of a pipette over the set gel to avoid any gel breakage.

To grow SMZTcrystals, the aqueous solutions of magnesium chloride , zinc chloride and Strontium chloride were mixed in certain proportion. The solution was centrifuged up to 1500 rpm for 90 minutes. Then the solution was poured over the set gel carefully using pipette and kept them undisturbed. The following reactions are expected to take place in a gel medium.

$SrCl2 .6H2O + C4H6O6 \rightarrow SrC4H4O6 .3H2O + 2HCl + 3H2O$ ……...….(1)

$(x)MgCl2 .6H2O + (y)ZnCl2 + (1-x-y)SrCl2 .6H2O + C4H6O6 \; Sr(1-x)\; Mg(x)\; Zn(y)C4H4O6 . 5H2O + 6HCl + 5H2O + O2$.....(2)

2.2 Characterization techniques

The TG analysis of grown crystals was carried out at a constant heating rate of 10˚C min-1 in the temperature range from ambient to 800˚C by using Perkin Elmer Thermo Gravimetric Analyzer. The obtained thermogram is shown in figure 5 . The elemental analysis was carried out by using EDAX spectral analysis.

III.RESULT AND DISCUSSION

3.1 Crystal growth

Both the crystals were harvested after 20 days. They were washed and cleaned by using distilled water. The crystals were different in size. The optimum growth conditionsare shown in table 1. Figures 1& 2 show the images of the grown ST and SMZT crystals respectively. The sizes of mixed crystals were comparatively smaller

than the pure crystals. Thus, it was found from the experiment that the addition of dopants increased the nucleation time with a reduction in crystal size.

Table 1: Growth conditions

Parameters	ST	SMZT
Den. of SMS	1.050	1.055
pH of Gel	5.0	5.5
Gel-setting time	1 day	1 day
Gel aging time	2 days	2 days
Con. of TA	1 M	1 M
Con. of U.R.	SrCl2 = 1M	SrCl2, MgCl2, ZnCl2 : 1M each
Ratio of U.R.	-	SrCl2 : MgCl2 : ZnCl2 = 7.5:1.25:1.25
Size (lxbxh)	10x8x6 mm3	7x3x2 mm3

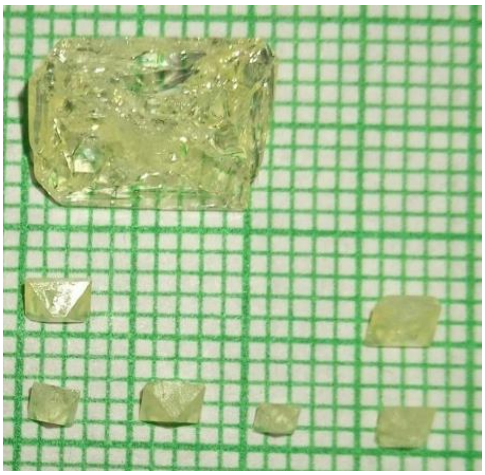

Fig 1: ST crystals

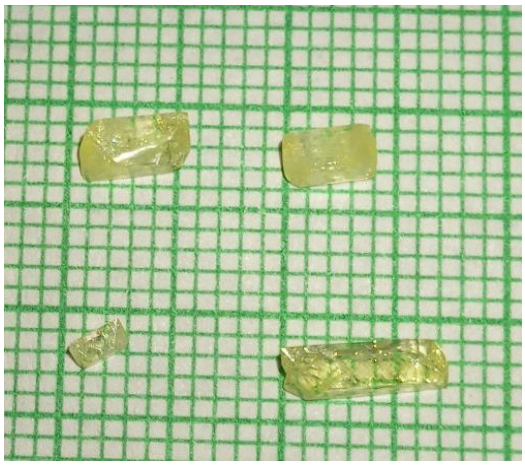

Fig 2: SMZT crystals

3.2 Elemental analysis

The spectra obtained from Energy Dispersive X-ray analysis confirm the presence of various elements in the grown crystals as shown in Figures3 and 4. The presence of the strontium element in pure ST crystal is confirmed. The relative weight of strontium is 18.39%. Also, the presence of magnesium, zinc and strontium elements are confirmed in SMZT crystal. The relative weight of magnesium, zinc and strontium is 0.12% , 13.16% and 10.57 % respectively.

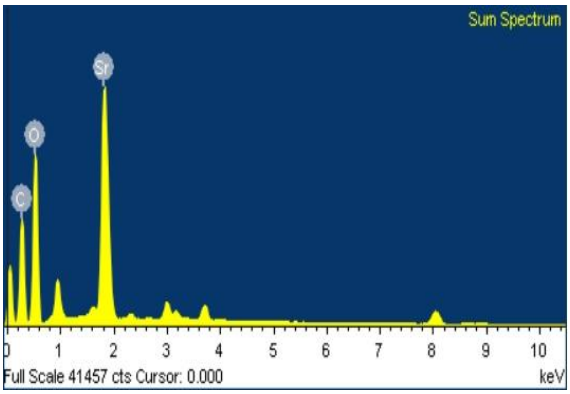

Fig 3: EDAX graph of ST crystals

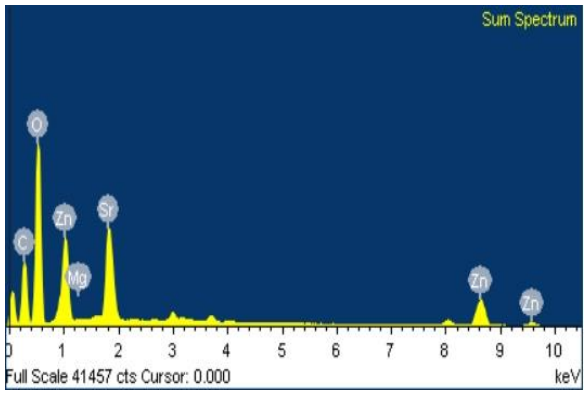

Fig 4: EDAX graph of SMZT crystals

3.3 Thermal behavior of crystals

TG curves obtained for pure ST and mixed SMZT crystal are showing different temperatures which indicate different degrees of thermal stability as discussed below. The TGA data are shown in table 2.

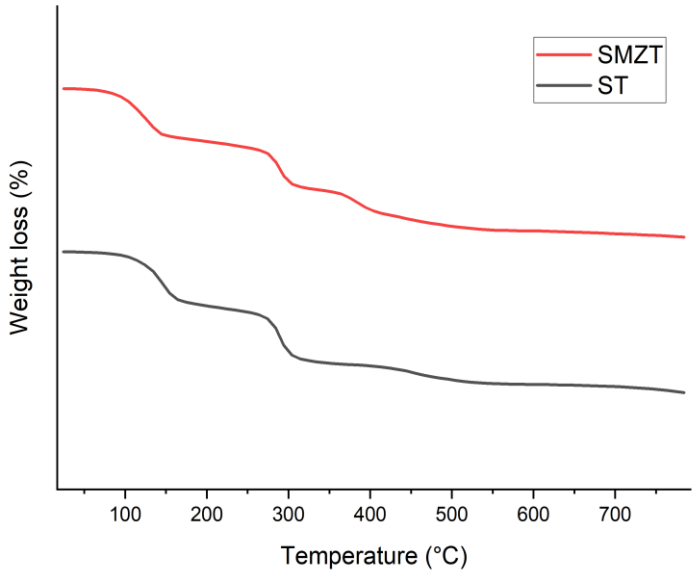

Fig. 5: TGA thermograms of ST and SMZT

Pure Strontium tartrate (ST):

Here ,the decomposition of crystals starts at a temperature of 44 ℃, which indicates that the pure ST crystal is stable up to 44 ℃. The first stage of decomposition between 44 ℃ and 168 ℃ indicates the formation of strontium tartrate tertrahydrate to strontium tartrate anhydrate. Here three water molecules are dehydrated in first stage. We can confirm that the crystal sample is trihydrate, as it contains three water molecules.The energy required to dislodge water molecules depends upon how strongly they are locked up in the lattice. As water molecules are ejected from the lattice in two different stages, it indicates that the water molecules are locked up in two different ways and thus require different amounts of energy for their ejection from the lattice. The second stage of decomposition starts at 250 ℃ and is completed at 326 ℃ resulting in the formation of strontium oxalate, which remains stable up to 351 ℃. During the third stage, between 352 ℃ and 572 ℃, strontium oxalate decomposes to strontium carbonate.

SMZT crystals:

Here, the decompositionstarts at a temperature of 51 ℃,which indicates that the SMZT crystal is stable up to 51 ℃. The first stage of decomposition, between 51 ℃ and 162 ℃ indicates the formation of strontium-magnesium-zinclevo-tartrate pentahydrate to strontium-magnesium-zinc levo-tartrate dihydrate. Here three water molecules are dehydrated in first stage. From this TG analysis, we can confirm that the crystal sample is pentahydrate, as it contains five water molecules.The second stage of decomposition starts at 257 ℃ and is completed at 349 ℃ , resulting in the formation of strontium-magnesium-zinc tartrate anhydrate, which remains stable up to 359 ℃. In the third stage, between 360 ℃ and 580 ℃, strontium-magnesium-zinc tartrate anhydrate decomposes to strontium-magnesium-zinc tartrate oxalate. The decomposition processes and the number of water molecules associated are shown inTable2. Thechemical formulas for different crystals can be written as: SrC4H4O6.3H2O for pure ST and Sr(0.75)Mg(0.125)Zn(0.125)C4H4O6.5H2O for SMZT.

Table 2:Weight loss in different stages of decomposition of ST & SMZT crystals

Sample	Stage	Temperature Range (℃)	Weight loss (%)		Lossof molecules
			Observed	Calculated	
ST	1	44- 168	18.344	18.640	$3H_2O$
	2	250 - 326	18.392	19.334	2CO
	3	352 – 572	7.813	9.68	CO
SMZT	1	51 - 162	17.443	17.143	$3H_2O$
	2	257 - 349	19.053	19.052	$2C$ & $2H_2O$
	3	360 – 580	7.942	11.428	$2H_2O$

3.4 Kinetic Study

The activation energy (Ea) and frequency factor (A) of the thermal degradation has been estimated by the standard Broido relation [7]. The kinetic parameters such as change in entropy, change in enthalpy and Gibb's free energies of grown crystals are also calculatedand tabulated in Table 3.

The slope of the plot of lnln(1/Y) vs. 1/T yields the required energy of activation. The plot gives a good linear fit for n=1.

Table 3: Activation energy and Thermodynamic parameters for ST and SMZT crystal

Samples & Stages		Activation Energy Ea (kJ/ Mol)	Frequency Factor A (S^{-1})	Change in Entropy ΔS (J/ K.Mol)	Change in Enthalpy ΔH (kJ/ Mol)	Gibb's Free Energy ΔG (kJ/ Mol)
ST	1	59.47	2.46×10^{7}	-105.43	53.18	93.13
	2	193.29	4.71×10^{17}	88.08	183.97	134.55
	3	96.31	4.84×10^{6}	-124.31	84.10	175.46
SMZT	1	78.27	9.96×10^{9}	-55.50	71.95	93.04
	2	156.31	1.25×10^{14}	19.47	146.74	135.53
	3	104.78	1.84×10^{7}	-113.32	92.43	176.63

IV. CONCLUSION

Pure ST and ternary SMZT crystals have been grown successfully. The elemental analysis of both crystals was studied by EDAX and it confirmed the presence of expected elements. The thermal stability of pure ST is found to be 44 ℃, while that of SMZT crystal is 51 ℃ , which is comparatively more than that of pure ST crystal. Thus, we can see that the presence of magnesium and zinc has affected the thermal stability of SMZT crystal.Also, the pure ST crystals lose three water molecules, while SMZT crystals lose five water molecules in the decomposition stages. It confirms that ST is trihydrateand SMZT is pentahydrate crystals. The activation

energy of pure ST is comparatively lesser than that of SMZT crystal which shows that more activation energy is required for water molecules to be released from SMZT crystals. This shows that water molecules are locked strongly in SMZT crystals compared to those in pure ST crystals. Correct formulas for crystal composition were obtained by EDAX and TGA analysis.

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Crowdfunding Transforming Start-up Funding and Encouraging Entrepreneurship in the Era of Digitalization

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ABSTRACT

Crowdfunding has come out as an essential force in the fast developing startup landscape, essentially changing how entrepreneurs acquire funding for their business foresights and translate ideas into reality. This research paper explores the idea of crowdfunding and its reflective effect on startup financing, predominantly within the framework of the digital era.

The investigation begins by describing crowdfunding and tracing its evolution from a modest notion to a substantialresource of startup funding. Numerous crowdfunding versions, including rewards-based, equity-based, and donation-based approaches, are examined to illustrate their functionality for entrepreneurs in search of monetarysupport.

A noteworthy aspect under study is how crowdfunding has democratized access to funding, empowering entrepreneurs from varied backgrounds to showcase their ideas and garner support from a global community of backers. Inspiring anecdotes of startups leveraging crowdfunding to launch innovative products, amplify their operations, and disrupt conservative industries are shared to highlight its empowering impact.

Nonetheless, the challenges related with crowdfunding are also acknowledged. These challenges cover navigating regulatory frameworks, nurturingfinancier confidence, and grasping the complexities of crowdfunding platforms. This research paper investigates the amplifying effect of digital tools and social media on crowdfunding campaigns, facilitating entrepreneurs in reaching potential backers and establishing resilient communities around their ventures.

Looking forward, the paper explores the future course of crowdfunding, anticipating emerging trends such as block chain-based crowdfunding, asset tokenization, and the integration of artificial intelligence within crowdfunding platforms. These progressions are intended to redefine the

landscape of startup financing in the predictable future.

In conclusion, this research paper identifies the transformative impact of crowdfunding on startup funding and the empowerment it extends to entrepreneurs in today's digital age. It underscores the necessity of continuous research and analysis to capitalize on the opportunities presented by crowdfunding while justifying its intrinsic challenges, guaranteeing sustained growth and optimistic contributions to innovation and economic development.

Keywords :-Crowdfunding, startup financing, digital era, rewards-based crowdfunding, equity-based crowdfunding, donation-based crowdfunding, democratization of funding, regulatory frameworks, digital tools, social media, block chain-based crowdfunding, asset tokenization, artificial intelligence, transformative impact, entrepreneurial empowerment.

Research Objective

1. To explore the evolution of crowdfunding as a significant force in the startup landscape.
2. To analyze various models of crowdfunding such as rewards-based, equity-based, and donation-based.
3. To examine how crowdfunding has democratized access to funding, empowering entrepreneurs from diverse backgrounds.
4. To investigate the challenges associated with crowdfunding.
5. To study the influence of digital tools and social media on crowdfunding campaigns.
6. To anticipate future trends in crowdfunding.
7. To identify and discuss the transformative impact of crowdfunding on startup financing
8. To emphasize the importance of ongoing research and analysis in leveraging the opportunities presented by crowdfunding.

I. INTRODUCTION

Crowdfunding refers to the method of gathering funds for a project or enterprise from a large number of individuals, typically through online platforms. It falls under the umbrella of crowdsourcing and alternative finance. While similar approaches can be carried out through mail-order subscriptions, charity events, and other means, the term "crowdfunding" specifically pertains to online-based fundraising mechanisms. This contemporary model of crowdfunding generally involves three main participants: the project initiator who presents the idea or project for funding, supporters who contribute to the idea, and a facilitating organization (known as the "platform") that brings these parties together to launch the project.

The scope of crowdfunding extends to financing various ventures, including for-profit entrepreneurial endeavors, creative initiatives, medical expenses, travel plans, and community-focused social entrepreneurship projects. Despite assertions linking crowdfunding closely to sustainability, empirical evidence indicates that sustainability plays a minor role in crowdfunding endeavors. Furthermore, criticisms have been raised regarding crowdfunding's potential to finance dubious or fraudulent treatments, particularly in cases involving expensive medical therapies.

II. TYPES OF CROWD FUNDING

1. Donation based Crowd Funding

The earliest and original form of crowdfunding is donation-based funding. This segment primarily consists of social impact entities aiming to achieve objectives like developing eco-friendly products or providing clean water to underprivileged nations. Support for these initiatives comes in the form of straightforward donations, with the satisfaction of contributing to a noble cause being the primary reward for the donor.

2. Reward based Crowd Funding

Reward-based crowdfunding involves individuals contributing money to a project or venture in exchange for non-financial rewards or incentives. These rewards can vary widely based on the project's nature and the creativity of the campaign organizers. Consider a startup company developing a new smartwatch with innovative health tracking features. To finance the final stages of product development and launch, they opt for a reward-based crowdfunding campaign on a well-known platform like Kickstarter or Indiegogo.

In this campaign, contributors interested in the smartwatch and its features are invited to participate. The company offers a tiered system of rewards corresponding to different contribution levels. For instance, a contribution of Rs. 2000 might earn the backer a thank-you note and a digital copy of the company's exclusive health tips booklet. Another level, say a contribution of Rs. 5,000, could include a pre-order of the smartwatch at a discounted price, along with the digital rewards. For higher contributions, backers might receive an early bird package with the smartwatch and additional accessories, or even a deluxe package comprising multiple smartwatches, personalized engraving, and a VIP invitation to the product launch event.

Throughout the campaign, the company updates backers on the funding progress, showcases the smartwatch's features and benefits, and engages potential backers through visuals like videos, photos, and testimonials. Once the campaign achieves its funding goal in Indian Rupees, the company utilizes the raised funds to complete product development, manufacture the smartwatches, and fulfill the rewards as promised within the specified timeframe.

This approach not only secures the necessary funds for the startup but also fosters a community of early supporters enthusiastic about the product and motivated by the unique rewards offered.

3. Equity based crowd funding

Equity-based crowdfunding is another method that offers rewards, where contributors can become shareholders in your company by investing capital in exchange for equity shares. By becoming equity owners, your contributors are entitled to financial returns on their investment and eventually receive a portion of the profits through dividends or distributions.

Case Study - Brahma Kumaris

Basically crowdfunding is a method of raising capital through the collective effort of friends, family, customers, and individual investors. This approach taps into the collective efforts of a large pool of individuals—primarily

online via social media and crowdfunding platforms. The Brahma Kumaris organization in India has indeed utilized crowdfunding methods to raise substantial funds for their initiatives. One notable example is their campaign to build a meditation center focused on promoting peace and spirituality. The organization leveraged crowdfunding platforms and social media to reach out to a wide audience and encourage donations from individuals who resonated with their mission.

The campaign highlighted the importance of meditation in fostering inner peace and harmony, appealing to people seeking spiritual growth and well-being. Through compelling storytelling and engaging content, the Brahma Kumaris effectively communicated the impact of their work and the benefits of supporting their cause.

Utilizing a transparent approach, the organization provided regular updates on the progress of the project, showcasing how donations were being used to construct the meditation center and support related programs. They also actively engaged with donors, expressing gratitude and demonstrating accountability for the funds received.

By tapping into the power of crowdfunding, the Brahma Kumaris were able to mobilize a large number of supporters who contributed varying amounts based on their capacity and commitment to the cause. This grassroots approach not only generated significant financial resources but also fostered a sense of community and collective responsibility among donors, strengthening their connection to the organization's mission and values.

The Brahma Kumaris have approximately one crore members. Each member contributes only one Rupee and thereby very quickly fund of Rupee one crore is raised. With this fund the organization acquires assets to meet its objective.

Case Study – Bengal man crowdfunds 'school of rich for poor', raises Rs 6 Crore

Mr. WaliRahmaniused the social media platform to successfully collect Rs 7 crore through crowdfunding in September 2023, achieving this amount within a week through social media campaigns. The funding was utilized to construct a new campus capable of accommodating approximately five times the number of students, equipped with modern laboratories and an updated curriculum. Mr. WaliRahmani, who established the school when he was 18 years old in 2018, had recently graduated from school himself.

III.RESEARCH METHODOLOGY

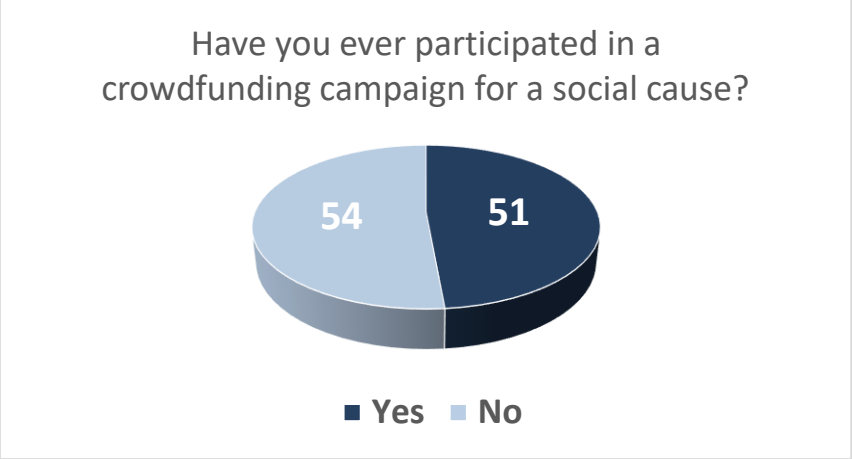
Primary Data

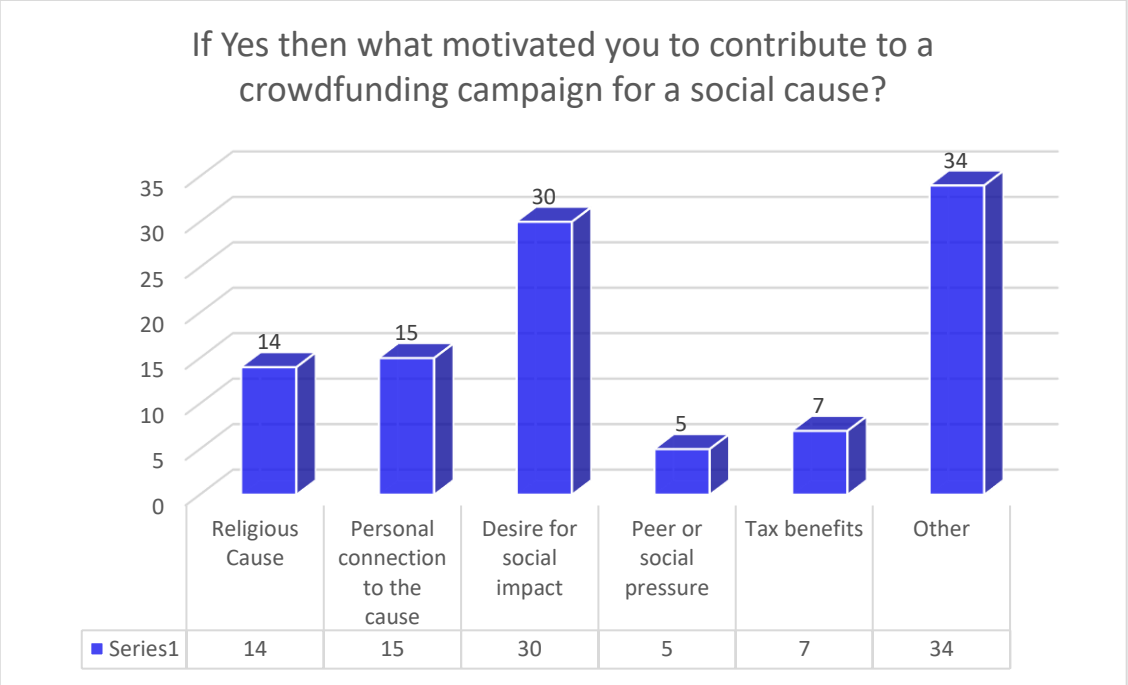
Information was gathered through the administration of a digital survey, which garnered responses from around 105 participants across Mumbai.

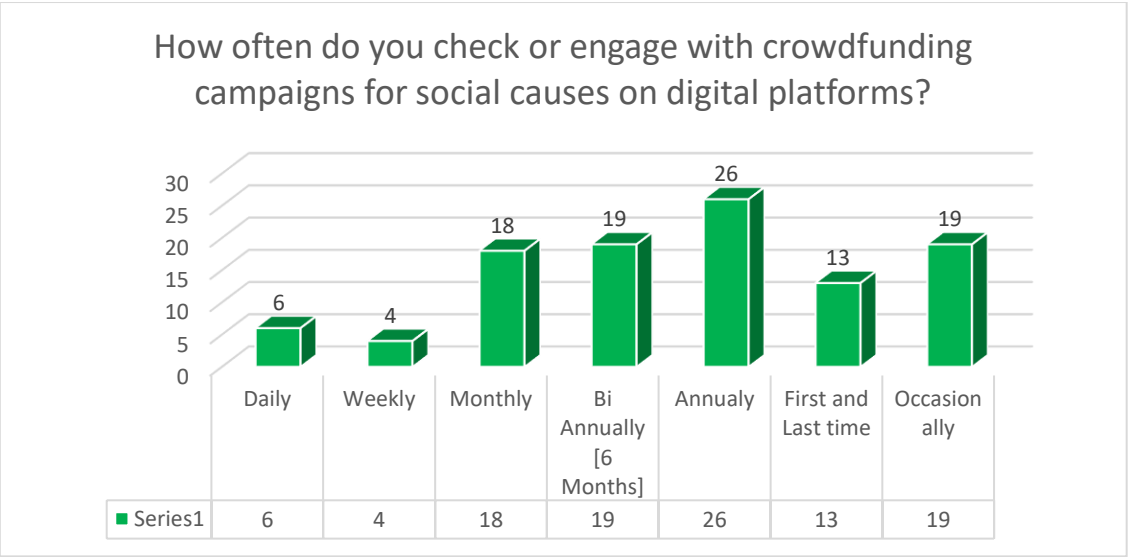
Secondary Data

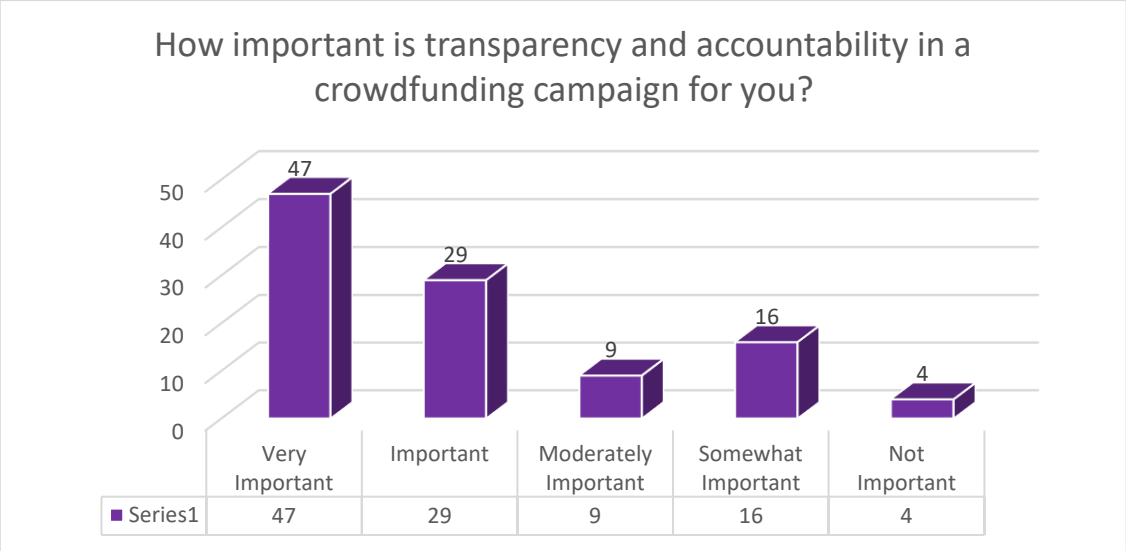
This research paper utilizes a mixed-method methodology, examining sources comprising journals, reports, and published articles to investigate the particular issue. Additionally, it incorporates perspectives from specialists, policymakers, and professionals spanning diverse sectors such as government, international organizations, social enterprises, and private companies.

