

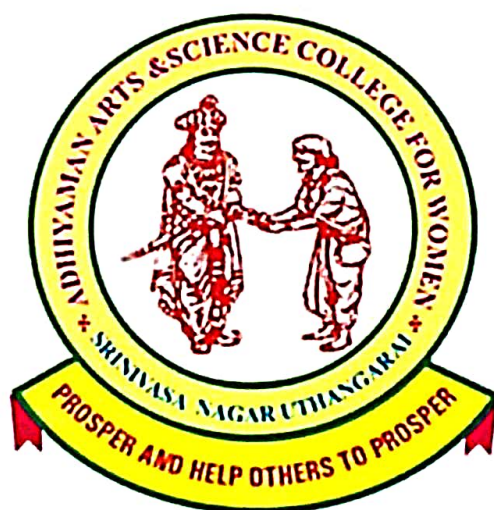
A TWO-DAY INTERNATIONAL CONFERENCE

on

**SCIENTIA 2026: GLOBAL FRONTIERS IN
ADVANCED MATERIALS, ENERGY AND
BIOMEDICAL INNOVATION**

05th & 06th October 2026

PROCEEDINGS



Organized by

**DEPARTMENT OF PHYSICS & CHEMISTRY
ADHIYAMAN ARTS AND SCIENCE COLLEGE FOR WOMEN
UTHANGARAI, KRISHNAGIRI,
TAMILNADU, INDIA.**

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GREETINGS



**Dr.S.THIRUMALMURUGAN, M.A., M.Sc.,M.Ed.,M.Phil.,Ph.D.,DCPIC., PGDCA.,
Chairman & Principal
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It gives me great pleasure to extend my warm greetings and best wishes to all the distinguished resource persons, researchers, academicians, faculty members, scholars, and participants of the Two- Day International Conference – SCIENTIA 2026: “Global Frontiers in Advanced Materials, Energy, and Biomedical Innovation,” organised by the Department of Physics & Chemistry, Adhiyaman Arts and Science College for Women, Uthangarai, on 5 & 6 October 2026.

In an era of rapid scientific and technological progress, research in advanced materials, sustainable energy, and biomedical innovation has become highly significant. These interdisciplinary fields can address some of humanity's most urgent challenges and contribute meaningfully to a sustainable, healthy, and technologically advanced future.

SCIENTIA 2026 offers an excellent international platform for researchers, academicians, scientists, and young scholars to exchange knowledge, present emerging research, share innovative ideas, and foster meaningful academic collaborations. I am especially pleased that this conference encourages our students and young researchers to explore the frontiers of science and develop a spirit of inquiry, creativity, and innovation.

At Adhiyaman Arts and Science College for Women, we strongly believe that education must go beyond classrooms and examinations. We strive to empower young women through

quality education, scientific thinking, research exposure, innovation, and leadership, enabling them to contribute confidently to society and the global scientific community.

I sincerely appreciate the efforts of the Department of Physics & Chemistry, Advisory Board, Convenors, Organising Secretaries, Organising Committee, faculty members, and students, whose dedicated work made this international conference possible. I also extend my heartfelt gratitude to all the eminent resource persons and participants for enriching SCIENTIA 2026 with their knowledge and expertise.

May this conference inspire new ideas, promote lasting collaborations, and open new pathways for scientific discoveries that benefit humanity.

I wish SCIENTIA 2026 every success and all participants a highly enriching and memorable academic experience.

With warm greetings and best wishes,

Dr. S. THIRUMALMURUGAN

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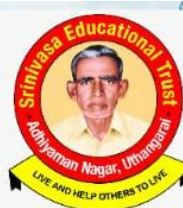
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PROGRAMME SCHEDULE



ADHIYAMAN ARTS AND SCIENCE COLLEGE FOR WOMEN, UTHANGARAI

— DEPARTMENT OF PHYSICS & CHEMISTRY —
SCIENTIA 2026



GLOBAL FRONTIERS IN ADVANCED MATERIALS, ENERGY AND BIOMEDICAL INNOVATION



Date: 05 & 06 October, 2026



Venue: Multipurpose Hall

DAY - I (05.10.2026)

PROGRAMME SCHEDULE

**INVOCATION
PRAYER SONG & TAMIL THAI VAZHTHU**
(10.00 AM - 10.10 AM)

WELCOME ADDRESS
10.10 AM - 10.15 AM

Dr. B.K. REVATHI
Assistant Professor
Department of Physics

PRESIDENTIAL ADDRESS
10.15 AM - 10.25 AM

Dr. S. THIRUMAL MURUGAN
Chairman & Principal
Adhiyaman Arts and Science College for Women,
Uthangarai

FELICITATION ADDRESS
10.25 AM - 10.35 AM

Dr. J. M. SHOBA
Secretary
Adhiyaman Educational Institutions, Uthangarai

HONOURING THE CHIEF GUEST
10.35 AM - 10.45 AM

RELEASE OF INTERNATIONAL CONFERENCE PROCEEDING
10.45 AM - 10.55 AM

INTRODUCTION ABOUT THE CHIEF GUEST
10.55 AM - 11.00 AM

Dr. R. VANITHA
Head & Assistant Professor
Department of Chemistry

FEATURED SPEECH - I
11.00 AM - 12.15 PM

Dr. T. SELVARAJU
Associate Professor of Chemistry,
Bharathiar University, Coimbatore

FEEDBACK SESSION
12.15 PM - 12.30 PM

LUNCH BREAK
12.30 PM - 1.15 PM



**INTRODUCTION ABOUT
THE CHIEF GUEST**

1.15 PM - 1.20 PM

Dr. C. KAVITHA

Assistant Professor
Department of Chemistry

FEATURED SPEECH – II

1.20 PM - 2.30 PM

Dr. L. AKILANDESWARI

Associate Professor of Chemistry,
Sri Sarada College for Women, Salem

BREAK TIME

2.30 PM - 2.45 PM

**INTRODUCTION ABOUT
THE CHIEF GUEST**

2.45 PM - 2.50 PM

Ms. P. JEEVA

Assistant Professor,
Department of Physics

FEATURED SPEECH – III

2.50 PM - 3.50 PM

Dr. R. RAJA

Assistant Professor of Physics,
SRM Institute of Science and Technology,
Chennai

FEEDBACK SESSION

3.50 PM - 4.00 PM

DAY - II (06.10.2026)

WELCOME ADDRESS

10.00 AM - 10.05 AM

S. MADHUMUTHA

II.M.Sc. Physics

INTRODUCTION ABOUT THE CHIEF GUEST

10.05 AM - 10.10 AM

Ms. R. RANJITHA

Assistant Professor
Department of Physics

FEATURED SPEECH - IV

10.10 AM - 11.10 AM

Dr. J. ABRAHAM REBAIRO

Assistant Professor of Physics
Madras Christian College Chennai

TEA BREAK

11.10 AM - 11.25 AM

ORAL PRESENTATION

11.25 AM - 12.30 PM

LUNCH BREAK

12.30 PM - 01.30 PM

INTRODUCTION ABOUT THE CHIEF GUEST

1.30 PM - 1.35 PM

Dr. R. SANGAVI

Assistant Professor
Department of Chemistry

FEATURED SPEECH - V

01.35 PM - 02.35 PM

Dr. M. ARIVAZHAGAN

Post Doctorate Research Fellow
Chiang Mai University Thailand

BREAK TIME

2.35 PM - 2.50 PM

VALEDICTORY SESSION

2.50 PM - 3.30 PM

FEEDBACK SESSION

3.30 PM - 3.40 PM

VOTE OF THANKS

3.40 PM - 3.50 PM

P. MONIKA

III.B.Sc. Chemistry

NATIONAL ANTHEM



Powering the Future: Opportunities and Challenges in Sustainable Energy Conversion and Storage

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ABSTRACT

The global transition toward a decarbonized energy system has placed sustainable energy conversion and storage at the center of scientific, technological, and policy discourse. While renewable energy sources such as solar and wind have achieved remarkable cost reductions and installation growth, the intermittent nature of these sources demands equally robust solutions for energy conversion and storage. This abstract presents a balanced overview of the opportunities and challenges shaping this critical field. Recent years have witnessed transformative advances in electrochemical energy technologies. Lithium-ion batteries dominate portable and electric vehicle applications, while sodium-ion and solid-state batteries emerge as promising alternatives. Supercapacitors offer high power density and exceptional cycle life. Electrocatalytic water splitting and fuel cells provide pathways for green hydrogen production and utilization. Nanostructured materials—carbon-based, metal oxides, and polymer composites—enhance performance across these platforms. Two-dimensional materials such as MXenes, metallenes and metal organic framework introduce new possibilities. In emerging markets, particularly India, renewable capacity has grown exponentially, with non-fossil sources now exceeding 50% of installed capacity. Despite these advances, systemic barriers impede sustainable deployment. At the materials level, trade-offs among cost, scalability, energy density, power density, and durability persist. Policy fragmentation and regulatory uncertainty further slow progress. Sustainable energy conversion and storage require a holistic approach. Continued innovation in materials, devices, and AI-driven discovery should be integrated. Only through such integrated efforts can the vision of a truly sustainable energy future be realized.

References:

1. Selvaraju et al., ACS Appl. Energy Mater. 9 (2026) 8525–8538.
2. Selvaraju et al., Int. J. Hydrog. Energy 245 (2026) 155704.
3. Selvaraju et al., Langmuir 42 (2026) 14318–14332.

4. Selvaraju et al., J. Energy Storage 149 (2026) 119983.
5. Selvaraju et al., Energy & Fuels 39 (2025) 22806-22818.
6. Selvaraju et al., ACS Appl. Energy Mater. 8 (2025) 11099–11114.
7. Selvaraju et al., Energy & Fuels 39 (2025) 13658-13673.
8. Selvaraju et al., Electrochim. Acta 518 (2025) 145789.
9. Selvaraju et al., ACS Appl. Energy Mater. 7 (2024) 9525-9542.
10. Selvaraju et al., Chem. Eng. J. 495 (2024) 153691.

The Quantum Revolution: A story of Five Puzzles that changed chemistry forever

Dr.L.Akilandeswari,

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ABSTRACT

The lecture focuses on the historical paradigm shift from classical physics to quantum mechanics and demonstrates how quantum principles serve as the foundation for modern quantum chemistry and nanotechnology. The transition to quantum theory was driven by a series of foundational experimental puzzles and conceptual breakthroughs: Max Planck's postulate of energy quanta to resolve the blackbody radiation problem more, Albert Einstein's photon hypothesis explaining the photoelectric effect, Ernest Rutherford's nuclear model highlighting classical atomic instability, Louis de Broglie's proposal of wave-particle duality confirmed by electron diffraction, and Werner Heisenberg's uncertainty principle. The quantum theory culminated in revolutionizing the Chemistry and Physics.

Beyond Silicon: Perovskite, Chalcogenide, and Quantum Dot Materials for Renewable Energy Applications

Dr. Raja Rajendran

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ABSTRACT

Most of today's solar panels use silicon solar cells. But silicon absorbs light badly, requires high-temperature, energy-intensive manufacturing, and offers little freedom to tune its properties. In this lecture we introduce three families of ‘beyond-silicon’ materials that can be made cheaply from solution and designed at the nanoscale: metal-halide perovskites, metal chalcogenides and semiconductor quantum dots. Students/Reseachers will learn what makes for a good solar absorber – band gap, light absorption, defects and stability – and how chemists and physicists engineer these properties. For perovskites, we discuss their crystal structure, additive control of crystal growth and healing of defects and light-induced ion motion to affect stability. We investigate how the band gap can be tuned by changing size and composition of chalcogenides and quantum dots. We study the use of such materials for quantum dot solar cells and solar driven hydrogen production from water. The lecture links basic science to real devices and encourages students to pursue research in clean-energy materials.

Keywords: solar cells; perovskites; metal chalcogenides; quantum dots; band gap; solar hydrogen

Beyond Deep Learning: The Next Era of Artificial Intelligence in Molecular and Materials Discovery

Dr. J. Abraham Rebairo

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ABSTRACT

The field of computational chemistry and materials science has moved beyond traditional, single-task deep learning. We are now entering a new era driven by versatile "foundation models," generative artificial intelligence, and autonomous laboratory systems. We outline how these advanced AI tools are fundamentally transforming the discovery of both new materials and biological molecules. In materials science, researchers are using massive datasets to train universal machine learning models that can quickly and accurately predict the properties of diverse atomic structures. At the same time, specialized generative models can now propose entirely new crystal structures by directly learning the rules of three-dimensional geometry and periodic boundaries. However, a major practical challenge remains: AI models often predict materials that appear perfectly stable in a computer simulation but are impossible to synthesize in a real-world laboratory due to real-world disorder and kinetic effects. To solve this, scientists are adopting new mathematical techniques, such as Generative Flow Networks and Flow Matching, which help the AI generate designs that are both innovative and physically realistic. In the biological sciences, advanced open-source AI models can now accurately predict how proteins, DNA, and drug molecules interact with one another dynamically. A major milestone for these technologies is the recent Phase IIa clinical trial success of Rentosertib (ISM001-055). This represents the first medicine where an AI system discovered both the biological disease target and designed the drug molecule itself. It has shown highly promising results in treating a severe lung disease and has even demonstrated the ability to reverse markers of biological aging in human patients. Finally, this new era is defined by the rise of "Self-Driving Laboratories." By using Large Language Models as reasoning engines, AI agents can now connect with robotic systems to plan, physically synthesize, and test new chemicals without human intervention.

Transition Metal-Based Functional Nanoarchitectures for Advanced Electrochemical Sensing Technologies

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ABSTRACT

The rapid advancement of electrochemical sensing technologies has created new opportunities for the sensitive, selective, rapid, and cost-effective detection of chemically, biologically, and environmentally important analytes. In this context, transition metal-based functional nanoarchitectures have emerged as versatile electrode materials because of their tunable electronic structures, rich redox chemistry, high catalytic activity, and distinctive surface properties. Rational engineering of these nanostructures enables efficient charge transfer, increased electroactive surface area, enhanced analyte adsorption, and improved electrocatalytic reaction kinetics, thereby providing significant advantages for the development of high-performance electrochemical sensors. This presentation will highlight recent advances in the design and development of transition metal-based functional nanoarchitectures, including metal nanoparticles, metal oxides, mixed-metal nanostructures, two-dimensional materials, and metal-based nanohybrids and heterostructures. Particular emphasis will be placed on strategies for controlling morphology, composition, surface defects, interfacial interactions, and electronic properties to achieve enhanced electrochemical sensing performance. The integration of transition metal nanostructures with conductive carbon materials, two-dimensional nanomaterials, and other functional components will also be discussed as an effective approach for constructing synergistic sensing interfaces. The electrochemical sensing principles and structure–property–performance relationships of these nanoarchitectures will be discussed with representative examples involving the detection of environmental pollutants, pharmaceutical and biologically relevant molecules, food contaminants, and other emerging analytes. Key analytical characteristics, including sensitivity, selectivity, detection limit, linear response, stability, reproducibility, and applicability to real samples, will be considered. Finally, current challenges and future perspectives toward portable, miniaturized, flexible, and point-of-care electrochemical sensing platforms will be outlined. Overall, the talk aims to demonstrate how rationally engineered transition metal-based nanoarchitectures can bridge fundamental nanomaterial design with practical electrochemical detection technologies for environmental monitoring, healthcare, food safety, and related applications.

GREEN SYNTHESIS AND CHARACTERIZATION OF COPPER OXIDE NANOPARTICLES USING CITRUS MEDICA LEAF EXTRACT

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ABSTRACT

Copper oxide (CuO) nanoparticles were synthesized through a plant-mediated green synthesis approach using Citrus medica leaf extract. The study was undertaken to obtain CuO nanoparticles by an environmentally friendly route and to examine their structural, optical, vibrational and morphological characteristics. The synthesized material was characterized using X-ray diffraction (XRD), ultraviolet-visible (UV-Vis) spectroscopy, Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). The XRD pattern exhibited characteristic diffraction peaks at 27.32° , 34.35° , 36.37° and 42.43° , which were assigned in the project to the (202), (313), (131) and (024) planes of CuO and compared with JCPDS data. The average crystallite/particle size reported from the project was about 55.06 nm. UV-Vis analysis showed an absorption maximum at 328 nm and the project reported an optical band-gap value of 3.7 eV. FTIR analysis indicated vibrational bands at 2871.45, 1587.73, 1386.98, 1079.04 and 605.55 cm^{-1} , with the low-wavenumber band assigned to Cu–O stretching. SEM observations showed irregular to nearly spherical particles with agglomeration. The results demonstrate that Citrus medica leaf extract can be employed as a plant-based route for the preparation of CuO nanoparticles.

Keywords: Copper oxide nanoparticles; Citrus medica, Green synthesis; XRD, FTIR, UV-Visible spectroscopy, SEM.

1. Introduction

Nanoscience deals with matter and phenomena at dimensions typically ranging from 1 to 100 nm, where materials can display properties that differ from their bulk counterparts. Nanomaterials possess high surface-to-volume ratios and may show distinctive optical, electrical, chemical and biological behaviour. These features have resulted in extensive interest in nanomaterials for materials science, electronics, energy, environmental technologies and biomedical research.

Nanoparticles can be produced through top-down and bottom-up strategies. Conventional physical and chemical routes can provide control over material formation, but they may require high energy input or chemical reducing and stabilizing agents. Green synthesis uses biological resources such as plant extracts, microorganisms or other natural materials. Plant extracts are particularly attractive because their phytochemicals can participate in reduction, stabilization and capping processes.

Copper oxide is a p-type semiconductor and an important transition-metal oxide. CuO nanoparticles have been investigated for applications including catalysis, gas sensing, electrochemical energy storage, solar-cell-related devices, antimicrobial materials, coatings and environmental remediation. Their properties are strongly influenced by crystallinity, particle size, morphology and surface chemistry.

Citrus medica belongs to the Rutaceae family. Its leaves contain bioactive constituents including phenolic compounds, flavonoids and essential oils. The project work identifies Citrus medica leaf extract as a natural reducing and stabilizing medium for CuO nanoparticle preparation. The present article condenses the project work into a research-paper format and focuses on the synthesis and characterization results obtained from the original study.

2. Materials and Methods

2.1 Materials

The materials reported in the project were copper sulphate, fresh Citrus medica leaf material, distilled water and acetone. The plant material was collected from a rural area and washed thoroughly with distilled water.

2.2 Preparation of Citrus medica Leaf Extract

The collected leaf material was washed and dried at room temperature in the shade for one week. Approximately 10 g of chopped plant material was weighed and mechanically powdered using a mortar. About 6 g of the dried powder was mixed with 100 mL of distilled water and heated at 50 °C for approximately 1 h. After cooling, the mixture was filtered using Whatman filter paper. The resulting clear extract was used as the plant-derived reducing and stabilizing medium.

2.3 Green Synthesis of CuO Nanoparticles

For the synthesis, 0.1 mol of copper sulphate was dissolved in 50 mL of distilled water and stirred for 30 min. The plant extract was then added and the mixture was continuously stirred for 1 h. A visible colour change was reported during the reaction, followed by standing at room temperature

for one day. The resulting material was washed two to three times, collected and dried in an oven at 75 °C. Finally, the dried product was ground to a fine powder using a mortar and designated as the synthesized CuO nanoparticle sample.

The project document contains an internal inconsistency in this experimental section: while the title, abstract and characterization discussion identify *Citrus medica* leaf extract, the synthesis paragraph names “papaya stem extract.” Because the overall study is consistently presented as *Citrus medica*-mediated CuO synthesis, the manuscript above follows *Citrus medica*; the original laboratory record should be checked before journal submission so that the plant material is stated correctly.

2.4 Characterization Techniques

The synthesized material was characterized using X-ray diffraction (XRD), UV-Visible absorption spectroscopy, Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). XRD was used to examine crystalline structure and estimate crystallite size. UV-Visible spectroscopy was used to determine the optical absorption behaviour and the band-gap value reported in the project. FTIR was used to identify characteristic vibrational bands and functional groups. SEM was used to examine particle morphology and surface features.

3. Results and Discussion

3.1 X-ray Diffraction Analysis

The XRD pattern obtained for the synthesized CuO nanoparticles exhibited diffraction peaks at 2θ values of 27.32°, 34.35°, 36.37° and 42.43°. In the original project, these reflections were indexed as (202), (313), (131) and (024), respectively, and were reported to be consistent with the cited JCPDS reference for CuO.

The occurrence of distinct diffraction peaks indicates that the synthesized material possesses a crystalline nature. Peak width was used for crystallite-size estimation through the Debye-Scherrer equation. The project tabulation reports individual calculated values for the selected peaks and gives an overall reported particle/crystallite size of approximately 55.06 nm in the conclusion. The reported nanoscale dimension places the material within the nanoparticle size regime.

The diffraction behaviour is important because crystal structure and crystallite size influence the optical, electrical, catalytic and surface properties of metal-oxide nanoparticles. The observed diffraction pattern therefore provides structural evidence supporting the formation of crystalline CuO in the synthesized product.