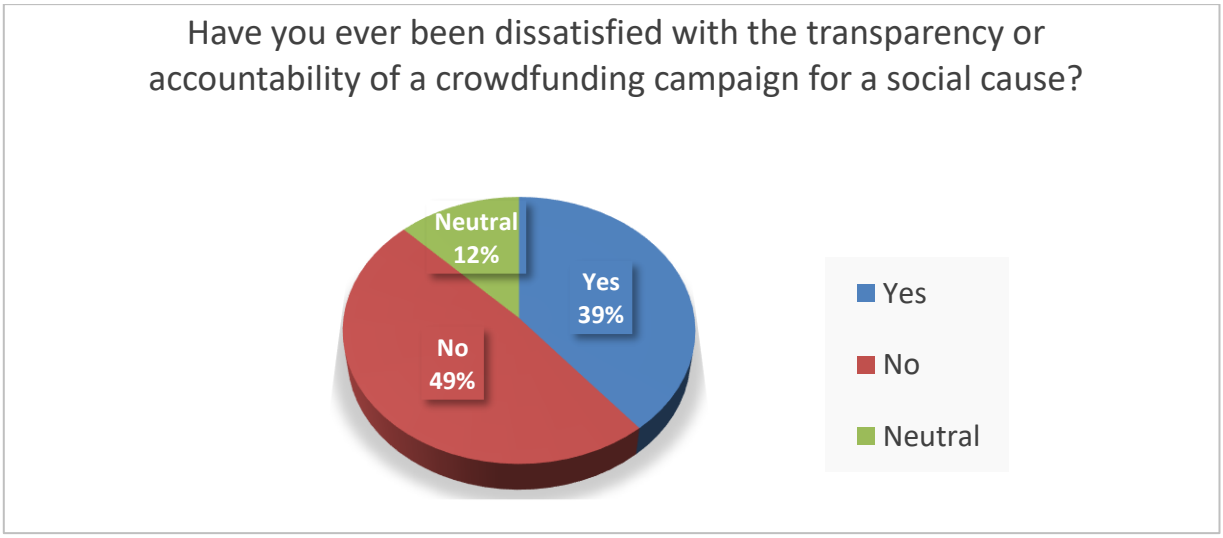
IV. DATA ANALYSIS

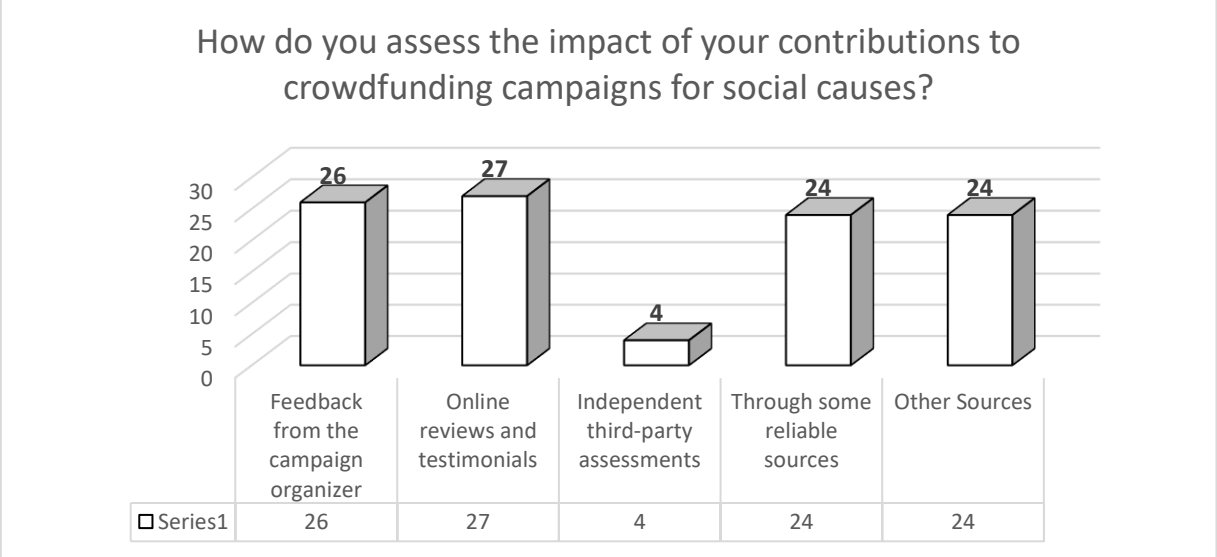


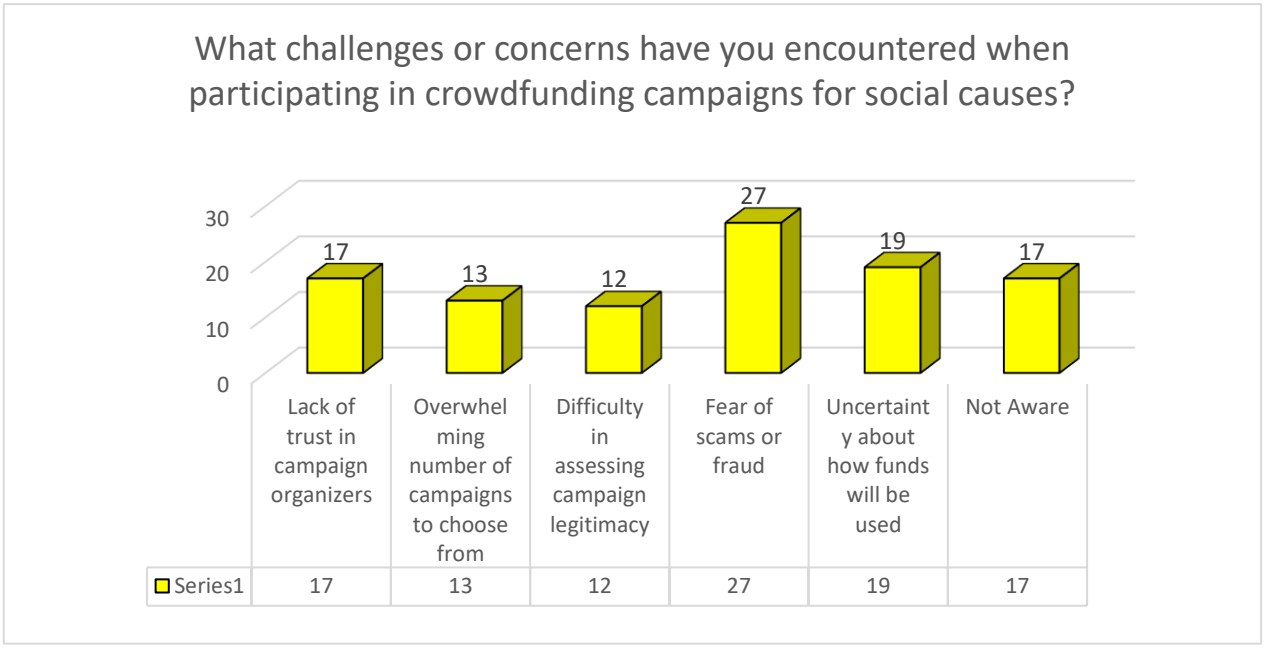





How important is transparency and accountability in a crowdfunding campaign for you?
50
40
30
20
10
0
47
29
9
16
4
Very Important
Important
Moderately Important
Somewhat Important
Not Important
Series1
47
29
9
16
4


Have you ever been dissatisfied with the transparency or accountability of a crowdfunding campaign for a social cause?
Neutral 12%
Yes 39%
No 49%
Yes
No
Neutral


How do you assess the impact of your contributions to crowdfunding campaigns for social causes?
30
25
20
15
10
5
0
26
27
4
24
24
Feedback from the campaign organizer
Online reviews and testimonials
Independent third-party assessments
Through some reliable sources
Other Sources
Series1
26
27
4
24
24



Based on the above primary data we can deduce that

Participants in crowdfunding campaigns for social causes are primarily motivated by a desire for social impact (30 respondents) and personal connection to the cause (15 respondents). Religious causes (14 respondents) and tax benefits (7 respondents) were less significant factors. Peer or social pressure played a minor role (5 respondents), while a substantial number cited "Other" reasons (34 respondents), indicating a diverse range of motivations.

The engagement frequency with crowdfunding campaigns for social causes varies widely, with responses ranging from daily (6 respondents) to first and last time (13 respondents). However, a significant proportion engages occasionally (19 respondents) or annually (26 respondents), suggesting a mix of regular and sporadic contributors.

Transparency and accountability are highly valued by participants, with 76% indicating that these factors are either very important (47 respondents) or important (29 respondents). Only a small minority (4 respondents) considered them not important.

While a majority of respondents (51) were not dissatisfied with the transparency or accountability of crowdfunding campaigns they participated in, a substantial number (41 respondents) reported dissatisfaction, indicating room for improvement in this aspect.

Participants primarily assess the impact of their contributions through feedback from the campaign organizer (26 respondents) and online reviews/testimonials (27 respondents). Independent third-party assessments were less commonly relied upon (4 respondents).

Key challenges and concerns faced by participants include fear of scams or fraud (27 respondents), uncertainty about fund usage (19 respondents), and lack of trust in campaign organizers (17 respondents). This highlights the importance of building trust and providing clear information in crowdfunding campaigns.

A large majority (80 respondents) plan to continue participating in crowdfunding campaigns for social causes in the future, indicating sustained interest and support for such initiatives.

Respondents generally feel a moderate to close alignment between their personal values and the causes they support through crowdfunding, with 75% indicating either very closely (29 respondents) or somewhat closely (46 respondents) aligned.

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Optical Sensors for In Situ Characterization and Monitoring of Electrochemical Energy Conversion Reactions

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ABSTRACT

Electrochemical energy conversion reactions play a pivotal role in various sustainable energy technologies, such as batteries, fuel cells, and electrolyzers. Understanding the underlying mechanisms of these reactions is crucial for optimizing device performance and lifespan. In situ characterization and monitoring techniques are indispensable for studying these reactions under realistic operating conditions. Optical sensors have emerged as powerful tools for in situ analysis due to their non-invasive nature, high sensitivity, and ability to provide real-time information. This review article provides an overview of recent advances in optical sensor technologies for in situ characterization and monitoring of electrochemical energy conversion reactions. We discuss the principles, applications, and challenges associated with various optical sensing techniques, including spectroscopy, microscopy, and imaging. Furthermore, we highlight recent developments in optical sensor design, integration, and data analysis strategies. Finally, we discuss future perspectives and potential research directions for advancing optical sensing capabilities in the field of electrochemical energy conversion.

Keywords: Optical sensors, Electrochemical energy conversion, In situ characterization, Spectroscopy, Microscopy, Imaging.

I. INTRODUCTION

Electrochemical energy conversion processes play a crucial role in various technological applications, including energy storage, generation, and sensing. These processes involve the conversion of chemical energy into electrical energy and vice versa, making them fundamental to the operation of batteries, fuel cells, and electrochemical sensors. Understanding the dynamics of electrochemical reactions is essential for optimizing device performance, enhancing energy efficiency, and ensuring long-term reliability. [1-3]

In situ characterization and real-time monitoring of electrochemical reactions are critical for unraveling the complex mechanisms governing these processes. Traditional characterization methods often involve ex situ analysis, which may not capture the transient behavior and spatial heterogeneity of electrochemical systems. Moreover, destructive techniques can alter the system under investigation, leading to inaccuracies in the obtained data. Therefore, there is a growing need for non-invasive, high-resolution techniques capable of providing real-time insights into electrochemical processes.[3-5]

Optical sensing techniques offer unique advantages for in situ characterization and monitoring of electrochemical energy conversion reactions. These techniques leverage the interaction of light with matter to extract valuable information about the chemical composition, morphology, and dynamics of electroactive species. Spectroscopy, microscopy, and imaging techniques, among others, enable researchers to probe electrochemical systems with high sensitivity and spatial resolution. By harnessing the power of light, optical sensors can provide valuable insights into reaction kinetics, phase transformations, and electrode-electrolyte interfaces in real-time.[5,6]

Optical sensors play a crucial role in advancing our understanding of electrochemical energy conversion reactions due to their unique capabilities for non-invasive and real-time monitoring. These sensors leverage the interaction of light with matter to extract valuable information about the chemical composition, structural changes, and reaction kinetics within electrochemical systems. [6] Spectroscopic techniques, such as UV-Vis, infrared, and Raman spectroscopy, enable researchers to probe the electronic and vibrational properties of electroactive species, providing insights into reaction mechanisms and intermediate species formation. Additionally, microscopy and imaging techniques offer high spatial resolution, allowing for the visualization of electrode morphologies, phase transformations, and electrochemical interfaces with submicron precision. [7] By integrating optical sensors into electrochemical setups, researchers can obtain detailed information about reaction kinetics, mass transport phenomena, and electrode-electrolyte interactions in real-time, facilitating the development of efficient and sustainable energy conversion devices.[6,7]

Furthermore, optical sensors offer versatility and adaptability across a wide range of electrochemical systems, from batteries and fuel cells to electrochemical sensors and beyond. Their non-destructive nature enables continuous monitoring of electrochemical processes without perturbing the system under investigation, making them ideal for long-term studies and operando analysis. [8] Optical sensors can also be tailored to specific applications by selecting appropriate detection wavelengths, probe molecules, and imaging modalities, allowing researchers to address diverse research questions and engineering challenges. Moreover, recent advancements in optical sensing technologies, such as plasmonic nanostructures, quantum dots, and optical fiber sensors, have expanded the capabilities of optical sensors, enabling enhanced sensitivity, multiplexed detection, and miniaturization. Overall, optical sensors play a vital role in advancing the field of electrochemical energy conversion by providing valuable insights into reaction mechanisms, optimizing device performance, and guiding the development of next-generation energy technologies.[7-9]

This paper aims to review recent advancements in optical sensing technologies for studying electrochemical energy conversion reactions. We will explore the principles behind various optical sensing modalities, their applications in different electrochemical systems, and their integration with conventional electrochemical setups. Furthermore, we will discuss the potential of optical sensors to drive innovation in energy storage, conversion, and sensing technologies. By shedding light on the latest developments in this field, we hope to inspire further research and development efforts towards more efficient and sustainable electrochemical devices.[7-10]

II. PRINCIPLES OF OPTICAL SENSING TECHNIQUES

Optical sensing techniques rely on the interaction between light and matter to extract valuable information about the chemical composition, structural characteristics, and dynamic behavior of materials. One of the fundamental principles underlying optical sensing is spectroscopy, which involves the measurement of the interaction between light and matter as a function of wavelength or frequency. [7-8] Spectroscopic techniques such as UV-Vis, infrared, and Raman spectroscopy provide valuable insights into the electronic, vibrational, and rotational properties of molecules, enabling the identification of chemical species, determination of molecular structure, and characterization of reaction kinetics. By analysing the absorption, emission, or scattering of light by materials undergoing electrochemical reactions, spectroscopic techniques offer non-destructive and high-resolution means of monitoring reaction intermediates, phase transformations, and electrode processes in real-time.[11-13]

In addition to spectroscopy, microscopy and imaging techniques are essential components of optical sensing, offering high spatial resolution and imaging capabilities. Microscopy techniques such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM) enable researchers to visualize electrode morphologies, surface topographies, and nanoscale features with submicron precision. Imaging techniques, including fluorescence microscopy, confocal microscopy, and optical coherence tomography (OCT), provide real-time visualization of dynamic processes within electrochemical systems, such as ion transport, redox reactions, and electrochemical phase transitions. [14] By combining spectroscopic and imaging modalities, optical sensing techniques offer a comprehensive approach to studying electrochemical energy conversion reactions, providing valuable insights into reaction mechanisms, kinetics, and spatial heterogeneity with unparalleled sensitivity and resolution.[13-15]

III.APPLICATIONS OF OPTICAL SENSORS IN ELECTROCHEMICAL ENERGY CONVERSION

- ***Battery systems (Li-ion, Na-ion, etc.)***

Optical sensors have revolutionized the field of electrochemical energy conversion by providing invaluable insights into the operation and performance of various battery systems. In the realm of lithium-ion (Li-ion) batteries, optical sensors play a crucial role in monitoring electrode morphology changes, electrolyte degradation, and the formation of the solid-electrolyte interphase (SEI). Techniques such as in situ Raman spectroscopy and microscopy enable researchers to track the evolution of lithium plating and dendrite formation, which are critical factors influencing battery safety and cycle life. Moreover, optical sensors facilitate the study of emerging battery chemistries, including sodium-ion (Na-ion) batteries, offering real-time monitoring of sodium ion insertion/extraction kinetics and structural changes in electrode materials. By providing high-resolution characterization of electrochemical processes, optical sensors contribute to the development of advanced battery materials and cell designs, leading to enhanced energy density, cycling stability, and safety.[15-17]

- ***Fuel cells (PEMFC, SOFC, DMFC)***

Fuel cells represent another key area where optical sensors find extensive applications, encompassing various types such as proton exchange membrane fuel cells (PEMFC), solid oxide fuel cells (SOFC), and direct methanol fuel cells (DMFC). Optical sensors are instrumental in elucidating electrochemical reactions, gas diffusion, and mass transport phenomena within fuel cell systems. Spectroscopic techniques enable in situ monitoring of

electrode catalyst activity, gas crossover, and fuel/oxidant concentrations, offering insights into reaction kinetics and cell performance optimization. Additionally, microscopy and imaging techniques provide visualization of electrode morphology, catalyst distribution, and electrolyte degradation, facilitating the diagnosis of degradation mechanisms and the development of durable fuel cell materials and stack architectures. Through the integration of optical sensors, researchers can improve fuel cell efficiency, durability, and overall system performance, advancing clean and sustainable energy generation technologies.[17-18]

- *Electrolyzers (Water splitting)*

Furthermore, optical sensors play a crucial role in electrolyzers for water splitting, a key process in renewable energy conversion and storage. Electrolyzers utilize electrical energy to split water into hydrogen and oxygen gases, offering a pathway for sustainable hydrogen production. Optical sensing techniques provide insights into electrochemical reactions occurring at the electrolyte-electrode interface, including water oxidation and hydrogen evolution processes. [18] Spectroscopic methods such as UV-Vis and infrared spectroscopy enable the detection of reaction intermediates, surface adsorbates, and catalyst activity, facilitating the development of efficient electrocatalysts for water splitting. Moreover, imaging techniques offer visualization of gas evolution, bubble dynamics, and electrode surface morphology, aiding in the optimization of electrolyzers performance and durability. By leveraging optical sensors, researchers can advance the development of cost-effective and scalable electrolysis technologies for renewable hydrogen production, driving the transition towards a carbon-neutral energy economy.[19-21]

IV. RECENT ADVANCES IN OPTICAL SENSOR TECHNOLOGIES

Recent advances in optical sensor technologies have significantly enhanced our ability to characterize and monitor electrochemical energy conversion reactions with unprecedented detail and precision. High-resolution imaging techniques have emerged as powerful tools for visualizing electrochemical processes at the nanoscale and microscale levels. Techniques such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM) enable researchers to observe electrode morphologies, surface structures, and interface dynamics with submicron resolution. [18-20] Moreover, advancements in fluorescence microscopy and confocal microscopy allow for real-time imaging of dynamic processes within electrochemical systems, such as ion transport, redox reactions, and electrochemical phase transitions. These high-resolution imaging techniques provide valuable insights into the spatial distribution of electroactive species, reaction kinetics, and electrode-electrolyte interfaces, facilitating the optimization of device performance and the development of novel materials for energy conversion applications.[19-21]

Integration of optical sensors with electrochemical setups has also seen significant progress, enabling seamless monitoring of electrochemical reactions under realistic operating conditions. By combining optical sensing modalities with electrochemical techniques such as cyclic voltammetry, chronoamperometry, and impedance spectroscopy, researchers can obtain comprehensive insights into reaction kinetics, mass transport phenomena, and electrode processes. Moreover, the development of in situ and operando optical sensing setups allows for real-time monitoring of electrochemical reactions as they occur, providing valuable feedback for device optimization and performance enhancement. [22-24] Multimodal sensing approaches, which combine multiple optical sensing modalities or integrate optical sensing with other characterization techniques such as X-ray diffraction or mass spectrometry, offer synergistic benefits for studying complex electrochemical systems. By leveraging recent advances in optical sensor technologies and integration strategies, researchers can gain deeper

insights into electrochemical energy conversion reactions, driving innovation and progress towards more efficient and sustainable energy technologies.[24-27]

V. CHALLENGES AND LIMITATIONS

Despite the significant advancements in optical sensor technologies for studying electrochemical energy conversion reactions, several challenges and limitations remain to be addressed. One key challenge is the development of optical sensors capable of operating under harsh electrochemical conditions, such as high temperatures, corrosive environments, and varying pH levels. Ensuring the stability and reliability of optical sensing components in such environments is essential for long-term monitoring and characterization of electrochemical systems. [23-27]

Additionally, the integration of optical sensors with electrochemical setups requires careful design and optimization to minimize interference from electromagnetic fields, stray light, and other sources of noise. Moreover, achieving high spatial and temporal resolution while maintaining compatibility with electrochemical setups poses technical challenges that need to be addressed. [27] Furthermore, the interpretation of optical data obtained from electrochemical systems can be complex, requiring sophisticated data analysis algorithms and modeling techniques to extract meaningful information about reaction mechanisms, kinetics, and material properties. Addressing these challenges will require interdisciplinary collaborations and continued innovation in optical sensor technologies, paving the way for further advancements in the field of electrochemical energy conversion.

VI. CONCLUSION

Finally, the optical sensors have emerged as invaluable tools for advancing research in electrochemical energy conversion. Through high-resolution imaging techniques and integration with electrochemical setups, optical sensors offer unprecedented insights into the dynamic processes occurring within battery systems, fuel cells, and electrolyzers. From monitoring electrode morphologies and reaction kinetics to visualizing electrolyte degradation and interface dynamics, optical sensors provide critical information for optimizing device performance and developing novel materials.

Their non-invasive nature and real-time monitoring capabilities make them essential for studying complex electrochemical reactions under realistic operating conditions. Overall, the use of optical sensors has significantly contributed to our understanding of electrochemical energy conversion processes, driving innovation and progress towards more efficient and sustainable energy technologies. Continued advancements in optical sensor technologies promise even greater insights into electrochemical systems, paving the way for continued advancements in energy storage, generation, and utilization.

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Exploring Influential Factors on Consumer Purchase Decisions : A Conceptual Investigation

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ABSTRACT

This study examines the various motivations people have for purchasing goods and services. It focuses on figuring out why people choose certain things over others. Instead of focusing on statistics, the researchers apply a method of analysis that includes looking at explanations and descriptions. Rather of doing brand-new research or surveys, they compile data from already-published sources. The study acknowledges certain limitations, too. It makes extensive use of theories and concepts without really testing them. Furthermore, it only examines one theory of human motivation. Despite these problems, the study highlights four primary factors that influence: their personal beliefs, their thoughts and feelings, and how individuals fit into society.

Keywords: Human Motivation, People's Purchasing Decisions.

I. INTRODUCTION

Studying consumer behaviour is a vast field. Consumers typically make purchasing decisions on a regular basis, and many of them are unaware of the variables that influence their choice of particular goods, services, or brands. A consumer's purchasing behaviour is influenced by a variety of factors. These aspects fall into four groups based on their unique characteristics: personal, psychological, societal, and economic. It's interesting to learn about the variables that influence consumers' purchasing decisions and how those variables can impact an individual or consumer's decision to buy a certain commodity or service. the psychological, social or cultural, economic, and personal aspects of purchasing a thing. Solomon et al. stated that, “The field of consumer behaviour covers a lot of ground: it is the study of the processes involved when individuals or groups select, purchase, use or dispose of products, services, ideas or experiences to satisfy needs and desires”. (Solomon, Bamossy, Askegaard & Hogg,2006, pp.3)

II. METHODOLOGY

The study concentrated on four variables that influence customer behaviour. The author made an effort to identify the variables influencing consumers' decisions about products or services. This study focuses on the variables that influence consumers' purchasing decisions. The goal of this study is to identify the variables that affect consumers' purchasing decisions.The research adopted a qualitative methodology. The research used secondary data. Data for this study was gathered from a number of publications, websites, blogs, papers that have been published, and articles from academic journals. The bibliography takes into account twelve references.

III.AFFECTING THE BUYING BEHAVIOR OF CONSUMERS

The following four primary elements influence the purchasing decisions of consumers:

1) Personalfactors
2) Psychologicalfactor
3) Culturalandsocialfactor
4) Economicfactor

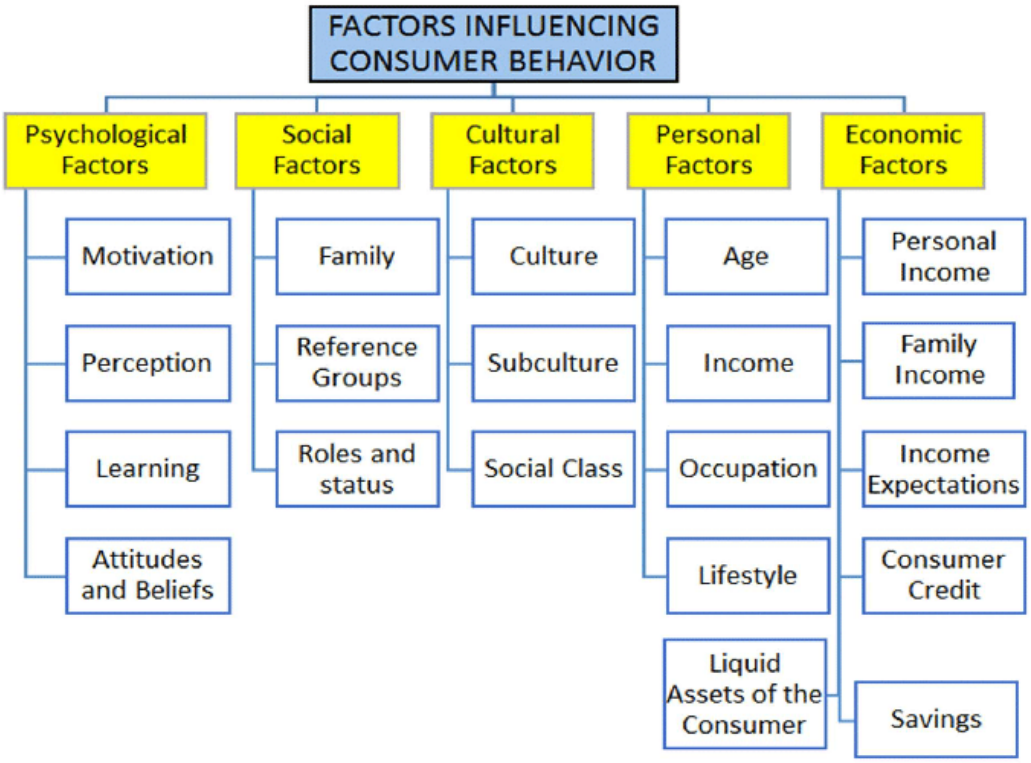

Fig.1:Factoraffectingconsumerbuyingbehavior

A. Psychological Factors-

The purchasing behaviour of consumers is also influenced by psychological factors. (Ali & Ramya, 2016) a different name for it is internal factor. The consumer's purchase process is significantly influenced by the environment (Kotler & Keller, 2016, pp. 187). People are frequently influenced by the products or services that other customers buy. A friend, relative, coworker, and so forth could be considered the "other consumer" (Rani, 2014). Because of the surroundings, a new product may thrill consumers when it enters the market. Psychology

and environment are related. Some businesses emphasize this element. The four components of the psychological factor are **motivation, perception, learning and memory**. (Pages 187, Kotler & Keller, 2016).

1) Motivation

Everybody has requirements, ranging from basic necessities to more complex ones. "A need that is sufficiently pressing to direct the person to seek satisfaction of the need" is how Kotler described motive. Numerous hypotheses on human motivation are offered by psychologists (Kotler et al., 2017, p. 150). Maslow's theory is the widely recognized and highly renowned explanation of human motivation provided by Abraham Maslow. The Maslow's theory was authored by Abraham Maslow. His goal was to elucidate why individuals are motivated by a specific need at a specific moment (Kotler & Keller, 2016, p. 188). The Maslow's Hierarchy of wants, which ranks human wants from least to greatest, is depicted in Figure 2. Maslow listed the following needs:

1) **Physiological:**basicneedsuchasair,food andwater.
2) **Safety:**securityandprotection.
3) **Belongingness**:needtofeellovedandbeacceptedbyothers.
4) **Esteem:**toaccomplishsomethingandhavesomestatusamongothers.
5) **Self-actualization:**feelself-fulfillment.

Figure 2 illustrates how a person attends to their basic physiological needs, which include food, water, shelter, and air. Once one's basic needs are met, they desire "safety," which is their second need. For example, when someone is hungry, they are more likely to eat than to call the police to ask for help. Following the fulfillment of their need for protection, the individual moves on to the third step, which is falling in love, and the list goes on. In simple terms, the behaviour is arranged according to need, from least to greatest.

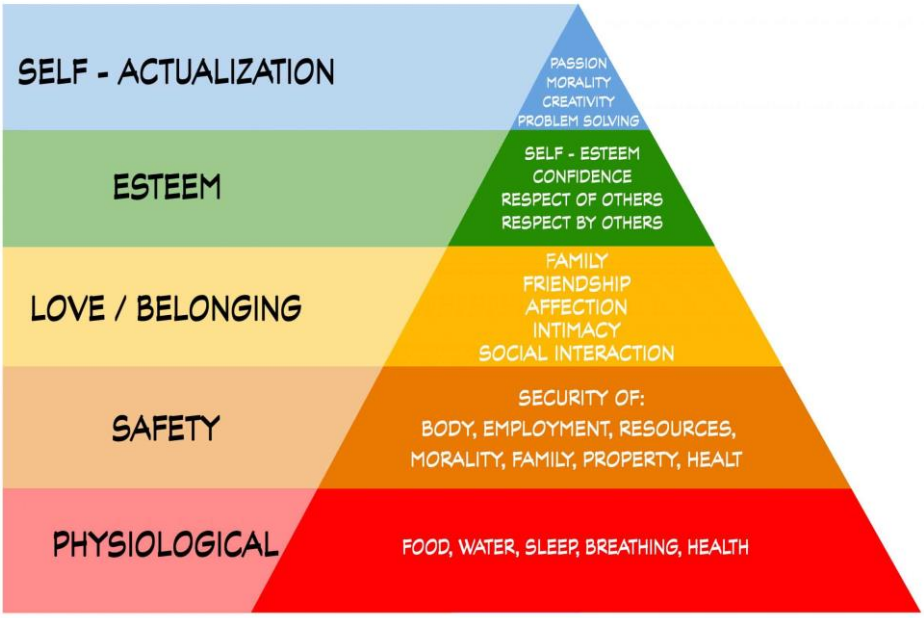

Fig.2:Maslow'sHierarchyofneed

2) Perception

The motivation's action is perception. Positive perception is the attitude that a motivated individual has toward a product when they respond well to it. A motivated person's negative reaction to anything is referred to as a negative view of that product. Among the psychological factors, perception is the most significant component.

As a result, it influences customers' purchasing decisions for all products. The process by which we select, organize, and interpret information inputs to build a meaningful image of the world is known as perception, according to Kotler et al. (Kotler et al., 2019). the judgment reached by the individual following the gathering of data. The data gathered by human senses. Senses include touch, smell, hearing, and taste.

3) Learning

Learning is the process by which an individual reacts to a particular circumstance. A person's behaviour reveals what they have previously learned. Learning describes how a person behaves. According to learning theorists, drives, stimulation, signals, responses, and reinforcement interact to produce learning. (Pages 191 in Kotler & Keller, 2016). According to Washburne (1936), learning can be described as "an increase, through experience, of problem-solving ability".

4) Memory

Working memory is defined as a specific quantity of information that may be kept in an accessible condition and is helpful for a variety of tasks (Adams, Nguyen, & Cowana, 2018). "Cognitive psychologists distinguish between long-term memory (LTM), a more permanent, essentially unlimited store of information, and short-term memory (STM), a temporary and limited store of information," according to Kotler & Keller (Kotler & Keller, 2016, pp. 193).

B. Social Factors-

One of the most important factors influencing customer purchasing behaviour is the social component. A person's family, friends, and online social network are all considered social factors. One such social aspect influencing consumer purchasing behaviour is word-of-mouth. "Two or more people who interact to accomplish individual or mutual goals" is Kotler's definition of a group. Additionally, Kotler stated, "Membership groups are those to which an individual belongs and has a direct influence." Reference groups, on the other hand, can be used as direct (in person encounters) or indirect points of comparison or reference for shaping an individual's behaviour or views. Individuals are frequently impacted by reference groups that they do not identify with (Kotler et al., 2017, pp. 144.) Kotler and Keller stated that “Some of these are primary groups with whom the person interacts fairly continuously and informally, such as family, friends, neighbours, and coworkers.

People also belong to Secondary groups, such as religious, professional, and trade-union groups, which tend to be more formal and require less continuous interaction” (Kotler & Keller, 2016, pp. 191).

The most powerful element influencing consumer purchasing behaviour is word-of-mouth.

A person's family and friends have a greater ability to influence them than other people, such salespeople for businesses, etc. A person places greater trust in friends and family than in other people. The person is more likely to heed the advice of friends or family than from strangers. A person's family is the most significant aspect of their life. A person has greater faith in their family than in anyone else. Family advice and suggestions are more significant in a person's life. A family member has more influence over the customer.

The influence of trustworthy friends, family, colleagues, and other consumers' personal remarks and recommendations on purchasing behaviour was stated by Kotler (Kotler et al., 2017, pp. 144). People spend more time on social media websites these days, which improves the social network. Blogs and social media platforms are examples of online social networks. The social media platforms include Twitter, Facebook, and

others. Businesses are putting more of an emphasis on leveraging online social media to connect with customers (Kotler et al. 2017, pp. 145).

C. Personal Factors

The personal factors that influence consumer purchasing behaviour include age and life stages, occupation, personality, lifestyle, and values. These are the result of combining personal characteristics that are direct and indirect. Some of these have an immediate impact on consumer purchasing behaviour, while others have an indirect impact. Businesses should emphasize the personal element, which usually applies to both specialized and everyday products. (Kotler et al., 2017, p. 147; Kotler & Keller 2016, pages. 183).

1) Age

The purchasing habits of consumers are always changing and evolving according to their age, stage of life, and stage of relationship. A person's preferences for products alter as they become older. For instance, a 70-year-old guy could be able to purchase a family vehicle instead of a sports car. Marketers have divided the population into age groups: under 12 years old, 13 to 18 years old, 19 to 26 years old, 27 to 35 years old, 36 to 50 years old, and above 50 years old. During these ages, a person's purchasing habits are constantly changing. These days influence a consumer's purchasing decisions for the rest of his life.

The second is all of the life cycle stages. The various stages of the life cycle or human relationships include getting married, getting divorced, having kids, having kids go to college, retiring, and so forth. At different stages of life, consumers also have diverse choices. It may happen if someone marries someone, gets married, has kids, and then sends those kids off to college. Businesses frequently determine the target market for their products and develop marketing plans based on the various stages of a consumer's life cycle or age. Companies may base the creation of their products on the ages or life cycle stages of their target audience. (Page 147, Kotler et al., 2017)

2) Occupation

A consumer's occupation affects its buying behaviour towards any goods or services. For example, a businessman may purchase more expensive goods or services when compared to other professionals. Occupation is a type of work performed in a job. The occupation concept is the “Set of jobs whose main tasks and duties are characterized by a high degree of similarities” (N.A., 2012). Occupation is a personal factor which affect the consumer buying behaviour. Companies should focus on occupation of consumer during the making of pricing of a product or develop a product.)

3) Lifestyle

A person's lifestyle is how they choose to live their own life in the world, according to their own style. Every individual has a unique way of living. "A person's pattern of living as expressed in his or her activities, interests, and opinions" is Kotler's definition of lifestyle.A person's activities, interests, and ideas make up their lifestyle. Activities include employment, interests, hobbies, sports, and social gatherings. A person's interests include things like food, clothes, family, and leisure activities. Opinions relate to the individual, social issue, and commercial product. A person's lifestyle shapes their perception in the community. A buyer purchases a lifestyle in addition to a product. The study of consumer lifestyles can yield benefits for companies. Following a lifestyle analysis of their target audience, businesses can develop their marketing plan. Following a study of

consumers' lifestyles, businesses can also produce the product (Kotler et al., 2017, pp. 149). A specific factor influencing consumer purchasing behaviour is lifestyle.

4) Personality

Kotler defines personality as "the distinctive psychological qualities that set an individual or group apart." Typically, personality is defined in terms of characteristics like aggression, defensiveness, adaptability, sociability, autonomy, dominance, and self-assurance (Kotler et al., 2017, pp. 150). A consumer's personality is revealed when they choose to buy a certain branded product over other branded products. Brands have individual personalities as well. "Brand personality is the specific mix of human traits that we can attribute to a particular brand," according to Kotler & Keller (Kotler & Keller, 2016, pp. 185).

The five brand personality attributes were determined by Jennifer Aaker in her research study, "Dimension of measuring brand personality":

1) Sincerity (frank, wholesome, upbeat, and grounded)
2) Excitement (bold, vivacious, creative, and modern)
3) Competence (smart, successful, and dependable)
4) Sophistication (beautiful, elegant, and endearing)
5) Ruggedness (being rugged and outdoorsy) (Page 150 in Kotler et al., 2017).

The majority of marketers create tactics that convince consumers toward their products or services by concentrating on the personalities of their target audience. One of the personal characteristics that influences a consumer's purchasing behaviour is their personality.

D. Economic Factors

Another factor influencing customer purchasing behaviour is the economic component. A consumer's choice of particular brand or product and its purchasing decision are influenced by their financial situation. Businesses can do research on customer spending and saving practices.For example, Samsung sells both expensive and inexpensive smartphones. According to (Ali and Ramya 2016), there are a number of economic elements, such as personal income, family income, savings, income expectations, consumer credit, and other economic factors. An individual's income is referred to as their personal income. A person's buying habit is influenced by their personal income. Based on the amount they earn after taxes,consumers make decisions. The total income of a family can be referred to as the family income. The combined earnings of all family members or the income from multiple family members. Itdependsonthefamiliesor working family members.

The term "income expectation" refers to income that could be earned through overtime, bonuses, or other sources. The money that stays after a person pays for all of their monthly bills is referred to as savings. The money that is supplied by banks or other financial institutions are referred to as consumer credit. Among the forms of consumer credit is a credit card. The government's policies, the slowdown, inflation, and other factors are among the other economic factors. if a person's limited money prevents him from purchasing an expensive item. So, the purchasing of products or services directly relates to income.

IV. LIMITATIONANDFUTURESTUDY

This study analyses the variables influencing consumers' purchasing decisions. It is not without restrictions, though. The researcher of this study exclusively examined the variables that influence consumers' purchasing

decisions. In theory, the study has limitations. The author did not provide a useful example. This theoretical technique can be put into practice to conduct more research. A product or brand, or an industry, may also be the subject of the study. The lack of real-world research is this study's other drawback. The observational study takes into account the need for more research on this subject. The author addressed one idea of human motivation; however, other theories, like those of Herzberg and Freud, may be studied further.

V. CONCLUSION

This study is based on variables that influence consumers' purchasing decisions. It can be determined that there are four primary factors that influence the purchasing decisions made by consumers: the psychological factor (motivation, perception, learning, and memory); the social factor; the economic factor (personal income, family income, income expectations, savings, consumer credit, and other economic factors); and the personal factor (age and stages of life, occupation, personality, and lifestyle). Furthermore, it was determined that a customer has an impact at various life cycle phases and ages. Consumer purchasing behaviour is also influenced by motivation and perception, and the consumer's surroundings has a significant impact on the decision to buy. This study contributes to our understanding of the factors influencing consumers' decisions on which products to purchase.

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Node MCU-Powered Active Solar Tracking System

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ABSTRACT

As renewable energy sources continue to gain momentum, solar energy emerges as a significant exemplar of this trend. The implementation of a solar tracking system enhances the efficiency of solar panels by maximizing energy absorption. This paper presents the design and deployment of an automatic single-axis active solar tracking system, employing the Node MCU (ESP 8266 module). Real-time data from various days is showcased to demonstrate the system's performance.

Keywords— Renewable energies, solar energy, solar tracking system, solar panel, single axis tracker, Node MCU

I. INTRODUCTION

The bustling pulse of modern civilization relies heavily on energy consumption to fulfill the aspirations and ambitions of its inhabitants. Energy has become an indispensable factor, intricately woven into every aspect of our lives. In light of this, the need for a perpetual and abundant energy source to sustain our growing population becomes apparent. However, conventional energy sources such as coal, natural gas, and oil are rapidly depleting, intensifying the struggle to meet escalating energy demands.

Amidst this challenge, solar energy emerges as a promising alternative, offering unparalleled abundance and accessibility. Solar tracking devices, among other innovations, harness the potential of solar energy. Solar cells, the building blocks of these devices, convert light energy into electricity, predominantly using materials like silicon, cadmium telluride (CdTe), and copper indium gallium (di)selenide (CIGS).

Various factors, including cell temperature, energy conversion efficiency, and maximum power point tracking, influence the efficiency of solar cells. These cells are assembled into solar panels, which capture and convert solar radiation into usable energy. Solar tracking systems, divided into single-axis and dual-axis trackers, optimize energy capture by precisely aligning with the sun's path throughout the day.

The phenomenon of day and night, as well as the changing seasons, significantly impacts the amount of sunlight intercepted by the Earth. Factors such as latitude, longitude, and the angle of the sun relative to the horizon determine the absorption of solar radiation. The elevation angle, zenith angle, and solar azimuth angle are key parameters in understanding solar radiation distribution across different locations and times.

As we navigate the complexities of energy sustainability, harnessing the potential of solar energy through innovative technologies like solar tracking systems holds promise for a more resilient and environmentally conscious future.

The trackers can be classified as follows:

Active solar trackers, which are directed by a controller and utilize sensors to track the sun's path, optimizing the absorption of radiation. They can be further categorized into single-axis solar trackers (tracking along a single cardinal axis) and dual-axis solar trackers (tracking along two orthogonal cardinal axes).

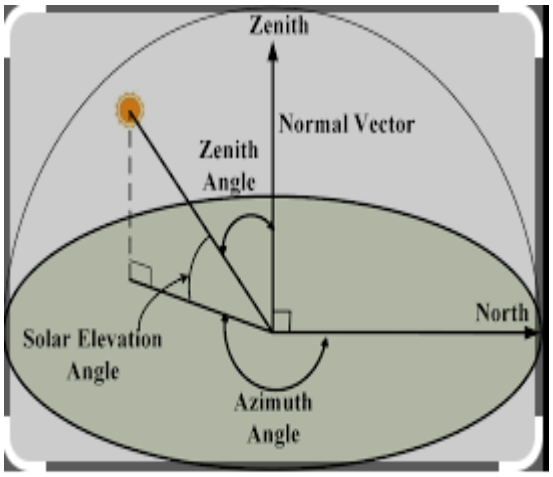

Fig. 1. Zenith and azimuth angel

Passive solar trackers, on the other hand, are guided by solar heat, causing motion by heating an easily compressible fluid.

Chronological solar trackers utilize the rotation of the earth and are based on different geographical locations.

Single-axis and dual-axis trackers are also major classifications based on the axis of rotation. Numerous studies have been conducted on designing Arduino-based dual-axis solar trackers. Additionally, a fuzzy-based PI controller has been implemented for an efficient tracking system.

The concept of maximum power point tracking (MPPT) aims to optimize power collection by adjusting the voltage in the photovoltaic (PV) module to its most effective level. Previous studies have indicated that the maximum power can be achieved from a solar tracker at a tilt of approximately ´´ ଢ଼ ଶ, which is considered the optimum point for MPPT. This paper proposes and implements the design of a single-axis active solar tracker using Node MCU. The organization of the paper is as follows: an introduction providing a brief overview and discussion of related current research, followed by methodology, hardware prototype description, experimental results, and conclusion.

II. METHODOLOGY

The design of the proposed solar tracker has evolved through the following steps:

Step 1: Configuration of the Node MCU.

Step 2: Placement of the LDR modules on the tracker.

Step 3: Activation of the motor as the output of the system to rotate the tracker upon detection of the required light input by the LDRs.

The block diagram of the proposed system is shown in Fig 2

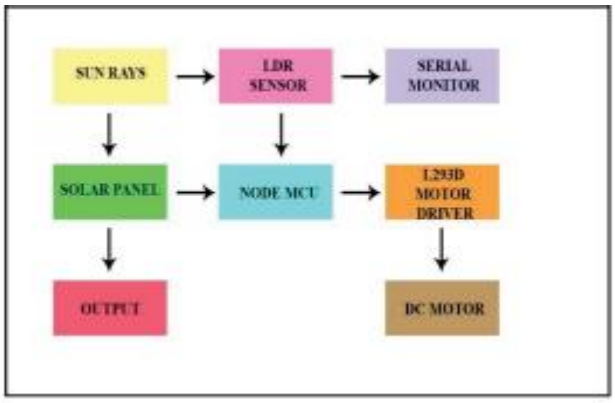

Fig. 2. Block diagram of the proposed solar tracker system

III.PROTOTYPE OF THE SYSTEM

The design and implementation of this proposed work can be divided into two modules as follows:

Hardware Prototype:

The hardware prototype is constructed using various electronic components and basic materials for mechanical support. The electronic components utilized in the prototype can be categorized into three main sections: the solar input, the controlling circuit, and the driving motors. The mechanical structure consists of steel rods, forming two pillars to support the solar panel, and an additional rod serving as the axis of rotation attached to the driving motors. The solar tracker system comprises a solar panel and two LDR modules functioning as photo sensors. These modules produce a low resistance output when exposed to high-intensity incident light.

Controlling Circuit:

The controlling circuit includes a controller that detects the direction of maximum light intensity and transmits the computed values to the driving module.

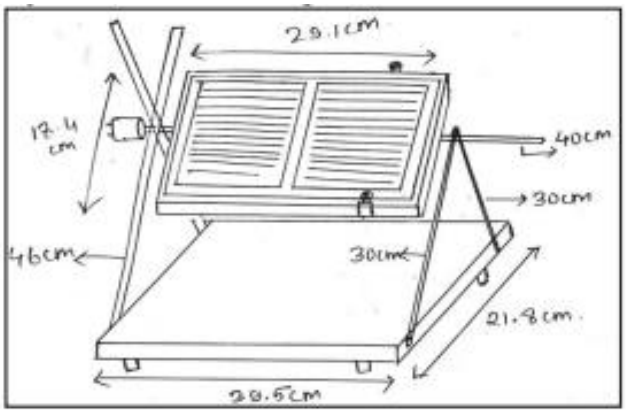

Fig. 3. Mechanical structure of the proposed solar tracking system

The mechanical structure utilizes iron rods to create two support arms for the solar panel, enabling the system to track the movement of the sun. The dimensions for the conceptual drawing of the mechanical structure of the proposed solar tracker, as shown in Fig 3, were determined through trial and error experimentation. Several considerations were taken into account during the experiment:

a) Different extreme positions of the tilted panel were checked.

b) The rotation point was positioned in the middle of the panel.

Each arm structure consists of two rods, each 30 cm in length, while the other arm is supported by two rods, each 46 cm in length. The structure incorporates a 40 cm long rod as the rotational axis. The base of the structure is constructed from a rectangular wooden base with dimensions of 39.5 cm x 21.8 cm. The solar panel used in the project measures 18.4 cm in width and 29.1 cm in length.

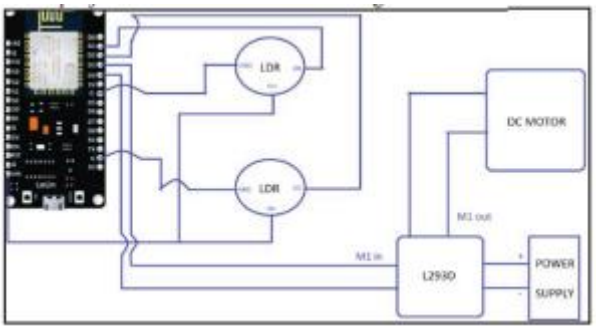

Fig. 4. Circuit connection of the sensors and motor driver with Node MCU

The computed values are transmitted to the motor driver (L293D), which then activates the DC motor to rotate either clockwise or counterclockwise based on the light intensity. The circuit diagram is depicted in Figure 4.

Fig. 5. Complete setup of automatic single axis solar tracker system

The real time system has been shown in Fig. 5.

Software Algorithm:

The algorithm is designed in an integrated development environment . The upload speed of the setup is set to 9600 and the setup is connected to COM5, the ESP8266 board. The flowchart has been shown in Fig.6

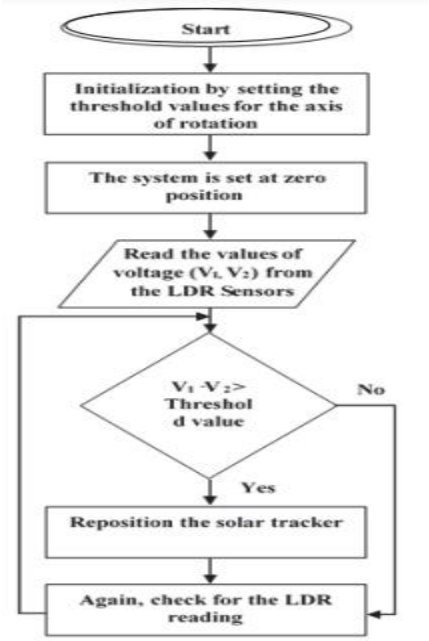

Fig. 6. Flow chart of the used algorithm automatic solar tracking system

IV. EXPERIMENTAL RESULT AND ANALYSIS

The designed solar tracker was utilized under various weather conditions to collect different datasets, which have been tabulated in Tables I, II, and III below. The outputs of the panel are directly influenced by the light intensity falling on its surfaces. The proposed single-axis solar tracking system is capable of maintaining peak voltage for an extended period, resulting in increased output. In Figure 7, a graph illustrating two different days is presented. The solar panel output on April 7, 2019, demonstrates that between 10:30 a.m. and 4:30 p.m., the output remains mostly constant, reaching its maximum as the light intensity remains high during this time period.

Table I: Solar Panel Output For A Bright Sunny Day On 3rd April 2019

Time	Solar panel Output (V)	Time	Solar Panel Output (V)
06:00	08.25	13:00	10.82
07:00	08.95	14:00	10.56
08:00	09.52	15:00	10.32
09:00	09.89	16:00	10.08
10:00	10.33	17:00	09.26
11:00	10.76	18:00	08.34
12:00	11.00		

Table Ii: Ldr Outputs For A Bright Sunny Day On 2nd April 2019

Time (Hrs.)	LDR1 (V)	LDR2 (V)
06:30	0.277	0.276
07:30	0.504	0.509
08:30	1.757	1.933
09:30	1.631	1.783
10:30	1.900	1.798
11:30	2.910	2.969
12:30	1.990	1.990
13:30	1.985	1.990
14:30	0.976	0.985
15:30	0.941	0.892
1630	0.824	0.594
1730	0.128	0.981

Table III. LDR Outputs For A Cloudy Day On 7th April 2019

Time (Hrs.)	LDR1 (V)	LDR2 (V)
06:30	0.277	0.276
07:30	0.504	0.509
08:30	1.757	1.933
09:30	1.631	1.783
10:30	1.900	1.798
11:30	2.910	2.969
12:30	1.990	1.990
13:30	1.985	1.990
14:30	0.976	0.985
15:30	0.941	0.892
16:30	0.824	0.594
17:30	0.128	0.981
18:30	0.982	0.968

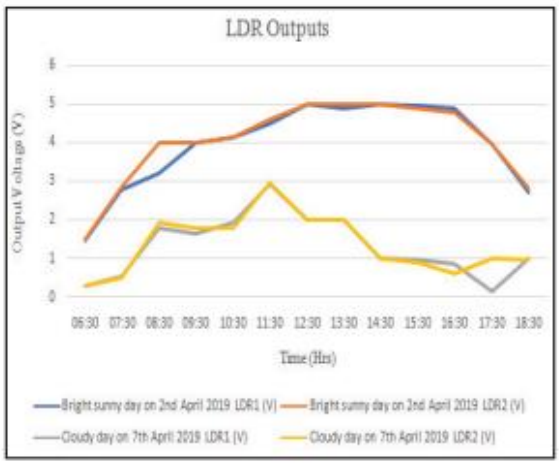

Fig. 7. LDR outputs for two different days

Table IV enlists certain advantageous features of the proposed solar tracking system.