S. No.	2θ (°)	θ (°)	cos θ	Assignment
1	27.32	13.66	0.9717	(202)
2	34.35	17.175	0.9554	(313)
3	36.37	18.185	0.9500	(131)
4	42.43	21.215	0.9063	(024)

Table 1. XRD peak positions and plane assignments

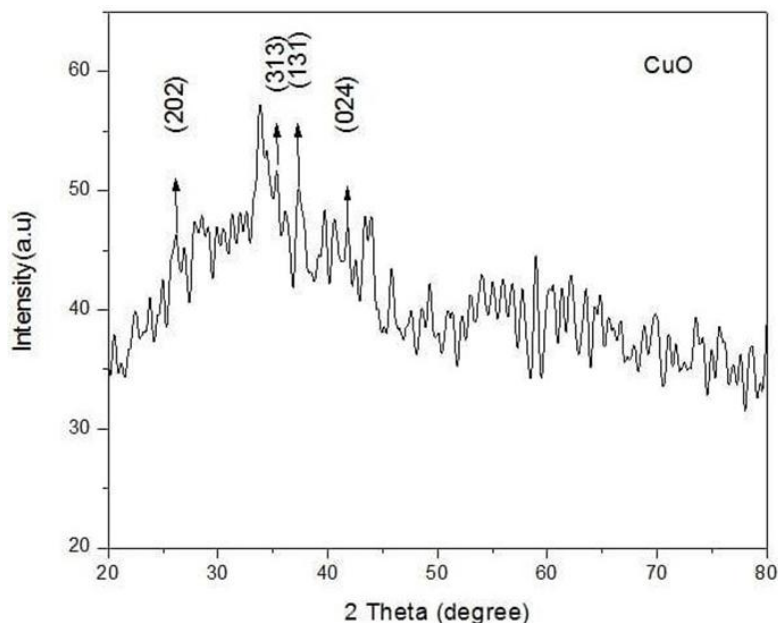


Fig.1 XRD spectrum of CuO nanoparticles synthesized using Citrus medica leaf extract.

3.2 UV-Visible Absorption Spectroscopy

The optical absorption behaviour of the synthesized CuO nanoparticles was examined in the wavelength range of 200–800 nm. The UV-Visible spectrum displayed an absorption maximum at 328 nm. The project interprets this absorption feature as evidence for the formation of the CuO nanoparticle sample.

The optical band-gap energy was estimated using the relation:

$$E_g = hc / \lambda$$

where h is Planck's constant, c is the velocity of light and λ is the absorption wavelength. The project reports a band-gap value of 3.7 eV and describes the material as dielectric on the basis of this value. For publication, the calculation should be presented exactly from the measured

wavelength and the adopted optical model, because band-gap determination can depend on the method used and on whether the absorption edge or peak wavelength is used.

The absorption spectrum provides useful information about the electronic and optical behaviour of the synthesized material. At nanoscale dimensions, changes in particle size, surface states and structural defects can influence optical absorption. The measured spectrum therefore complements the structural information obtained from XRD.

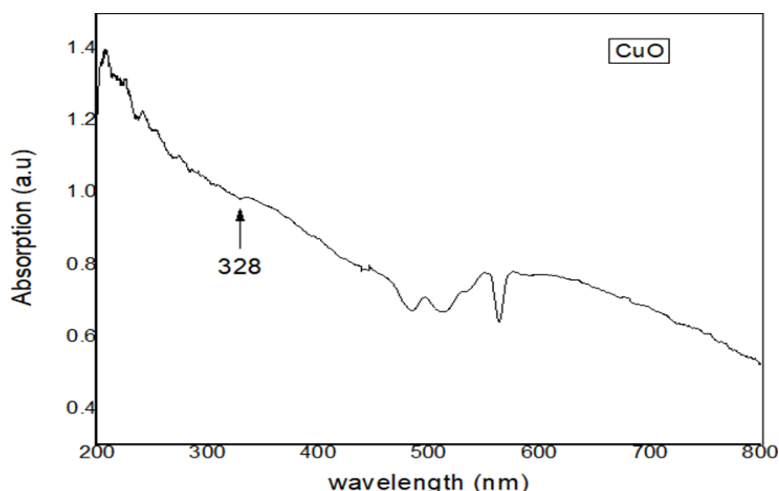


Fig.2 UV spectrum of CuO nanoparticles synthesized using Citrus medica leaf extract.

3.3 Fourier Transform Infrared Spectroscopy

FTIR spectroscopy was employed to identify the vibrational features associated with functional groups and metal–oxygen bonding in the synthesized material. The spectrum was recorded in the 4000–500 cm^{-1} region.

Wavenumber (cm^{-1})	Assignment in project	Vibration
2871.45	Alkane C–H	Stretching
1587.73	Aromatic C=C	Stretching / bending
1386.98	Amine C–N	Stretching / bending
1079.04	Alcohol C–O	Stretching
605.55	Metal oxide Cu–O	Stretching

Table 2. FTIR bands reported for the synthesized CuO nanoparticles.

The band at 605.55 cm^{-1} was assigned in the project to Cu–O stretching and provides vibrational evidence associated with the copper-oxide framework. The higher-wavenumber bands were attributed to organic functional groups. Such bands can arise from phytochemical constituents associated with the plant extract and may participate in stabilization or capping of the synthesized nanoparticles.

The presence of plant-derived functional groups together with the Cu–O vibration supports the role of the plant extract in the green synthesis process. FTIR therefore provides complementary chemical information to the crystalline information obtained from XRD.

The original project contains the FTIR spectrum as Fig. 5.3. The original high-resolution FTIR plot should be inserted in the final manuscript with the caption: “Fig. 3. FTIR spectrum of CuO nanoparticles synthesized using *Citrus medica* leaf extract.”

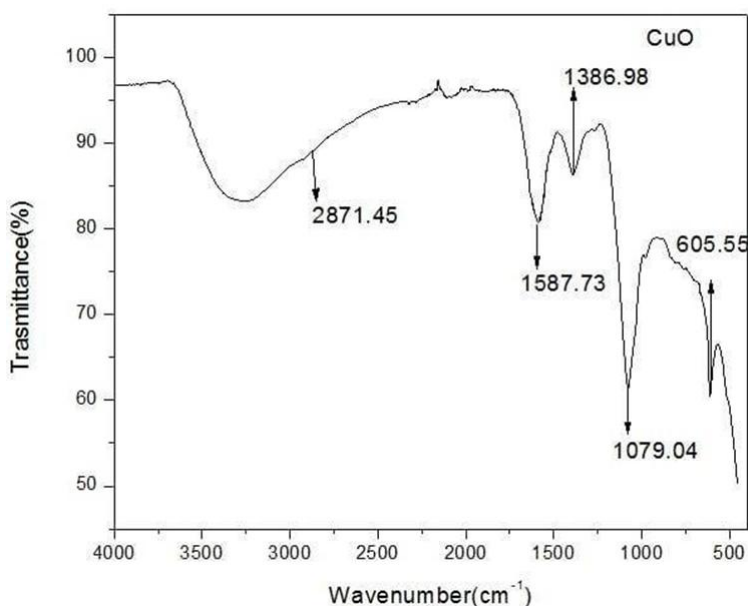


Fig.3 FTIR spectrum of CuO nanoparticles synthesized using *Citrus medica* leaf extract

3.4 Scanning Electron Microscopy Analysis

SEM was used to examine the surface morphology of the synthesized CuO nanoparticles. According to the project, the SEM micrograph showed irregular and nearly spherical morphology. The nanoparticles were observed to be agglomerated, which was attributed to high surface energy

and interactions between nanoparticles. The particle distribution was described as non-uniform, with clusters occurring in some regions.

Agglomeration is commonly relevant in nanoparticle systems because the large surface area associated with nanoscale particles increases surface interactions. Therefore, the SEM observation provides useful information about the physical appearance of the synthesized powder and complements the nanoscale structural information obtained from XRD.

The original project contains SEM characterization images. These should be inserted as a high-resolution multi-panel figure, if available, with the caption: The magnification and scale bar should be retained from the original SEM report rather than estimated.

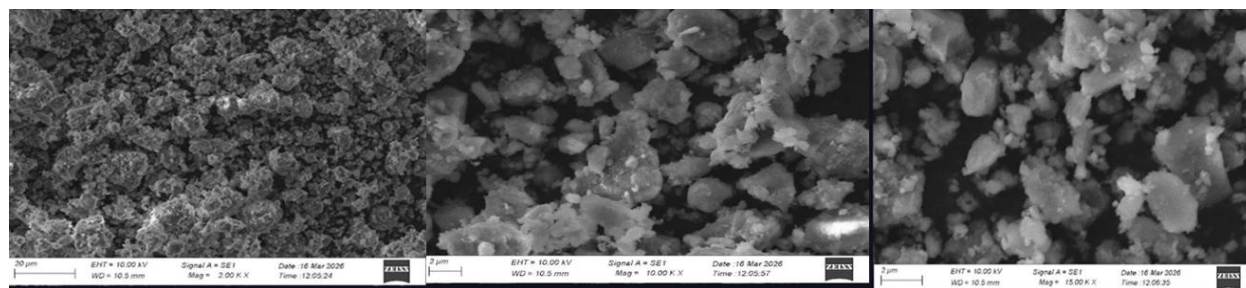


Fig.4. SEM images of CuO nanoparticles synthesized using *Citrus medica* leaf extract.

4. Conclusion

Copper oxide nanoparticles were synthesized through a green, plant-mediated approach using *Citrus medica* leaf extract and were characterized by XRD, UV-Visible spectroscopy, FTIR and SEM. The XRD pattern exhibited the characteristic diffraction peaks reported for CuO, confirming the crystalline nature of the synthesized product. The project reports an average nanoscale size of approximately 55.06 nm.

UV-Visible spectroscopy showed an absorption maximum at 328 nm and the project reported an optical band-gap value of 3.7 eV. FTIR analysis revealed bands corresponding to alkane C–H, aromatic C=C, amine C–N, alcohol C–O and metal–oxygen vibrations, with the Cu–O stretching band observed at 605.55 cm^{-1} . SEM analysis showed irregular to nearly spherical particles with agglomeration and non-uniform distribution. Overall, the work demonstrates the feasibility of using *Citrus medica* leaf extract as a natural medium for CuO nanoparticle synthesis. The approach is relatively simple and uses a plant-derived extract, supporting the broader objective of developing more environmentally conscious nanoparticle synthesis routes. Further studies involving elemental

composition, particle-size distribution, surface charge, photocatalytic activity and antimicrobial testing would strengthen the application-oriented evaluation of the synthesized CuO nanoparticles.

References

1. Hosseini-Koupaei, M.; Shareghi, B.; Saboury, A. A.; Davar, F.; Sirotkin, V. A.; Hosseini-Koupaei, M. H.; Enteshari, Z. Catalytic Activity, Structure and Stability of Proteinase K in the Presence of Biosynthesized CuO Nanoparticles. *International Journal of Biological Macromolecules* 2019, 122, 732–744.
2. Jan, H.; Shah, M.; Usman, H.; Khan, M. A.; Zia, M.; Hano, C.; Abbasi, B. H. Biogenic Synthesis and Characterization of Antimicrobial and Antiparasitic Zinc Oxide Nanoparticles Using Aqueous Extracts of the Himalayan Columbine (*Aquilegia pubiflora*). *Frontiers in Materials* 2020.
3. Berra, D.; Salah Eddine, L.; Boubaker, B.; Ridha, O. M.; Laouini, S. E.; Benhaoua, B.; Ouahrani, M. R.; Berrani, D.; Rahal, A. Green Synthesis of Copper Oxide Nanoparticles by *Phoenix dactylifera* L. Leaves Extract. *Digest Journal of Nanomaterials and Biostructures* 2018, 13(4), 1231–1238.
4. Nagajyothi, P. C.; Pandurangan, M.; Kim, D. H.; Sreekanth, T. V. M.; Shim, J. Green Synthesis of Iron Oxide Nanoparticles and Their Catalytic and In Vitro Anticancer Activities. *Journal of Cluster Science* 2017, 28(1), 245–257.
5. Karpagavinayagam, P.; Vedhi, C. Green Synthesis of Iron Oxide Nanoparticles Using *Avicennia marina* Flower Extract. *Vacuum* 2019, 160, 286–292.
6. Arularasu, M. V.; Devakumar, J.; Rajendran, T. V. An Innovative Approach for Green Synthesis of Iron Oxide Nanoparticles: Characterization and Its Photocatalytic Activity. *Polyhedron* 2018, 156, 279–290.
7. Subhapriya, S.; Gomathipriya, P. Green Synthesis of Titanium Dioxide (TiO₂) Nanoparticles by *Trigonella foenum-graecum* Extract and Its Antimicrobial Properties. *Microbial Pathogenesis* 2018, 116, 215–220.
8. Sone, B. T.; Diallo, A.; Fuku, X. G.; Gurib-Fakim, A.; Maaza, M. Biosynthesized CuO Nanoplatelets: Physical Properties and Enhanced Thermal Conductivity Nanofluidics. *Arabian Journal of Chemistry* 2020, 13(1), 160–170.
9. Umar, A.; Ibrahim, A. A.; Nakate, U. T.; Albargi, H.; Alsaiani, M. A.; Ahmed, F.; Alharthi, F. A.; Ali Alghamdi, A.; Al-Zaqri, N. Fabrication and Characterization of CuO Nanoplates Based Sensor Device for Ethanol Gas Sensing Application. *Chemical Physics Letters* 2021, 763, 138204.

10. Rajendaran, K.; Muthuramalingam, R.; Ayyadurai, S. Green Synthesis of Ag-Mo/CuO Nanoparticles Using *Azadirachta indica* Leaf Extracts to Study Its Solar Photocatalytic and Antimicrobial Activities. *Materials Science in Semiconductor Processing* 2019, 91, 230–238.
11. Mohamed, A. A.; Abu-Elghait, M.; Ahmed, N. E.; Salem, S. S. Eco-Friendly Mycogenic Synthesis of ZnO and CuO Nanoparticles for In Vitro Antibacterial, Antibiofilm, and Antifungal Applications. *Biological Trace Element Research* 2021, 199(7), 2788–2799.

Green Synthesis of Nickel Oxide Nanoparticles Using *Saraca Asoca* Bark Extract And Their Antibacterial Activity

Dr.R.Vanitha

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Krishnagiri- 635207*

vanithavvmn@gmail.com

ABSTRACT

The present study reports the green synthesis of nickel oxide nanoparticles (NiO NPs) using *Saraca asoca* bark extract as a natural reducing and stabilizing agent. The aqueous bark extract was prepared and used for the synthesis of NiO nanoparticles by reacting it with nickel sulphate and sodium hydroxide under controlled heating and continuous magnetic stirring. The resulting precipitate was collected, dried, and powdered for further analysis. The synthesized NiO nanoparticles were characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray Diffraction (XRD), and Scanning Electron Microscopy coupled with Energy Dispersive X-ray Analysis (SEM–EDAX) to investigate their optical properties, functional groups, crystalline structure, surface morphology, elemental composition, and purity. The antibacterial activity of the synthesized NiO nanoparticles was evaluated against selected bacterial strains. The study demonstrates that *Saraca asoca* bark extract can serve as an eco-friendly and sustainable biological resource for the synthesis of NiO nanoparticles with potential antibacterial applications.

Keywords: *Saraca asoca*, Green synthesis, Nickel oxide nanoparticles, FTIR, XRD, UV–Visible spectroscopy, Antibacterial activity.

INTRODUCTION

Nanotechnology is one of the rapidly developing fields of modern science that deals with the design, synthesis, characterization, and application of materials at the nanoscale, generally ranging from 1 to 100 nm. Nanomaterials exhibit unique physicochemical properties, including high surface-area-to-volume ratio, enhanced reactivity, optical, electrical, magnetic, and catalytic properties, which differ considerably from their bulk counterparts. Owing to these characteristics, nanoparticles have found wide applications in medicine, biotechnology, environmental remediation, catalysis, electronics, energy storage, and antimicrobial technologies.

Nanoparticles can be synthesized by physical, chemical, and biological methods. Conventional physical and chemical methods may involve high energy consumption and the use of toxic chemicals, reducing agents, and organic solvents. Therefore, green synthesis has emerged as an environmentally friendly and cost-effective alternative for the preparation of nanoparticles. Biological materials such as plants, microorganisms, and algae contain bioactive phytochemicals capable of reducing metal ions and stabilizing the resulting nanoparticles. Plant-mediated synthesis is particularly attractive because it is simple, economical, relatively rapid, and does not require highly toxic reducing agents. *Saraca asoca* (Roxb.) Willd., commonly known as Ashoka, is an important medicinal plant belonging to the family Fabaceae. Different parts of the plant, particularly the bark, have traditionally been used in Ayurvedic medicine. The bark contains various bioactive constituents, including flavonoids, tannins, glycosides, phenolic compounds, lignans, and other phytochemicals. These compounds possess reducing, stabilizing, antioxidant, and antimicrobial properties, making *S. asoca* bark a promising biological source for the green synthesis of nanomaterials.

Nickel oxide (NiO) is a p-type semiconductor with a wide band gap of approximately 3.6–4.9 eV and possesses excellent chemical stability, optical, electrical, magnetic, and catalytic properties. NiO nanoparticles have attracted considerable attention because of their potential applications in sensors, photocatalysis, energy storage devices, electrochemical systems, smart windows, and antimicrobial materials. Their nanoscale dimensions and large surface area can enhance their interaction with microbial cells and contribute to antimicrobial activity.

Antibacterial nanomaterials are gaining importance because of the increasing concern over microbial resistance to conventional antibiotics. NiO nanoparticles have been reported to exhibit antibacterial activity against both Gram-positive and Gram-negative bacteria. Their antimicrobial action may be associated with surface interactions, oxidative stress, membrane damage, and the generation of reactive oxygen species. Green-synthesized NiO nanoparticles may additionally contain phytochemical compounds derived from the plant extract, which can contribute to their biological activity.

In the present study, NiO nanoparticles are synthesized using *Saraca asoca* bark extract as a natural reducing and stabilizing agent. The synthesized nanoparticles are characterized using UV–Visible spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), and Scanning Electron Microscopy with Energy-Dispersive X-ray Analysis (SEM–EDX) to investigate their optical, functional, crystalline, morphological, and elemental properties. The antibacterial activity of the synthesized NiO nanoparticles is subsequently evaluated against selected bacterial strains. This green synthesis approach provides an environmentally friendly route for the preparation of functional NiO nanoparticles with potential applications in antimicrobial and biomedical fields.

2. MATERIALS AND METHODS

2.1 MATERIALS

The materials used for the green synthesis of nickel oxide nanoparticles (NiO NPs) were *Saraca asoca* bark powder, nickel sulphate (NiSO_4), sodium hydroxide (NaOH), and distilled water. The equipment used included a magnetic stirrer, glass rod, beakers, filter paper, and an oven.

2.2 SYNTHESIS OF NICKEL OXIDE NANOPARTICLES

Fresh bark of *Saraca asoca* was collected, washed thoroughly with distilled water, and dried. The dried bark was ground into a fine powder. Approximately 20 mL of distilled water was added to the bark powder, and the mixture was heated to prepare the aqueous bark extract. The heated mixture was allowed to cool and was filtered to obtain a clear *Saraca asoca* bark extract.

The obtained bark extract was transferred into a 250 mL beaker. Nickel sulphate (2 g) was added to the extract under continuous stirring. Sodium hydroxide (NaOH) solution was then added gradually to the reaction mixture to facilitate the formation of nickel hydroxide precursor. The mixture was continuously stirred using a magnetic stirrer and maintained at the required temperature until the reaction was completed and a precipitate was formed.

The resulting precipitate was collected and dried in an oven at 120 °C. The dried material was subsequently ground into a fine powder. The obtained powder was used as the synthesized nickel oxide nanoparticle product. Thus, NiO nanoparticles were prepared through a green synthesis approach using *Saraca asoca* bark extract as a biological reducing and stabilizing agent.

3. RESULTS AND DISCUSSION

3.1 TESTING AND CHARACTERIZATION OF NICKEL OXIDE NANOPARTICLES

The synthesized nickel oxide (NiO) nanoparticles were subjected to various characterization techniques to investigate their optical, functional, crystalline, elemental, and morphological properties. The following analyses were carried out:

- UV–Visible spectroscopy
- Fourier Transform Infrared Spectroscopy (FTIR)
- X-Ray Diffraction (XRD)
- Energy-Dispersive X-Ray Spectroscopy (EDX)
- Scanning Electron Microscopy (SEM)
- Antibacterial activity

3.2 UV–VISIBLE SPECTROSCOPIC STUDIES

The UV–Visible absorption spectrum of the NiO nanoparticles synthesized using *Saraca asoca* bark extract was recorded to investigate their optical properties. The synthesized NiO nanoparticles exhibited significant absorption in the UV region, indicating the formation of nanosized NiO particles.

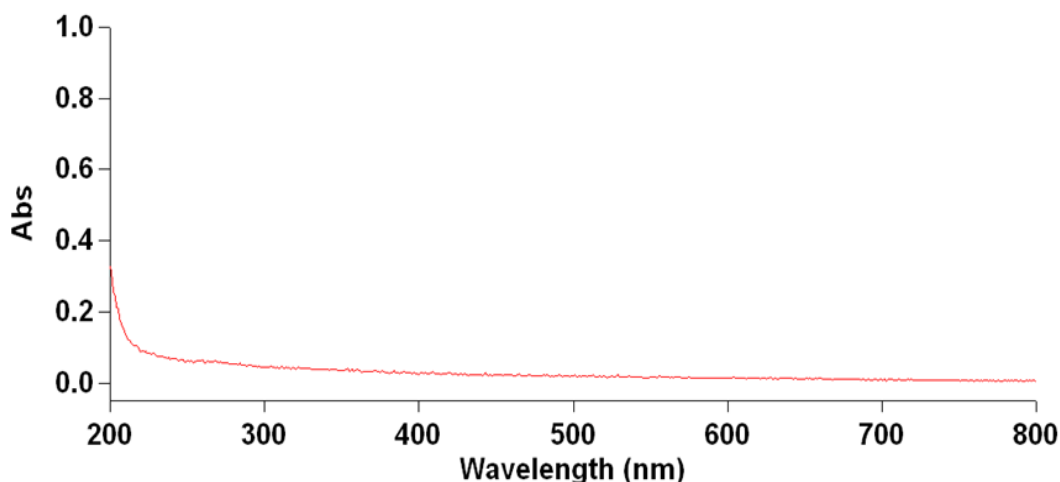


Fig. 3.1 UV – Visible spectrum NiO nanoparticles

The optical band gap of the synthesized NiO nanoparticles was estimated from the absorption data. The calculated band-gap energy was approximately 2.7 eV. The variation in band-gap energy compared with bulk NiO may be associated with particle size, surface defects, oxygen vacancies, and other structural features of the synthesized nanoparticles. The absorption observed below 300 nm indicates the characteristic optical response of the synthesized NiO nanoparticles.