Table IV: Advantageous Features Of The Proposed Solar Tracker

SL No.	Features
1.	Reduced system complexity Due to single axis tracking system
2.	Enhanced system output based on LDR output
3.	Capable of logging data of system output by using PLX-DAQ application
4.	ESP 8266 ca be configured in sleep mode which will reduce power consumption of the tracking system in the absence of sunlight.
5.	System can be made IOT enabled by further modification of the present work.

V. CONCLUSION

This paper presents the design and implementation of a laboratory prototype for a single-axis active solar tracking system. The controller utilized in this prototype is an ESP8266 module. With the integration of a high-power-rated solar panel, this prototype system can serve as an alternative power generation source. For this study, a 5-watt solar panel was employed. Various datasets were recorded using the implemented tracker under different atmospheric conditions, such as sunny and gloomy days. The solar tracker adjusts its position around the axis based on the maximum light intensity to ensure optimal solar energy reception by the solar panel. Additionally, this work can be expanded to include a double-axis solar tracker with added IoT functionality. This enhancement would enable remote monitoring of the system, catering to diverse applications across different locations.

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Dark Matter : Are they Insulators to Electromagnetic Radiation?

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ABSTRACT

The detection of dark matter is the greatest outstanding problem in modern cosmology. Several attempts have been taken for this without any remarkable success. To find out a suitable way of detection we need to understand its nature comprehensively. In the present article, a hypothesis is described considering dark matter as a normal matter. Its peculiar behavior is explained considering its existence in BEC state in the coolest part of the universe which makes it an electromagnetic insulator. Depending upon this hypothesis an experimental verification method is proposed.

Keywords: Dark matter; Bose einstein Electromagnetic insulator; Hypothesis condensation;

I. INTRODUCTION

Detection of dark matter is one of the greatest outstanding problems of present day fundamental physics. This is because the nature of the socalled dark matter is still unknown to the world of particle physics and cosmo particle physics. Importantly, understanding the nature of dark matter and detection of its existence is the prime concern of cosmologists to justify the Standard Models (SM) of our universe [1,2].

According to the SM, ordinary matter contributes less than 20% of the total matter of the universe [3]. The remaining part of the budget matter is unknown to us and considered as the dark matter. In the standard model of cosmology, the matter is considered as an entity that follows the relation of its energy density with its length scale as a^{-3}, where a is the scale factor. For radiation, energy density is inversely proportional to the fourth power of the scale factor (a^{-4}). Contrary to this, energy density remains constant during the change of the scale factor for any cosmological constant. In SM, space is considered a cosmological constant. But, till now, such relation is not proved for dark matter. All possibilities are still open for it. It may be the same kind of entity as any kind of entity among these three or it may be a new kind of entity that follows a different relation. The answer to this question will help a lot to understand dark matter. Thus, we may verifythe effect of dark matter on the cosmological model taking fictitious relationships of energy density and scale factor for it. These fictitious relationships of energy density and scale factor must include three above mentioned relationships also.

In different ways, researchers are trying to overcome this problem. One group of people, disbelievers of dark matter, is trying to restructure the cosmological models by modifying the theory of gravity such that there would be no need for it to describe our universe comprehensively. But, day by day, new experimental results are obtained which are strongly corroborating the existence of dark matter. Thus, other groups of researchers are trying to elaborate on the nature of dark matter by postulating new elementary particles like axions [4]. A successful ΛCDM model requires the existence of dark matter [5]. Without its presence, the structure formation of the early universe would not be possible according to the big bang model. The structure would not be reproducible also [6]. Lord Kelvin is the first man who estimated the existence of dark bodies when he tried to explain the observed results of velocity dispersion of the stars that are orbiting around the center of the milky way galaxy with the estimated results from the theory [7]. Later, in 1906, French mathematician Henri Poincare used the term dark matter to discuss Kelvin's work, though there was a suspicion of a similar kind of entity long back in 1922 by Dutch astronomer Jacobs Kapteyn [8]. This idea was nurtured by several groups of astronomers [9,10].

With the advancement of astronomy and cosmology research and the inventions of high resolution measurement techniques. The observation of gravitational lensing of background objects by galaxy clusters gave a strong boost in favour of the existence of dark matter. Dark matter researchers are tried to set up new directors to capture it. Different methodologies are followed. But all of these attempts have come out unsuccessful. This is because of the lack of sufficient knowledge about the nature of dark matter. It is obvious that without detecting a thing its properties could not be characterized properly. And, at the same time, it is also true that the scarcity of appropriate characterization of an entity designing its detector is like finding the needle in Khan's pile. Thus, the dark matter problem is like the chicken egg problem so far. The only feature of dark matter is known to us is that it has high gravitational force but it is non-luminescence, i.e. it does not interact with electromagnetic radiation. Depending upon this little knowledge about dark matter, we may proceed in two different ways. We can formulate different mathematical models of the universe postulating a few properties of dark matter and then by comparing theoretical results with experimental results we can judge whether our postulates about dark matter are true or not. This way of finding is like laying fruit by throwing stones. There is full of uncertainty with a chance of accidental success. On another path, we may postulate possibilities of properties of dark matter and find a suitable way to test it depending upon its postulated nature. In this method, we can at least eliminate a few possibilities or find out a few properties. Thus, this approach may be fruitful. The present way of detection of dark matter considering it as axiom falls in this category. The present research work is designed following this philosophy. In this investigation, dark matter is considered as a normal matter with some special features which are responsible for its abnormal gesture.

II. LITERATURE REVIEW

Among a lot of possibilities about the nature of dark matter, it is very easy to consider it as similar to normal matter because the properties of normal matter are quite well known. If we could explain the reason behind its abnormal phenomenon as we have experienced for dark matter, our problem will be solved. This approach is not examined so far. Normal matter shows gravity. Thus, if we could explain its darkness, i.e. non-interaction with electromagnetic radiation, our job will be done.

To understand the non-interaction of dark matter radiation interaction, we have to analyze how matter radiation interactions take place. When radiation interacts with matter, three different incidents may occur

absorption of radiation, the reflection of radiation and emission of radiation. Reflection and emission make the object directly visible. The absorption of radiation makes the object hot and is followed by thermal emission. Thus, it is possible to detect the object by a thermal detector. To remain undetectable under radiation, these three processes should be shut down by the object.

Let us find how these three processes could be shut down by dark matter. If it absorbs radiation completely, there would not be any reflection, i.e., the object would behave like a perfect black body. But, a perfectly black body is a very good emitter. If we consider that emission is not possible, then heating will be there. Hence, our present job is to find out an appropriate way to stop emissions as well as heating.

In the case of normal matter, emission takes place due to the excitation of excited electrons. Thus, to be an emission less object, possibilities of any kind of excitation should be ceased. May it be true for dark matter? Yes, it may be. How? It is known that the so called dark matter only exists in the coolest part of the universe where the temperature is very close to ok. Thus, there is a high possibility of Bose Einstein condensate of these particles. The BEC of a huge amount of particles will lead to a state where there would be an infinite energy gap between the ground state and the excited state. Not only that at this state as all particles behave like a single particle its rest mass will be infinite and hence change of its vibrational state by finite radiation energy would not be possible. Thus, there would not be any heating of it. This condition may make dark matter a non-luminescence or non-interacting particle.

III.DISCUSSION

Our postulates satisfy that a normal matter may behave like dark matter if an infinite number of such particles undergo Bose Einstein condensation. This is possible at a very low temperature region of the universe. Thus, we can say that dark matter is an insulator to electromagnetic radiation. Due to the presence of BEC, the mass density of dark matter will be high enough to exhibit a good gravitational attraction force.

If we consider dark matter as described above, then how could we detect them? In reply to this question, it could be prescribed that if we disintegrate them by any means of way, we would be able to detect them. If we measure the total observable mass before and after the explosion of a black hole near any dark matter dominated region of the universe, a change of observable mass will indicate the correctness of this postulate.

IV.CONCLUSION

In the present article dark matter is treated as a normal matter which exists in a BEC state in the universe. Due to the condensation of an infinite number of particles, its effective rest mass becomes infinite which makes it an electromagnetic insulator. Considering this phenomenon of dark matter, a detection method is prescribed also. Future experimental verification may reveal the corn erectness of this hypothesis.

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Studies on Antibiogram of Pathogens Isolated from Kham River at Aurangabad City, Maharashtra, India

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ABSTRACT

The Kham river is an important river of Aurangabad city. However, due to increasing population, urbanization and industrialization, it is getting poliuted at many sites. There have been the reports many epidemics of common diseases in and around Aurangabad. With this view, the common pathogens were isolated from the water samples collected from different polluted sites and were identified by using physicochemical and cultural characteristics. The antibiogram of these isolates was studied by poly dics method. As majority of the isolates were found to be sensitive to common antibiotics as well as resistant, suggesting presence of hazardous pollutants in the river.

Keywords: Kham river, pathogens, antibiotics.

I. INTRODUCTION

Water is distributed in nature as surface and ground water in different forms like rain water, river water, spring water etc. Water play a crucial role in any change in environment by affecting both flora and fauna of the nearby places and its contamination that can create harm to human beings as well as to the environment. The quality of the river water is greatly influenced by industrial, agricultural and plethora of human activities which affect its physic-chemical characteristics and microbial qualities[1].

Aurangabad city is spread over on area of about 137.40 Sq. Kms. With over 10 lakhs population(2010). Aurangabad city is the major district of Marathwada region of Maharashtra and it is situated on the banks of Kham river in altitude 19^0 53' 59" north and longitude 75^0 20' east. The city stands in the Dudhana valley between the Lakenvara range on the north and the Satara hills on the south. Kham river originates from the Jatwada hills near the city, 65 Km river flows through Aurangabad before it meets the Nathsagar water body near the NadikadcheGoan.

The continuous emanations of treated and untreated wastes from city drainage play a vital role in toxicating the river water quality of this region[2]. Sources of entry of microbial pathogen into river includes rain water surface- runoff, storm sewer spillages or overflow, discharge of untreated effluent came poor sanitation and

poor treatment of waste water and catastrophic floods[3][4], and thus infecting and killing of populations of both human and animal[5].

Two groups , coliforms and fecal streptococci, were used as indicators of possible sewage contamination[5] because they are commonly found in human and animal feces and are generally not harmful themselves and indicate the possible presence of pathogenic bacteria, viruses, and protozoans that are enteric[7]. Their presence in streams suggests the presence of pathogenic microorganisms[8], which makes *E.coli*to be used as an indicator of fecal pollution for decades[9]. Detailed knowledge of microbial pollution in river water is crucial for watershed management activities to maintain safe waters for recreational and economic purposes[10]. The concentrations of heterotrophic bacteria correspond commonly with contamination by organic matter[11] that changes with the weather condition.

An antibiogram is a cumulative summary of *in vitro* antimicrobial susceptibility test results obtained with bacteria and/or fungi recovered from patients with infection over a defined period of time in a given healthcare setting.Further, antibiogram can serve as a valuable tool for optimising antimicrobial therapy in patients with infection and an extremely useful information resource for active antimicrobial stewardship programmes. Antibiograms are often used by clinicians to assess local susceptibility rates, as an aid in selecting empiric antibiotic therapy, and in monitoring resistance trends over time within an institution.

II. MATERIAL AND METHODS

i. Selection of sites for water sample collection

Six sampling points, of water from Kham river, were identified. These sampling stations were Makai gate(east and west), Barapulla gate(east and west) and Lokhandi pool of Chhawani(east and west). The study period was June,2022 to September,2022, The water samples were collected aseptically in sterile 500 mL DuransSchoot glass bottle using the standard procedure and methods prescribed by American Public Health Association[12].

ii. Total Coliform count by Most Probable Number (MPN) Test

Most Probable Number (MPN) test was performed to assess the domestic pollution level in the selected area for total Coliform count. The technique involves three successive steps namely, presumptive test, confirmatory test and completed test. This method has direct application in quantification studies for media and for alternate microbiological methods. The number of broth tubes producing gas used to determine the statistical range of coliform.

iii. Total Plate Count(TPC) enumeration

TPC were enumerated by employing serial dilution agar plating method. Serial dilutions of the samples were prepared upto 10-5 by adding 1 ml water sample to 9 ml sterile physiological saline (0.8%). An amount consisting of 1 ml from each dilution was transferred aseptically onto duplicate sterile petri plates and approximately 15- 20 ml of molten plate count agar (45^0C) (Himedia, Mumbai, India) was added. The sample and agar were mixed mixed thoroughly by slowly rotating the plates several times. The plates were allowed to set and then incubated in inverted position at 37^0C for 24 – 48 hrs. Colony counts were made from plates with less than 300 but more than 30 colonies and results expressed as actual colony counts multiplied by the dilution factors(cfu/ml).

iv. Isolation and identification of Bacterial pathogens from water samples

By using inoculation needle, the samples were streaked for the growth of isolated colonies on nutrient agar. Then the plates were incubated at 37°C for 24 hrs for bacteria. Once a bacterium has been obtained in pure

culture, it has to identify. Identification of microorganisms is based on several criteria like morphology, staining reaction (gram staining), microorganism's shows diverse culture characters and the diversity also depends on the type of medium used for culturing. Growth parameter such as size, colour, texture, margin, elevation, consistency etc. was used in identification of colonies.

v. Biochemical Characterization of the Isolates

The biochemical tests performed include Indole production test, Methyl red test, Vogues-Proskauer test, Citrate Utilization test, Oxidase production test, Catalase production test, Triple Sugar Iron Agar test, Carbohydrate Fermentation. These biochemical tests were performed as per standard microbiological methods [16].

vi. Determination of drug sensitivity

The identified isolates were tested for drug sensitivity by overlaying the suspension of overnight culture of the test isolate on the surface of nutrient agar plate and keeping the poly discs of antibiotics on the inoculated agar surface. These drugs belonged to 11 classes of antibiotics: Ampicillin, Piperacillin, Ceftizoxime, Gentamicin, Trimoxazole, Chloramphenicol, Tetracycline, Amikacin, Cefotaxime, Ciprofloxacin and Ofloxacin. Antibiotic classes and mechanism of action is depicted in Table4. The standard agar disc diffusion method was performed [14]. The results were recorded after incubation at 37oC for 24 hrs.

III.RESULTS AND DISCUSSION

The occurrence of different pathogens at various sites in the Kham river at Aurangabad city and its morphological , cultural and antibiogram results of representative isolates are given in Table 1, 2, 3, and 5. Six bacterial pathogens were isolated and identified as *E.coli, Salmonella* spp., *Shigella* spp., *Proteus* spp., *Vibrio* spp., and *Pseudomonas* spp. During the study period from June,2022 to September, 2022. The MPN of coliforms was found in the range of $11X10^{11}$to 30 $X10^{11}$/100 ml. The highest coliform density was found in the monsoon. The coliform count is exceeding the water quality standards i.e. one/100 ml as per safe drinking water act.

Occurrence of fecal coliforms in 95% of water samples tested. The bacterial genera were found as *Salmonella, Shigella, Proteus, Vibrio* and *Pseudomonas* spp. Highlights severe contamination. As per Jassim *et al.*[15] waterborne athogenic bacteria, in water streams continue to be one of the most serious public health concerns, owing to their high expense of removal via traditional techniques in sewage treatment plants, as well as their morbidity, mortality and destruction of nature.

The antibiogram studies of the isolates shows that *E.coli, Salmonella, Shigella* and *Proteus* species were sensitive to many antibiotics which are commonly used in the treatment while the *Pseudomonas* have shown resistance to large number of antibiotics(Table 5). These findings are consistent with those of Mahgoub*et al.*[16].

It is clear from the present findings that the aquatic environment of Kham River has undergone deterioration. Some of the pollutants may be responsible for increasing the antibiotic resistance and should be dealt with seriously as emergence of antibiotic resistant pathogens is dangerous.

Proper remedial measures should be taken immediately in order to restore it from further deterioration. This calls for proper treatment, disposal and management of wastes being discharged in the river. Since it is a historical and important river covering major part of Aurangabad city, it should be well protected from contamination by proper maintenance.

Table 1. Morphological characteristics of bacterial isolates from water samples

Sr No.	Name of bacteria	Size of colony	Shape	Arrangement	Gram's nature
1	*E.coli*spp.	3 mm	Rod	Single	-ve
2	*Salmonella*spp.	2 mm	Rod	Single	-ve
3	*Shigella*spp.	-	Rod	Single/pair/short chain	-ve
4	*Proteus* spp.	-	Rod	single/pair	-ve
5	*Vibrio* spp.	3 mm	Curved rod	Single/pair	-ve
6	*Pseudomonas* spp.	1 mm	cocci	Single/pair/short chain	+ve

Table 2. Cultural characteristics of bacterial isolates from water sample

Sr No.	Name of pathogens	Form	Colour	Margin	Elevation	Odour
1	*E.coli*spp.	Circular	White/metallicsheen	Entire	Raised	Fecal
2	*Salmonella*spp.	Circular	Colourless	Entire	Raised	Unpleasant
3	*Shigella*spp.	Irregular	Yellow	Lobate	Convex	Fruity
4	*Proteus* spp.	Circular	Pale or colourless	Entire	Convex	Fishy
5	*Vibrio* spp.	Circular	Yellow	Entire	Raised	Fishy
6	*Pseudomonas* spp.	Circular	Flour yellow	Undulate	raised	Fruity

Table 3. Enumeration of MPN,TPC and bacterial pathogens from river water during June to Sept.2022.

Test	June		July		August		September	
	US	DS	US	DS	US	DS	US	DS
MPN(Coliforms	$18x10^{11}$	$22x10^{11}$	$15x10^{11}$	$17x10^{11}$	$13x10^{11}$	$17x10^{11}$	$18x10^{11}$	$22x10^{11}$
TPC	$22x10^{6}$	$29x10^{6}$	$18x10^{6}$	$20x10^{6}$		$15x10^{6}$	$20x10^{6}$	$23x10^{6}$ $30x10^{6}$
*E.coli*spp.	+	+	+	+		+	+	+ +
Salmonella spp.	+	+	+	+		+	+	+ +
*Shigella*spp.	+	+	+	+		+	+	+ +
Proteus spp.	+	+	+	+		+	+	+ +
Vibrio spp.	-	-	-	-		-	-	- -
Pseudomonas spp.	+	+	+	+		+	+	+ +

Legends: US- Upstream DS- Downstream

MPN- No./100 ml Total Plate Count: per ml

Table 4. Mechanism of action f selected antibiotics

Name of antibiotics	Class of antibiotics	Mechanism of action
Ampicillin	Penicillin	Inhibits cell wall synthesis
Cefotaxime	Cephalosporin	Inhibits cell wall synthesis
Chloramphenicol	Amphenicol	Inhibits protein synthesis
Ceftizoxime	Cephalosporin	Inhibits cell wall synthesis
Oflaxacin	Quinolone	Inhibits cell wall division
Amikacin	Amynoglycoside	Blocks protein synthesis
Co-Trimaxazole	Sulfonamide	Inhibits folic acid synthesis
Piperacillin	Penicillin	Inhibits cell wall synthesis
Ciprofloxacin	Quinolone	Inhibition of bacterial DNA gyrase
Tetracycline	Polyketaide	Inhibits protein synthesis
Gentamicin	Amynoglycoside	Inhibits protein synthesis

Table 5.Antibiogram of different pathogens isolates from Kham rivrer.

Antibiotic	AS	BA	CF	PC	CH	CP	CI	TE	OF	GM	AK
Pathogens											
*E.coli*spp.	S	SSSSSSSSS									
*Salmonella*spp.	R	S	R	S	R	RR	S	R	RR		
*Shigella*spp.	S	SSSSSSSSS									
Proteus spp.	SSSSSSSS		R	S							
Vibrio spp.	-	-	-	-	-	-	-	-	-	-	-
Pseudomonas spp.	RRRRR	S	R	RR	S	S					

AS: Ampicillin (20 mcg) BA: Co-Trimaxazole (25 mcg) S: Sensitive

CF: Cefttotaxime (30mcg) PC: Piperacillin(100 mcg) R: Resistant

CH: Chloramphenicol (30mcg) CP: Ciprofloxacin (5 mcg)

CL: Ceftizoxime (30 mcg) TE: Tetracycline (30 mcg)

OF: Ofloxacin (5 mcg) GM: Gentamicin (10 mcg)

AK: Amikacin(30 mcg)

IV. CONCLUSION

The present research work clearly indicatesthat Kham river water is highly contaminated by bacteria those are present in all sort of environmental conditions that allows human involvement which are predominated by indicator organisms. Bacteria seems to be responsible for the degradation of organic and inorganic compounds from where they derive their nutritional requirement hence the present study strongly suggests to develop certain standards for Kham river water in Aurangabad city for the health concern of the population residing in its bank , also the study of bacterial population those are used in remediation of metal pollutant deposited in river water from various industrial resources can help in removal of those metal from the river water.

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Agro-tourism: Scope, Gains and Constraints

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ABSTRACT

Agricultural tourism is a global trend that allows city inhabitants to escape the concrete and rediscover their rural roots. In addition, visiting farmers, agronomists, and other agricultural specialists can assess global agricultural advancements that have been heavily affected by contemporary technology. Agro-tourism, an innovative aspect of agriculture, emerged as a result of modern technologies. As a result, the study of agricultural tourism is critical in the current state of affairs.

Agro-tourism is not simply a specialized business within the larger tourist industry, but also a driver of rural revival, cultural interchange, and global sustainability. It encourages policymakers, practitioners, and stakeholders to work together to create a thriving and inclusive agro-tourism sector that Gains for both Farmers and communities.

Keywords: Agro-tourism, Rural revival, Cultural interchange, Agricultural advancements, Sustainable development, Urban-rural connection.

I. INTRODUCTION

Tourism is now widely acknowledged as a growth driver in many countries throughout the world. Several countries have altered their economy by maximizing their tourist potential. Tourism has the potential to produce significant employment and additional revenue for both skilled and unskilled workers. Today, the notion of traditional tourism has evolved. Some new fields of tourism have evolved, such as agrotourism.It investigates the wide spectrum of activities covered by agriculture tourism, such as farm tours, agricultural festivals, farm stays, and agritourism experiences.

Promotion would bring many direct and indirect benefits to the people. Agriculture is the core of India's economic life. More than a profession or a business, agriculture is India's culture, with around 85% of the population directly or indirectly dependent on agriculture and almost 26% of India's GDP coming from agriculture.

Objectives of Research:

1. To influence people's attitudes towards agriculture.
2. To investigate the relevance of agricultural tourism.
3. To identify the issues and advantages of agrotourism.

Importance of Research:

More than a profession or a business, Agriculture is India's culture. Due to irregular monsoon, fluctuations in prices for agricultural products and some internal weaknesses, the company is now losing money. Therefore, the contribution of agriculture to national GDP would be increased if additional revenue generating activities were added to existing agricultural production.

Research Methodology:

The current study on Agro-tourism is based on secondary data. The information has been gathered from relevant books, research papers, and articles. Some data has been obtained from the websites of the Government of India and the Ministry of Agriculture. Some suggestion been drawn from Agri Tourism Development Corporation.

Concept of Agro-tourism:

In general, Agro-tourism is the process of luring tourists or visitors to an area or region utilized mostly for agriculture. Agricultural tourism is the notion of visiting a working farm or any agricultural, horticultural, or agribusiness enterprise for the goal of leisure, education, or active participation in the activities of the farm or operation.

Agro-Tourism is an Agri-Business activity in which a native farmer or person from the area offers tours of their agriculture farm to allow visitors to see them growing, harvesting, and processing locally grown foods such as coconuts, pineapple, sugarcane, corn, or any other agricultural produce that they would not find in their city or country.

Farmers frequently offered homestays and schooling. Agro-Tourism and Eco-Tourism are closely connected. Eco-tourism is provided by tour companies; however, with agro-tourism, farmers give tours to their agriculture farms while also offering entertainment, education, and fun-filled experiences for urban residents.

Furthermore, this activity introduces tourists to nature and rural activities in which they may engage, be delighted, and enjoy the experience of visiting.

SWOT Analysis:

Strengths	Weaknesses	Opportunities	Threats
A rich agricultural background with a variety of farming approaches.	Seasonal changes and weather-related operations.	Extending agro-tourism options to incorporate value-added experience.	Rivalry with other tourist places and attractions.
Tourists get the opportunity to engage in real, hands-on activities.	Rural places have little infrastructure and facilities.	Collaborate with community members to create supporting policies and activities.	Regulatory restraints and administrative barriers.
Contributing to rural economic growth and employment creation.	In comparison to other popular tourist locations, there is a lack of marketingknowledge.	Incorporation of technology to improve tourist experiences and efficiency in operations	This poses a risk of detrimental environmental consequences.

Scope of Agro-tourism:

1. An affordable entrance to the cost of meals, lodging, amusement, and travel Tourism. This expands the tourist base. The current notion of travel and tourism is restricted to a small segment of the population; nevertheless, the concept of travel and tourism has expanded to include a broader population, broadening the scope of tourism.
2. The urban populace is interested in the farming sector and lifestyle. Agro-tourismcanfulfill the interest of this part of the population by re-discoursing the rural life, which is rich in diversity.
3. Strong demand for healthy family-oriented leisure activities.
4. Health-conscious urban families look for pro-nature towns to make living easier.
5. Everyone tries to work more in different ways in order to acquire more contemporary contorts. As a result, he never feels at ease. Tourism is the method of location. Peace and serenity are integrated into Agro-Tourism since it is remote from metropolitan populations.
6. In resorts and cities, overcrowding disturbs each other's calm. Thus, calm extends beyond cities and resorts. Despite the fact that resorts and farmhouses artificially create a village ambiance in suburban regions, it appears to be tiger-colored. Artificiality is emphasized and not fulfilling.
7. There is room for growth in the villages' agro-atmosphere, including agri-shops, culinary tourism, choose and own your tree plot, bed and morning meal, camel riding, fishing, boating, herbal walks, rural games, and health.
8. Educational benefit of Agro-Tourism: Agro-tourism might generate awareness about rural people about agriculture science amongst urban schoolchildren.

Agro-Tourism Gains for –

Farmers:

- Diversification of farmers' revenue streams.
- There is an opportunity for direct selling of agricultural goods.
- Enhancement of farm visibility and brand awareness.
- Opportunities for value-added product sales and agritourism experiences.

Communities:

- Economic growth is achieved by increasing local expenditure.
- Job creation in a variety of industries, including hospitality, transportation, and retail.
- Infrastructure improvements will encourage tourism activities that benefit the community.
- Local customs are promoted and cultural heritage is preserved.
- Increased communal pride and feeling of identity.
- Opportunities for community people to get involved in tourism-related companies.
- Increased money leads to improvements in public services and facilities.

Income Generating activity :

- Farm Tour
- Sell of organic products (vegetables, fruits)
- Exhibition of different seeds and crops
- Festive and culture
- Handi crafts gifts
- Local cuisine food stall
- Increase in transportation business

- Fishing and animal ridings

Challenges in Agro-Tourism:

- Seasonal variations in visitor numbers and agricultural activity.
- Regulatory barriers and compliance needs.
- Rural places have little infrastructure and facilities.
- Balancing agricultural activities with tourism needs.
- Visitors pose a risk of damaging crops and property.
- Lack of awareness and marketing issues.
- Dependence on weather and natural calamities.
- Competition from other tourist places and attractions.
- Sustainability worries over increased foot traffic and environmental effect.

Constraint of Agro- Tourism:

- Cultural and linguistic obstacles for overseas tourists.
- There is a lack of skilled people and hospitality skills in remote locations.
- Traditional rural villages are resistant to embracing tourists.
- Overtourism poses a risk to natural resources.
- Lack of complete knowledge about Agro-tourism.
- Lack of funds to provide basic infrastructure for agrotourism.
- Small farmers lack communication skills and a business attitude.
- Many farmers have tiny holdings with poor land quality.
- Agriculture is dependent on irregular Manson season.

II. CONCLUSION

The Indian tourism industry is rapidly increasing. Agri-tourism idea value addition benefits future producers. Agri-tourism development can help a farmer become a future entrepreneur.

Agritourism promotes rural development by creating employment opportunities and empowering rural communities.

The population lives in cities and wants to experience rural life and learn more about it. It is a good potential to build an agro-tourism, but there is an issue of poor knowledge about this industry in farmers, as well as the problem of financing and right vision in farmers.

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Solid State Characterisation of Montelucast sodium by XRD, DSC, TGA, IR and Microscope

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ABSTRACT

This study was aimed to solid state characterization by using x-ray diffraction, thermal analysis, Image by microscopy and spectral studies of Montelucast sodium. From the XRD diffractogram it is observed that there is no change in polymorphic form along with there is no any differences diffraction pattern since there is no any diffraction peak, proves that it is amorphous compound. The X-ray powder diffract gram of Montelucast reveals no crystallographic peak just halos suggesting that Montelucast was amorphous in nature.IR spectrum shows characteristic peaks 3354.22cm-1.(O- Stretching),3055.25,2976.17,2924.09cm-1(C-Stretching),1571.99cm-1(C=O carboxylate salt, stretching). Microscopic image analysis also proves that compound is amorphous in nature since there is no any crystal observed. The DCS analysis further conform that by glass transition event, that compound is amorphous in nature the thermal behavior of Montelucast. TGA analysis provides insight into the thermal stability of Montelucast, indicating it's not significant weight loss at up 200 ° C Temperature.

Keywords: Image Analysis, DSC, TGA, PSA, XRD, Microscope, IR

I. INTRODUCTION

Montelucast sodium is chemically (R-(E))-1-(((1-(3-(2-(7-chloro-2-quinolinyl) ethenyl) phenyl)-3(2-(1-hydroxy-1-methylethyl) phenyl)propyl)thio)methyl)cyclopropaneacetic acid, monosodium salt [1] Children with asthma receive daily treatment and according to international guidelines the first choice of treatment is inhaled corticosteroids. The treatment is often combined with adrenergic β2 receptor agonists. The second choice for treatment is leukotriene receptor antagonists, for example, Montelucast (Singulair®), which is approved for use in children (<12 years)[2,3] Montelucast, a cysteinyl leukotriene type 1 receptor antagonist, can alleviate leukotriene-mediated bronchoconstriction, increased vascular permeability, and mucus secretion, and is recommended for asthma treatment in both children and adults (4-6).

Active pharmaceutical ingredients (APIs) can exist in different polymorphic forms as well as in amorphous state. Polymorphic and amorphous forms of APIs can differ in physicochemical properties which in turn can significantly influence their therapeutic safety and effectiveness of the treatment. [7]

Prioritizing the research of polymorphism is always necessary to fully comprehend the rapid absorption of low bloodstream solubility of medications. [8, 9, 10]These situations include those in which it's essential to dissolve pharmaceuticals faster or at higher concentrations to optimize absorption and achieve an appropriate systemic exposure for treatments with restricted solubility. [11, 12, 13]. More importantly, API polymorphisms have a direct effect on therapeutic product stability, solubility, and bioavailability. [14]

Montelucast sodium is having amorphous and crystalline forms reported and crystalline from is more stable over amorphous from. [15, 16] Amorphous from is metastable. Metastastable forms are more bioavailable in nature since solubility is at higher site.[17] Based on these available dada it is observed that further in-depth study of amorphous form for solid state study is necessary and hence present research paper deal with solid state characterization of the Montelucast Sodium amorphous from is necessity. Montelucast Sodium amorphous form characterization plan with XRD, DSC, TGA, and dynamic image analysis.

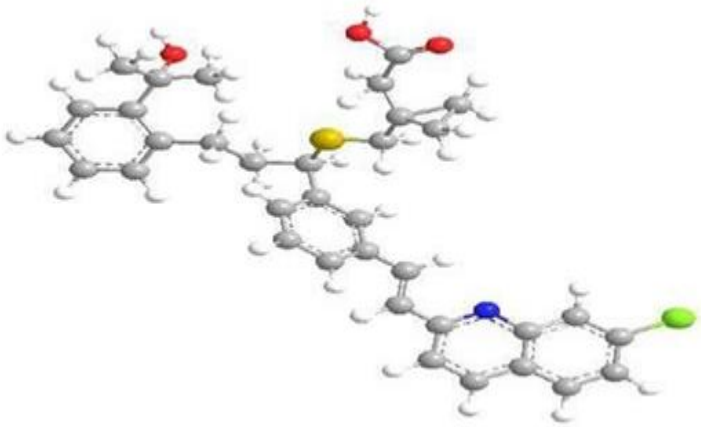


Fig 1 Structure of Montelucast Sodium

II. MATERIALS AND METHODS

Materials

Active Pharmaceutical Substance-Montelucast, Isopropyl alcohol, Ethyl acetate, Glycerin.

Instrumentation: FTIR Spectroscopy -Shimadzu, IR Affinity 1S. Hydraulic Press, Vacuum Oven, Mortar and Pestle. XRPD-PANalytical, X'Pert PRO, TGA-TA Waters, DSC Mettler Toledo-3+, Microscope-Zeiss-Axioscope.

Method

Procedure for TGA

Thermogravimetric Analysis were performed on a TGA, Model-Q1000, instrument conditions were kept as Equilibrate 30°C,Ramp rate 10°C/min up to 300°C,isothermal for 5 min.

Procedure for XRD

Powder XRD analysis were performed on PANalytical Corporation, Eindhoven, Netherlands was carried out with a Cu-Ka radiation as source. Data were collected at a step size of 0.0131303 and time per step 49.725 over a range of (2Ɵ) 2 to 40. The generator settings were 45kV and 40 mA.

Procedure for IR

Fourier transform infrared (FTIR) spectroscopic Spectra were obtained by using FTIR spectrophotometer, Shimadzu, model IR Affinity 1-S. sample were prepared by ATR method. The spectra were scanned over wavenumber range from 4000 to 600 cm-1

Procedure for Microscope

Recording image of sample using Microscope carried out with Make Zeiss and Model Axioscope 40.

Procedure for Image Analysis.

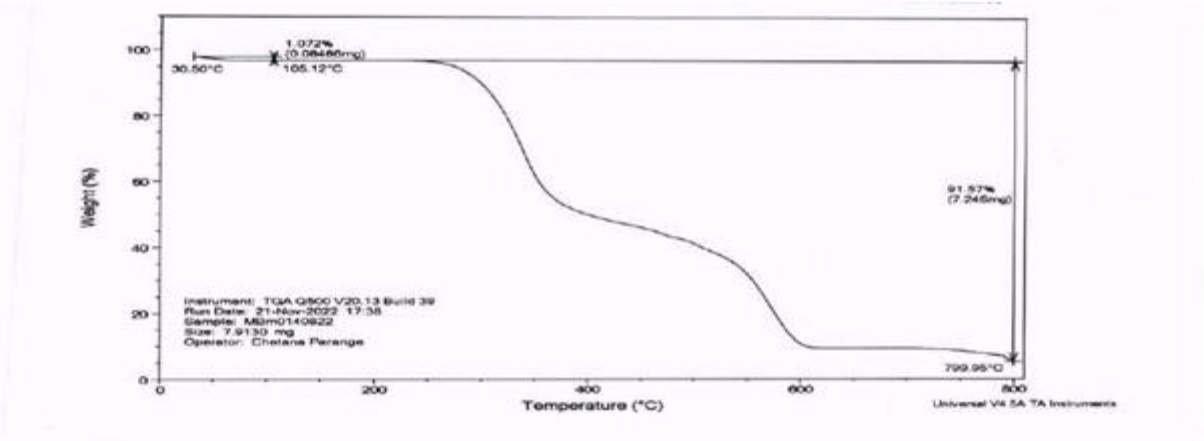
Image analysis were obtained by using Image Analyser (Make- Microtrac Model-SIA).

III.RESULTS AND DISCUSSION

1. TGA Analysis

Thermogravimetric analysis was used to study the relative Montelucast sodium sample moisture absorbed and treated sample, when equilibrate at 30°C, ramp rate 10°C/Min up to 800°c, Isothermal for 5 min, then from the data it was observed that, loss at 105°C is 1.072%

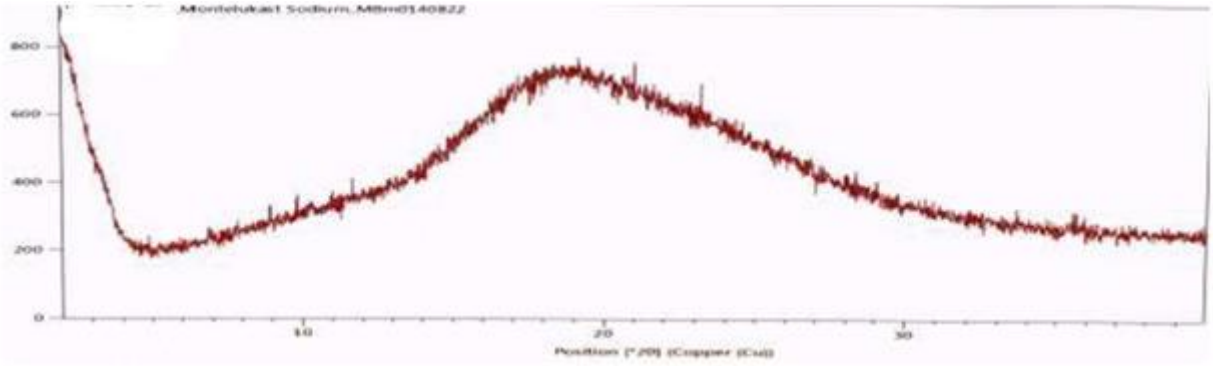
Figure 02 TGA Thermogram



2. XRD Analysis

The polymorphic state of Montelucast was evaluated using PANanalytical. The PXRD patterns obtained experimentally Montelucast sodium sample showed excellent agreement (Fig.2), demonstrating that they were no peak in difractogram suggest that it is amorphous in nature and can be conclude that The X-ray powder difractogram of Montelucast reveals no crystallographic peak just halos suggesting that Montelucast was amorphous.

Figure 03 XRD Histogram of Montelucast

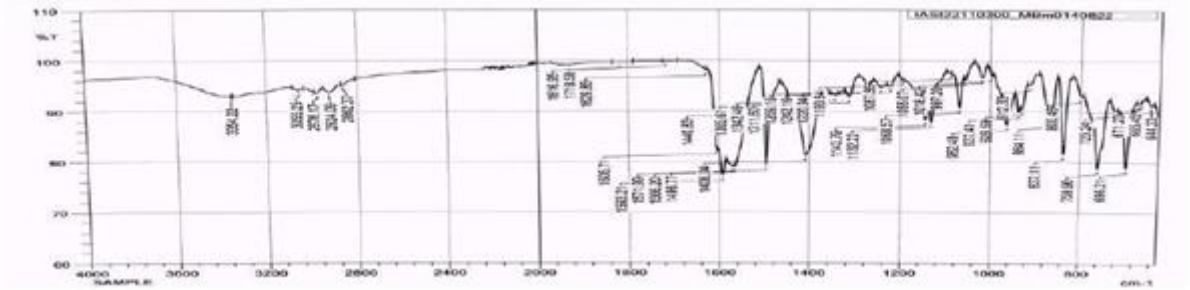


3. FT-IR Analysis

Prepare the pellet and record IR absorption spectrum in the range of 4000 cm-1 to 650 cm-1. Montelucast showed characteristic peaks 3354.22cm-1.

(O- Stretching), 3055.25, 2976.17, 2924.09cm-1(C-Stretching), 1571.99cm-1(C=O carboxylate salt, stretching)

Figure 04 Fourier transform infrared spectrum of Montelucast



4. Microscopic Analysis

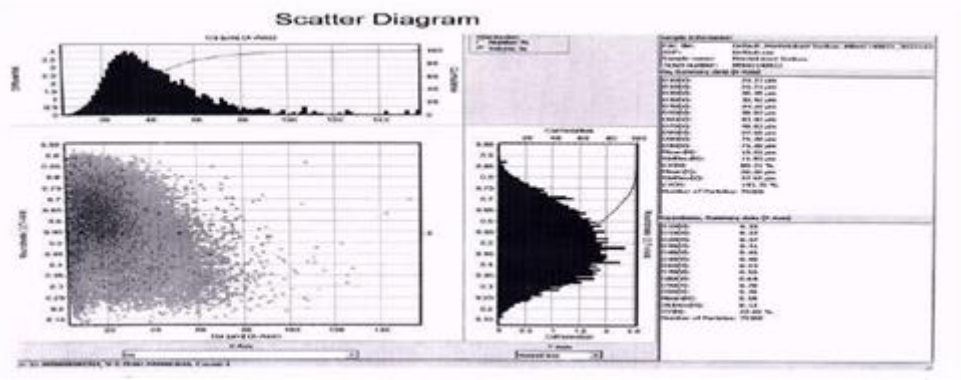
Microscopic analysis were performed sample containing glycerine, mounted few drops of sample on clean glass slide and examine the mixture using microscope and imaged were recorded and found that it is in agreement with that of XRD difractogram that it compound is amorphous in nature.

Figure 05 Microscopic image of Montelucast

5. Image Analyser

Taken sample in 100 ml beaker added 4 drops of dispersant and make paste by using rod then added 10-20 ml dispersant stir well and sonicated for 5 min and carry out analysis and particle size distribution recorded as ,

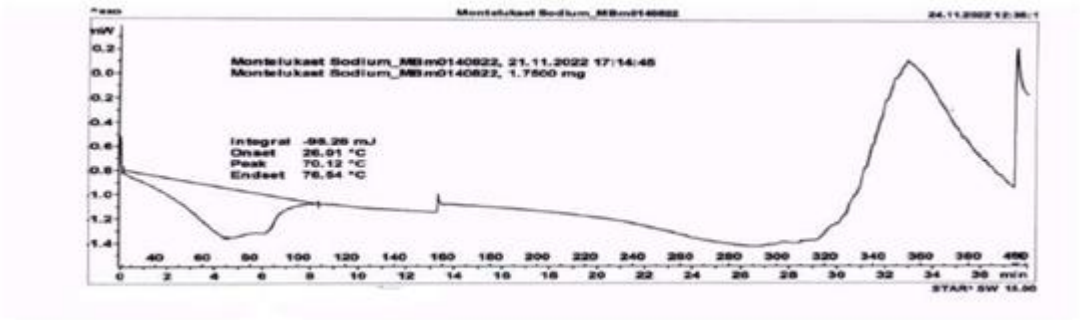
Figure 06 Particle size distribution of Montelucast



6. DSC Analysis

The thermograms of Montelucast were shown in Fig.05 it exhibited a broad endothermic peak with a slight shoulder at range about 40–114°C corresponding to dehydration of water absorbed by Montelucast molecule and overlapping with glass transition of amorphous Montelucast. The enthalpy (J/g) increased from 80.29 initial to 143 resulting from dehydration of addition water amount absorbed by Montelucast during storing,

Figure 07 DSC Thermogram of Montelucast



IV. CONCLUSION

This research paper aimed to characterize the solid state characteristics of Montelucast using various analytical techniques, including XRD, DSC, TGA, particle size analysis, and image analysis. The IR spectrum exhibits distinctive peaks. O-Stretching: 3354.22 cm-1; C- Stretching: 3055.25, 2976.17, 2924.09 cm-1; C=O carboxylate salt, stretching: 1571.99 cm-1. Through XRD analysis, it was determined that Montelucast possesses an amorphous structure with a specific diffraction pattern, aiding in its identification, Images obtained by image analysers and microscopy reveal that the substance is amorphous in form. The DCS analysis revealed the thermal behaviour of Montelucast, showing the presence of a glass transition, which can be attributed to its amorphous nature, TGA analysis provides insight into the thermal stability of Montelucast beyond 200ºC indicating its weight loss at different temperature internals, Overall, the combination of this technique allowed for the compressive characterization of Montelucast, offering valuable insight into its physicochemical

properties. The findings of this research will contribute to the development and optimization of Montelucast based pharmaceutical products and formulations.

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Data Availability Statement
The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest
The authors declare no conflict of interest.

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Transmission Electron Microscopy Studies to the Encapsulation of AgNPS

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ABSTRACT

Stable silver nanoparticles were formed by treating aqueous solution of AgNO3 for the first time with the Dioscorea deltoidea tuber extract which act as a reducing, stabilizing and capping agent. Effect of starch has also been studied on the optical properties and morphology of advanced Ag-nanoparticles formation. UV-visible spectroscopy was used to monitor the quantitative formation of silver nanoparticles. The synthesized silver particles show an intense surface plasmon resonance band in the visible region at 425 nm. Result indicated significant changes in the morphology and/ or agglomeration tendency with starch. We used the iodometric titration to conform the encapsulation of AgNPs inside the helical structure of starch. The reversible nature of encapsulation has been studied by UV-visible spectroscopic technique and Transmission electron microscopy (TEM) measurement and through digital images. TEM results show the formation of stable AgNPs with and without stabiliser at same concentration of AgNO3, Gives spherical, Silver nanotriangles and nanorods, anisotropic silver nanoparticles, silver nanohexagon, and irregular silver nanoparticles like capped structure with stabiliser and spherical, rod, triangular, irregular silver nanoparticles as well as truncated triangular pentagonal like structure in absence of stabiliser. Diameter of the AgNPs ranging from 11.21 nm to 103.47 nm.

Keywords: D. deltoidea tuber extract, starch, Diosgenin, AgNPs, Morphology

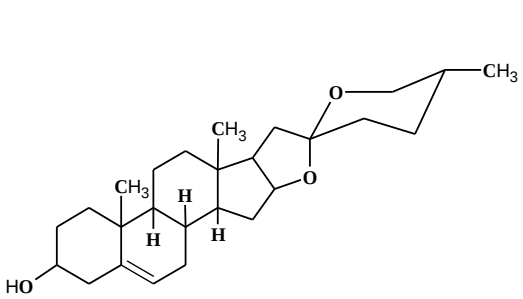
I. INTRODUCTION

Nanobiotechnology shows the interaction of nano and biotechnology, which is an emerging field dedicated to new creation, improvement, and utility of nanoscale structures for advanced biotechnology [1]. A vast and an important area of research in this field is the synthesis of nanoparticles with different chemical compositions, sizes, shapes, and controlled morphology. From the last two decade, the biosynthesis of Nobel metal

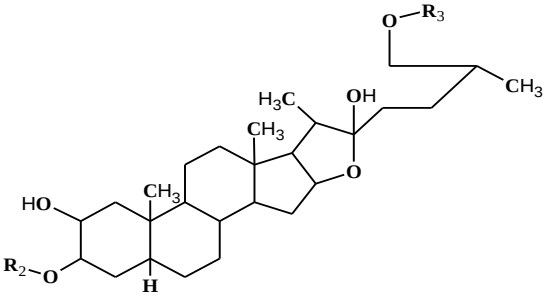
nanoparticles (silver, gold, platinum, and palladium) has received very important attention due to the growing need to develop environmentally sociable technologies in materials synthesis [2-5]. Nanoparticles exhibited utterly novel characteristics due to their extremely small size and large surface to volume ratio, as compared to the large particles of bulk materials [6]. Nanoparticles of Nobel metal (silver, gold, platinum and palladium) are mostly applied in fast moving consumer goods such as soaps, shampoos, detergent, cosmetic products, and toothpaste, they have also application in medical and pharmaceutical products [7]. Silver nanoparticles used in sensor technology, biological levelling, and many other biomedical applications [8-13]. Nanoparticles can be synthesis by using a number of routinely used chemical and physical methods. But these methods are very energetic and capital intensive, and they employ toxic chemicals nonpolar solvents in the synthesis procedure. Therefore it requires the development of a clean, reliable, biocompatible, benign, and eco-friendly process to synthesize nanoparticles. So this need, leads to turning researchers toward "green" chemistry and bioprocesses [14]. So the use of plant system has been considered a green route and a reliable method for the biosynthesis of nanoparticles owing to its environmental friendly nature [15, 16]. It is evident from past reported that Plants system have been used for rapid and extracellular biosynthesis of Nobel metal nanoparticles [17-19]. Therefore the Green biochemical methods for the synthesis of advanced Ag-nanomaterials by the natural resources especially from the seeds, leaves, tuber and fruits were the eco-friendly alternatives to chemical reduction methods. Extract of various leafs, plants, algae, fungi and yeast acted as reducing, capping and shape-directing agent in the green synthesis of silver and gold nanoparticles [20–23]. Shankar and co-worker also reported that gold and silver nanoparticles can be synthesized using plant extracts [24, 25].Recently we successfully synthesize silver nanoparticles of Allium sativum, Camellia sinensis, and citrus lemon by use of their extract [26-28].

The genus Dioscorea, a monocotyledon, species belonging to the family Dioscoreaceae, comprises approxmately 600 species of the genus Dioscorea, Among them Disocorea deltoidea has been much sought after by private agencies and pharmaceutical firms, having been continuously collected and used in India. It is a underground root like tuber mostly black in color with hair. D. deltoidea has profound therapeutic applications due to its unique phytochemistry. The genus Dioscorea has recently gained much importance due to source of steroidal sapogenins like diosgenin. Diosgenin act as promising starting material for synthesis of cortisone, progestrone, for the chemical synthesis of steroidal drugs, and is impressively important to the pharmaceutical industry [29]. The roots yield cortisone, a steroidal hormone, used in treating rheumatic diseases and ophthalmic disorders which is useful in preparation of sex hormones [30]. A new steroidal saponin like, orbiculatoside B, together with a pair of furostanol saponins, protobioside and methyl protobioside, from the fresh rhizomes of D. deltoidea also serve as a common food, particularly among the hill tribes and the poor [31,32]. Ghosh S, et al. use Dioscorea bulbifera tuber extract for Synthesis of silver, gold nanoparticles [33]. However, to date, there are no reports on the synthesis of silver nanoparticles using D. deltoidea tuber extract. In this paper, we report on the quick synthesis of silver nanoparticles by reduction of aqueous Ag^+ ions using D. deltoidea tuber extract. Our objective in this work was to prepare nanoparticles using a biomaterial that addresses two major factors, ie, the requirement for the biomaterial to be environmentally benign and produce no toxic industrial waste and for it to be cost-effective and easily produced. We also discuss the effects of reaction conditions, temperature and $AgNO_3$ concentration, on the rate of synthesis of AgNPs. Phytochemical analysis revealed that D. deltoidea tuber extract present mostly flavonoid, phenolics, reducing sugars, starch, diosgenin, ascorbic acid, and citric acid. The biosynthesis process was quite fast, and AgNPs were formed within 3 hours. The choice of D. deltoidea as reducing agent is based on its rich content of steroid sapogenin known as Diosgenin. Out of

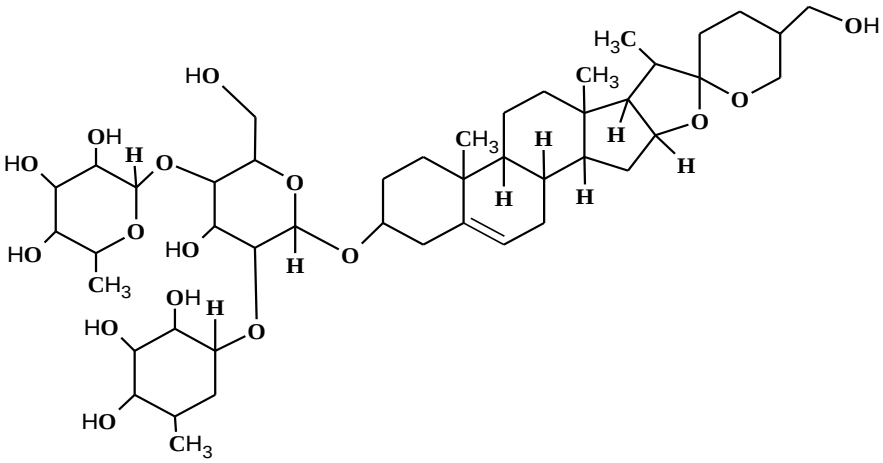
constituent discuss above and in (Scheme 1), Disogenin, a typical steroid sapogenin, compounds is the major existing species present in the D.deltoidea tuber aqueous extract [34]



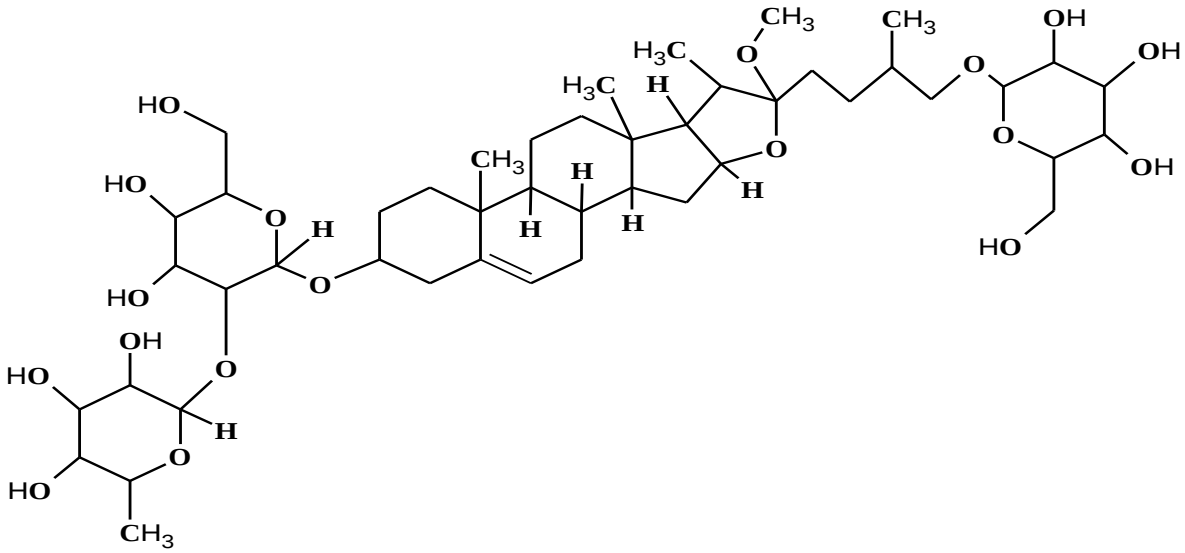
Disogenin



Furostanol Saponin



Orbiculatoside B



Methyl protobioside

Scheme 1. Molecular structures of some constituents of *Dioscorea deltoidea tuber* extrat

2. Experimental

II. MATERIALS AND METHODS

2.1 Materials and preparation of extract

Dioscorea deltoidea tubers were collected from Poonch district of gigantic Pir Panjal range (Jammu and Kashmir, India) in the month of April. D. deltoidea tubers were cleaned properly by removing their hairy root and washed 4-5 times through tap water and then through distilled water. Collected tubers of d. deltoidea were used without drying. After peeling, plant tuber solution was prepared by taking 10 g of thoroughly washed tuber into 500 ml Erlenmeyer flask with 250 ml of sterile distilled water and then boiling the mixture for 30 mins. After heating, the solution was cooled, decanted, and filtered through Whatman no. 1 filter paper, and the filtrate was stored in amber colored air tight bottle at 10°C and used within a week for the preparation of AgNPs. Water used as the solvent was previously subjected to deionization in an all glass apparatus, followed by double distillation (first time in alkaline $KMnO_4$). Silver nitrate, oxidant ($AgNO_3$, Merck India, 99.99%), starch (stabilizers) were used as received without further purification. Starch solution (2.0 %) was prepared by dissolving the required amounts in the deionized water, boiled for 15 min in a 500cm^3 Erlenmeyer flask with constant rapid stirring to avoid the aggregation of starch. The mixture was cooled and filtered with Whatman paper No. 1. Filtrate was collected and used. All glassware was washed with aqua regia (3:1 HCl and HNO_3) and rinsed deionized water, followed by subsequent drying.