3.3 FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPIC STUDIES

Fourier Transform Infrared (FTIR) spectroscopy is an important analytical technique used to identify the functional groups and chemical bonds present in a material. The FTIR spectrum of the synthesized NiO nanoparticles was recorded in the range of 400–4000 cm^{-1} .

A broad absorption band in the higher wavenumber region was observed around 2930 cm^{-1} , which can be associated with O–H stretching vibrations and organic groups originating from the plant extract. The peak around 1725 cm^{-1} may be attributed to C=O stretching vibrations, while the band around 1579 cm^{-1} may be associated with asymmetric stretching vibrations of oxygen-containing functional groups. The characteristic absorption band observed around 455 cm^{-1} can be assigned to the Ni–O stretching vibration, confirming the formation of nickel oxide.

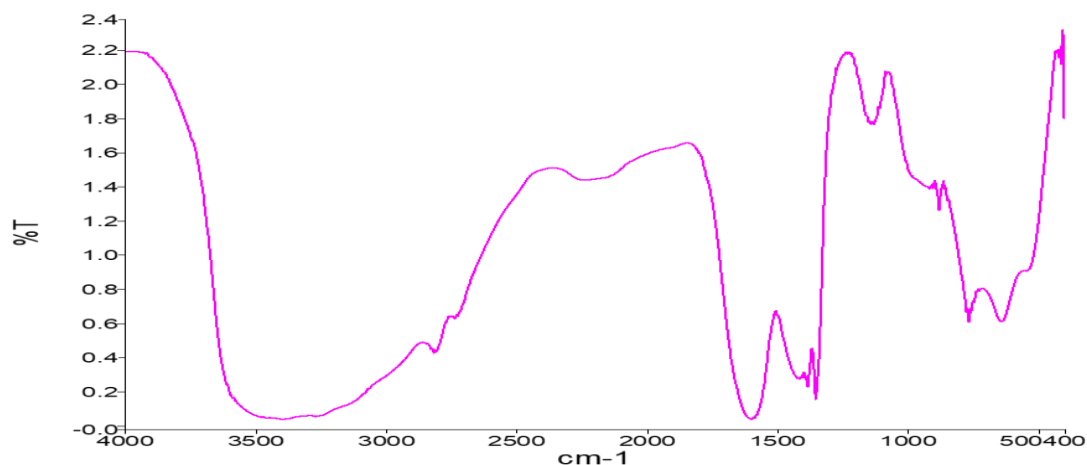


Fig. 3.2 FTIR spectrum of synthesized NiO nanoparticles

The presence of different functional groups indicates that phytochemicals present in *Saraca asoca* bark extract may have participated in the reduction, stabilization, and capping of the synthesized nanoparticles.

3.4 X-RAY DIFFRACTION (XRD) ANALYSIS

X-Ray Diffraction (XRD) analysis was carried out to determine the crystalline nature and structural characteristics of the synthesized NiO nanoparticles. The XRD pattern showed distinct diffraction peaks, indicating the crystalline nature of the synthesized material.

The observed diffraction peaks at approximately 20.39°, 31.03°, 31.73°, 37.00°, 41.08°, 42.97°, and 53.21° indicate the crystalline nature of the synthesized sample. The average crystallite size of the NiO nanoparticles was calculated using the Debye–Scherrer equation and was found to be approximately 30.71 nm.

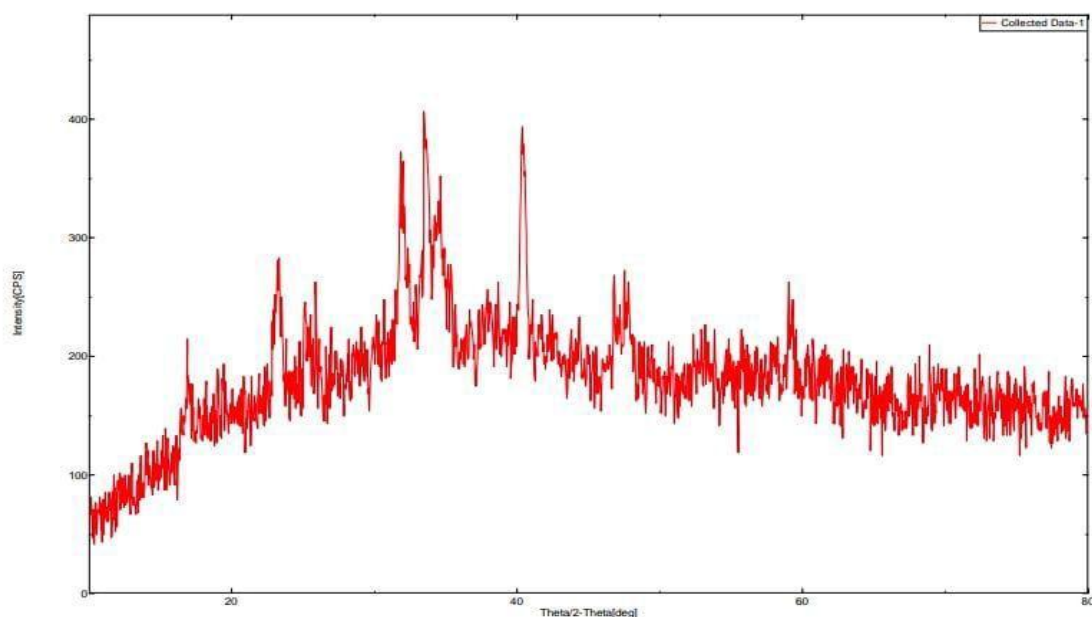


Fig. 4.3 XRD pattern of synthesized NiO nanoparticles

The crystallite size obtained from XRD indicates the nanoscale nature of the synthesized material. Differences between crystallite size obtained from XRD and particle size observed by SEM may arise because XRD determines the coherent crystallite size, whereas SEM provides information about the morphology and particle dimensions.

3.5 ENERGY-DISPERSIVE X-RAY SPECTROSCOPY (EDX)

Energy-Dispersive X-Ray Spectroscopy (EDX) was used to determine the elemental composition of the synthesized NiO nanoparticles. EDX analysis is generally coupled with SEM and provides information about the elements present in the sample based on the characteristic X-rays emitted when the sample is irradiated with an electron beam.

The EDX spectrum of the synthesized sample showed the presence of nickel (Ni) and oxygen (O) as the major elements. The elemental composition was reported as approximately

67.3% Ni and 32.7% O. The absence of significant additional elemental peaks suggests that the synthesized material predominantly consists of nickel and oxygen.

These results support the formation of NiO nanoparticles using *Saraca asoca* bark extract.

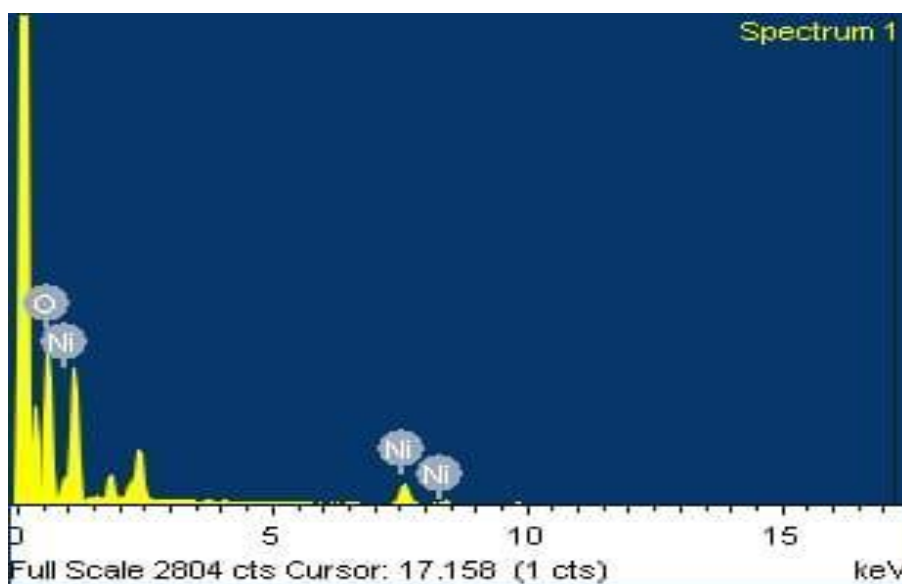


Fig. 3.4 EDX spectrum of synthesized NiO nanoparticles

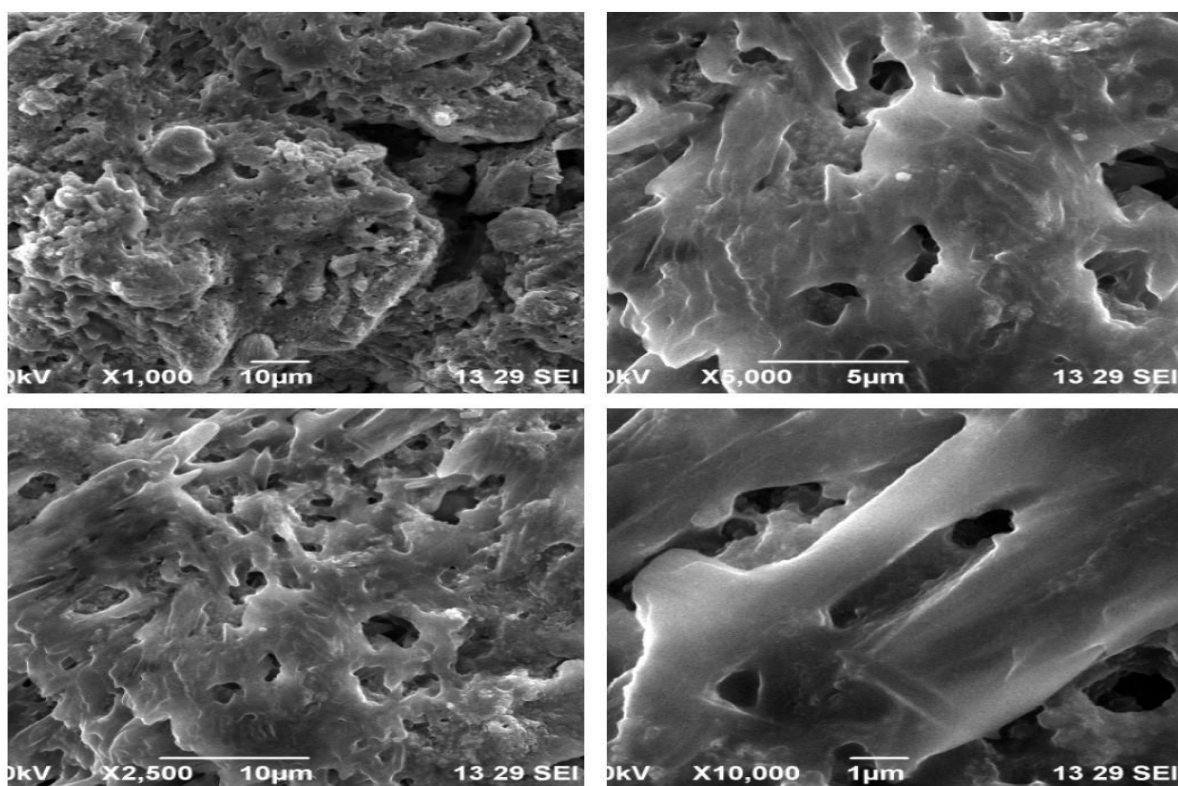
4.6 SCANNING ELECTRON MICROSCOPY (SEM)

Scanning Electron Microscopy (SEM) was used to study the surface morphology and approximate particle size of the synthesized NiO nanoparticles. The SEM images revealed the formation of nanosized particles with relatively uniform morphology.

The particle size was observed to be approximately in the range of 50–70 nm, with an average particle diameter of about 60 nm. Some degree of particle aggregation may be attributed to the high surface energy of nanoparticles. The difference between the average particle size obtained from SEM and the crystallite size obtained from XRD may be due to the aggregation of individual crystallites.

The SEM results confirm the formation of nanoscale NiO particles through the green synthesis route using *Saraca asoca* bark extract.

Fig. 3.5 SEM images of synthesized NiO nanoparticles



3.7 ANTIBACTERIAL ACTIVITY

The antibacterial activity of the synthesized NiO nanoparticles was evaluated against three bacterial strains, namely *Escherichia coli*, *Pseudomonas* sp., and *Staphylococcus* sp. The antibacterial effect was assessed based on the diameter of the zone of inhibition surrounding the sample-treated discs.

The synthesized NiO nanoparticles exhibited antibacterial activity against the tested bacterial strains, as evidenced by the formation of inhibition zones. Among the tested organisms, the highest antibacterial activity was observed against *E. coli* under the experimental conditions employed.

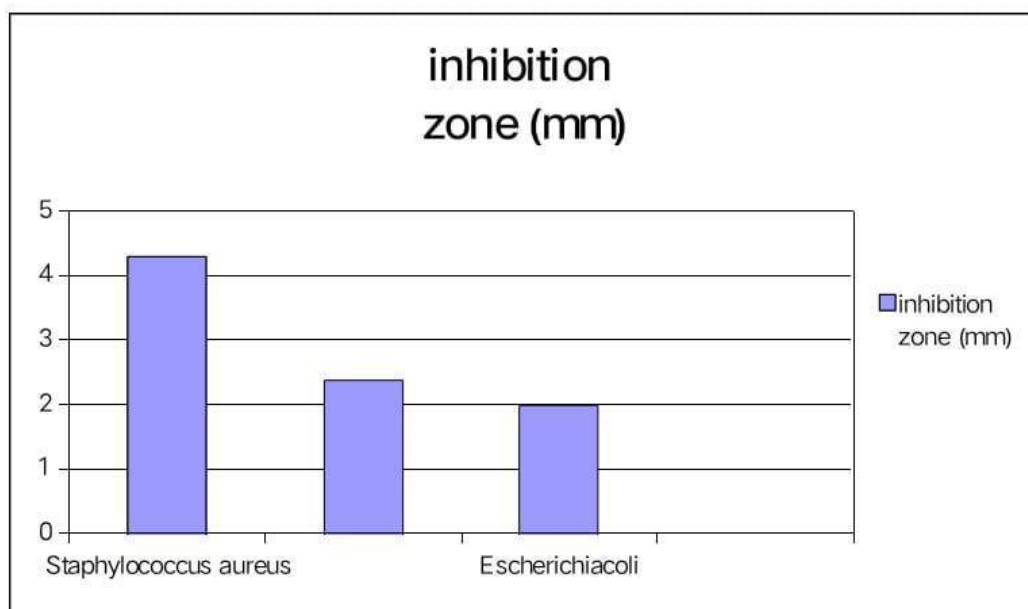


Fig. 3.6 Antibacterial activity of synthesized NiO nanoparticles

The antibacterial activity of NiO nanoparticles may be associated with their interaction with bacterial cell membranes, generation of reactive oxygen species, and other surface-mediated effects. The observed antibacterial activity indicates the potential of green-synthesized NiO nanoparticles for antimicrobial applications.

CONCLUSION

The present study demonstrates a simple and environmentally friendly approach for the synthesis of nickel oxide (NiO) nanoparticles using *Saraca asoca* bark extract. The phytochemicals present in the bark extract can act as natural reducing, stabilizing, and capping agents during nanoparticle formation, thereby providing an alternative to conventional chemical synthesis methods. The synthesized NiO nanoparticles were characterized using UV–Visible spectroscopy, FTIR, XRD, EDX, and SEM techniques. The UV–Visible analysis indicated an

optical band-gap energy of approximately 2.7 eV. FTIR analysis confirmed the presence of characteristic functional groups and the Ni–O bond. XRD analysis confirmed the crystalline nature of the synthesized material, with an estimated crystallite size of approximately 30.71 nm. EDX analysis revealed nickel and oxygen as the major elements, while SEM analysis confirmed the formation of nanosized particles with an approximate particle size of 50–70 nm. The synthesized NiO nanoparticles also exhibited antibacterial activity against the tested bacterial strains, including *Escherichia coli*, *Pseudomonas* sp., and *Staphylococcus* sp., with comparatively higher activity observed against *E. coli* under the experimental conditions. Overall, the findings indicate that *Saraca asoca* bark extract can be utilized as a biological resource for the green synthesis of NiO nanoparticles. The synthesized nanoparticles possess promising physicochemical and antibacterial properties and may have potential applications in antimicrobial materials, environmental applications, sensors, catalysis, and other nanotechnology-based fields.

REFERENCE

1. J. Sivakumar, C. Premkumar, P. Santhanam and N. Saraswathi (2011), Biosynthesis of Silver Nanoparticles Using *Calotropis gigantea* Leaf, *African Journal of Basic & Applied Sciences*, Vol. 3, No.6, pp. 265-270
2. Ponarulselvam, Panneerselvam, Murugan, Aarthi, Kalimuthu, Thangamani (2012), Synthesis of silver nanoparticles using leaves of *Catharanthus roseus* Linn. G. Don and their antiplasmodial activities, *Asian Pacific Journal of Tropical Biomedicine*, pp. 574-58.
3. Christian, P.; Von der Kammer, F.; Baalousha, M.; Hofmann, T. Nanoparticles: Structure, properties.
4. S.Pandey, M.G.H. Zaidib, S.K Gururani, Recent developments in clay polymer nanocomposites, *Sci. J. Rev.* 2 (2013) 296–328.
5. T. Quirk, There's plenty of room at the bottom, *Eng. Sci.* (2006) 22-36.
6. Roco & Bainbridge, 2002b, 2005, 2001; Roco, Mirkin, & Hersam, 2011, Barben, Fisher, Selin, & Guston, 2008, (Wajcman, 2008), Zucker, Darby, Furner, Liu, & Ma, 2007, Hayles, 2004, (Milburn, 2004).
7. S. Senapati, PhD thesis, University of Pune, 2005.
8. H. Klefenz, *Eng. Life Sci.*, 2004, 4, 211–8.
9. D. Goodsell, *Bionanotechnology: Lessons from Nature*, Willey-Less,
10. New Jersey, USA, 2004, pp. 1–8.

11. W. C. W. Chan and S. Nie, *Science*, 1998, 281, 2016–8.
12. M. Khatami, R. S. Varma, N. Zafarnia, H. Yaghoobi, M. Sarani, V. G. Kumar, *Sustain. Chem. Pharm.* 2018e, 10, 9.
13. K. Karthik, S. Dhanuskodi, C. Gobinath, S. Prabukumar, Sivaramakrishnan, J. Mater. Sci. Mater. Electron. 2018b, 7, 5459.
14. M. Khatami, H. Alijani, M. Nejad, R. Varma, *Appl. Sci.* 2018a, 8, 411.
15. J. Iqbal, B. A. Abbasi, R. Ahmad, T. Mahmood, B. Ali, A. T. Khalil, A. Munir, *Appl. Microbiol. Biotechnol.* 2018b, 102, 9449.
16. Y. Han, S. Zhang, N. Shen, D. Li, X. Li, *Mater. Lett.* 2017, 188, 1.
17. N. Mayedwa, N. Mongwaketsi, S. Khamlich, K. Kaviyarasu, N. Matinise, M. Maaza, *Appl. Surf. Sci.* 2018, 446, 266.
18. Ravindra P. Singh, Vineet K. Shukla, Raghvendra, S. Yadav, Prashant K. Sharma, Prashant K. Singh, Avinash C. Pandey (2011), Biological approach of zinc oxide nanoparticles formation and its characterization, *Advanced Materials Letters*, Vol. 2 No.4, pp.313-317, Akl M. Awwad¹, Nidà M. Salem, Amany O. Abdeen (2012), Biosynthesis of Silver Nanoparticles using *Olea europaea* Leaves Extract and its Antibacterial Activity, *Nanoscience and Nanotechnology*, Vol. 2, No.6, pp. 164-170.
19. Vidya C, Hiremath S, Chandrababha M, Antonyraj ML, Gopal IV, Jain A, Bansal K (2013) Green synthesis of ZnO nanoparticles by *Calotropis gigantea*. *Int J Curr Eng Technol* 1:118–120.
20. Dahl JA, Maddux BLS, Hutchison JE. *Chem Rev* 2007;107:2228, Hutchison JE. *ACSNano* 2008; 2:395.
21. Akl M. Awwad¹, Nidà M. Salem, Amany O. Abdeen (2012), Biosynthesis of Silver Nanoparticles using *Olea europaea* Leaves Extract and its Antibacterial Activity, *Nanoscience and Nanotechnology*, Vol. 2, No.6, pp. 164-170
22. Doble M, Kruthiventi AK. *Green chemistry and engineering*. Cambridge: Academic Press; 2007.
23. Abboud Y, Saffaj T, Chagraoui A, El Bouari A, Brouzi K, Tanane O, et al. Biosynthesis, characterization and antimicrobial activity of copper oxide nanoparticles (CONPs) produced using brown alga extract (*Bifurcaria bifurcata*). *Appl Nanosc* 2014;4(5):571-6.
24. Jha AK, Prasad K, Kulkarni AR. Synthesis of TiO₂ nanoparticles using microorganisms. *Colloids Surf B Biointerfaces* 2009;71(2):226-9.
25. Dhoondia ZH, Chakraborty H. *Lactobacillus* mediated synthesis of silver oxide nanoparticle *Nanomater Nanotechnol* 2012;2:2-15.