2.2 Preparation and Characterization of silver nanoparticles

Preliminary observations showed that extract play an important and/or crucial role in the preparation of different colored silver sols. In this typical experiment D. deltoidea extract, 10.0 cm^3 were added in a reaction mixture ($AgNO_3$, 5 cm^3 of 0.01 mol dm^{-3} + starch (2.0 cm^3; 2 %). + distilled H_2O) in absence and presence of starch. Surprisingly, the colourless reaction mixture became brown which indicating reduction of Ag^+ ions into Ag^0, which leads to the formation of colloidal silver.

The morphology and size of AgNPs was observed by Transmission Electron Microscopy (TEM, Hitachi, and H7 100). The yellow and deep wine color silver sols were deposited to a copper grid at room temperature. After drying, sample was analyzed at 80 kV. The optical property of AgNPs was analyzed via UV-visible (UV-Vis, Perkin Elmer, Lambda 35) absorption double beam spectrophotometer with a deuterium and tungsten iodine lamp in the range from 300–600 nm at room temperature.

2.3 Kinetic measurements

The kinetic measurements were carried out in a three necked reaction vessel fitted with a double surface condenser to check evaporation by adding the required concentrations of $AgNO_3$, starch and water (for dilution maintained). The progress of the reaction was followed spectrophotometrically by adding the required concentrations of D. deltoidea extract. The absorbance of the appearance of yellowish-brown color was measured at 425 nm at definite time intervals.

2.4 Encapsulation studies

Iodometric titration was used to find out the possible role of soluble starch during the synthesis of AgNPs. In a separate experiment, AgNCs were prepared by adding $AgNO_3$ (5.0 cm^3; 0.01 mol dm^{-3}) in a solution of starch (2.0 cm^3; 2 %) and [extract] = 10.0 cm^3. The resulting brownish-yellow color (10 cm^3) was titrated against 0.1 N iodine solution (I_2/ KI). The stable blue colour of starch-iodine complex was obtained, 2.0 cm^3 of AgNPs solution was further added in the blue color and the visible spectra were recorded at regular intervals. The

morphology and size of blue colour of starch-iodine complex, reversible yellowish AgNPs was observed by Transmission Electron Microscopy (TEM, Hitachi, and H7 100). The blue and yellow color silver sols were deposited to a copper grid at room temperature. After drying, sample was analyzed at 80 kV

III.RESULTS AND DISCUSSION

Silver nanoparticles exhibit yellowish brown color in aqueous solution due to excitation of surface plasmon vibrations in silver nanoparticles. Reduction of silver ion to silver nanoparticles during contact to the D. deltoidea extracts could be followed by color change. Surface plasmon resonance (SPR) bands are influenced by the size, shape, morphology, composition and dielectric environment of the prepared nanoparticles [35]. The choice of D. deltoidea as reducing agent is based on its rich content of Diosgenin, a steroid sapogenin, compounds. To prepare the stable silver nanoparticles via the chemical reduction method, it is important to choose appropriate stabilizer and reducing agent. It is known that in the case of silver nanoparticles, the UV-vis absorption spectra are very sensitive to the particle size and their aggregation state, since the silver nanoparticles strongly absorb in the visible region due to surface plasmon resonance [36-39]. UV-visible spectroscopy is one of the extensively used techniques for characterization of AgNPs. The shape of the spectra and position of the wavelength maximal gives initial information about the size and the size distribution of the AgNPs [40].Figure 1, shows the UV–visible spectra of the nanoparticles obtained at constant [extract] = 10.0 cm^3, $[Ag^+]$ = 3.33 (■), 10.0 (●), 16.66 (♦), 23.66 (○), 33.33 × 10^{-4} mol dm^{-3} (▲), [extract] = 10.0 cm^3, starch (2.0 cm^3; 2 %). Temperature = 30 ^{0}C respectively. In these observations, the anisotropic growth of AgNPs was confirmed by the appearance of characteristic SPR band at ca. 425 nm in the UV-Vis region. On increasing the reaction-time, a sharp peak begins to develop. Figure 2, shows the UV–visible spectra of the nanoparticles obtained at constant $[Ag^+]$ = 16.66 × 10^{-4} mol dm^{-3}, [extract] = 1.0 (■), 3.0 (●), 5.0 (♦), 7.0 (○) and 10.0 (▲) cm^3, starch (2.0 cm^3; 2 %). Temperature = 30 ^{0}C. Since peak wavelength did not shift significantly during the reaction with increasing [extract] and reaction time, indicating that the morphology of the AgNPs was not affected by the increase in [extract]. Inspections of Fig. 1, 2, indicate that resulting color shows no SRP broad or any shoulder in the whole entire UV-vis. region. The increases in absorbance are attributed to the increase in nanoparticles size with reaction time and $[Ag^+]$.

As the reaction proceeds, the width of the band has also increased, which might be due to the excitation of different multiple modes present in faceted and anisotropic growth of particles. The typical color of silver nanoparticles strongly depends on the nature and/or types of the stabilizers. Yellowish color intensifies with time showing the size of the nanoparticles increases. After the addition of starch intense yellow color observed with in short period of time but the same color does not appear in absence of starch. From this observation it is clear that starch not only capped the nanoparticles but also assist in the formation of large sized nanoparticles which is clear from TEM images. Although there was no significant synthesis at t = 0 minutes and t = 30 minutes, the rate of synthesis increased at t = 60 minutes at a very rapid rate and was completed in 3 hours in as indicated in Fig. 3, and The reaction-time curve indicates no significant variation in absorbance after 3h, suggesting that nucleation and growth occurs within this period. The perfect transparent yellowish-brown color remains stable for months with no visible sign of precipitation, aggregation, or oxidation. AgNPs formed with D. deltoidea tuber extract were found to be very stable, possibly because of the different constituent present in the extract that prevented agglomeration, even after 30 days. The phytochemicals mainly diosgenin present in the tuber were believed to be responsible for reducing the Ag^+ to Ag^0, but the shape is possibly

believed to be controlled by chemical factors like ascorbic acid and citric acid. On the basis of above results and discussion, Scheme. 2, mechanism to the reduction of Ag^{+} ions by constituents of D. deltoidea tuber extract is proposed.

$$\text{Diosgenin-OH} + Ag^{+} \xrightarrow{\text{rds}} \text{Radical} + Ag^{0} \quad \text{(Nucleation)} \quad (1)$$

$$\text{Radical} + Ag^{+} \xrightarrow{\text{fast}} \text{Oxidized diosgenin} + Ag^{0} \quad \text{(Nucleation)} \quad (2)$$

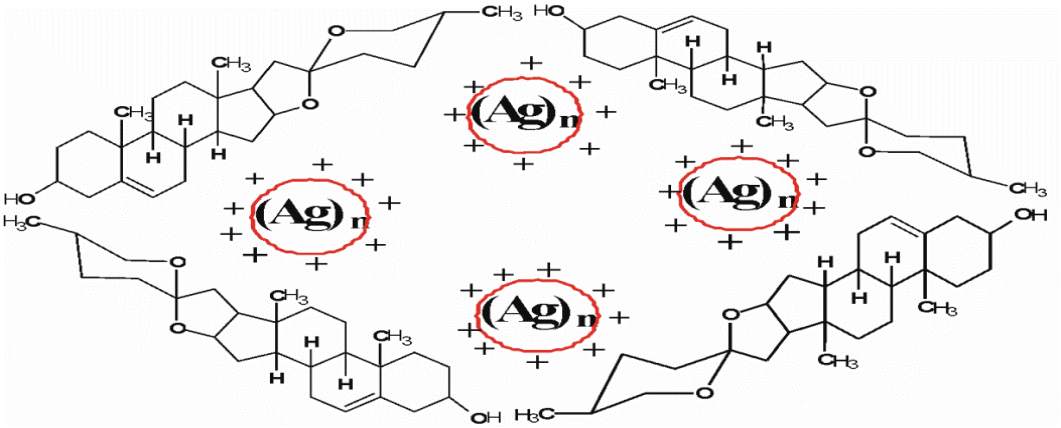
$$Ag^{0} + Ag^{+} \xrightarrow{\text{fast}} Ag_2^{+} \quad \text{Growth} \quad (3)$$

$$Ag_2^{+} + Ag_2^{+} \xrightarrow{\text{fast}} Ag_4^{2+} \quad \text{Growth} \quad (4)$$

$$(Ag_4^{2+})n + \text{tuber extract} \xrightarrow{\text{fast}} \text{Yellow colour silver sol} \quad \text{(Adsorption)} \quad (5)$$

Scheme 2. Mechanism to the formation of AgNPs.

Hydroxy groups of reducing steroidal saponin diosgenin (Scheme. 2) reduce Ag^{+} into Ag^{0} (Eq.1; rate-determining step, rds). The neutral atom Ag^{0} reacts with Ag^{+} to form the relatively stabilized Ag_2^{+} clusters as shown in Eq.(3). Ag_2^{+} clusters dimerize to yield Ag_4^{2+} (yellow-color silver sol; stable species for along time in presence of a saponin even under air and growth stops at the stage of this species (Eqs. (4).



Scheme 3. Adsorption of diosgenin on the surface of AgNPs

Thus, the capping- and/or shape-directing role may be explained in terms of excess diosgenin adsorption (although highly schematic) onto the surface of AgNPs (Scheme 3). The above explanations and proposed mechanism are in good agreement with the hypothesis highly developed by the Shi et al. that the reducing-cum-stabilizing role of diosgenin and shape-directing role of proteins to the size-controlled synthesis of AgNPs, respectively [41]. The diosgenin and other saponin are a good choice as reducing-, capping, stabilizing, and shape-directing agents particularly when nanomaterials are planned for use for biological applications.

3.2. TEM images

Morphology of the silver nanoparticles that produced (Reaction conditions: $[Ag^{+}] = 16.66 \times 10^{-4}$ mol dm^{-3}, [extract] = 10.0 cm^3, Temperature = 30 ^{0}C), and $[Ag^{+}] = 16.66 \times 10^{-4}$ mol dm^{-3}, [extract] = 10.0 cm^3, [starch] = 2.0 cm^3 of 2%, Temperature = 30 ^{0}C) were determined by using TEM measurements as shown in Fig.4. (A) of AgNPs and selected electron diffraction ring patterns (B), similarly in Fig.5. (A) of AgNPs and selected electron diffraction ring patterns (B) respectively. In order to establish the effect of stabilizers, TEM samples were taken at the same time from two separate experiments. Interestingly, two features are apparent from the TEMs in

presence of stabilizer(s). Tem images result indicate diameter of the AgNPs ranging from 11.21 nm to 103.47 nm. First, the silver nanoparticles are spherical, Silver nanotriangles and nanorods, anisotropic silver nanoparticles, silver nanohexagon, and irregular silver nanoparticles as well as truncated triangular pentagonal like structure in absence of stabiliser Fig.4 (A). Second, these particles are capped in presence of stabiliser regularly in such a manner, leads to the formation of beautiful silver nanoparticles. Such type of capping was not observed in Fig.4 (A). The reason for the aggregation is due to the presence of excess amounts of reducing moieties. The TEM analyses corroborates well with the results drawn from the corresponding reaction-time curves (Fig.2). Diffraction rings can be seen when corresponding selected area electron diffraction of AgNPs was conducted (Fig. 4, 5 (B) which also corroborate the small size and crystalline nature of the silver nanoparticles by the appearance of lattice fringes similar to a lattice spacing. The six-fold symmetry of the diffraction spots indicates that the surface of particles was bounded by {111}faces. The other sets of spots could be indentified as {211} , {222} and {422} planes according to the pure face-centered cubic (fcc) silver structure.These results are in good agreement with the results of Bakshi et al, that the capping ability of lipids and/or normal surfactants originates due to electrostatic interactions between the polar head groups and charged nanoparticles surface; the surface passivation exits in the form of a lipid bilayer which provides excellent steric and charge stabilization (due to Derjaguin-Landau-Verwey-Overbeek theory) to colloidal nanoparticles. Therefore, they acted as capping agents in addition to reducing agents. Morphology of silver nanoparticles can be controlled not only by the starch but also by the reaction-time alteration and [Ag^+]. Although nanospheres dominated the population of the synthesized silver nanoparticles as evident from TEM images, in some cases anisotropy was observed similar to other reports [42]. Anisotropy among the silver nanoparticles could be due to the recent report by Huang et al mentioning that nascent silver crystals formed using leaf powder of *Cinnamomum camphora* were gradually enclosed by protective molecules, which as a result eliminated rapid sintering of smaller nanoparticles, resulting in formation of nanotriangles [43].

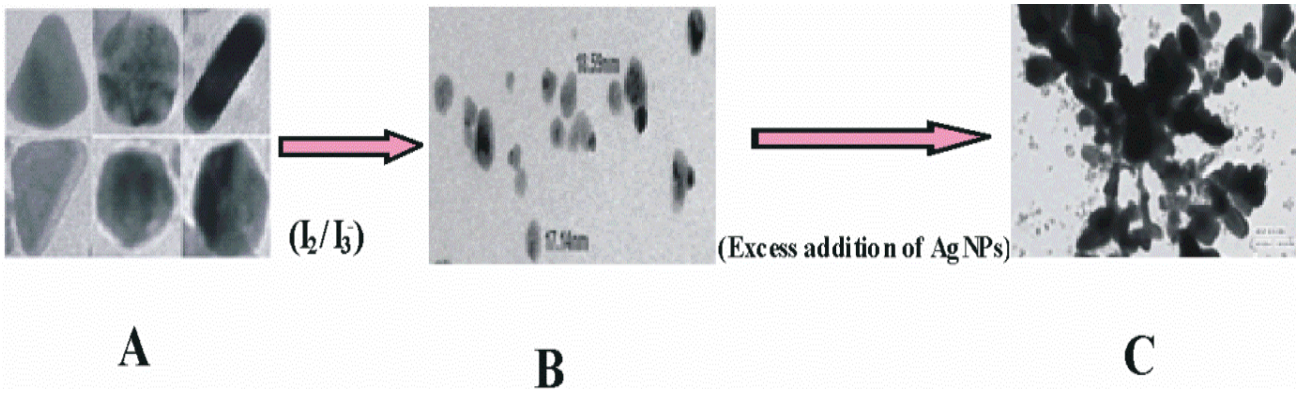
Encapsulation studies

The results of iodometric titrations of starch-capped AgNPs were summarized in Fig. 6 (A) as absorbance-wavelength profiles. Spectra of starch capped silver nanoparticles (■) and KI- iodine (♦).The starch nanoparticles solution was titrated with iodine, and the spectra at various stages are as follows: addition of two drop KI- iodine reagent (yellow turbidity;○), three drop formation of blue starch-iodine complex; (●) and the addition of excess silver nanoparticles resulting in the formation of yellow turbidity (▼). The absorption spectrum of prepared AgNPs consists a single sharp band in the visible region at 425 nm (Fig. 6 (A) ;(■), while the KI-I_2 regent covers the whole visible region of the spectrum and is light brown in color (Fig. 6 (A); (♦).Upon addition of 2 drop of 1.0 N KI-I_2 (iodine is not very soluble in water, therefore the iodine reagent is made by dissolving iodine in water in the presence of KI. This makes a linear triiodide ion complex which is soluble that slips into the coil of the starch causing an intense blue-black color) solution to a solution of yellow colored of AgNPs (10.0 cm^3), the solution becomes pale yellow, the peak at 425 nm disappears completely and a new shoulder begins to develop in the vicinity 400 nm (Fig. 6 (A); (○) which might be due to the formation of poly-dispersed silver nanoparticles. Further, addition of one drop of the reagent, the same solution becomes deep-blue having two peaks at ca. 400 nm and 625 nm (Fig. 6 (A); (●)). This deep-blue colour was due to the complexation between starch and iodine (Mendham, Denney, Barnes, & Thomas, 2000) [44]. A blue-black color results if starch contains amylose. If starch amylose is not present, then the color will stay orange or yellow. Starch amylopectin does not give the color. Further addition of 5.0 cm^3 of AgNPs in the same solution, the reaction mixture turned again pale-yellow resulting in the formation of a shoulder at only 400 nm (Fig. 6 (A);

(▼). It thus seems that the AgNPs is rather unstable in presence of KI-I_2 reagent and is rapidly converted into larger particles, which might be due to the reversible encapsulation of silver nanoparticles. This red-shift is attributed to the strong interactions between the adsorbed Ag^+ and I^- ions on the surface of Ag_4^{2+}, vide infra, the nucleoplilicity of the I^- ion is better than that of Br^- or Cl^- ions (Al-Lohedan, Bunton, & Moffatt, 1983) [45]. The peak of starch-iodine complex at 600 nm disappeared completely. Our observations are in good agreement to the reversible encapsulation and the dissolved polyaniline as well as the composite could be recovered by replacement with molecular iodine (Sarma, & Chattopadhyay, 2004) [46]. On the basis of Figs. 6 and 7 data, we may safely concluded that reaction proceeds through the formation of AgNPs, iodide- starch complex and finally silver nanoparticles detach the iodine from iodine-starch because the greater affinity of iodine towards silver in comparison to amylose respectively, and starch encapsulated the AgNPs into its helical from structure as iodine in starch. Digital images shown in Fig. 6 (B) also indicate the formation of silver nanoparticles (A), starch capped silver nanoparticles formation of blue starch-silver-iodine complex (B), and addition of excess silver nanoparticles resulting in the formation of yellow turbidity (C) these images clearly shown the reversibility and possibility for the formation of these types of nanoparticles. A possible kind of mechanism is also discuss in Encapsulation of silver nanocomposites and effects of stabilizers which clearly indicates that, the probable role of amylose during the synthesis of AgNPs [47].

TEM images

In order to confirm the spectroscopic data, TEM images of prepared blue starch-iodine complex; and the addition of excess silver nanoparticles resulting in the formation of yellow turbidity were also recorded. TEM analysis in Fig. 7. yielded 8.72 to 27.22 nm for blue starch-silver-iodine complex ($[Ag^+] = 16.66 \times 10^{-4}$ mol dm^{-3}, [extract] = 10.0 cm^3, Temperature = 30 ^{0}C.) which shows that size of blue starch-iodine complex nanoparticles are very small as compared to the size of AgNPs and also there was a big difference in shape as changes into irregular spherical from triangle, rod, and truncated hexagonal as shown in Fig. 4, 5. This occurs might be due to the formation of a linear triiodide ion complex which is soluble that slips into the coil of starch and decreases the size of AgNPs further addition of 4.0 cm^3 of AgNPs in the same solution, the reaction mixture turned again pale-yellow to obtain parent compound i.e. Reversible encapsulation occurs. TEM images of AgNPs of the yellow turbidity upon Addition of excess silver nanoparticles in blue starch-silver-iodine complex shown in Fig.8, TEM measurement result shows formation of AgNPs with diameter 13.21 to 200 nm. It thus seems that the AgNPs is rather unstable in presence of KI-I_2 reagent and is rapidly converted into larger particles, which might be due to the reversible encapsulation of silver nanoparticles. TEM images in scheme 4. clearly not only shows difference in shape and size but also confirm the formation of AgNPs (A) (triangle, spherical, rod and truncated hexagonal), upon addition of iodine to formed blue starch-iodine complex (B), in this case shape and size of nanoparticles totally changes as compared to (A) into irregular spherical and finally converted again into aggregated yellowish AgNPs (C).



Scheme 4. TEM images of Reversible encapsulation AgNPs in starch

IV. CONCLUSIONS

In this study we reported the reduction of silver nitrate by Diosgenin a steroid sapogenin in absence and presence stabilizers. Upon mixing, all of the ionic silver is reduced to form a colored silver sol. Under our experimental conditions, and presence of stabilizer(s), are important to obtain stable silver nanocomposites.TEM images result indicated significant changes in the morphology and/ or agglomeration tendency with starch. Transmission electron microscopy (TEM) results show the formation of stable AgNPs with and without stabiliser at same concentration of $AgNO_3$, Gives spherical, silver nanotriangles and nanorods, anisotropic silver nanoparticles, silver nanohexagon, and irregular silver nanoparticles. It is also reported that encapsulated silver nano-composites in starch could be recovered by replacement with molecular iodine.

V. REFERENCES

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Figure captions

Fig.1. UV-visible spectra of AgNPs prepared by $AgNO_3$ + Dioscorea deltoidea tuber extract in starch. *Reaction conditions*: $[Ag^+]$ = 3.33 (■), 10.0 (●), 16.66 (♦), 23.66 (○), 33.33 × 10^{-4} mol dm^{-3} (▲), [extract] = 10.0 cm^3, starch (2.0 cm^3; 2 %). Temperature = 30 ^{0}C.

Fig.**2**. UV-visible spectra of AgNPs prepared by $AgNO_3$ + Dioscorea deltoidea tuber extract in starch. Reaction conditions: $[Ag^+]$ = 16.66 × 10^{-4} mol dm^{-3}, [extract] = 1.0 (■), 3.0 (●), 5.0 (♦), 7.0 (○) and 10.0 (▲) cm^3, starch (2.0 cm3; 2 %). Temperature = 30 ^{0}C.

Fig.3. Reaction time plots for AgNPs formation at different $[Ag^+]$. Reaction conditions: $[Ag^+]$ = 3.33 (■), 10.0 (●), 16.66 (○), 33.33 × 10^{-4} mol dm^{-3} (▲), [extract] = 10.0 cm^3, starch (2.0 cm^3; 2 %), Temperature = 30 ^{0}C.

Fig.4. TEM images (A) of AgNPs and selected electron diffraction ring patterns (B). Reaction conditions: $[Ag^+]$ = 16.66 × 10^{-4} mol dm^{-3}, [extract] = 10.0 cm^3, Temperature = 30 ^{0}C.

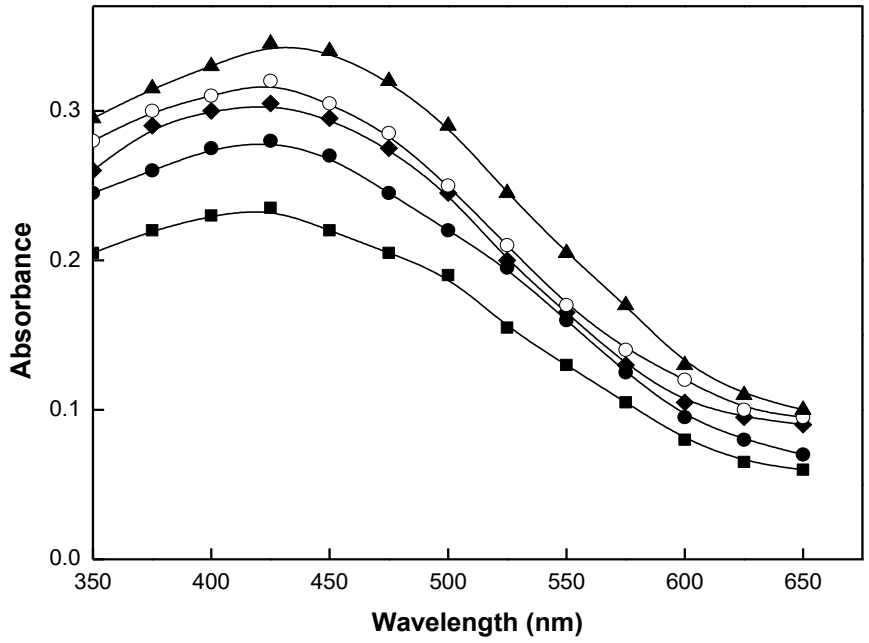
Fig.5. TEM images (A) of AgNPs and selected electron diffraction ring patterns (B). Reaction conditions: $[Ag^+]$ = 16.66 × 10^{-4} mol dm^{-3}, [extract] = 10.0 cm^3, [starch] = 2.0 cm^3 of 2%, Temperature = 30 ^{0}C

Fig.6 (A). Spectra of starch capped silver nanoparticles (■) and KI- iodine (♦).The starch nanoparticles solution was titrated with iodine, and the spectra at various stages are as follows: addition of two drop KI- iodine reagent (yellow turbidity;○), three drop formation of blue starch-iodine complex; (●) and the addition of excess silver nanoparticles resulting in the formation of yellow turbidity (▼), and in Fig. 6 (b). Optical images of AgNPs formation in presence of starch. Reaction conditions: $[Ag^+]$ = 16.66 × 10^{-4} mol dm^{-3}, [extract] = 10.0 cm^3, [starch] = 2.0 cm^3 of 2%, Temperature = 30 ^{0}C (A), on addition of KI- iodine reagent formation of blue starch-iodine complex (B), and addition of excess silver nanoparticles resulting in the formation of yellowish turbidity (C)

Fig.7. TEM images (A and B) of blue starch-silver-iodine complex. Reaction conditions: $[Ag^+]$ = 16.66 × 10^{-4} mol dm^{-3}, [extract] = 10.0 cm^3, Temperature = 30 ^{0}C.

Fig.8. TEM images (A and B) of AgNPs of the yellow turbidity upon Addition of excess silver nanoparticles in blue starch-silver-iodine complex.

Fig. 1.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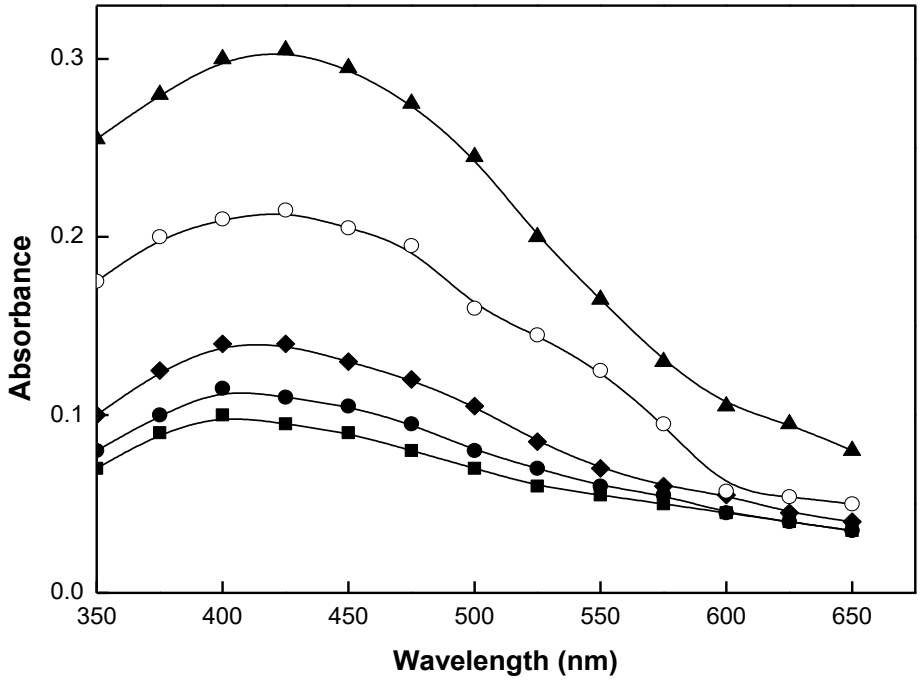
Wavelength (nm)

Fig. 2.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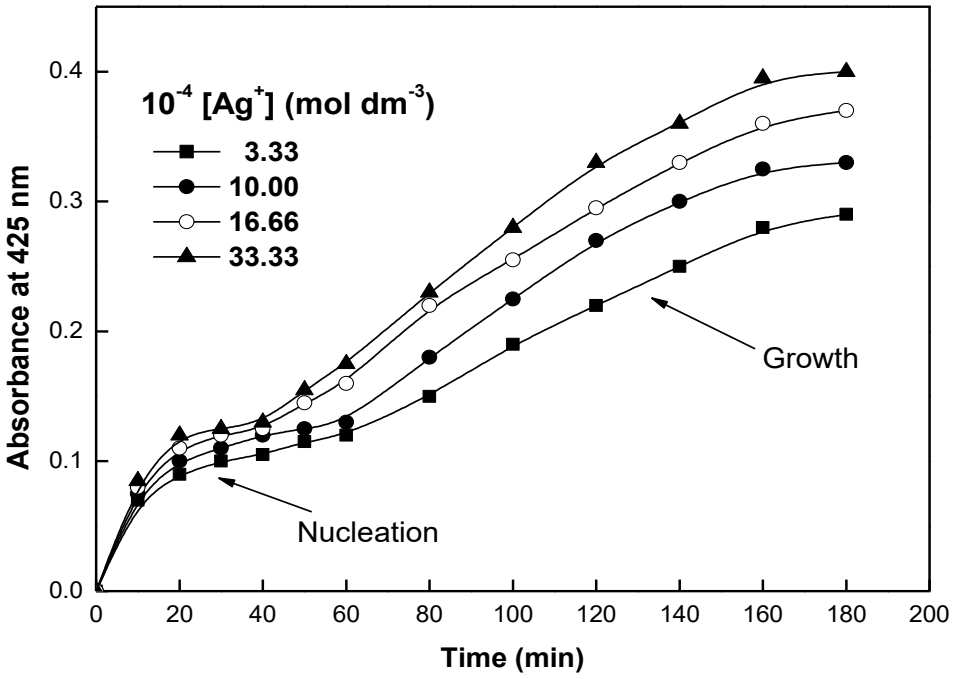
Wavelength (nm)


10^{-4} [Ag^{+}] (mol dm^{-3})
3.33
10.00
16.66
33.33
Absorbance at 425 nm
Time (min)
Nucleation
Growth
0.0
0.1
0.2
0.3
0.4
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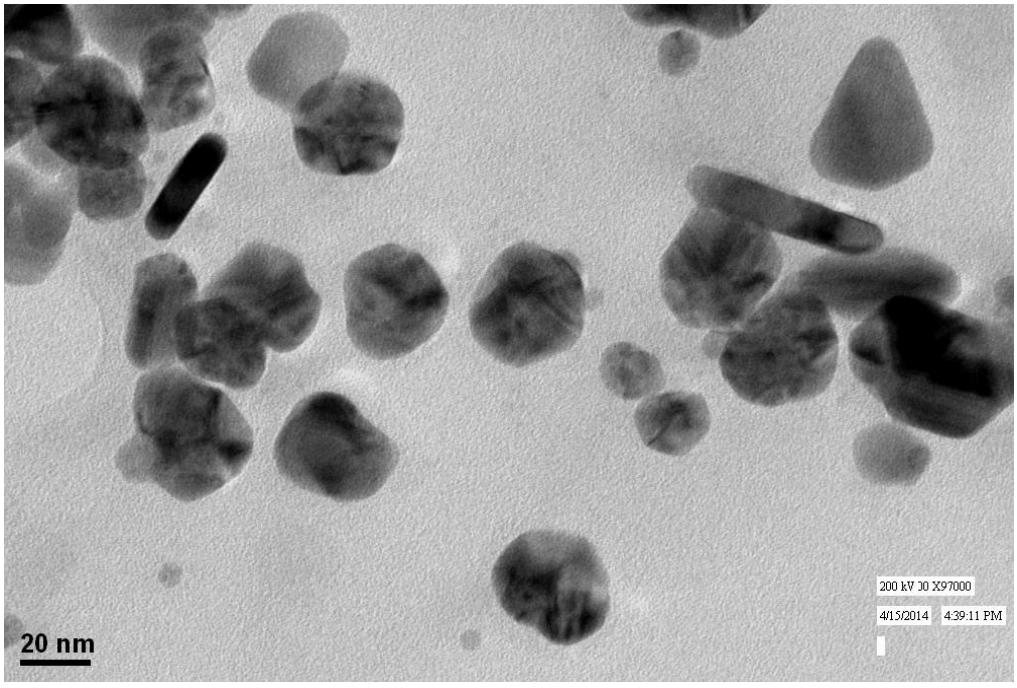
20
40
60
80
100
120
140
160
180
200

Fig. 3.

Fig. 4.

A


20 nm
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B

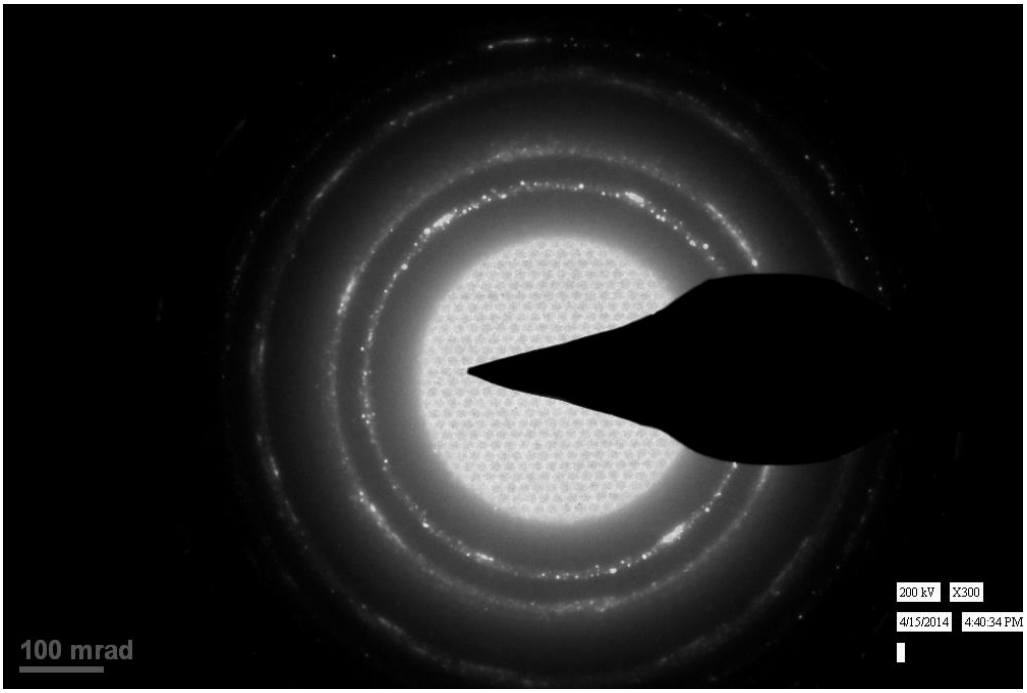
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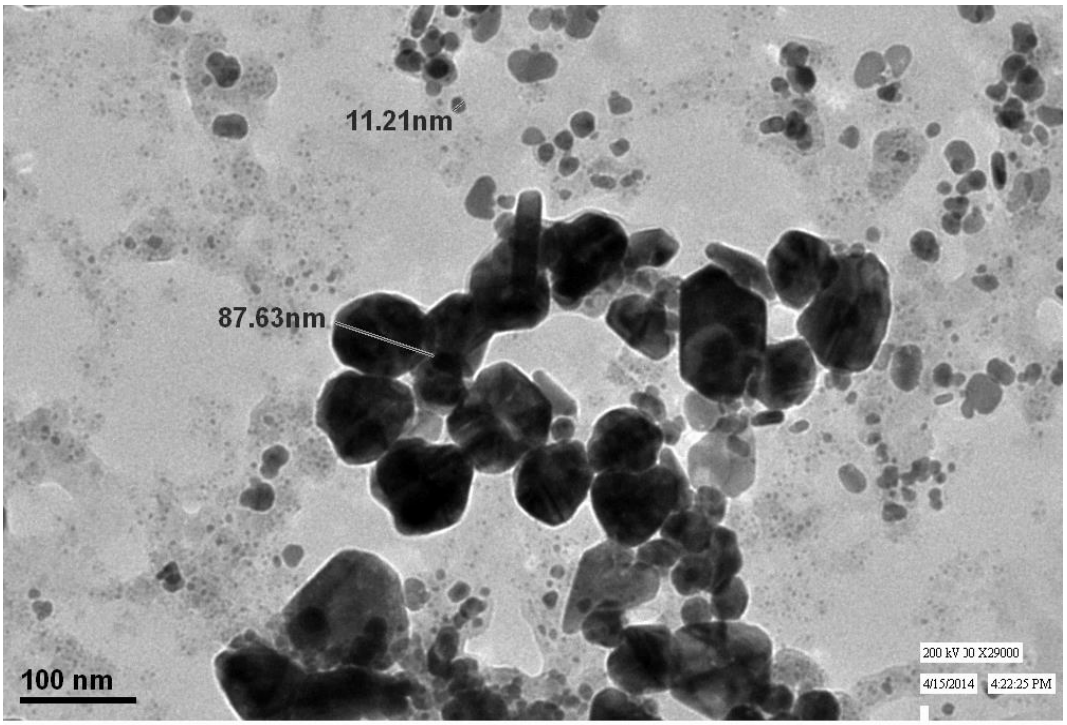
Fig. 5.

A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87.63nm
100 nm
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B

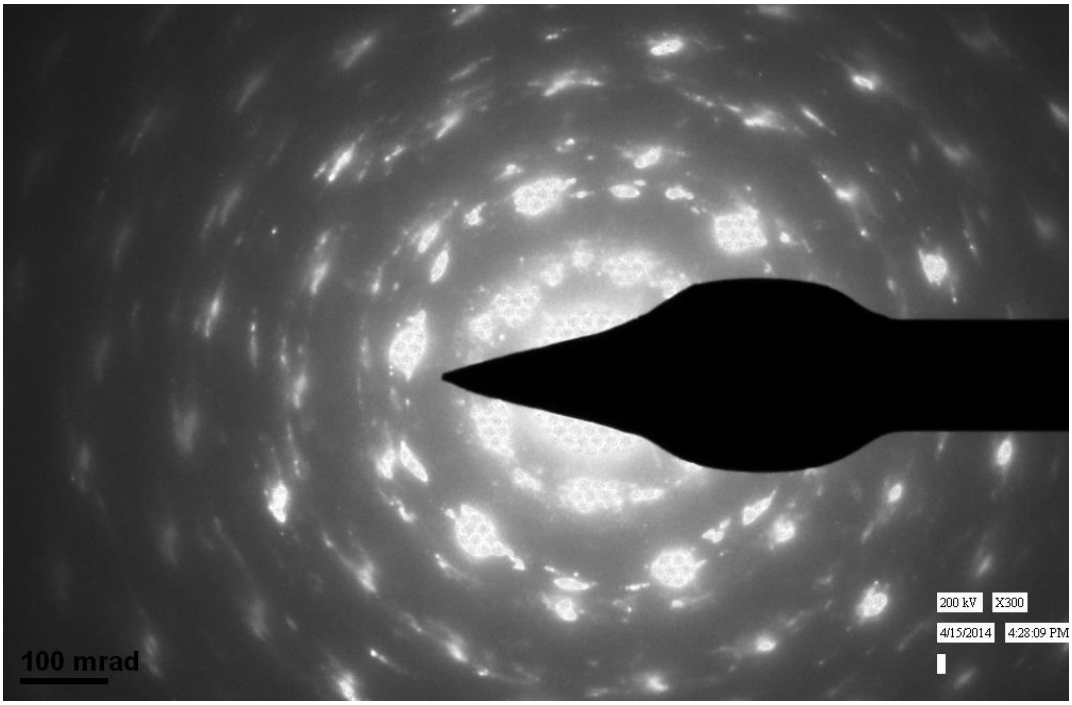
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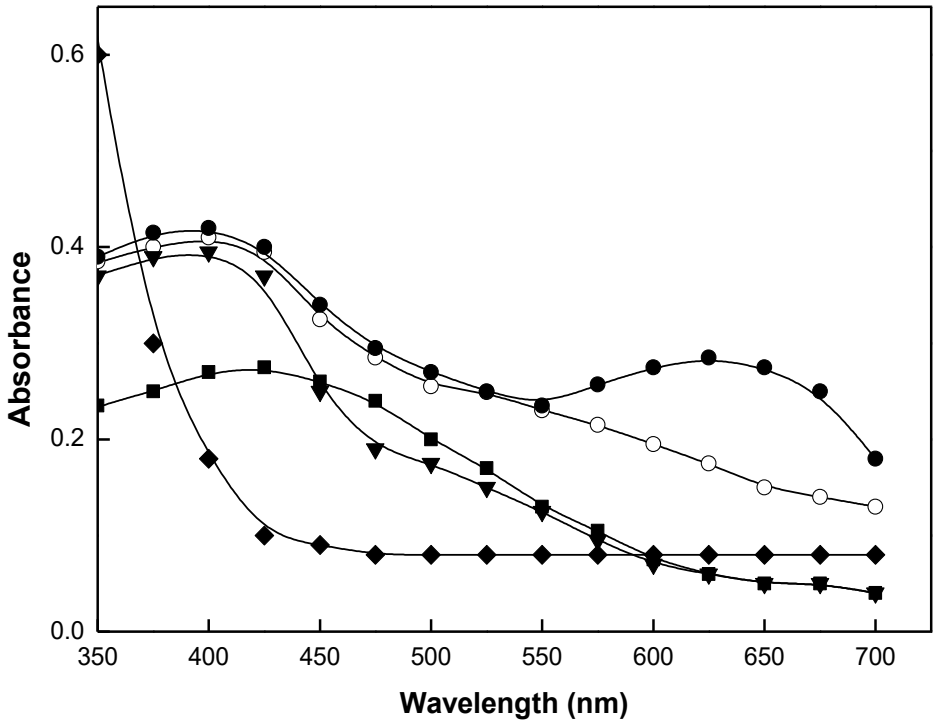
Fig. 6.

A


Absorbance
Wavelength (nm)
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0.4
0.6
350
400
450
500
550
600
650
700

B

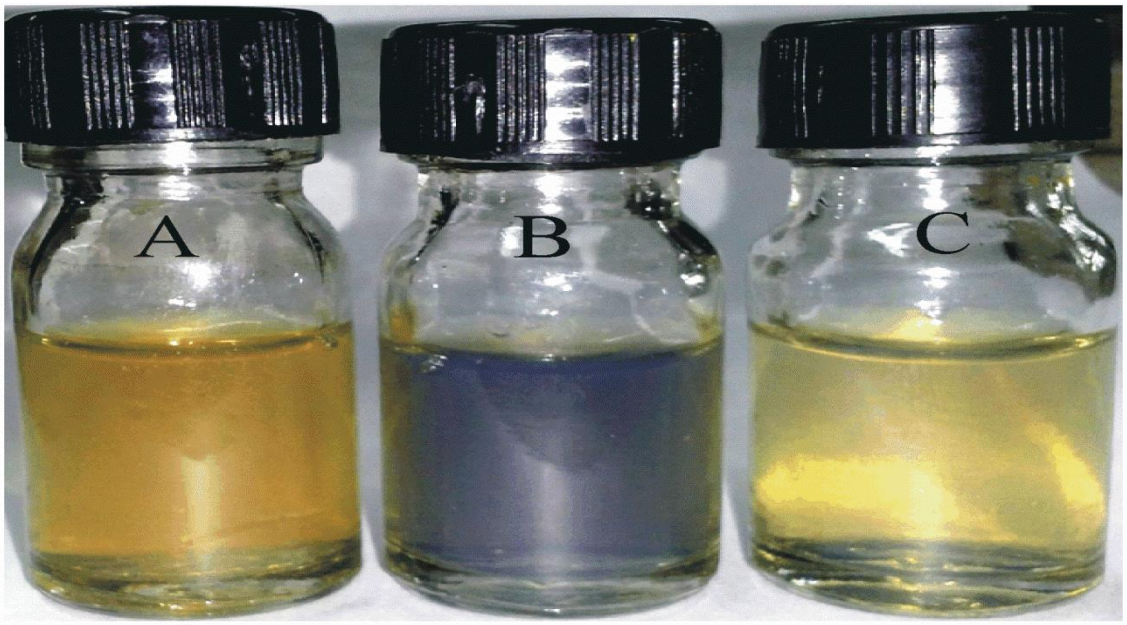


Fig. 7.

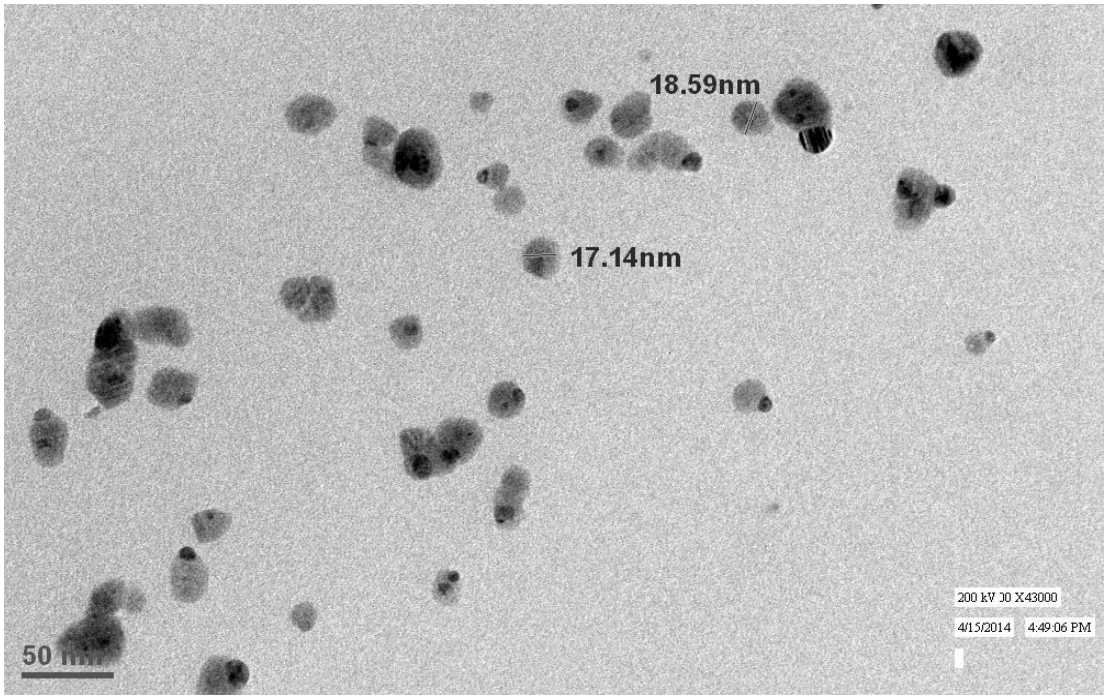
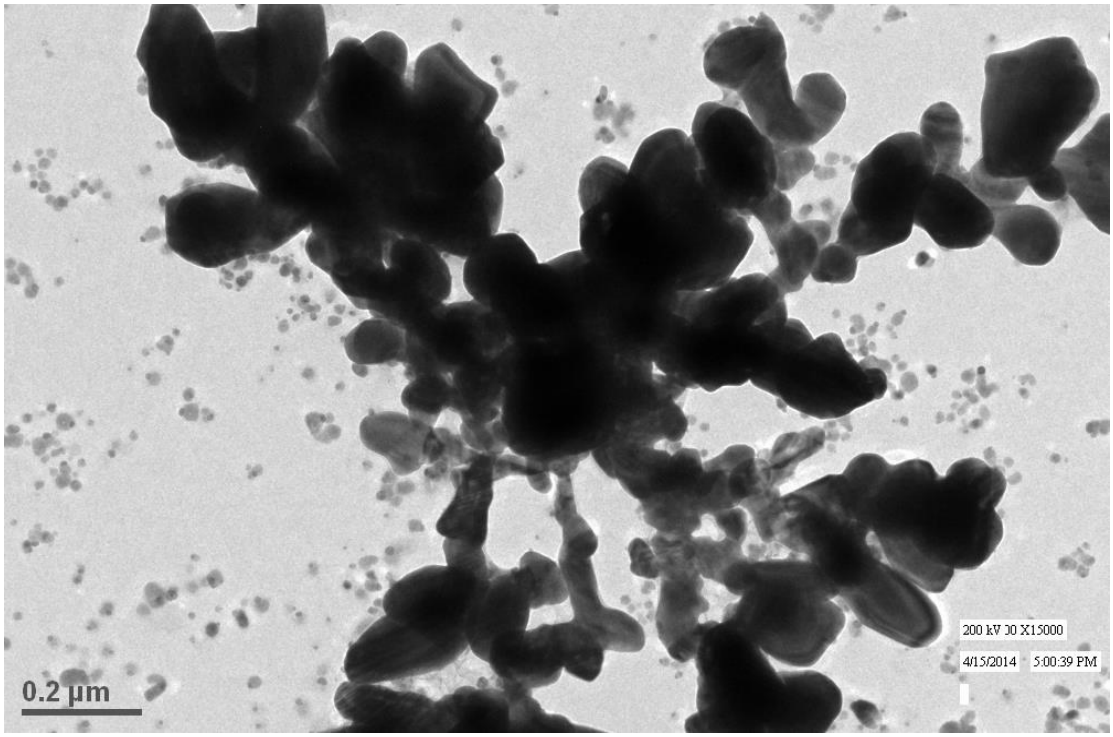


Fig. 8.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Advancements in pH-Metric Studies of Transition Metal Complexes: Methodologies, Applications and Future Directions

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ABSTRACT

Transition metal complexes represent a fascinating and versatile class of compounds with profound implications across diverse scientific disciplines. Over the years, pH-metric studies have emerged as a powerful tool for investigating the formation, stability, and behaviour of transition metal complexes. This review comprehensively surveys recent advances in pH-metric studies of transition metal complexes, providing an in-depth analysis of the methodologies, insights gained, and applications in various fields.

The review begins with an overview of the principles underlying pH-metric titrations and their application to transition metal complex systems. It explores the factors influencing the choice of ligands and metal ions, emphasizing the impact of ligand design and metal coordination geometry on complex stability. Case studies featuring transition metal ions such as Fe(III), Cu(II), Zn(II), Mn(II), and Ni(II) are highlighted to exemplify the versatility and applicability of pH-metric studies across different systems.

Furthermore, this review explores the implications of pH-metric studies in catalysis, medicinal chemistry, and environmental science. Insights into metal-ligand interactions gleaned from pH-metric investigations contribute to the design of more efficient catalysts, inform drug development strategies, and enhance our understanding of metal speciation in natural systems.

The evolving landscape of pH-metric studies in transition metal complexes is critically assessed, and future directions in this dynamic field are outlined. As the demand for a deeper understanding of metal-ligand interactions grows, this review aims to serve as a comprehensive resource for researchers and practitioners, fostering advancements at the intersection of coordination chemistry and applied sciences.

Keywords: pH-metric studies, transition metal complexes, equilibrium constants, ligand-metal interactions, coordination chemistry, applications

I. INTRODUCTION

Transition metal complexes, characterized by the coordination of metal ions with various ligands, stand at the forefront of interdisciplinary research due to their diverse applications in fields such as catalysis, medicinal chemistry, and environmental science. The precise understanding of the thermodynamics governing the formation and stability of these complexes is pivotal for harnessing their potential in these applications. pH-metric studies have emerged as a powerful and versatile approach, providing unique insights into the intricacies of metal-ligand interactions.