26. Baskar G, Chandhuru J, Fahad KS, Praveen AS. Mycological synthesis, characterization and antifungal activity of zinc oxide nanoparticles. *Asian J Pharm Technol* 2013;3(4):142-6.
27. Munusamy S, Bhakayaraj K, Vijayalakshmi L, Stephen A, Narayanan V. Synthesis and characterization of cerium oxide nanoparticles using *Curvularia lunata* and their antibacterial properties. *Int J Innov Res Sci Eng* 2014;129:255-8.
28. http://www.dagardens_saraca1.html, <http://www.saracindica.com/Ayurvedic>
Pharmacopoeia of India. 2001. Vol. I; Part-I: 17-18.
29. Rosangkima G, Prasad SB. Antitumour activity of some plants from Meghalaya and Mizoram against murine ascites Dolton's lymphoma. *Indian J Exp Biol.* 2004;42:981-988.
30. Rao KVK, Schwartz SA, Nair HK, et al. Plant derived products as a source of cellular growth inhibitory phytochemicals on PC-3M, DU-145 and LNCaP prostate cancer cell lines. *Curr Sci.* 2004;87:1585-1588.
31. Anitha B, Mohan R, Athiperumalsami T & Suthaa S. Ethnomedicinal plants used by the Kanikkars of Tirunelveli District. Tamil Nadu, India to treat skin diseases. *Ethnobotanical leaflets*, 2008; 12(1).

Tuning Electronic Structure through Metal Doping in Nanocomposites for Advanced Supercapacitor Electrodes

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ABSTRACT

Among the various metal oxide materials, ZnO is a very important semiconductor material. ZnO are used in an increasing number of industrial products such as rubber, paint, coating and cosmetics. Transparent electrode, solar cells, gas sensors and chemical sensor are the advantageous $d\pi$ and $p\pi$ metal doped ZnO nanomaterials. ZnO nanoparticles also have a properties of optical, electrical, and photocatalytic. The Cu and Bi doping ZnO nanoparticles and its effect was investigated. The structural, morphological, compositional and optical characterization was analysed by the prepared pure transition metal doped ZnO nanoparticle. The X-Ray diffraction spectra proves the structure is wurtzite for the $p\pi$ and $d\pi$ metal doped ZnO nanoparticles. The SEM image shows that the sample prepared from the $p\pi$ and $d\pi$ metal doped ZnO nanoparticles are the assembly of hexagonal structure. The EDAX spectrum reveals that the composition of the prepared sample are free from the impurities. The electrolyte ions have copious amount of time to undergo intercalation/decalation process which improves the specific capacitance, the prepared Zinc oxide Nps have capacitive in nature. The enhanced specific capacitance and charge or discharge rates promising them the electrodes in super capacitors, have combining high energy, densities with high levels of power delivery.

KEYWORDS : ZnO, Nanoparticles, Capacitance properties SEM, EDAX.

INTRODUCTION

Nanotechnology is an important field of a modern research dealing with the synthesis, design, and manipulation of particle structure ranging from approximately 1-100nm. Electrical, optical and chemical properties can be tuned by changing the size of particle in which the nanometer is important in semiconductor. ZnO Oxide Nps are still a hot area for research even after sample work has been done by researchers across the world. It is a versatile material for doping of different transition metals

among other metal oxides. Nps having a large family of morphological structures, high electron mobility and n- type carrier defects, it is suitable for a number of applications such as memory devices, optoelectronic devices, spintronics, solarcells and sensors. ZnO is considered as the best metal oxide in which it has been used as a normally hexagonal wurtzite structure and it is also known as a n type semiconductor with the binding gap of 60MeV and band gap of 3.37e V. It is present in the crust of the earth as the mineral zincite. ZnO material has a refractive index, high thermal conductivity, binding, antibacterial and UV protection properties and it also have more beneficial for many science application. Electron beam evaporation and electron spinning method are used in the synthesise of different zinc oxide nanostructured powder and films. Supercapacitors, one of the most promising electrochemical energy storage systems, have attracted much attention because of their pulse power supply, high dynamic of charge propagation, and long cycle life.

EXPERIMENTAL

MATERIALS

Copper Nitrate, Bismuth Nitrate, Zinc Sulphate, Sodium Hydroxide pellets were purchased in Merck and Distilled water were used for the reaction.

SYNTHESIS OF COPPER AND BISMUTH ZnO NANOPARTICLES

The p π and d π transition metal doped Nps were synthesized using Copper and Bismuth as dopants. Copper Nitrate (CuNO₃) and Bismuth Nitrate (BiNO₃) were used as Copper and Bismuth precursors, Cu doped and Bi doped ZnO Nps were synthesis by adding appropriate amount of Copper and Bismuth precursors with Zinc precursors. In a typical procedure Zinc sulphate and 1.5 M of Sodium hydroxide (NaOH) were dissolved in 100ml of water and magnetically stirred until homogeneous solution was obtained and the beginning of reaction the solution was transferred to teflon lined autoclave and maintained at 160⁰C for about 5 hours and then air cooled at room temperature precipitates were filtered out, washed with deionized water and ethanol to remove the impurities. The precipitate was dried in air at 60⁰C for 3 hours to obtain monodisperse ZnO nanoparticles.



Copper nitrate

Bismuth nitrate

**Doping of CuNO_3
 BiNO_3**



Zinc Sulphate

Sodium hydroxide

**ZnSO_4 is kept in stirrer for
an hour**



Zinc Nanocomposites



Doping of CuNO_3 , BiNO_3 and ZnSo_4

SCHEME:1 Synthesis of Nanocomposite from Different Doping Material

RESULT AND DISCUSSION

XRD ANALYSIS

The crystal structure and phase of the $p\pi$ and $d\pi$ doped ZnO nanoparticles were investigated using X-ray diffractometer (XRD) in the θ range 20° - 80° . The sharp peaks at scattering angle 2θ of 31.91° , 34.74° , 36.60° , 47.66° , and 56.89° , which corresponds to the (100), (002), (101), (102), and (110) planes respectively (Fig.1). All the diffraction peaks were well indexed to the hexagonal phase (Wurtzite structure) of ZnO. The substitution of Bismuth and copper does not affect the structure of ZnO.

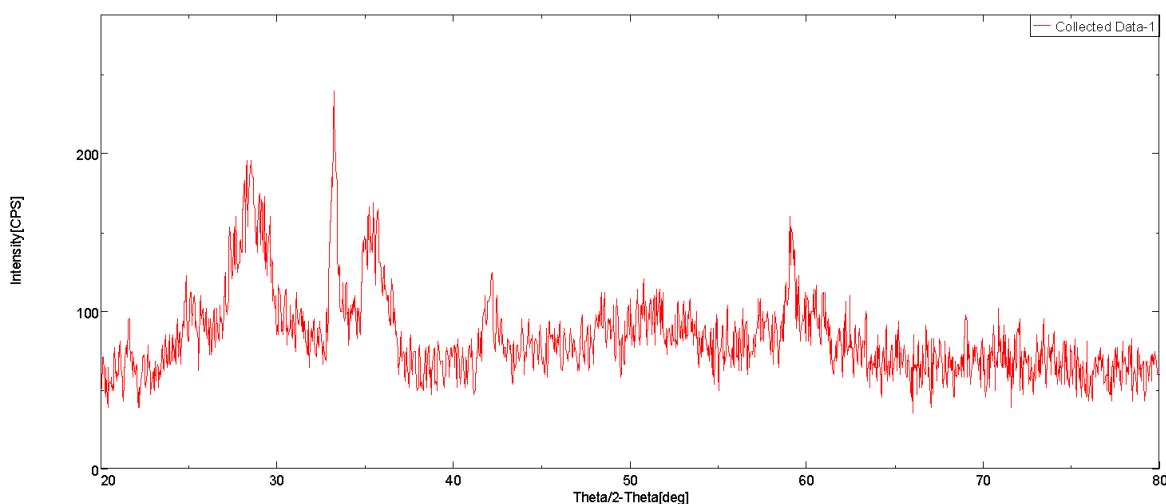


Fig 1. XRD spectra of Bi and Cu doped ZnO

EDAX

Energy X-ray analysis (EDAX) is a technique used for the measurement of nanoparticles by SEM. The compositional analysis of as prepared ZnO nanoparticles was investigated using EDAX. EDAX spectra of ZnO, Bi and Cu doped ZnO nanoparticles is shown in fig1.2. EDAX analysis confirms the presence of zinc (Zn), oxygen (O), Bismuth (Bi) and Copper (Cu) in $d\pi$ and $p\pi$ doped ZnO nanocrystals. EDAX spectrum shows that prepared samples are free from impurities. Atomic percentage of Copper and Bismuth in Cu doped Bi doped ZnO nanoparticles is given in Fig.2

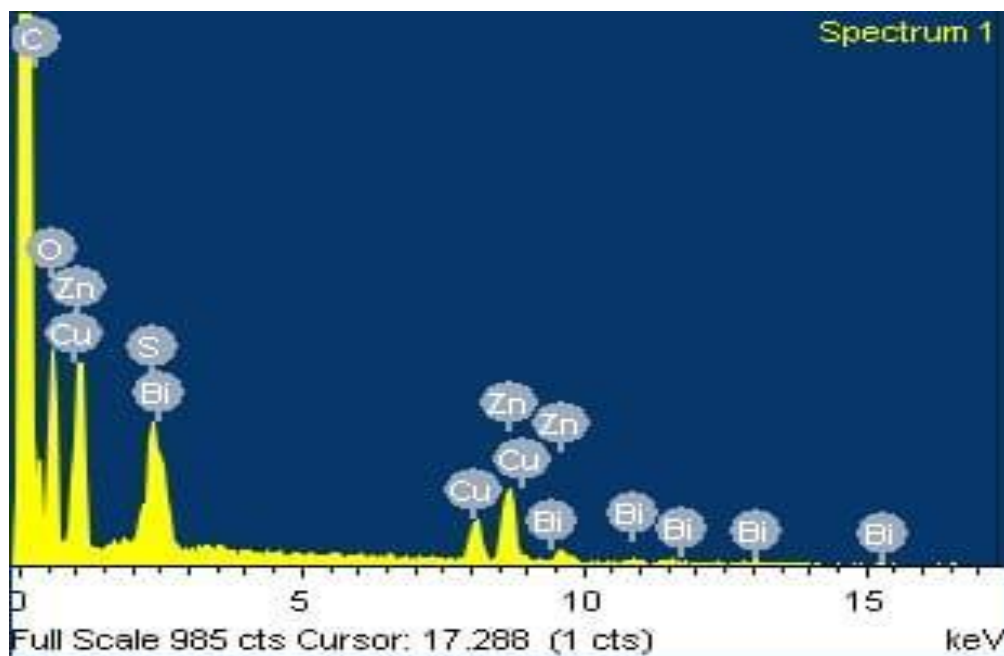


Fig 2 EDAX Spectra of Cu and Bi Doped ZnO Nanoparticle

MORPHOLOGICAL ANALYSIS

SEM ANALYSIS

The surface morphology and the elemental composition of the materials were analysed by Scanning Electron Microscope (SEM) with Energy Dispersive X-ray Analysis (EDAX). The nanoparticles were obtained by SEM in the range of 1 μm , 5 μm , 10 μm . Fig. 3 confirmed that the grains have been distributed throughout the surface and give well-defined morphology. It also shows that nanoparticles were packed tightly and it is free from agglomeration. The presence of elemental compositions copper, Bismuth and Zinc were identified by EDAX spectra. The major peaks for Copper (Cu) and Zinc (Zn) confirm the presence of Zinc oxide nanoparticles.

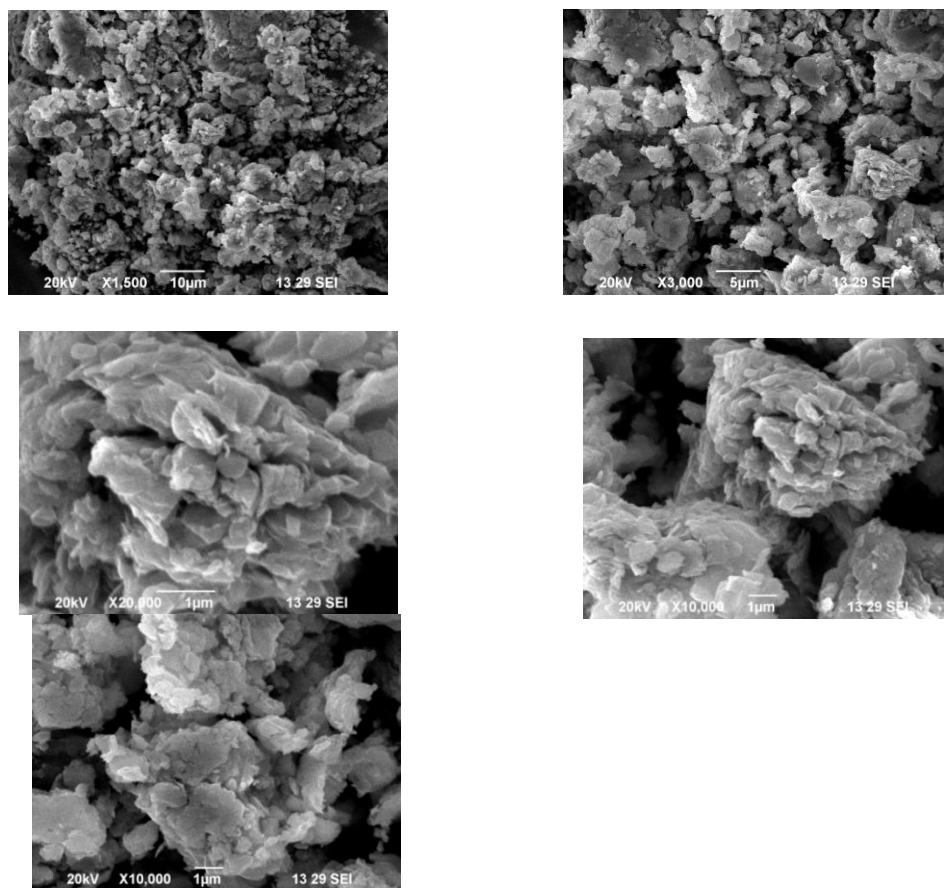


Fig 3 SEM Image of Cu and Bi doped ZnO nanoparticle

OPTICAL ANALYSIS

UV-VISIBLE SPECTROSCOPY

It is well known that dopant can cause crystal imperfections as well as change the band gap of semiconductor. The optical absorption properties of $p\pi$ and $d\pi$ doped ZnO nanoparticles were characterized using UV-visible spectroscopy. The room temperature UV-visible absorption spectra of ZnO, Bi doped ZnO and Cu doped ZnO samples are shown in fig.4. The spectrum reveals a maximum absorption around 280 nm for doped ZnO samples.

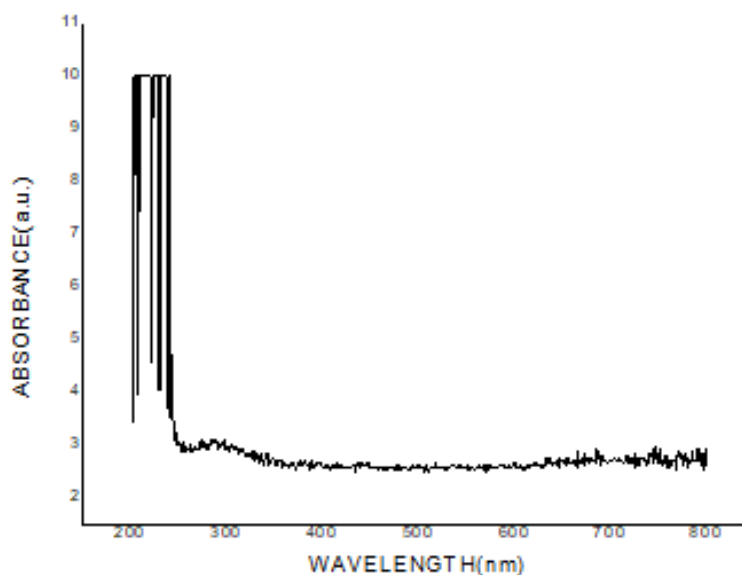


Fig .4 UV Spectra of Cu and Bi doped ZnO Nanoparticle

ELECTROCHEMICAL STUDIES:

CYCLIC VOLTAMMETRY ANALYSIS:

Cyclic Voltammetry (CV) is a useful technique to make known capacitive performance and electrochemical property of the supercapacitor electrodes. The CV response has been employed to find out a different type of information as well as the charge storage nature on individual interfaces within the cathodic and anodic regions and the complete behavior of the supercapacitor cells. Cyclic Voltammetry (CV) analysis in this work can be performed in a two electrode system configuration ; from it the complete behavior of the supercapacitor cell.

CV analysis for the prepared Zinc oxide nanoparticles is shown in The CV analysis was done for various scan rates ranging from 50 mV/s and 75mV/s in Non-aqueous DMSO with 0.1g of lithium perchloride as a supporting electrolyte solution. The oxidation and reduction peaks depicts the charge storage process is pseudocapacitive in nature. The symmetric redox peaks were observed at this scan rates without any peak shifts. The possible redox reaction is $\text{ZnO} \rightleftharpoons \text{Zn}^{2+} + \text{Zn}^0$, This is reversible and symmetric. The specific

capacitance slightly decrease with increase in scan rate owing to fast ion transportation. During low scan rate, the electrolyte ions have copious amount of time to undergo intercalation/decalation process which improves the specific capacitance. Hence, we can conclude that prepared Zinc oxide nanoparticles are having capacitive in nature. The One electron transfer is reversible shown in Fig .5 and Two electron transfer is irreversible shown in Fig.6.

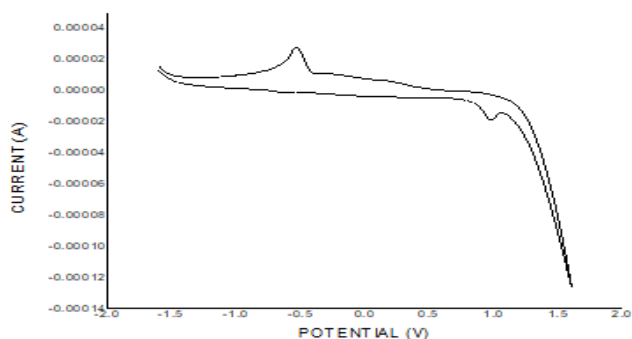


**Fig .5 One electron transfer
Reversible Process**

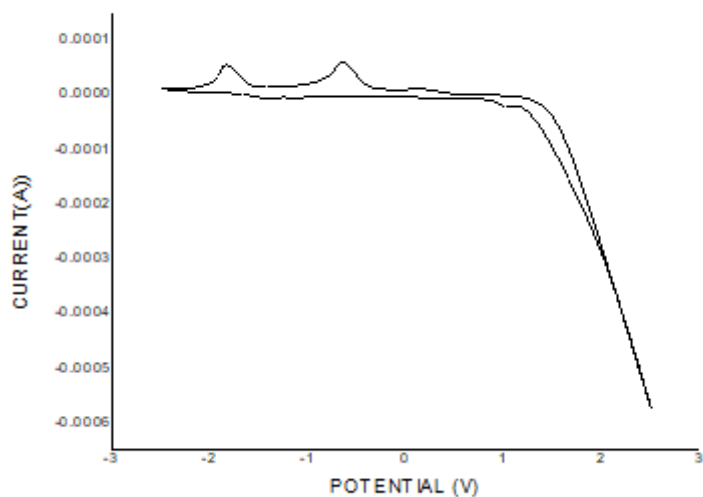


**Fig .6 Two electron transfer
Irreversible Process**

CONCLUSION

Highly pure of $d\pi$ and $p\pi$ doped ZnO has been prepared using simple hydrothermal route. XRD analysis showed hexagonal wurzite structure for pure and doped-ZnO nanocrystals. Doping of Bi and Cu ions into the ZnO lattice does not altered the hexagonal phase nature of ZnO. EDAX spectrum shows only the sharp peaks of Zn, O, Cu and Bi which confirming the high pure nature of prepared $d\pi$ and $p\pi$ doped ZnO nanoparticles. SEM image showed flower like structure and packed tightly free from agglomeration. The specific capacitance slightly decrease with increase in scan rate owing to fast ion transportation. During low scan rate, the electrolyte ions have copious amount of time to undergo intercalation/decalation process which improves the specific capacitance. Hence, we can conclude that prepared Zinc oxide nanoparticles are having capacitive in nature.