The exploration of metal-ligand equilibria through pH-metric titrations has evolved into a sophisticated methodology, allowing researchers to probe the nuances of complex formation under controlled pH conditions. This approach not only provides a comprehensive understanding of the equilibrium constants governing these interactions but also sheds light on the molecular dynamics that underpin the stability of these complexes.

In this review, we embark on a comprehensive examination of recent advances in pH-metric studies of transition metal complexes. We delve into the principles of pH-metric titrations, exploring their application to a myriad of transition metal ions, including but not limited to Fe(III), Cu(II), Zn(II), Mn(II), and Ni(II). The discussion encompasses the diverse ligands employed, emphasizing the influence of ligand structure on complex stability and the ensuing implications for catalytic processes and medicinal applications.

The analytical techniques and methodologies employed in pH-metric investigations have witnessed significant advancements. From state-of-the-art instrumentation to sophisticated computational methods, researchers have leveraged cutting-edge tools to extract precise information about the equilibrium constants and molecular interactions governing these complex systems. Notably, advancements in data analysis, including global fitting approaches and statistical validation, contribute to the robustness of the obtained results.

Beyond the fundamental insights gained, this review explores the practical implications of pH-metric studies in catalysis, medicinal chemistry, and environmental science. The impact of metal-ligand interactions on catalytic efficiency, drug development, and environmental metal speciation is discussed, highlighting the translational potential of pH-metric studies in addressing real-world challenges.

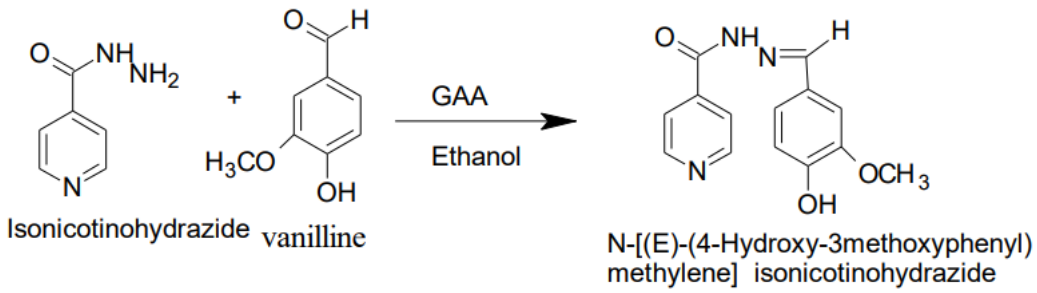
As we navigate through the exciting developments in pH-metric studies of transition metal complexes, this review aims to serve as a valuable resource for researchers and practitioners, fostering a deeper understanding of coordination chemistry and its applications across scientific domains. The subsequent sections will delve into specific aspects of methodology, case studies, and emerging trends, providing a comprehensive overview of the evolving landscape in this dynamic field.

II. LITERATURE SURVEY

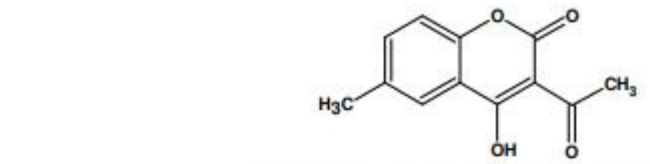
In this study by Tanaji N. Bansode, the pH-metric method was employed to investigate the stability constants of promazine (PMZ) complexes with Fe(III), Cd(II), Pb(II), Cu(II), and Zn(II) metal ions in aqueous medium at temperatures of 298 K and 308 K and 0.1 M ionic strength. The potentiometric titration technique facilitated the determination of proton-ligand and metal-ligand stability constants, while computational methods were utilized to derive metal-ligand stability constants. Thermodynamic parameters, including ΔG, ΔH, and ΔS, were determined potentiometrically. The study demonstrated that stability constants decreased with an increase in temperature, suggesting a temperature-dependent influence on the formation of stable complexes. Additionally, the thermodynamic analysis revealed the exothermic nature of the reaction process, with entropy and enthalpy factors favoring complexation. Overall, this comprehensive investigation provides valuable insights into the thermodynamics and molecular interactions governing the formation of promazine-metal complexes, contributing to the understanding of metal-ligand interactions in aqueous environments.

Zamzam Taher Omar et al. conducted a pH-metric study on transition metal complexes with the pharmacologicallyactive ligandN-[(E)-(4-Hydroxy-3-methoxyphenyl)methylene]isonicotinohydrazide. They explored the interactions of Mn (II), Co (II), Ni (II), Cu (II), and Zn (II) metal ions with the synthesized ligand in a 70% ethanol–water medium. The ligand, obtained through the condensation of an anti-mycobacterial agent with an aromatic aldehyde, was characterized using various spectroscopic techniques. The study revealed a distinct order of stability for the binary complexes: Cu (II) > Co (II) > Mn (II) > Ni (II) > Zn (II). The research contributes insights into the pH-dependent behavior of transition metal complexes and their potential pharmacological applications, showcasing a systematic approach from synthesis to comprehensive analysis.

Synthesis Pathway for Organic Ligands :

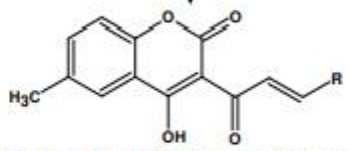


In this study by M. V. Hathi et al., novel metal complexes of first transition metal ions with a chromene derivative as ligands were synthesized and characterized through elemental analysis. The ligand, 3-[{3-(9'-anthryl)}-prop-2-enoyl]-4-hydroxy-6-methyl-2H-chromen-2-one, was examined for its interaction with M (II) ions (M = Mn, Cu, Ni, Co) using pH measurements and Irving-Rossotti titration technique. The research delves into factors influencing the formation and stability of metal complexes. The coupling of transition metals with coumarin derivatives is noteworthy for potential applications, given the distinct physiological activities exhibited by certain coumarins. The study provides valuable insights into the chelating characteristics of the synthesized ligand and its metal complexes, offering a foundation for further exploration in analytical chemistry and potential biomedical applications.



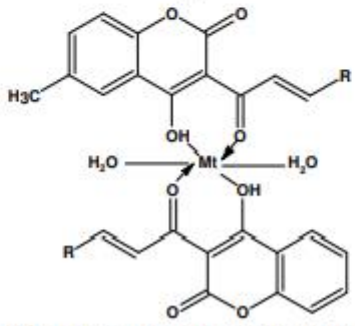
3-Acetyl - 4-hydroxy -6-methylcoumarin (I)

3-Chloro benzaldehyde



3-[{3-(3'-Chloro phenyl)}-prop-2-enoyl]-4-hydroxy-6-methyl-2*H*-chromen-2-one
[Where R = 3'-Chloro phenyl]

Metal Salt



Bis -(3-[{3-(3'-Chloro phenyl)}-prop-2-enoyl]-4-hydroxy-6-methyl-2*H*-chromen-2-one)
Mt^{+2}Complex(II).

The study by Praneeta V. Susatkar explores the complex formation between Cu(II), Ni(II), Co(II), and Fe(III) metal ions and two 2-hydroxy-4-substituted phenyl-6-substituted phenyl pyrimidines, namely [H4AHBP] (L1) and [H4CHBP] (L2). Conducted at 0.1 M ionic strength in a 70% dioxane-water mixture, the investigation employs the Bjerrum method as adopted by Calvin and Wilson. The research reveals that Cu(II), Ni(II), Co(II), and Fe(III) metal ions form 1:1 and 1:2 complexes with ligands L1 and L2. The proton-ligand and metal-ligand stability constants (pK and log k) are estimated and compared, shedding light on the impact of substituents on these values. The work adds valuable insights to the field of metal-ligand interactions, particularly focusing on the physiochemical properties and stability of complexes in various solvent systems, providing a foundation for potential analytical applications.

The paper by A.B. Patil investigates the pH-metric behavior of ternary complexes formed by Mn (II), Co (II), Ni (II), Cu (II), and Zn (II) metal ions with primary ligands aspartic acid (ASP) and glutamic acid (GLU), and secondary ligands nicotinic acid (NA) and ascorbic acid (AA). The study, conducted in aqueous medium at 302 ± 0.5 K and 0.1 M ionic strength, employs pH-metric techniques to determine proton-ligand and metal-ligand stability constants. The results reveal the formation of 1:1:1 mixed ligand complexes, and the obtained stability constants exhibit the Irving-Williams order. The systematic investigation sheds light on the intricate interactions within these ternary complexes, providing valuable insights into the coordination chemistry of transition metal ions with biologically relevant ligands.

The study by J.P. Nehete and team investigates the interaction between transition metal ions and the substituted heterocyclic drug Clarithromycin in a 70% ethanol-water mixture. Using pH-metric methods, the research explores proton-ligand and metal-ligand stability constants at 0.02 M ionic strength. Results indicate

the formation of 1:1 and 1:2 complexes with the drug. The work provides a comprehensive review of relevant literature, emphasizing the significance of stability constant studies in diverse applications. The systematic approach and detailed experimental procedures enhance our understanding of metal-ligand interactions, contributing valuable insights to coordination chemistry.

The study conducted by S.A. Olagboye explores the pH-metric behavior of transition metal complexes with azole-based ligands, specifically benzimidazole and 1,2,3-triazole, in a water-methanol medium. The research investigates metal-ligand complexation through pH-metric titrations at different temperatures, revealing stability constants and thermodynamic stabilities. The findings suggest that the metal complexes are exothermically favorable, and their spontaneity is supported by negative Gibbs free energy values. The study highlights the influence of temperature on the stability of the complexes, with the optimum formation observed at 35°C. The results contribute to understanding the coordination chemistry of these azole-based ligands with Fe(III), Ni(II), and Zn(II) ions.

The research conducted by D. D. Kayande and colleagues focuses on the stability constant study of ternary complexes involving transition metal elements (Fe, Co, Ni, Cu, Zn) with pharmacologically active ligands, nicotinamide, and alanine. The study, employing pH-metric techniques at 25±0.1°C, investigates the formation and stability of these complexes in a 70% ethanol-water medium at 0.1M ionic strength. The stability constants were determined using potentiometric pH titrations, and the order of stability was found to be Co (II) > Fe (II) > Cu (II) > Ni (II) > Zn (II). The results suggest potential applications in the drug industry, emphasizing the importance of understanding the impact of biologically active ligands on complex stability. The study provides valuable insights into the interactions between transition metals and pharmacologically relevant ligands, contributing to the broader field of coordination chemistry.

Dr. S. A. Quazi conducted a pH-metric study investigating the complexation of para-aminobenzoic acid (PABA) with transition metal ions (Co, Cu, Fe, Ni, Zn, Cd) in aqueous solutions at 27°C with a 1N $NaNO_3$ ionic strength. Using the Irving Rossoti titration method and computer calculations with the SCOGS program, the protonation constant and formation constants of metal complexes (1:2 metal-to-ligand ratio) were determined. PABA, a water-soluble compound relevant to sulfonamide antibiotics and folic acid synthesis, was selected due to its limited literature coverage and potential pharmaceutical importance. The study reveals the order of stability constants: Co (II) > Cu (II) > Fe (III) > Ni (II) > Zn (II) > Cd (II), indicating varying metal affinities for complex formation. The research contributes to understanding ligand-metal interactions in drug development and coordination chemistry, offering valuable insights into PABA-metal interactions for potential pharmaceutical applications. The study's methodology, including computer-assisted equilibrium constant calculations, enhances its robustness.

The study by K. B. Vyas, G. R. Jani, and M. V. Hathi investigates the formation constants of binary complexes between d10 metal ions (Cu(II), Ni(II), Co(II), and Mn(II)) and a substituted coumarin derivative. The ligand's chelating characteristics were explored for potential analytical reagent applications. pH-metric titrations, employing the Irving-Rossotti method at 30±1 °C and ionic strength μ=0.1 M $NaNO_3$, revealed varying stability orders for different metal ions. The research contributes insights into ligand-metal interactions, particularly in biochemical reactions and analytical contexts. The computer-assisted equilibrium constant calculations enhance the reliability of the findings.

III.CONCLUSION

In summary, the comprehensive review of various studies on transition metal complexes and ligands highlights the intricate nature of coordination chemistry. Investigations employing pH-metric methods, potentiometric titrations, and computational analyses reveal temperature-dependent influences, stability orders, and the impact of ligand substituents on complex formations. From the dynamic behavior of promazine complexes to the systematic exploration of binary and ternary systems, each study contributes valuable insights into the thermodynamics and molecular interactions governing metal-ligand coordination. These findings extend our understanding of diverse applications, including potential pharmacological uses and analytical chemistry. Collectively, these studies significantly enrich the field of coordination chemistry, paving the way for further exploration in interdisciplinary scientific research

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Studies on Mulberry Pests in Yalgud Village of Kolhapur District, Maharashtra

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ABSTRACT

Sericulture is known for the production of raw silk from silkworm rearing.Mulberry, the sole food plant for Bombyx mori L. is invaded by several polyphagous pests that result in the reduction of mulberry yield, depleting the leaf's nutritive value and makes unsuitable for feeding to silkworm. The present investigation was conducted to find out the diversity of pests infesting mulberry in Yalgud village, Hatkanangle taluka, Kolhapur district, Maharashtra during the summer (2023), monsoon (2023) and winter (2023-24) seasons. The study revealed that various pests were found infesting mulberry. During the overall study period, the sap sucker such as Maconellicoccus hirsutus, Dialeuroporadecempuncta, Aleurodicus disperses, Paracoccus marginatus, jassids and thrips were recorded, whereasseveral defoliators viz., Spilosomaobliqua, Amata passalis, leaf webber and Spodopteraliturawere also observed.

Keywords: Sericulture, Bombyx mori, Mulberry, pests

I. INTRODUCTION

Sericulture is worldwide known for the production of raw silk from silkworm rearing. The host plant for the*Bombyx mori* L. is mulberry. The quality and quantity of mulberry leaves is one of the major requirements for their growth and development(Nagaraju, 2002). The mulberry is a perennial foliage plant with deep roots that produces a high biomass and is rich in protein. It also provides an endless supply of food and cover for a wide range of pests, all of which in different degrees seriously harm foliage. There are around 300 documented insect and non- insect pest species that affect mulberry (Kotikal, 1982).The pests seriously harm the silkworm host plants, which declines the quantity and quality of the leaves and eventually declines the cocoon productivity (Singh and Thangavelu, 1994). The majority of pests that cause damage to the mulberry come under the orders viz., Lepidoptera, Hemiptera, Thysanoptera, Coleoptera, Orthoptera and Isoptera are the

major pests of mulberry Sengupta*et al.,* 1990).The majority of the farmers belonging to the Yalgud village have been engaged in sericulture activities for the last 10-15 years. Their livelihood depends upon the sericulture. It is necessary to investigate the current scenario of pests in their mulberry field.

II. MATERIAL AND METHODS

The survey and surveillance of pests weredone in mulberry fields of Yalgud village, Hatkanangletaluka, Kolhapur district, Maharashtraduring the summer (2023), monsoon (2023) and winter (2023-24).For the study, five mulberry fields were selected randomly, and ten plants were screened from each field at monthly intervals.The observed pests from the same plants were brought to the research laboratory of the Department of Zoology, Shivaji University, Kolhapur for screening and identification.

III.RESULTS AND DISCUSSION

The present investigation revealed the mulberry was infested with a variety of pests in Yalgud village. The majority of farmers in Yalgud village have planted the V1 variety for silkworm rearing. During the survey, various pests such as Sap suckerand defoliators were observed. The Sap sucker(sucking pests) such as *Maconellicoccus hirsutus, Dialeuroporadecempuncta, Aleurodicus disperses, Paracoccus marginatus,* Jassids and Thrips were recorded. Several defoliators were also observed during the survey viz., *Spilosomaobliqua, Amata passalis,* Leaf webber and *Spodopteralitura*. The *Maconellicoccus hirsutus*known as pink mealy bug, its incidence was noticed high in summer but low in monsoon. The mulberry whitefly (*Dialeuroporadecempuncta)* was also observed in summer and winter buta higher incidence was recorded in the winter season. Spiralling whitefly was also observed on mulberry leaves. However the infestation of *Aleurodicusdispersus*was low as compared to *Dialeuroporadecempuncta*.The infestation of Sap suckerwas noticed high as compared to the defoliators on the mulberry. Similarly, Avhadand Hiware (2013) reported several pests such as Bihar hairy caterpillar, leaf roller, Jassids, cutworms etc. occurred on mulberry in Aurangabad, Maharashtra state, India.Sakthivel*et al.* (2019) also reported the current status of several mulberry pests.

Table.1- Occurrence of mulberry pests in Yalgud village, Hatkanangle taluka, Kolhapur

Sr. No.	Pests observed	Seasons			Mode of feeding
		Summer (2023)	Monsoon (2023)	Winter (2023-24)	
1	*Maconellicoccus hirsutus* Green	+	+	-	Sap sucker
2	*Dialeuroporadecempuncta* Quaintance & Baker	+	-	+	Sap sucker
3	*Spilosomaobliqua* Walker	+	+	-	Defoliator
4	Thrips	+	+	-	Sap sucker
5	*Spodoptera litura*Fabricius	-	+	+	Defoliator
6	Jassid	-	-	+	Sap

					sucker
7	Leaf webber	-	+	+	Defoliator
8	*Amata passalis*	-	+	-	Defoliator
9	*Paracoccus marginatus* Williams andGranara de Willink	+	-	-	Sap sucker
10	*Aleurodicusdispersus* Russell.	+	-	+	Sap sucker
(+) Present, (-) Absent					

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CONFLICT OF INTEREST

All authors declares no conflict of interest

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Creating a Universal Crop Cutter Through Design and Fabrication

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ABSTRACT

Agriculture plays a vital role in Indian economy. India is a country which is dependent on farming as a main source of income for many families. As far as Indians scenario is concerned, more than 75 percent farmers are belonging to small and marginal land carrying .So any improvement in the productivity related task help to increase Indian farmer's status and economy. Now a day's agriculture equipments have lot of limitation and it required more energy to operate. The purpose of the project is to fabricate and enhance the design specifications of harvesting machine for multipurpose crop which should be helpful for the farmers having less & marginal land. Further, the comparative study of harvesting from manual method, machine method and proposed machine method is discussed. It is observed from the results that, the proposed machine method shows reasonably good result when compared manual method and machine method.

I. INTRODUCTION

Agriculture is both a science and an art, involving cultivation of the soil and raising crops. It is commonly referred to as farming. In India, agriculture plays a vital role in the economy, serving as the primary source of income for many families. With over 75 percent of farmers working on small and marginal land holdings, any improvement in productivity-related tasks can significantly enhance the status of Indian farmers and contribute to the economy. However, the current agricultural equipment faces numerous limitations and requires considerable energy to operate efficiently.

In addition to these challenges, Indian agriculture is confronted with serious issues such as a scarcity of agricultural labor, particularly during peak working seasons and normal times. This shortage is primarily due to

increased non-farm job opportunities offering higher wages, the migration of labor to cities, and the social status of agricultural workers in society.

II. METHODOLOGY

(Problem Definition and Solution)

Agriculture stands as the cornerstone of India's economy, playing a pivotal role in shaping its economic and social landscape. Nevertheless, the agricultural sector grapples with significant challenges, chief among them being the shortage of agricultural labor. This shortage persists not only during peak seasons but also in regular periods, fueled by the allure of better-paying non-farm jobs, the migration of laborers to urban areas in search of brighter prospects, and the relatively low societal status associated with agricultural work.

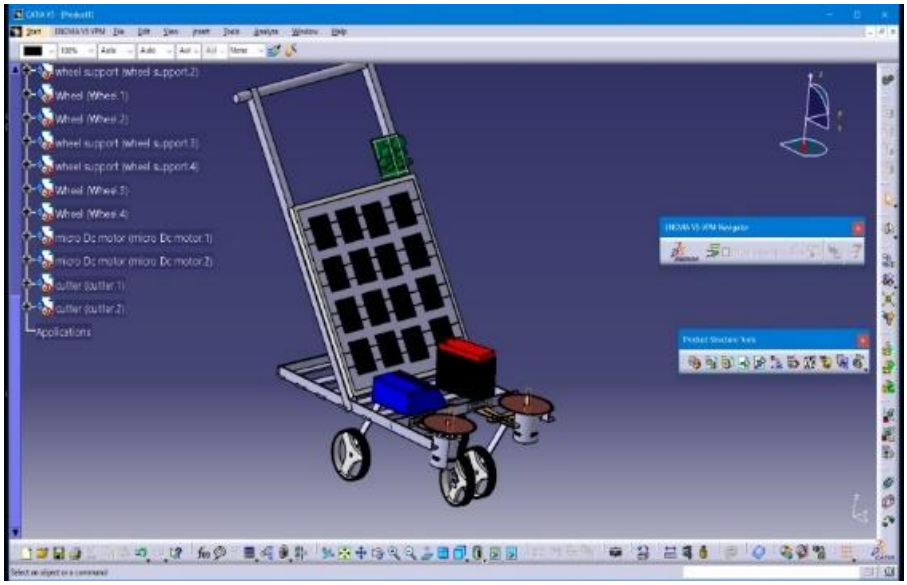
In India, crop cutting primarily occurs through two methods: the traditional manual approach, also known as the conventional method, and the mechanized approach utilizing crop cutting machines. Crop cutting represents a critical phase in the agricultural cycle, directly impacting crop yield and subsequent farmer profitability.

Currently, the conventional manual method dominates crop cutting practices in India, where laborers manually harvest crops using handheld tools. However, this method is labor-intensive and time-consuming, presenting significant challenges for small-scale farmers with limited resources. To address these challenges and support Indian farmers, there is a pressing need for innovative solutions such as the design and implementation of efficient crop cutting machines.

By leveraging advanced software tools like CATIA, the design process for these machines can be streamlined, ensuring optimal performance and cost-effectiveness. The introduction of mechanized crop cutting machines holds immense potential to transform the agricultural landscape, reducing costs and time associated with crop cutting and improving economic standards, particularly for small-scale farmers.

Furthermore, while crop cutting is crucial, the subsequent stage of crop harvesting also demands considerable time and effort from farmers. Currently, harvesting is predominantly manual, adding to the labor burden

III.CONSTRUCTION (Design)



Manufacturing & Assembly Procedure :

- Firstly the frame of crop cutter is made according to the design finalized by using steel angle bars.
- Wheels are attached to the frame by means of stems and welding joints.
- The battery base is formed on frame by placing a plywood sheet and then the battery and solar charge converter is placed on it.
- Blades are then installed on the top end of the motors using nut and bolt fitment.
- Both the motors are then attached to the frame using a hinge that connects both the motors and the frame
- The solar panel is adjusted at a specific angle which woud be the best for facing sunlight for the better solar utilisation for charging batteries.
- All the connections have been made using wires and heat sleeve tubes and proper arrangement of wires has been done.
- The blades included are of high quality and heavy duty.

IV. WORKING

Power Source: Traditional crop cutting machines typically rely on internal combustion engines, such as petrol or diesel engines. However, to prioritize environmental sustainability, we have opted for a solar panel and battery setup.

The cutting mechanism comprises multiple strategically positioned blades or cutting units on the machine. These blades are engineered to efficiently slice through crop plants at the desired height.

The crop cutting machine is operated by man euvering it across the field. Depending on its design, the machine can be manually pushed. The operator ensures proper alignment and positioning for effective cutting.

As the machine advances, the motor drives the rotation of the blades, creating a rapid cutting action upon contact with the crop plants. Crop cutting machines often feature adjustable cutting height mechanisms, allowing customization based on crop type and harvesting needs.

Upon cutting, the harvested crops are collected using a tray or chute attached to the machine. These collected crops are then transported to subsequent processing or storage areas.

Maintenance and Safety: Similar to other mechanical equipment, crop cutting machines require regular maintenance for optimal performance. This maintenance includes blade sharpening, battery upkeep, and overall machine inspection. Safety features such as blade guards are also essential.

By utilizing crop cutting machines with motorized blades, farmers can significantly reduce manual effort and time required for crop cutting. These machines offer enhanced efficiency, precision, and productivity compared to traditional manual methods. Additionally, mechanized crop cutting machines contribute to reduced labor costs, improved harvesting speed, and increased overall farm productivity.

V. CONCLUSION & RESULTS

The primary aim of a crop cutter is to minimize labor costs associated with harvesting while addressing challenges stemming from labor shortages. This is particularly crucial as traditional labor-intensive harvesting methods often lead to laborers experiencing back pain and blisters on their hands, limiting their availability for field work. To overcome these challenges, implementing a crop cutter offers several significant benefits:

Cost Reduction: Utilizing a crop cutter system can result in a substantial reduction in harvesting costs, typically ranging from 60% to 70% compared to conventional methods.
Suitable for Small-scale Farmers: The crop cutter system is specifically tailored to meet the needs of small-scale farmers who own land areas ranging from 2 to 5 acres.
Time Savings: Compared to conventional methods, the crop cutter system significantly reduces harvesting time by approximately 50% to 60%.
Maintenance and Operation: The crop cutting system is engineered for user-friendly maintenance and operation, enabling farmers to utilize the technology without requiring extensive training or technical expertise.
Economic Efficiency: The crop cutting system eliminates the need for additional manual labor, resulting in cost-effective operation and maximizing cost savings for farmers. Enhanced Safety: The crop cutting system prioritizes operational safety, significantly reducing the risks associated with manual labor and potential injuries.
Incorporating a crop cutting system into their farming operations allows farmers to achieve significant cost savings, decrease dependence on manual labor, enhance efficiency, and improve overall safety during the harvesting process.

VI. FUTURE SCOPE OF PROJECT

"The crop cutter machine" holds promise for future advancements, opening up a range of potential avenues for development. Here are some ideas for further improvement:
Adjusting Cutting Teeth: By simply modifying the size of the cutting teeth, the crop cutter can be repurposed as a lawn mower. This adaptability allows for the machine to be utilized across different crops, adjusting to varying loads by altering the power and blade size accordingly.
Adding Curved Collectors: To enhance efficiency, curved collectors can be integrated onto the sides of the crop cutter. These collectors would gather the cut crops and automate the process of bundling them together. The bundled crops can then be ejected at the rear of the cutter for easier collection and handling.
Incorporating Additional Power for Sugarcane Applications: In situations where the machine is utilized for sugarcane cutting, extra power can be incorporated by integrating parallel springs into the prime mover. For example, capacity can be augmented by introducing four parallel springs, providing the machine with the requisite strength to tackle the demands of sugarcane cutting.

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