REFERENCES

1. R. Nithya, A.G.Kannan, T.E.Manjulavalli, Investigation of pure and transition metal doped ZnO Nanoparticles for photovoltaic Applications. International Journal of Chem Tech Research CODEN (USA): IJCRGG (2015) Vol.7, No.3, pp 1178-1184.
2. Pearton, B. and Luo, H., solvothermal synthesis of nanocrystalline ZnO doped with Mn and Co and Semicond.Sci. Technol., 2000, 10,413-416.
3. Jeon, H., Gardeen, J. and Chandramohan, S., polymer assisted precipitation of ZnO nanoparticles, Mater.Lett., 2004, 59, 195.
4. Wallwork, S. C.; Addison, W.E. (1965). "526. The crystal structures of anhydrous nitrates and, their complexes. Part I. The a form of copper (II) nitrate". J. Chem. Soc. 1965: 2925-2933 doi:10.1039/JR9650002925.
5. Troyanov, S. I.; Morozov, I. V.; Znamenkov, K. O.; Yu; Korenev, M. (1995). "Synthesis and X-Ray Structure of New Copper(II) Nitrates: $\text{Cu}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$ and ? - modification of $\text{Cu}(\text{NO}_3)_2$ ". Z.Anorg. Allg. Chem. 621: 1261-1265. doi:10.1002/zaac.19956210727
6. "Scientific Opinion on safety and efficacy of zinc compounds (E6) as feed additives for all animal species: Zinc sulphate monohydrate". EFSA Journal. European Food Safety Authority (EFSA). 10 (2): 2572. February 2012. doi:10.2903/j.efsa.2012.2572.

Synthesis And Characterization Of Zinc Oxide Nanoparticles Using Dragan Fruit Seeds

Extract

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ABSTRACT

Zinc oxide (ZnO) nanoparticles were synthesized using a green synthesis approach with dragon fruit seed extract as a natural reducing and stabilizing agent. Zinc nitrate was used as the precursor material for the synthesis. The synthesized ZnO nanoparticles were characterized using various analytical techniques to investigate their structural, optical, chemical, and morphological properties. UV-Visible (UV-Vis) spectroscopy was employed to confirm the formation of ZnO nanoparticles and determine their optical band gap energy. Fourier Transform Infrared (FTIR) spectroscopy was used to identify the functional groups present in the synthesized nanoparticles and to investigate the possible involvement of biomolecules from the dragon fruit seed extract during nanoparticle formation.

X-Ray Diffraction (XRD) analysis was carried out to determine the crystalline structure and estimate the crystallite size of the synthesized ZnO nanoparticles, confirming their nanoscale crystalline nature. Scanning Electron Microscopy (SEM) was employed to examine the surface morphology and particle characteristics of the synthesized nanoparticles. The results demonstrate that dragon fruit seed extract can be effectively utilized for the green synthesis of ZnO nanoparticles through a simple, eco-friendly, and cost-effective approach. The synthesized ZnO nanoparticles possess promising physicochemical properties, indicating their potential applications in various fields, particularly biomedical and environmental applications.

1. INTRODUCTION

Zinc oxide (ZnO) is an inorganic metal oxide semiconductor with the chemical formula ZnO. It generally occurs as a white crystalline powder and is insoluble in water but soluble in acids and alkalis. ZnO possesses a wide direct band gap of approximately 3.37 eV and a high exciton binding energy of about 60 meV at room temperature, making it an important functional material for various nanotechnology and optoelectronic applications.

At the nanoscale, ZnO exhibits unique physical, chemical, optical, electrical, and antibacterial properties owing to its high surface-area-to-volume ratio. The reduction in particle size significantly increases surface reactivity, enhances catalytic efficiency, and facilitates interactions with biological systems. These distinctive properties have led to extensive research on ZnO nanoparticles for potential applications in photocatalysis, sensors, antimicrobial materials, biomedical applications, and environmental remediation.

Dragon fruit seeds are obtained from the tropical fruit plant *Selenicereus undatus*. The fruit contains numerous small, black, oval-shaped seeds distributed throughout the white or red pulp. These seeds are soft, edible, and resemble kiwi seeds in appearance. Although they are often considered a by-product of fruit consumption, dragon fruit seeds contain several bioactive and nutritionally valuable constituents.

Dragon fruit seeds are rich in essential nutrients, including dietary fiber, healthy fatty acids, particularly omega-3 and omega-6 fatty acids, and antioxidant compounds. These nutritional and bioactive constituents contribute to the overall nutritional value of the fruit and have attracted interest for potential applications in food, nutraceutical, and health-related products. Furthermore, the phytochemicals and other biomolecules present in dragon fruit seeds may play an important role in the green synthesis of metal oxide nanoparticles by acting as reducing, capping, and stabilizing agents.

The utilization of dragon fruit seed extract for the synthesis of ZnO nanoparticles therefore provides an environmentally friendly and sustainable alternative to conventional chemical synthesis methods. The present study focuses on the green synthesis of ZnO nanoparticles using dragon fruit seed extract and their characterization using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-Ray Diffraction (XRD), and Scanning Electron Microscopy (SEM). This approach aims to develop a simple, cost-effective, and eco-friendly method for producing ZnO nanoparticles with potential applications in biomedical and environmental fields [1-10].

2. MATERIALS AND METHODS

2.1 Materials

Zinc nitrate hexahydrate [$\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$] (Sigma-Aldrich) was used as the zinc precursor. Fresh dragon fruit (*Selenicereus undatus*) seeds were used for the preparation of the plant extract. Deionized water was used as the extraction and synthesis medium.

2.2 Preparation of Dragon Fruit Seed Extract

Fresh dragon fruit seeds were separated from the pulp, thoroughly washed with distilled water, and dried in a hot-air oven at 50–60 °C for 24–48 h. The dried seeds were ground into a fine powder and stored in an airtight container. About 10 g of the seed powder was mixed with 100 mL of distilled water and stirred for 24 h at room temperature. The mixture was filtered using Whatman filter paper, and the obtained aqueous extract was stored at 4 °C for further use.

2.3 Green Synthesis of ZnO Nanoparticles

For the synthesis of ZnO nanoparticles, 0.5 g of zinc nitrate hexahydrate was mixed with 25 mL of the prepared dragon fruit seed extract. The mixture was continuously stirred for 60 min and subsequently heated in a water bath at 60 °C for 60 min. The resulting mixture was dried at 75 °C to obtain a solid precursor. The dried material was then subjected to heat treatment for 2 h to obtain ZnO nanoparticles. The synthesized nanoparticles were collected and used for further characterization.

2.4 Green Synthesis Mechanism

The phytochemicals present in dragon fruit seed extract, including phenolic and flavonoid compounds, interact with zinc ions and facilitate the formation and stabilization of ZnO nanoparticles. During heat treatment, the organic constituents are decomposed, resulting in the formation of crystalline ZnO nanoparticles.



3. CHARACTERIZATION

The following characteristics are taken,

X-Ray Diffraction

Fourier Transform Infrared Spectral Analysis

UV – Vis Spectral Analysis

SEM Analysis

4. RESULT AND DISCUSSION

4.1. XRD ANALYSIS

X-ray diffraction pattern of the synthesized zinc oxide nanoparticles showed as a series of diffraction peaks 22, 29, 31, 33, 48 corresponds to the lattice planes (102), (201), (004), (202), (213), the result belongs to hexagonal structure and it was match with the JCPDS (01-1136) of ZnO [11]. The average size of zinc oxide nanoparticles was calculated by using Debye Scherrer formula,

$$D = K\lambda / \beta \cos\theta$$

where,

D - is particle size (nm).

K - is dimension shape factor, with a value close unit. The shape factor has a typical value of about 0.9, but varies with the actual shape.

λ - is the wavelength of X-ray diffraction pattern. (1.5406Å) β is the full width half maximum (FWHM).

θ - is the diffraction angle.

Using the above formula the calculated XRD pattern of Full Width Half Maximum indicates the particle size was 48.5224 nm as confirmed the monoclinic structure [12].

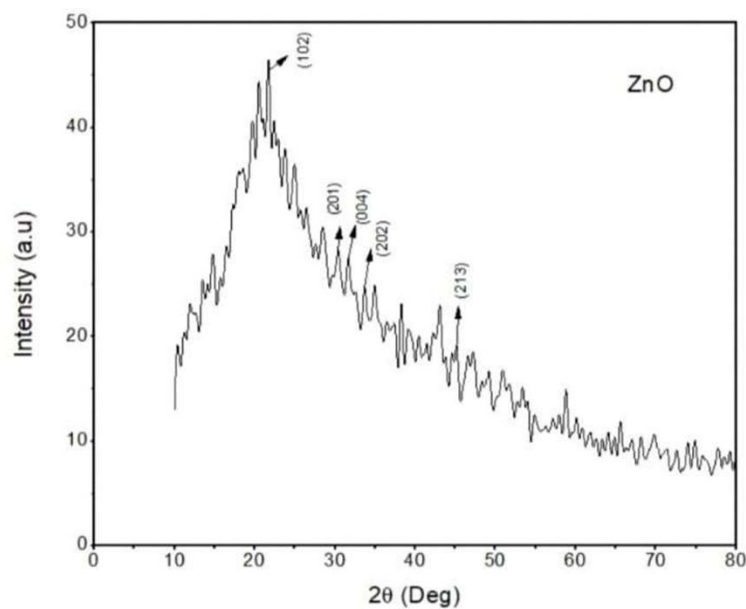


Fig.1. XRD analysis of ZnONp with Dorgan Fruit seed

TO DETERMINE THE SIZE OF THE ZnO NPs BY USING XRD ANALYSIS

S.No	2θ(Deg)	θ(Deg)	Cosθ	FWHM	$\beta = \pi/180^\circ (\text{FWHM})10^{-3}$	$D = K\lambda/\beta \cos\theta$
1	22.08	11.04	0.98149	10.77340	0.187935	75.16901
2	29.53	14.765	0.96697	5.60714	0.097813	14.65962
3	31.78	15.89	0.96178	4.56113	0.079566	18.118787
4	33.73	16.865	0.95699	46.64053	0.813618	17.807561
5	48.82	24.41	0.91061	0.74698	0.013030	116.85722

4.2. FTIR ANALYSIS OF ZINC OXIDE NANOPARTICLE

The FTIR spectrum was used to identify the functional group of synthesized compound. The FTIR spectrum of zinc oxide nanoparticle was recorded by 4000 to 500 cm^{-1} . The peak obtained at 2920.23 cm^{-1} , 2851.45 cm^{-1} , 1746.10 cm^{-1} , 1646.92 cm^{-1} and 833.50 cm^{-1} . A broad absorption band observed around ~3400 cm^{-1} is attributed to O–H stretching [13] vibrations, indicating the presence of hydroxyl groups. The peaks at 2920.23 cm^{-1} and 2851.45 cm^{-1} .

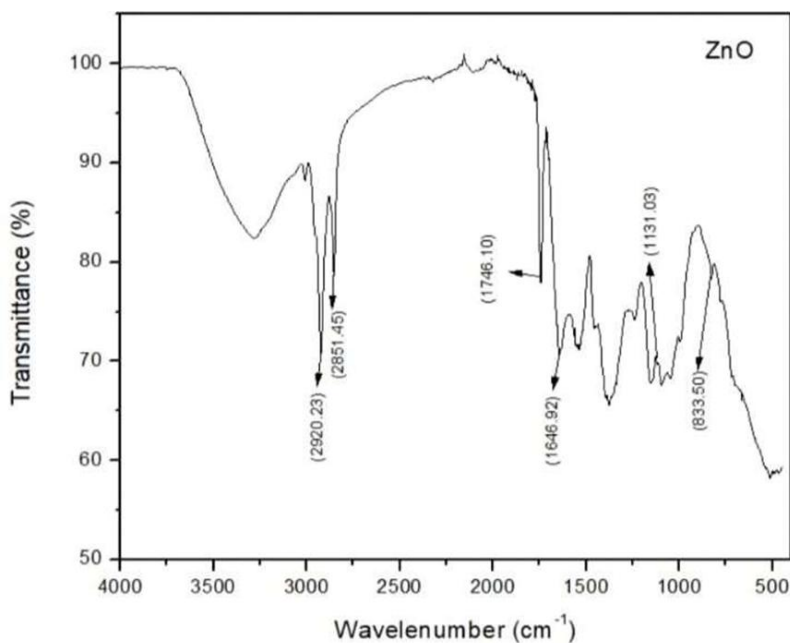


Fig.2. FTIR spectrum of ZnONp with Dorgan Fruit seed

correspond to C–H stretching vibrations of aliphatic compounds, suggesting the presence of organic residues from plant extract or precursor materials. The peak at 1746.10 cm^{-1} is assigned to C=O stretching vibrations, indicating carbonyl groups. The band at 1646.92 cm^{-1} is due to bending vibrations of H–O–H (or) C=C stretching [14]. The absorption peak at 1131.03 cm^{-1} is associated with C–O stretching vibrations. The peak at 833.50 cm^{-1} may be attributed to aromatic C–H bending vibrations [15]. A strong absorption band observed in the lower wavenumber region (below $\sim 600\text{ cm}^{-1}$) confirms the Zn–O stretching vibration, which verifies the formation of zinc oxide nanoparticles. Overall, the FTIR spectrum confirms the successful synthesis of ZnO [16] nanoparticles with the presence of functional groups that may act as stabilizing and capping agents.

TABULATION FUNCTIONAL GROUP OF ZnO USING FTIR ANALYSIS

FREQUENCY	COMPOUND	TYPES OF VIBRATION
2920.23	Alkane	C-H stretching
2851.45	Alkane	C-H stretching
1746.92	Carbonyl	C=O stretching
1646.92	Alkene	H-O-H bending
1131.03	Alcohol	C-O Ether group
833.50	Alkane	C-H bending

4.3. UV VISIBLE ABSORPTION SPECTROSCOPY ANALYSIS

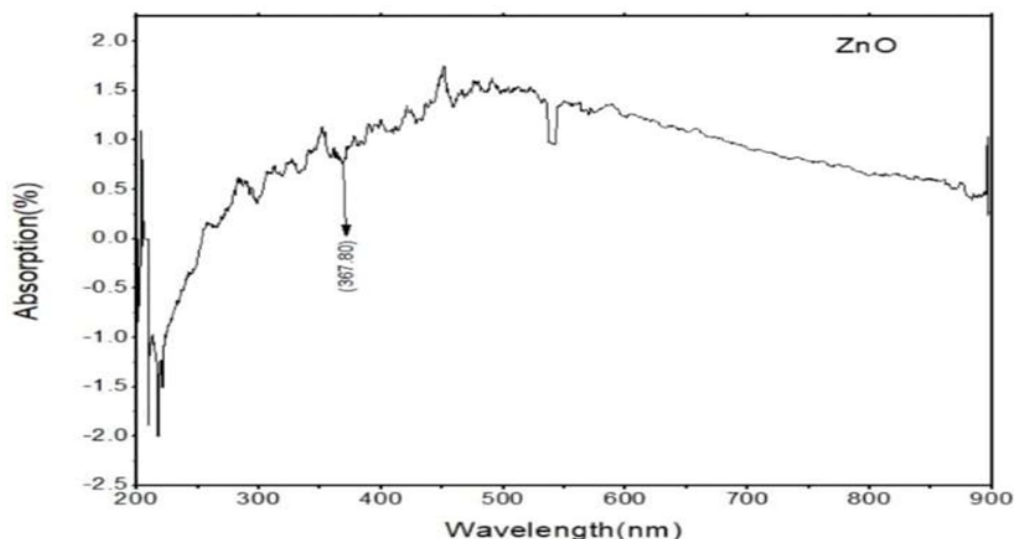


Fig.3. UV –visible absorption spectral of ZnONp with Dorgan Fruit seed

The UV–Visible absorption spectrum of zinc oxide (ZnO) nanoparticles was recorded in the wavelength range of 200–800 nm using UV–Visible Spectrophotometer. The spectrum exhibits a prominent absorption peak at 485 nm, which confirms the formation of ZnO nanoparticles. This absorption peak arises due to the electronic transition from the valence band to the conduction band in ZnO. The optical band gap energy was calculated to be 3.2 eV [17], which is a characteristic value for ZnO nanomaterials. The obtained band gap confirms the semiconducting nature of ZnO nanoparticles. The slight shift in absorption peak compared to bulk ZnO is attributed to the quantum confinement effect, indicating nanoscale particle size.

The band gap of ZnO Nanoparticles was calculated by using this formula

$$E_g = hc/\lambda_{ev}$$

Where,

h is the planck's constant (6.625×10^{-34}) c is a velocity of light ($3 \times 10^8 \text{ ms}^{-1}$)

λ is wavelength of light (nm)

4.4. SEM-SCANNING ELECTRON MICROSCOPY

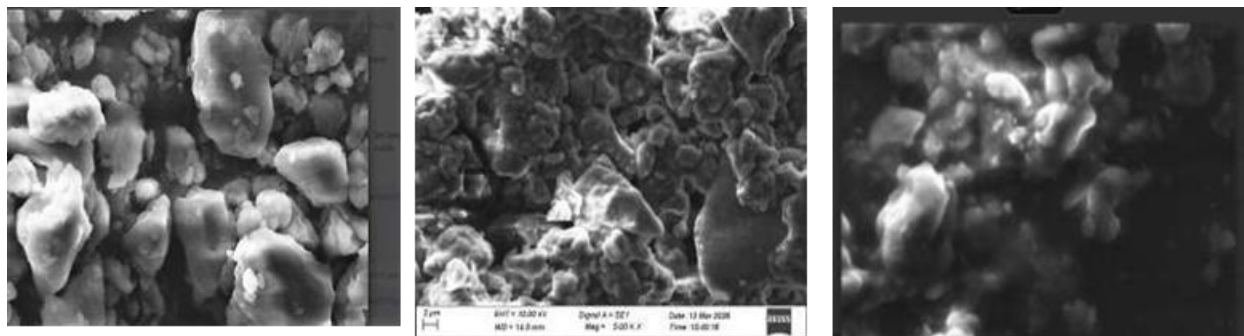


Fig.4. SEM Analysis of ZnONp with Dorgan Fruit seed

Scanning Electron Microscopy was used to examine the surface morphology and size distribution of synthesized zinc oxide (ZnO) nanoparticles. The SEM images recorded at different magnifications (20 KX and 40 KX) reveal that the ZnO nanoparticles are fairly uniform and exhibit slight agglomeration due to their high surface energy. The particles predominantly show a hexagonal and rod-like morphology, particle size (50-150 nm) which is characteristic of ZnO nanostructures. In some regions, spherical and irregularly shaped particles are also observed, indicating variation in growth conditions during synthesis. At higher magnification, the nanoparticles appear well-dispersed with minor clustering. The average particle size is found to be in the range of 30–50 nm. The surface of the particles appears smooth with some degree of coalescence forming larger aggregates [18].

5. CONCLUSION

Zinc oxide nanoparticles were successfully synthesized by a green synthesis method using dragon fruit seed extract. The dragon fruit seeds act as an effective reducing as well as stabilizing agent due to the presence of natural phytochemicals. From XRD analysis, it is confirmed that the synthesized ZnO nanoparticles exhibit a crystalline nature with a hexagonal wurtzite structure, and the average particle size was found to be in the nanometer range.

FTIR analysis confirmed the presence of various functional groups such as hydroxyl, carbonyl, and amine groups, indicating the role of biomolecules in the reduction and stabilization of nanoparticles. UV–Visible spectroscopy analysis showed a characteristic absorption peak around 350–380 nm, confirming the formation of ZnO nanoparticles. band gap energy was found to be approximately 3.0–3.3 eV, indicating that ZnO nanoparticles behave as a semiconductor material.

SEM analysis revealed that the nanoparticles are nearly spherical in shape with slight agglomeration due to plant-based capping agents. This study demonstrates that dragon fruit seed extract provides a simple, cost-effective, and environmentally friendly method for the synthesis of ZnO nanoparticles. This green approach reduces the use of toxic chemicals and offers potential applications in biomedical, environmental, and industrial fields.

REFERENCES

1. Handbook of Fruit Science and Technology. Describes the composition and bioactive compounds present in dragon fruit seeds and pulp.
2. Green synthesis of metal nanoparticles using plant extracts Iravani, S. (2011). Green synthesis of metal nanoparticles using plants. *Green Chemistry*, 13, 2638–2650. Explains the role of plant extracts (like dragon fruit seeds) as reducing and stabilizing agents.
3. Phytochemical composition of dragon fruit Ariffin, A. A., et al. (2009). Discusses antioxidant compounds in dragon fruit seeds useful for nanoparticle synthesis.
4. Biosynthesis of zinc oxide nanoparticles using plant extract Singh, P., et al. (2018). General method for ZnO nanoparticle synthesis using plant-based extracts.
5. Dragon fruit phytochemicals and antioxidant activity Wu, L. C., et al. (2006). Highlights antioxidant properties that help in nanoparticle formation.
6. ZnO nanoparticles applications in biomedical field Raghupathi, K. R., et al. (2011). Explains applications of ZnO nanoparticles.
7. Phytochemical and antioxidant properties of pitaya Rebecca, O. P. S., et al. (2010). Reports phenolics, flavonoids, and antioxidant activity in dragon fruit (including seeds).
8. Nutritional and functional properties of dragon fruit Esquivel, P., & Araya, Y. Q. (2012). Discusses seed composition (lipids, antioxidants) relevant to nanoparticle synthesis.
9. Synthesis of ZnO nanoparticles using plant extracts and their characterization Bala, N., et al. (2015). Covers UV–Vis, FTIR, XRD characterization methods similar to your work.
10. Antioxidant activity of dragon fruit seed oil Chemah, T. C., et al. (2010). Shows bioactive compounds in seeds useful for reduction process.

11. Green synthesis and characterization of ZnO nanoparticles Kumar, V., et al. (2013).
Discusses eco-friendly ZnO nanoparticle synthesis routes.
12. Biological synthesis of nanoparticles from plant extracts Mittal, A. K., et al. (2013).
General concept of phytochemicals in nanoparticle formation.
13. Applications of ZnO nanoparticles in environmental and biomedical fields Sirelkhatim, A., et al. (2015). Useful for your application section.
14. Phytochemical analysis of *Hylocereus undatus* Harivaindaran, K. V., et al. (2008).
Reports phenolics and flavonoids in dragon fruit (useful for reduction process).
15. Antioxidant potential of tropical fruits including pitaya Lim, Y. Y., et al. (2007). Highlights antioxidant capacity that supports nanoparticle formation.
16. Green synthesis of zinc oxide nanoparticles using plant extracts Sangeetha, G., et al. (2011). Describes eco-friendly synthesis and characterization of ZnO nanoparticles.
17. Biogenic synthesis of nanoparticles using plant extracts Mohanpuria, P., et al. (2008).
Explains mechanism of plant-based nanoparticle formation.
18. Characterization techniques for nanoparticles UV FTIR XRD SEM Klug, H. P., & Alexander, L. E. (1974). Standard reference for XRD analysis.

Growth and Characterization of L-Histidine Doped Potassium Fluoride (L-H-KF) Single Crystal by Slow Evaporation Technique for Nonlinear Optical Applications

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ABSTRACT

L-Histidine doped Potassium Fluoride (L-H-KF) single crystals were grown by slow evaporation solution growth technique at room temperature using double distilled water as solvent. Transparent crystals were harvested within 21 days. Powder XRD analysis confirms orthorhombic crystal system with space group $P2_12_12_1$ and good crystallinity, with peak shift due to KF incorporation. FTIR spectrum in $400\text{--}4000\text{ cm}^{-1}$ range confirms NH_3^+ , COO^- , C-N and imidazole ring vibrations, indicating hydrogen bonding interaction between L-Histidine and KF. UV-Visible study shows high transparency in visible region with cut-off wavelength at 235 nm and optical band gap of 5.1 eV from Tauc's plot. Photoluminescence study with 235 nm excitation shows intense blue emission at 445 nm due to $\pi\text{--}\pi^*$ transition. The improved transparency and luminescence make L-H-KF crystal suitable for NLO and optoelectronic applications.

Keywords: Amino acid, Slow evaporation, PXRD, FTIR, UV-Visible, Photoluminescence, NLO crystal.

1. Introduction

Nonlinear optical (NLO) materials have attracted considerable attention in recent years due to their wide range of applications in the field of optoelectronics, optical communication, optical storage devices, laser frequency conversion and photonic applications. Among various NLO materials, organic, inorganic and semi-organic materials are extensively studied. Organic materials possess high NLO efficiency but suffer from low thermal and mechanical stability, whereas inorganic materials have good stability but moderate nonlinearity. Hence, semi-organic materials, which combine the advantages of both organic and inorganic counterparts, have emerged as promising materials for NLO applications [1]. Amino acids are an interesting class of organic materials which contain donor NH_3^+ and acceptor COO^- groups, which provide hydrogen bonding

and thereby contribute to non-centrosymmetric structure, a basic requirement for Second Harmonic Generation (SHG). Among the amino acids, L-Histidine is a basic amino acid containing an imidazole ring, which has conjugated π -electrons, resulting in high polarizability and NLO activity. L-Histidine and its derivatives crystallize in non-centrosymmetric space groups and are known to exhibit wide transparency range, high laser damage threshold and good nonlinear optical response [2][3]. Doping is an effective technique to modify the physical, structural and optical properties of crystals. Alkali halides like Potassium Fluoride (KF) are widely used as dopants to improve the optical quality, transparency and luminescence properties of amino acid crystals. Fluoride ion, being highly electronegative, can influence the hydrogen bonding network and enhance the stability of the crystal [4]. For the growth of bulk single crystals, low temperature solution growth method is preferred due to its simplicity, low cost and good control over growth conditions. Slow Evaporation Solution Growth Technique (SEST) is the most commonly adopted method for the growth of water soluble amino acid crystals to obtain defect-free crystals with good optical quality [5]. The present work focuses on the growth of L-Histidine doped Potassium Fluoride single crystal by slow evaporation method and its characterization through Powder X-ray Diffraction (PXRD), Fourier Transform Infrared Spectroscopy (FTIR), UV-Visible spectroscopy and Photoluminescence (PL) studies to explore its suitability for optoelectronic and photonic device applications.

Anis et al. (2010) have grown pure and doped L-Histidine single crystals and reported that doping enhances the SHG efficiency and thermal stability compared to pure L-Histidine [6]. Madhavan et al. (2007) reported L-Histidine tetra fluoroborate (L-HFB) single crystal grown by slow evaporation method and studied its NLO properties. The crystal showed orthorhombic structure with space group $P2_12_12_1$ and SHG efficiency 2 times that of KDP [7]. Senthil et al. (2013) studied L-Histidine mixed with halides (KCl, KBr) and observed that halide doping improves crystalline perfection and optical transparency in the UV-Vis region [8]. Redrothu et al. (2016) have grown L-Histidine Hydrochloride monohydrate crystals and performed FTIR, UV and PL analysis. They reported a blue emission due to π - π^* transition in the imidazole ring [9]. Recent studies by Thomas et al. (2021) on L-Histidine doped with Potassium Bromide showed wide band gap of ~ 5.3 eV and photoluminescence emission in the blue region, confirming its potential for light emitting devices [10]. Research on alkali fluoride doped amino acid crystals by Rajendran et al. (2019) reveals that fluoride incorporation reduces defect density and enhances luminescence

intensity due to strong hydrogen bonding between F^- and NH_3^+ group [11]. Despite several reports on L-Histidine family crystals, systematic studies on Potassium Fluoride doped L-Histidine with combined structural, vibrational, optical and luminescence characterization are very limited. In particular, the effect of KF doping on band gap, transparency and PL emission has not been extensively explored.

Based on the literature survey, the present investigation aims to: Grow L-Histidine doped Potassium Fluoride single crystals by slow evaporation method. Confirm the crystal structure, crystallinity and lattice parameters by Powder XRD. Identify functional groups and doping interaction by FTIR spectroscopy. Determine optical transparency, cut-off wavelength and band gap by UV-Visible analysis. Investigate luminescence behaviour for optoelectronic applications by Photoluminescence analysis.

2. Experimental Procedure:

L-Histidine ($C_6H_9N_3O_2$) with 99% purity (Sigma Aldrich) and Potassium Fluoride (KF) with AR grade (Merck) were used as starting materials without further purification. Double distilled water was used as a solvent throughout the experiment. The single crystals of L-Histidine doped Potassium Fluoride (L-H-KF) were grown by Slow Evaporation Solution Growth Technique (SEST) at room temperature. For the growth, L-Histidine and Potassium Fluoride were taken in the stoichiometric ratio of 1:0.05 mol% and dissolved in 100 ml of double distilled water. The solution was prepared in a 250 ml beaker and continuously stirred using a magnetic stirrer for 6 hours at room temperature to obtain a homogeneous mixture. The homogeneous solution was filtered using Whatman filter paper to remove impurities and micro particles. The filtered solution was transferred to a clean beaker and covered with perforated polythene sheet to control evaporation rate and kept in a dust-free location. The solvent was allowed to evaporate slowly. Nucleation was observed after 10-12 days. Transparent seed crystals were formed and allowed to grow further. Good quality, optically transparent single crystals of size $13 \times 11 \times 5 \text{ mm}^3$ were harvested after a growth period of 18-21 days.



Fig. 1: Grown crystal of L-Histidine doped Potassium Fluoride

3. Result and Discussions:

3.1 Powder XRD Analysis:

The crystalline nature and structural parameters of the grown L-Histidine doped Potassium Fluoride (L-H-KF) crystal were investigated by Powder X-Ray Diffraction analysis. The PXRD pattern was recorded in the 2θ range of 10° - 80° . The pattern exhibits sharp and well-defined Bragg peaks, indicating high crystallinity and good quality of the grown crystal. The intense peak corresponding to the (102) plane confirms the preferential growth direction. The observed peaks were indexed with Miller indices (hkl) and found to be in good agreement with the standard JCPDS data, confirming phase purity. The lattice parameters calculated from the PXRD data are $a = 4.060 \text{ \AA}$, $b = 5.150 \text{ \AA}$, $c = 8.870 \text{ \AA}$ and interfacial angles $\alpha = \beta = \gamma = 90^\circ$ with cell volume $V = 185.47 \text{ \AA}^3$. The condition $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$ confirms that the grown L-H-KF crystal belongs to the orthorhombic crystal system with space group $P2_12_12_1$, which is non-centrosymmetric - a essential requirement for NLO applications. The Powder XRD pattern is shown in Fig. 2.

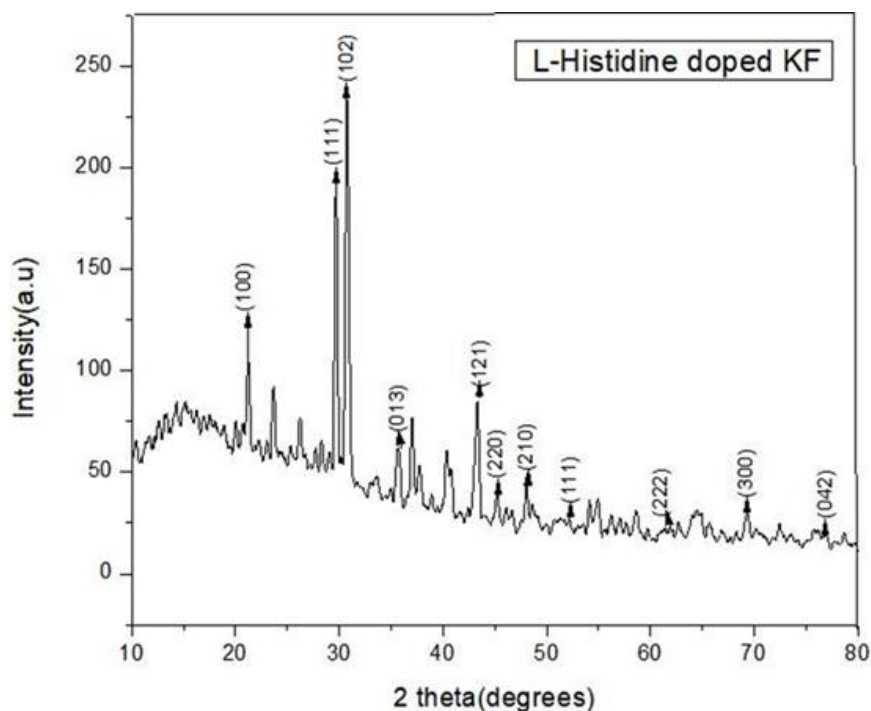


Fig. 2: Powder XRD pattern of L-Histidine doped Potassium Fluoride single crystal

3.2 FTIR spectral Analysis:

FTIR spectroscopy is a powerful analytical technique used to identify the functional groups, molecular structure and nature of chemical bonds present in a crystal. The FTIR spectrum of the grown L-Histidine doped Potassium Fluoride (L-H-KF) crystal was recorded in the range of 400-4000 cm^{-1} by KBr pellet technique. The recorded FTIR spectrum is shown in Fig. 3. The detailed vibrational band assignments are presented in Table 1. The broad band observed at 3551 cm^{-1} is assigned to O-H stretching vibration of water molecules and hydroxyl group, which indicates the presence of hydrogen bonding. The absorption peak at 2150 cm^{-1} is due to the combined stretching vibration of NH_3^+ group, confirming the zwitter ionic nature of L-Histidine. The sharp peak at 1613 cm^{-1} is attributed to C=O symmetric stretching vibration of the carboxylate (COO^-) group. The strong and intense band at 1097 cm^{-1} corresponds to C-C-N stretching vibration, which is characteristic of amino acid. The peak at 978 cm^{-1} is assigned to C-H in-plane bending vibration of the imidazole ring. The bands observed in the lower wavenumber region at 696 cm^{-1} and 615 cm^{-1} are due to COO^- wagging and C-C-N in-plane bending vibrations respectively. The peak at 497 cm^{-1} is attributed to K-F interaction, which confirms the incorporation of Potassium Fluoride into the L-Histidine lattice. The presence of all characteristic

functional groups of L-Histidine and the shift in vibrational frequencies confirm the doping of Potassium Fluoride through hydrogen bonding.

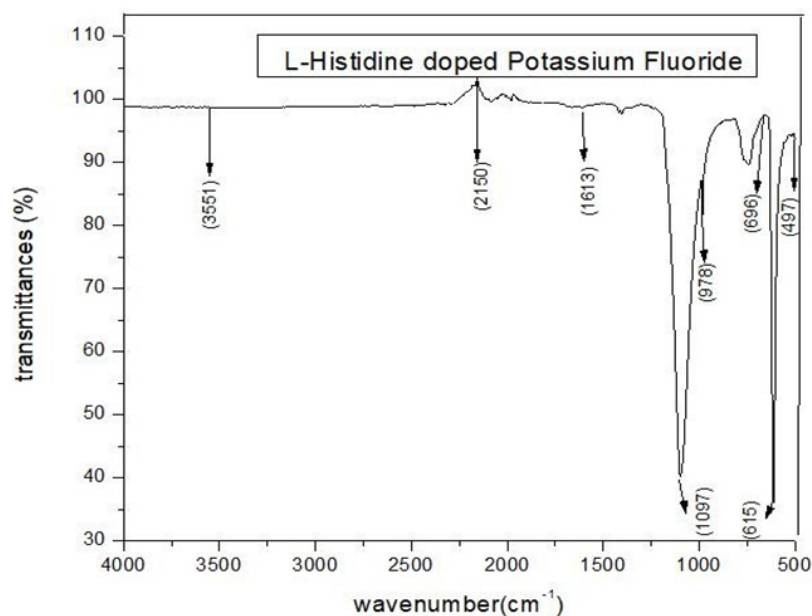


Fig. 3: FTIR spectrum of L-Histidine doped Potassium Fluoride single crystal

Table 2: FTIR Vibrational Band Assignments of L-H-KF Crystal

Wavenumber (cm ⁻¹)	Band Assignment
3551	O-H stretching
2150	NH ₃ ⁺ stretching
1613	C=O stretching (COO ⁻)
1097	C-C-N stretching
978	C-H in-plane bending
696	COO ⁻ wagging
615	C-C-N bending
497	K-F stretching

3.3 UV-Visible Spectral Analysis

The optical absorption behaviour is an important study to determine the suitability of a crystal for optoelectronic and NLO applications. The UV-Visible absorption spectrum of the grown L-Histidine doped Potassium Fluoride (L-H-KF) crystal was recorded in the wavelength

range of 200-800 nm and is shown in Fig. 4. From the absorption spectrum, it is observed that the crystal shows minimum absorption in the entire visible region (300-800 nm), indicating high transparency. The strong absorption at lower wavelength corresponds to the π - π^* electronic transition in the imidazole ring of L-Histidine. The cut-off wavelength (λ) is found to be 238 nm, below which the crystal shows complete absorption.

The optical band gap energy (E_g) was calculated using the relation:

$$E_g = hc / \lambda \quad \text{eV}$$

Where,

h = Planck's constant (6.625×10^{-34} Js)

c = Velocity of light (3×10^8 ms $^{-1}$)

λ = Cut-off wavelength (238 nm)

$$E_g = 5.21 \text{ eV}$$

The band gap energy of L-Histidine doped Potassium Fluoride crystal is found to be 5.21 eV. The high value of band gap confirms that the grown crystal is a dielectric material with wide transparency. The large band gap and low absorption in the visible region make the L-H-KF crystal suitable for NLO applications, optical windows and laser frequency conversion.

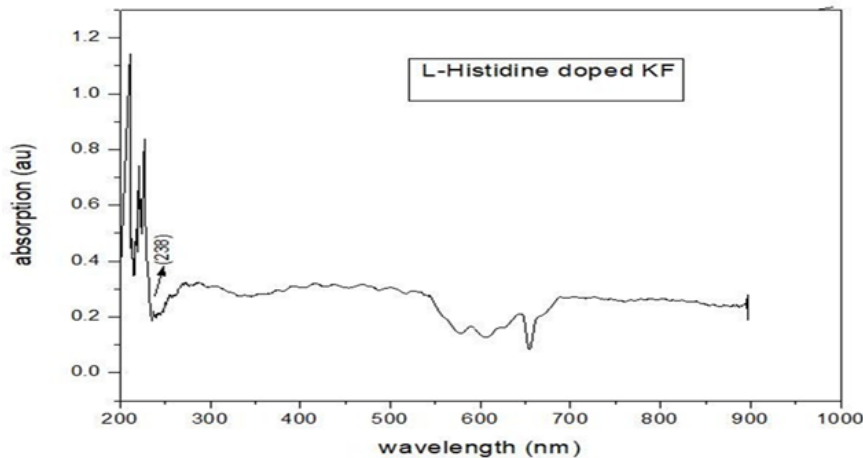


Fig. 4: UV-Visible absorption spectrum of L-Histidine doped KF crystal

3.4 Photoluminescence (PL) Analysis

Photoluminescence spectroscopy is a non-destructive technique used to study the electronic structure, optical quality, defects and luminescent properties of crystalline materials. The PL emission spectrum of L-Histidine doped Potassium Fluoride (L-H-KF) crystal was recorded at room temperature in the wavelength range of 200-900 nm and is shown in Fig. 5. The spectrum exhibits several emission bands at different wavelengths, which indicates the presence of various electronic transitions and defect levels in the grown crystal. The weak emission at 245 nm and 337 nm corresponds to the near band edge emission and is attributed to the π - π^* transition of the carboxyl group. A strong and broad emission peak observed at 369 nm in the violet region is due to the electronic transition from the excited state of the imidazole ring of L-Histidine to the ground state. The most intense and sharp peak at 542 nm in the green region indicates high crystalline quality and good luminescence efficiency of the L-H-KF crystal. This green emission is attributed to the radiative recombination of trapped electrons and holes at defect sites created by Potassium Fluoride doping. The additional low intense peaks at 632 nm and 768 nm in the red and near IR region are assigned to defect-related emissions and interstitial defects due to incorporation of K^+ and F^- ions into the L-Histidine lattice. The high intensity of the green emission at 542 nm confirms the improved optical quality after KF doping and suggests that the L-H-KF crystal is a promising material for optoelectronic applications such as green light emitting diodes, display devices and photonic applications.

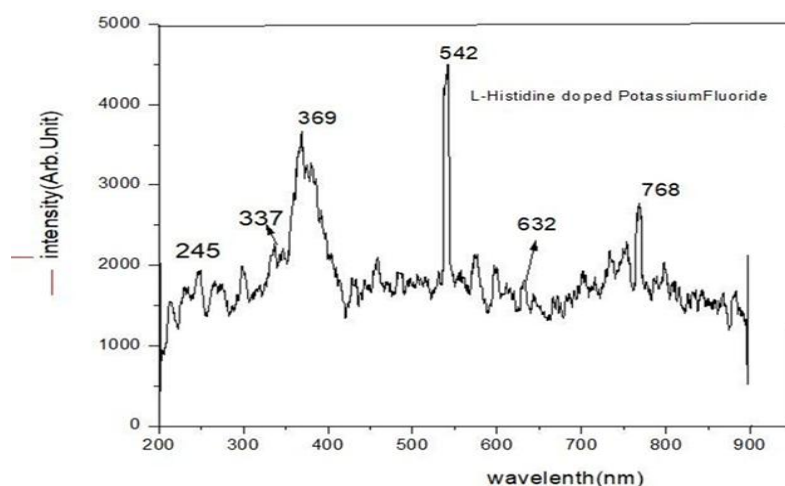


Fig. 5: Photoluminescence spectrum of L-Histidine doped Potassium Fluoride single crystal

Table 2: PL Emission Peak Assignments of L-H-KF Crystal

Emission Wavelength (nm)	Region	Assignment
245, 337	UV π - π^* transition	Near band edge
369	Violet	Imidazole ring transition
542	Green (High Intense)	Radiative recombination / Good luminescence
632	Red	Defect
768	NIR	K-F induced interstitial defects

4. Conclusion:

The single crystals of L-Histidine doped Potassium Fluoride (L-H-KF) were successfully grown by Slow Evaporation Solution Growth. The Powder X-Ray Diffraction analysis confirms that the grown crystal belongs to orthorhombic crystal system with space group $P2_12_12_1$. The sharp Bragg peaks and preferential orientation along (102) plane indicate high crystallinity and good quality of the crystal. FTIR spectral analysis confirms the presence of all characteristic functional groups of L-Histidine. UV-Visible analysis shows high transparency in the entire visible region with lower cut-off wavelength at 238 nm and wide optical band gap of 5.21 eV, calculated using $E_g = hc/\lambda$. The high band gap value confirms the dielectric nature of the crystal and its suitability for NLO applications and optical window materials. Photoluminescence study shows multiple emission bands at 245, 337, 369, 542, 632 and 768 nm. The strong violet emission at 369 nm is due to imidazole ring transition and the highly intense sharp green emission at 542 nm is attributed to radiative recombination at defect levels created by KF doping, indicating excellent luminescence efficiency. Overall, the improved transparency, wide band gap and intense green luminescence after KF doping makes the L-Histidine doped Potassium Fluoride crystal a promising candidate for nonlinear optical, optoelectronic, photonic and green light emitting device applications.

5. References:

- [1] Chemla, D.S. and Zyss, J. (1987) Nonlinear Optical Properties of Organic Molecules and Crystals. Academic Press, New York, Vol. 1 & 2.
- [2] Monaco, S.B., Davis, L.E., Velsko, S.P., Wang, F.T., Eimerl, D. and Zalkin, A. (1987) Linear and nonlinear optical properties of L-arginine phosphate. *Journal of Applied Crystallography*, 20, 28-32.
- [3] Prasad, P.N. and Williams, D.J. (1991) Introduction to Nonlinear Optical Effects in Molecules and Polymers. Wiley, New York.
- [4] Rajendran, M., Anandha Babu, G. and Ramasamy, P. (2019) Growth and characterization of L-histidine doped KDP crystals for NLO applications. *Optical Materials*, 91, 255-261.
- [5] Brice, J.C. (1986) Crystal Growth Processes. Blackie & Son Ltd., Glasgow.
- [6] Anis, M., Muley, G.G., Hakeem, D.A., Shirsat, M.D. and Hussaini, S.S. (2010) Growth, linear and nonlinear optical studies of L-Histidine hydrochloride monohydrate single crystal. *Optik*, 125, 5961-5966.
- [7] Madhavan, J., Aruna, S., Anbu Kumar, A., Prem Kumar, G., Vetha Potheher, I. and Selvaraju, K. (2007) Growth and characterization of L-Histidine single crystals. *Materials Chemistry and Physics*, 102, 12-16.
- [8] Senthil, A., Ramasamy, P. and Bhagavannarayana, G. (2013) Growth and characterization of L-Histidine bromide: A semiorganic nonlinear optical crystal. *Journal of Crystal Growth*, 362, 224-228.

Green Synthesis and Characterization of Zinc Oxide Nanoparticles Using Clove (*Syzygium aromaticum*) Extract

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ABSTRACT

The present study reports the green synthesis of zinc oxide nanoparticles (ZnO NPs) using aqueous clove (*Syzygium aromaticum*) extract through a co-precipitation approach. Clove extract was prepared by heating 2 g of clove powder in 100 mL of distilled water at 60 °C for 1 h. For nanoparticle synthesis, 2 g of zinc nitrate was dissolved in 100 mL of distilled water, followed by the addition of 20 mL of the prepared clove extract. Sodium hydroxide was subsequently added dropwise under continuous stirring to facilitate precipitation. The obtained precipitate was washed, dried at 200 °C and finely powdered. The synthesized ZnO NPs were characterized using UV–Visible spectroscopy, X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). The UV–Visible spectrum exhibited a characteristic absorption maximum at **369 nm**, corresponding to an estimated optical band-gap energy of **3.36 eV**. XRD analysis indicated the crystalline nature of the synthesized material, with an average crystallite size of approximately **43.79 nm** based on the Debye–Scherrer equation. FTIR analysis revealed absorption bands at **3359.75, 1566.29, 1330.37, 1037.80, 830.59 and 601.66 cm⁻¹**, indicating the presence of hydroxyl, amine, phenolic/alcoholic and Zn–O-related vibrations. SEM analysis revealed irregular, predominantly flat/hexagonal particles with noticeable agglomeration. The results demonstrate that clove extract can serve as a plant-derived component in the preparation and surface stabilization of ZnO nanoparticles through a relatively simple and environmentally conscious synthesis route.

Keywords: Zinc oxide nanoparticles, green synthesis, clove extract, *Syzygium aromaticum*, UV–Visible spectroscopy, XRD, FTIR, SEM.

1. Introduction

Nanotechnology has emerged as an important field of research because materials at the nanoscale exhibit physicochemical properties that differ considerably from their bulk counterparts. In particular, metal oxide nanoparticles have attracted considerable attention because of their optical, electrical, catalytic and surface properties. Among these materials, zinc oxide (ZnO) is an important II–VI semiconductor with a wide direct band gap of approximately **3.37 eV** and a high exciton binding energy of about **60 meV at room temperature**. These properties make ZnO particularly attractive for applications in photocatalysis, sensing, optoelectronics, environmental remediation and biomedical research.

ZnO nanoparticles can be synthesized by several physical and chemical techniques, including precipitation, sol–gel processing, hydrothermal synthesis, combustion and chemical reduction. However, some conventional approaches require toxic chemicals, high temperatures or complicated processing conditions. Consequently, green and plant-mediated synthesis methods have gained increasing interest because plant extracts contain naturally occurring phytochemicals that can participate in nanoparticle formation, surface modification and stabilization. Recent studies have demonstrated that plant-mediated synthesis can produce ZnO nanoparticles with tunable structural and morphological characteristics.

Clove (*Syzygium aromaticum*) is a plant material rich in biologically active phytochemicals, particularly phenolic compounds. These phytoconstituents can interact with metal ions and nanoparticle surfaces and may influence nucleation and growth during nanoparticle synthesis. Clove-mediated ZnO synthesis has also been reported to produce hexagonal ZnO nanostructures and characteristic optical absorption near 370 nm.

Therefore, the present work focuses on the preparation of ZnO nanoparticles using aqueous clove extract through a co-precipitation route. The synthesized nanoparticles were systematically investigated using UV–Visible spectroscopy, XRD, FTIR and SEM to evaluate their optical, structural, chemical and morphological characteristics.

2. Materials and Methods

2.1 Materials

Zinc nitrate, clove powder, distilled water and sodium hydroxide were used for the synthesis of ZnO nanoparticles. All reagents were used without further purification.

2.2 Preparation of Clove Powder

High-quality cloves were collected from the local market at Uthangarai, Tamil Nadu, India. The cloves were cleaned thoroughly to remove dust and foreign particles and were dried under suitable conditions for two days. The dried cloves were ground into a fine powder using a mortar and pestle. The powder was sieved and stored in an airtight container until further use.

2.3 Preparation of Clove Extract

An aqueous clove extract was prepared by adding **2 g of clove powder to 100 mL of distilled water**. The mixture was continuously stirred and maintained at **60 °C for 1 h** to facilitate the extraction of water-soluble phytochemical constituents. After extraction, the mixture was cooled to room temperature and filtered using Whatman filter paper. The resulting clear filtrate was used for the synthesis of ZnO nanoparticles.

2.4 Synthesis of ZnO Nanoparticles

A total of **2 g of zinc nitrate** was dissolved in **100 mL of distilled water** and continuously stirred for 1 h to obtain a homogeneous precursor solution. Subsequently, **20 mL of clove extract** was added gradually under continuous stirring.

Aqueous sodium hydroxide solution was then added dropwise until the formation of a visible precipitate was observed. The precipitate was separated and washed twice with distilled water to remove unreacted species and soluble impurities. The washed precipitate was dried at **200 °C** until moisture was removed completely. The dried material was ground into a fine powder and used for subsequent characterization.

3. Characterization Techniques

The synthesized ZnO nanoparticles were characterized using UV–Visible spectroscopy to investigate their optical absorption properties. X-ray diffraction was employed to determine the crystalline structure and estimate the crystallite size. FTIR spectroscopy was used to identify the functional groups associated with the synthesized nanoparticles. SEM was used to examine the surface morphology and particle aggregation.

4. Results and Discussion

4.1 UV–Visible Spectroscopic Analysis

The optical absorption characteristics of the synthesized ZnO nanoparticles were investigated using UV–Visible spectroscopy in the wavelength range of approximately 200–900 nm. The obtained spectrum is shown in **Figure 1**.

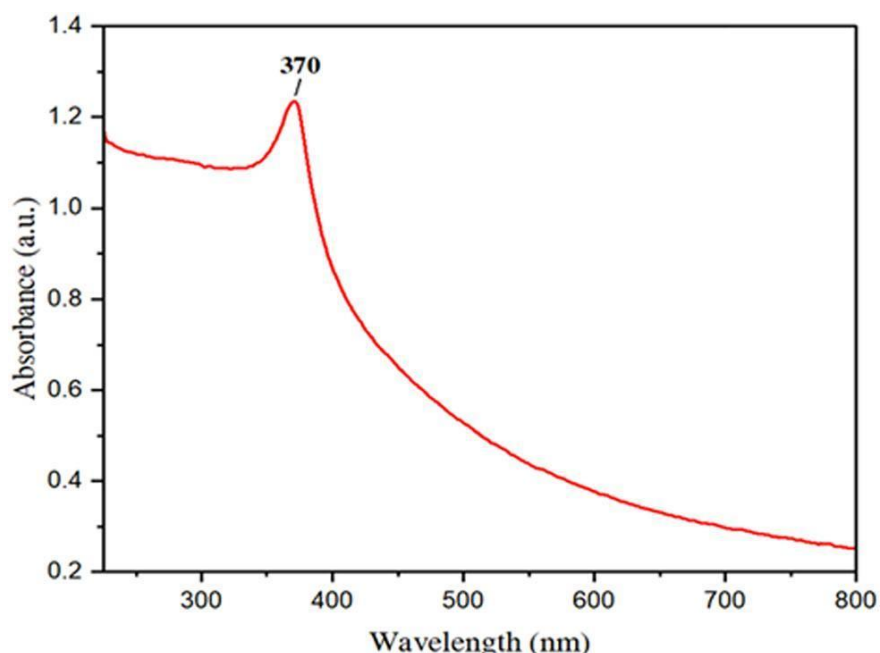


Figure 1. UV–Visible absorption spectrum of clove-mediated ZnO nanoparticles.

The spectrum exhibits a distinct absorption feature at **369 nm**. This absorption is characteristic of ZnO nanoparticles and is associated with electronic transitions near the fundamental absorption edge. A ZnO absorption maximum around 370 nm has also been reported for clove-mediated ZnO nanoparticles.

The optical band gap was estimated using:

$$E_g = \frac{hc}{\lambda}$$

where E_g is the optical band-gap energy, h is Planck's constant ($6.626 \times 10^{-34} \text{ J s}$), c is the velocity of light ($3.0 \times 10^8 \text{ m s}^{-1}$), and λ is the absorption wavelength.

For $\lambda = 369 \text{ nm}$:

$$E_g = \frac{(6.626 \times 10^{-34})(3 \times 10^8)}{369 \times 10^{-9}}$$

The calculated value is approximately **3.36 eV**.

This value is close to the reported band gap of ZnO, approximately 3.37 eV, confirming the semiconductor nature of the synthesized material.

Table 1. Optical parameters of synthesized ZnO nanoparticles

Parameter	Observed value
Absorption wavelength, λ_{max}	369 nm
Calculated band gap	3.36 eV
Material	ZnO semiconductor

4.2 X-Ray Diffraction Analysis

The crystalline nature of the synthesized ZnO nanoparticles was investigated by X-ray diffraction. The experimental XRD pattern is presented in **Figure 2**.

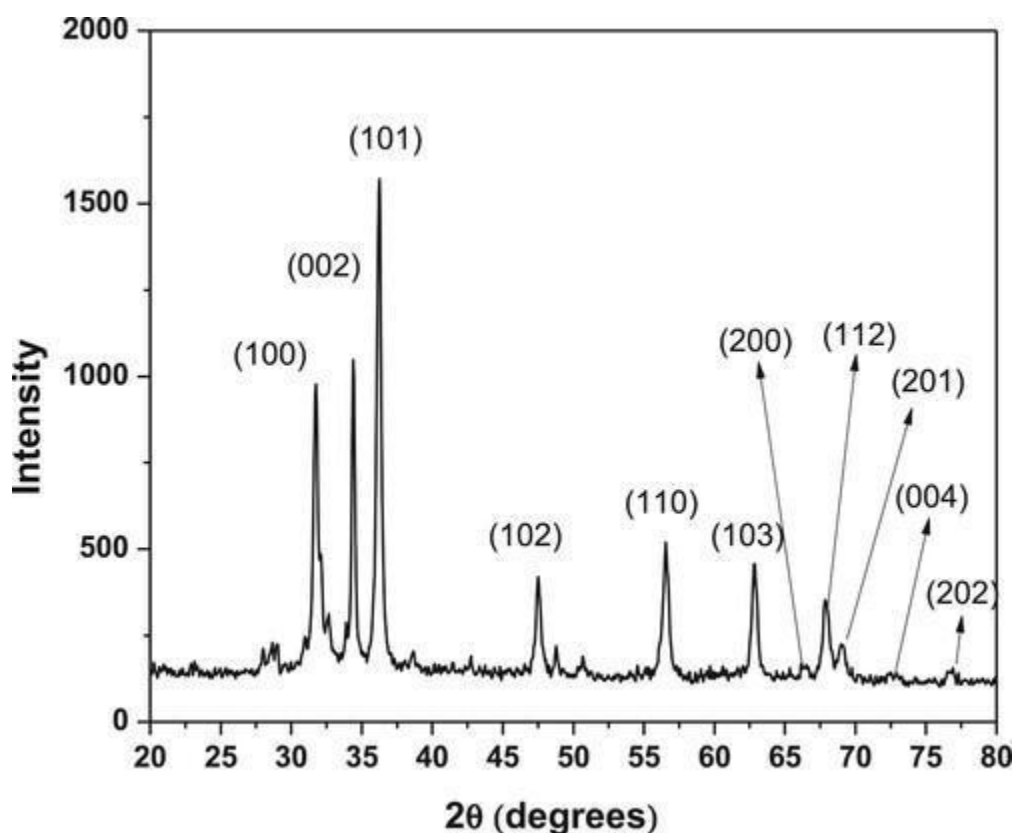


Figure 2. XRD pattern of the synthesized ZnO nanoparticles.

The supplied XRD pattern exhibits diffraction features in the 2θ range of approximately $20\text{--}80^\circ$. The major features in the supplied plot are labelled at approximately 26.03° , 30.69° , 34.83° , 41.34° and 45.23° .

The mean crystallite size was calculated using the Debye–Scherrer equation:

$$D = \frac{K\lambda}{\beta \cos \theta}$$

where, D is the crystallite size, K is the Scherrer constant (approximately 0.9),

λ —is the Cu $K\alpha$ wavelength ($1.5406 \text{ \AA}$),

β —is the FWHM in radians and

θ —is the Bragg angle.

Based on the FWHM values supplied, the calculated average crystallite size is **43.79 nm**.

Table 2. Crystallite-size calculation from XRD data

2θ (°)	θ (°)	$\cos \theta$	FWHM (°)	β (rad)	D (nm)
26.03	13.015	0.9743	0.3352	0.00585	24.71
30.69	15.345	0.9643	0.1728	0.00302	48.46
34.83	17.415	0.9541	0.1618	0.00282	52.04
41.34	20.670	0.9356	0.1749	0.00305	49.95
Average					43.79

Standard wurtzite ZnO normally exhibits prominent reflections around 31.7° , 34.4° and 36.2° , indexed as (100), (002) and (101), respectively, with further peaks around 47.5° , 56.6° and 62.8° .

4.3 FTIR Analysis

FTIR spectroscopy was performed to identify the functional groups associated with the synthesized ZnO nanoparticles. The FTIR spectrum obtained in the range of $4000\text{--}500\text{ cm}^{-1}$ is shown in **Figure 3**.

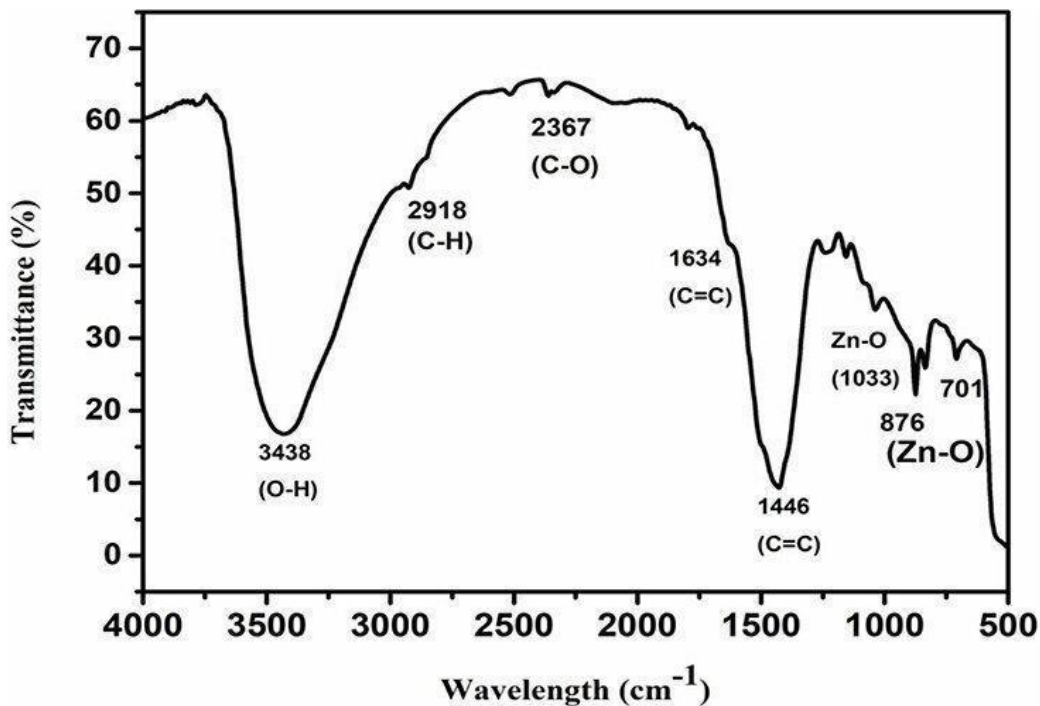


Figure 3. FTIR spectrum of the synthesized ZnO nanoparticles.

The observed absorption bands were located at **3359.75, 1566.29, 1330.37, 1037.80, 830.59 and 601.66 cm^{-1}** . The broad band at **3359.75 cm^{-1}** is associated with O–H stretching vibrations, which may originate from hydroxyl groups and/or adsorbed moisture. The band at **1566.29 cm^{-1}** is assigned to N–H bending vibrations. The absorption at **1330.37 cm^{-1}** can be associated with C–O vibrations of phenolic constituents, while the band at **1037.80 cm^{-1}** corresponds to C–O stretching vibrations.

The band at **830.59 cm^{-1}** is associated with N–H-related vibration. The absorption band at **601.66 cm^{-1}** is attributed to Zn–O stretching vibration, providing evidence for the formation of ZnO.

Table 3. FTIR band assignments

Wavenumber (cm^{-1})	Assignment	Vibration
3359.75	Hydroxyl	O–H stretching
1566.29	Amine	N–H bending
1330.37	Phenolic	C–O vibration
1037.80	Alcohol	C–O stretching
830.59	Amine	N–H bending
601.66	ZnO	Zn–O stretching

The presence of several oxygen-containing functional groups is consistent with the contribution of plant-derived phytochemicals to the surface chemistry of the nanoparticles. The low-wavenumber Zn–O vibration is particularly important as evidence for ZnO formation.

4.4 Scanning Electron Microscopy Analysis

The morphology of the synthesized ZnO nanoparticles was examined using SEM. The supplied micrograph was recorded at **45.00 kX magnification**, with a scale bar of **300 nm**, as indicated in the image.

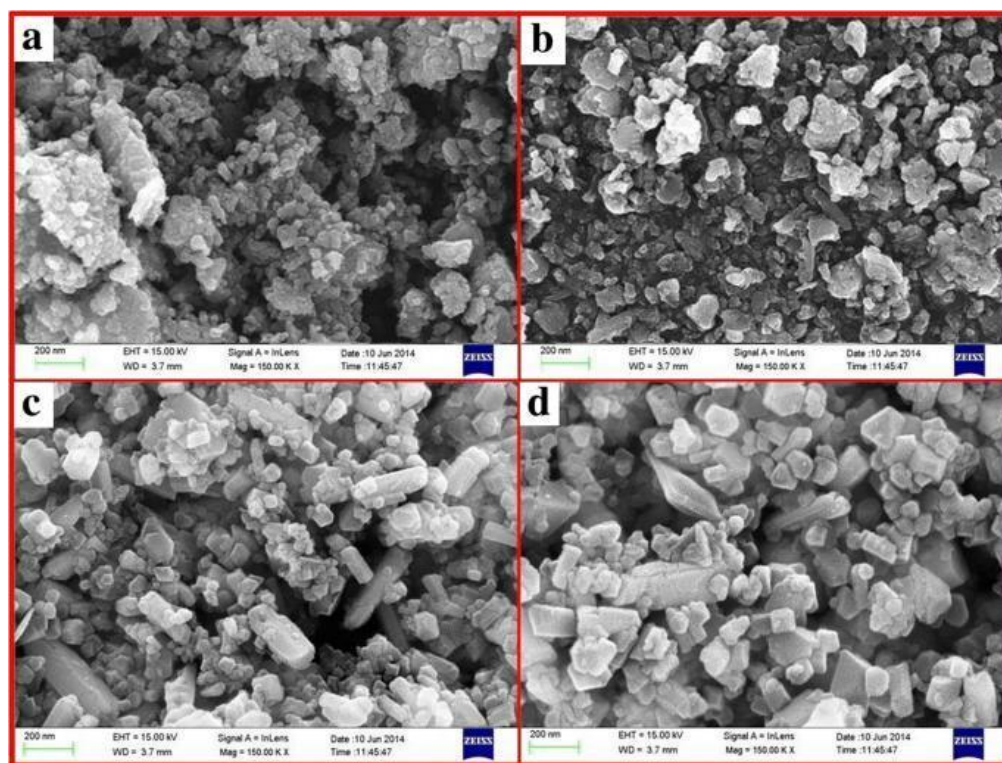


Figure 4. SEM micrograph of the synthesized ZnO nanoparticles.

The SEM micrograph reveals irregularly shaped particles with predominantly angular/hexagonal features. Considerable particle aggregation is observed, which may result from the high surface energy of nanoparticles and interparticle interactions during drying. The particles appear to be distributed non-uniformly throughout the observed field.

The morphological observations are consistent with the formation of nanoscale ZnO structures. However, the crystallite size calculated from XRD (**43.79 nm**) should not be directly equated with the physical particle dimensions observed in SEM because XRD determines coherent crystallite size, whereas SEM provides morphological information.

5. Conclusion

ZnO nanoparticles were successfully prepared using aqueous clove (*Syzygium aromaticum*) extract through a co-precipitation route. The synthesized material was characterized using UV–Visible spectroscopy, XRD, FTIR and SEM.

The UV–Visible spectrum showed an absorption maximum at **369 nm**, with an estimated optical band gap of **3.36 eV**. XRD analysis yielded an average crystallite size of **43.79 nm** using the Debye–Scherrer equation. FTIR analysis identified hydroxyl, amine, phenolic/alcoholic and Zn–O-related vibrational bands, indicating the presence of surface-associated phytochemical

constituents. SEM analysis revealed irregular, predominantly angular/hexagonal particles with noticeable agglomeration.

Overall, the results demonstrate the potential of clove extract as a plant-derived component for the preparation of ZnO nanoparticles using a relatively simple synthesis procedure. The obtained optical, structural and morphological properties indicate that the material warrants further investigation for potential photocatalytic, environmental and antimicrobial applications. However, application-specific performance should be experimentally evaluated before making claims regarding particular end uses.

REFERENCE

- [1] Aminu zaman M, Ying LP, Goh WS, Watanabe A. Green synthesis 6(10):8468–83; <https://doi.org/10.1021/nn303929aof> zinc oxide nanoparticles using aqueous extract of *Garcinia man.*
- [2] Mushtaq M, Ali B, Ali M, BiBi N, Raut R, Suliman GM, et al. Green synthesis of zinc oxide nanoparticles doped *Leucas aspera* leaf extract and its photocatalytic applications. *Journal of Optoelectronic and Biomedical Materials*, 16(4), 189–197.
- [3] Kołodziejczak-Radzinski & Jesionowski (2014) Zinc Oxide-From Synthesis to Application: A Review *Materials*, 7, 2833–2881. A comprehensive review including FTIR characteristics of ZnO.
- [4] Ahmad, N., Alam, M. K., Shehbaz, A., Khan, A., Mannan, A., Hakim, S. R., Owais, M, "Antimicrobial activity of clove oil and its potential in the treatment of vaginal candidiasis", *Journal of drug targeting*, 13 (10), pp. 555-561, (2005).
- [5] Vahidi, A., Vaghari, H., Najia, Y., Najia, M. J., Jafarizadeh-Malmiri, H., "Evaluation of three different green fabrication methods for the synthesis of crystalline ZnO nanoparticles using *Pelargonium zonal* leaf extract", *Green Processing and Synthesis*, 8(1), pp. 302-308, (2019).
- [6] Kołodziejczak-Radzinski & Jesionowski (2014) Zinc Oxide-From Synthesis to Application: A Review *Materials*, 7, 2833–2881. A comprehensive review including FTIR characteristics of ZnO.
- [7] Sayyar, Z. Malir, H., "Photocatalytic and antibacterial activities study of prepared self-cleaning nanostructure surfaces using synthesized and coated ZnO nanoparticles with Curcumin Nano dispersion", *Festschrift für Crystallography-Crystalline Materials*, 234(5), pp. 307-3328, (2019).
- [8] Azam, A., Ahmed, F., Arshi, N., Chaman, M., Naqvi, A. H., "Formation and characterization of ZnO Nano powder synthesized by sol–gel method", *Journal of Alloys and Compounds*, 496(1-2), pp. 399-402, (2010).
- [9] Sobhy M, Ali SS, Khalil MA, et al. Exploring the potential of zinc oxide nanoparticles against pathogenic multi-drug-resistant *Staphylococcus aureus* from ready-to-eat meat and its proposed mechanism. *Food Control*. 2024; 156:110117. doi: 10.1016/j.foodcont.2023.
- [10] Kołodziejczak-Radzinski & Jesionowski (2014) Zinc Oxide-From Synthesis to Application: A Review *Materials*, 7, 2833–2881. A comprehensive review including FTIR characteristics of ZnO.

- [11] Hashim, M. U., & Ibrahim, O. M. S. (2024). Green synthesis of ZnO nanoparticles using clove oil extract and antibacterial activity against MRSA. *Uttar Pradesh Journal of Zoology*, 45(4), 97–110.
- [12] Haunani, K., Hegazy, S., Asaeda, H., Beche Lany, M., & Barhoum, A. (2024). Green synthesis of hexagonal-like ZnO NPs modified with clove and *Thymus capitates* extracts. *Materials*, 17(17), 4340.
- [13] Lakshmi's, T. R., Kalagadi, N. K., Muddily, V., et al. (2019). Bio fabrication of ZnO NPs with *Syzygies aromaticum**bud extract and antifungal activity. *Frontiers in Microbiology*, 10, 1244.
- [14] Mother, H. et al. (2023). Clove-mediated ZnO NPs: characterization and biomedical potential. *Journal of Nanostructures*, 13(2), 215–224.
- [15] Periyasamy, S., & Anand, T. (2023). Clove extract as fuel for combustion synthesis of ZnO NPs. *Materials Today: Proceedings*, 72, 1456–1462.

Green Synthesis and Characterization of Copper Oxide (CuO) Nanoparticles Using Punica granatum (Pomegranate) Peel Extract

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ABSTRACT

Copper oxide (CuO) nanoparticles were synthesized by a simple, eco-friendly co-precipitation method using aqueous Punica granatum (pomegranate) peel extract as a natural reducing and stabilizing agent, with copper sulphate as the precursor. Formation of the nanoparticles was indicated by a visible colour change of the reaction mixture from straw yellow to light green/black, and finally to a dark brown paste on drying. The synthesized nanoparticles were characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), UV–Visible spectroscopy, and scanning electron microscopy (SEM). XRD confirmed a monoclinic CuO phase consistent with JCPDS file no. 01-1117, with an average crystallite size of 22.6 nm calculated using the Debye–Scherrer equation. FTIR spectra revealed functional groups — hydroxyl, alkane, carbonyl, aromatic and alcohol/phenolic groups — derived from the peel phytochemicals, together with a characteristic Cu–O stretching band at 594.86 cm^{-1} , confirming nanoparticle formation. UV–Visible spectroscopy showed a distinct absorption peak at 369.20 nm, corresponding to an optical band gap of 3.36 eV, confirming semiconducting behaviour. SEM analysis revealed an irregular, nearly spherical and agglomerated particle morphology with non-uniform clustering. These results confirm that Punica granatum peel extract — an agricultural by-product — is an effective, low-cost and sustainable reducing agent for producing crystalline, semiconducting CuO nanoparticles with potential environmental and biomedical applications.

Keywords: *Green synthesis; Copper oxide nanoparticles; Punica granatum; XRD; FTIR; UV–Visible spectroscopy; SEM*

1. Introduction

Nanomaterials, with at least one dimension confined to the 1–100 nm range, exhibit enhanced optical, electrical and chemical properties relative to their bulk counterparts, enabling wide-

ranging applications in electronics, energy, medicine and environmental protection [1,4]. Among metal-oxide nanomaterials, copper oxide (CuO) has attracted considerable interest as a low-cost, chemically stable p-type semiconductor with demonstrated antibacterial, catalytic and photocatalytic properties.

Conventional physical and chemical synthesis routes for CuO nanoparticles often require toxic reagents, high energy input and generate hazardous by-products. Green synthesis using plant extracts offers a sustainable, low-cost and environmentally benign alternative, in which plant-derived phytochemicals such as flavonoids, tannins and phenolic compounds act simultaneously as reducing and capping agents [6,10]. Numerous plant-mediated CuO nanoparticle syntheses have been reported using extracts of *Catharanthus roseus*, *Verbascum thapsus*, green tea and lavender leaves, coffee, *Piper nigrum* and *Coriandrum sativum*, *Cedrus deodara*, *Ephedra alata*, *Moringa oleifera*, *Justicia schimperiana*, *Aegle marmelos* and *Ocimum sanctum*, among others [7–9]. These studies consistently confirm the formation of crystalline, nanoscale CuO particles with monoclinic structure and demonstrate useful antibacterial, antioxidant, photocatalytic and electrochemical properties, underscoring the versatility and reliability of biological synthesis routes.

Punica granatum (pomegranate) peel, an agricultural by-product typically discarded after fruit processing, is rich in tannins, flavonoids and polyphenolic compounds with well-documented antioxidant, antibacterial and antifungal activity. Utilizing this peel as a reducing and stabilizing agent for nanoparticle synthesis therefore combines eco-friendly nanomaterial production with valorization of agricultural waste. In the present study, aqueous *Punica granatum* peel extract was employed in a co-precipitation reaction with copper sulphate to synthesize CuO nanoparticles. The synthesized nanoparticles were characterized by XRD, FTIR, UV–Visible spectroscopy and SEM to determine their crystal structure, functional groups, optical band gap and surface morphology, with a view toward sustainable nanomaterial production for environmental and biomedical applications.

2. Materials and methods

2.1. Materials

Fresh pomegranate (*Punica granatum*) fruit peels were used as the plant source. Copper (II) sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), analytical grade, was used as the metal precursor without further purification. Double-distilled water was used throughout the experiments.

2.2. Preparation of *Punica granatum* peel extract

Fresh pomegranate peels were collected, thoroughly washed with distilled water, and shade-dried for several days. The dried peels were chopped into small pieces, and approximately 25 g of the chopped peel was boiled with 100 mL of distilled water at 60–70 °C for about 20 min. The resulting mixture was filtered to remove solid residues, yielding a clear pomegranate peel extract that served as the natural reducing and stabilizing agent.

2.3. Green synthesis of CuO nanoparticles

An aqueous solution of copper(II) sulphate was prepared by dissolving 0.05 mol of the salt in distilled water. The pomegranate peel extract was added dropwise to the copper sulphate solution under continuous magnetic stirring, and the reaction mixture was heated and maintained at 60–80 °C. During the reaction, the colour of the mixture changed from straw yellow to light green/black, indicating reduction of copper ions by the peel phytochemicals. The solution was then allowed to stand at room temperature for one day, during which it transformed from a watery consistency into a dark brown paste. This paste was collected and dried in an oven at 250 °C, after which it was ground into a fine powder using a mortar and pestle to obtain the final CuO nanoparticles.

2.4. Characterization

The crystal structure and phase composition of the synthesized nanoparticles were examined by powder X-ray diffraction (XRD) using Cu K α radiation ($\lambda = 1.5406 \text{ \AA}$). Functional groups associated with phytochemical capping and Cu–O bond formation were identified by Fourier transform infrared (FTIR) spectroscopy over the range 400–4000 cm^{-1} . Optical absorption behaviour and the optical band gap were determined by UV–Visible spectroscopy. Surface morphology was examined by scanning electron microscopy (SEM).

3. Results and discussion

3.1. XRD analysis

The XRD pattern of the synthesized sample (Fig. 1) shows diffraction peaks at $2\theta = 23.5^\circ$, 25.8° , 27.5° , 31.5° and 42.0° , corresponding to the (020), (113), (022), (004) and (024) planes, respectively. These reflections match a monoclinic crystal structure and are in good agreement with JCPDS file no. 01-1117, confirming successful formation of the CuO phase. The average crystallite size (D) was calculated from the FWHM of the well-resolved diffraction peaks using the Debye–Scherrer equation:

$$D = K\lambda / (\beta \cos \theta) \quad (1)$$

where D is the crystallite size (nm), K is the shape factor (≈ 0.9), λ is the X-ray wavelength ($1.5406 \text{ \AA}$), β is the full width at half maximum (FWHM, in radians), and θ is the diffraction angle. The calculated crystallite sizes for the individual peaks and the corresponding average value are summarized in Table 1.

Table 1. Structural parameters and crystallite size of CuO nanoparticles determined from XRD data.

S. No.	2θ ($^\circ$)	θ ($^\circ$)	$\cos \theta$	FWHM ($^\circ$)	β (rad)	D (nm)
1	23.5	11.75	0.9790	15.6409	0.2728	51.9164
2	25.8	12.9	0.9748	1.0012	0.0175	8.1279
3	27.5	13.75	0.9713	1.2712	0.0222	6.4302
4	31.5	15.75	0.9625	34.3151	0.5986	24.0655

The average crystallite size obtained was 22.6 nm, confirming the nanoscale, monoclinic nature of the synthesized CuO particles.

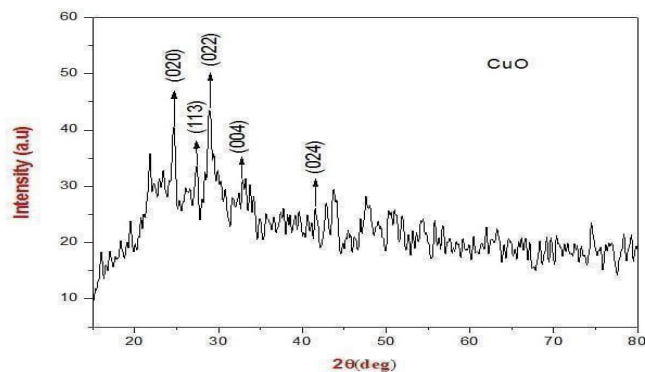


Fig. 1. XRD pattern of CuO nanoparticles synthesized using Punica granatum peel extract.

3.2. FTIR analysis

The FTIR spectrum of the synthesized CuO nanoparticles (Fig. 2), recorded over 400–4000 cm^{-1} , shows a broad absorption band in the region of 3200–3400 cm^{-1} attributed to O–H stretching vibrations, indicating the presence of hydroxyl groups or adsorbed water. The peak at 2923.79 cm^{-1} corresponds to C–H stretching of aliphatic compounds, while the strong band at 1724.72 cm^{-1} is assigned to C=O stretching of carbonyl groups. The peak at 1599.53 cm^{-1} represents C=C stretching of aromatic rings, and the band at 1320.37 cm^{-1} is due to C–O stretching of alcohols or phenolic groups, indicating the presence of organic compounds acting as reducing and stabilizing agents. The most significant peak at 594.86 cm^{-1} corresponds to Cu–O stretching vibrations, confirming successful formation of copper oxide nanoparticles. All observed bands were found to be in accordance with the reported vibrational frequencies of CuO.

Table 2. FTIR functional group assignments for the synthesized CuO nanoparticles.

Frequency (cm^{-1})	Functional group	Vibration type
3200–3400 (broad)	Hydroxyl / adsorbed water	O–H stretching
2923.79	Alkane	C–H stretching
1724.72	Carbonyl	C=O stretching
1599.53	Aromatic rings	C=C stretching

1320.37	Alcohol / phenolic	C–O stretching
594.86	Metal oxide	Cu–O stretching

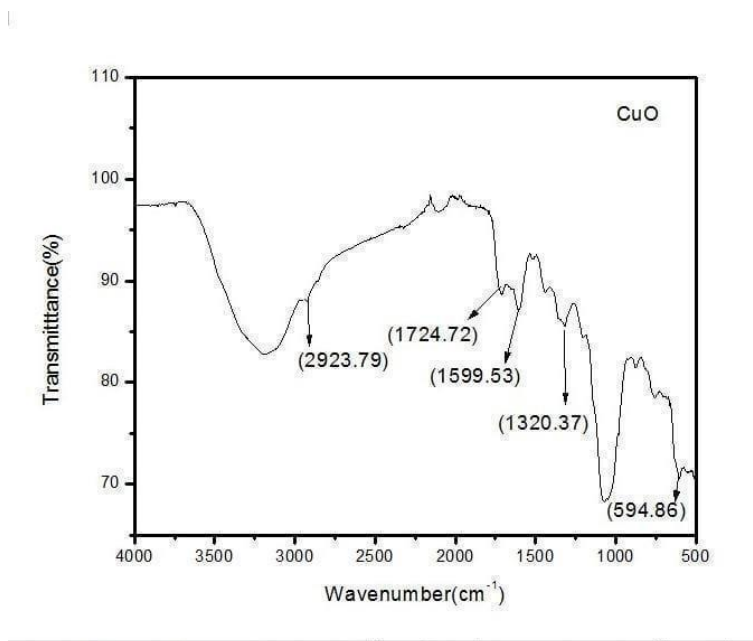


Fig. 2. FTIR spectrum of CuO nanoparticles synthesized using Punica granatum peel extract.

3.3. UV–Visible spectroscopy

The optical properties of the synthesized CuO nanoparticles were studied by UV–Visible absorption spectroscopy (Fig. 3), which confirms nanoparticle formation through a distinct absorption peak at 369.20 nm. The optical band gap energy (E_g) was estimated using the Planck–Einstein relation:

$$E_g = hc / \lambda \quad (2)$$

where h is Planck's constant ($6.626 \times 10^{-34} \text{ J}\cdot\text{s}$), c is the velocity of light ($3 \times 10^8 \text{ m/s}$), and λ is the wavelength of the absorption peak (369.20 nm). The calculated band gap energy was found to be approximately 3.36 eV, confirming that the synthesized CuO nanoparticles exhibit semiconductor behaviour.

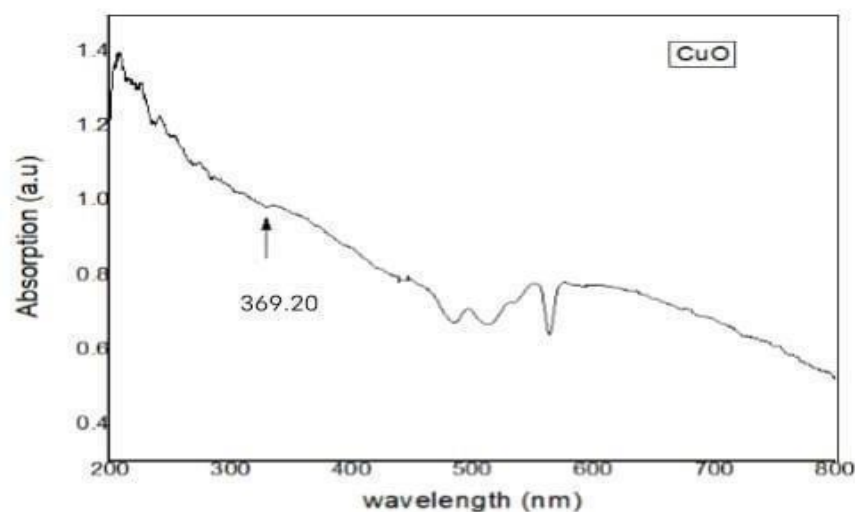


Fig. 3. UV–Visible absorption spectrum of CuO nanoparticles

3.4. SEM analysis

The surface morphology of the synthesized CuO nanoparticles was examined by SEM (Fig. 4). The micrographs reveal an irregular, nearly spherical particle morphology, with the nanoparticles found to be agglomerated owing to their high surface energy and inter-particle interactions. Particle distribution is non-uniform, with dense clusters formed in certain regions. Higher-magnification imaging (Fig. 4b) shows individual nanostructures with lateral dimensions in the range of approximately 180–185 nm, as marked in the micrograph, while lower-magnification imaging (Fig. 4c) confirms the overall agglomerated, clustered morphology across the sample. The observed morphology confirms that the synthesized CuO particles lie within the nanoscale range, consistent with the crystallite size determined from the XRD analysis.

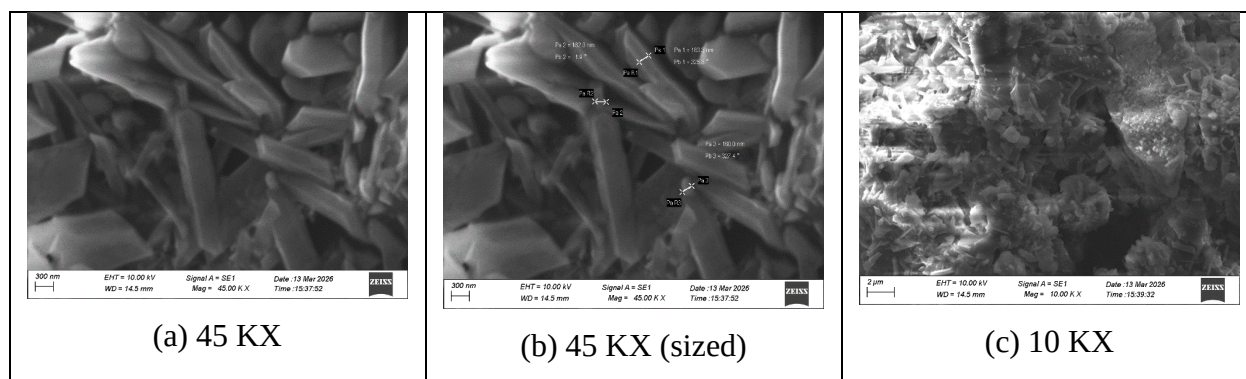


Fig. 4. SEM micrographs of CuO nanoparticles at (a, b) 45 KX and (c) 10 KX magnification.

4. Conclusion

Copper oxide (CuO) nanoparticles were successfully synthesized via a green co-precipitation route using Punica granatum peel extract as a natural reducing and stabilizing agent. XRD analysis confirmed the formation of a monoclinic CuO phase, consistent with JCPDS file no. 01-1117, with an average crystallite size of 22.6 nm. FTIR analysis confirmed the presence of hydroxyl, alkane, carbonyl, aromatic and alcohol/phenolic functional groups responsible for the reduction and stabilization of the nanoparticles, together with a characteristic Cu–O stretching band at 594.86 cm^{-1} . UV–Visible spectroscopy revealed an absorption peak at 369.20 nm corresponding to a band gap of 3.36 eV, confirming semiconducting behavior. SEM analysis showed an irregular, nearly spherical and agglomerated particle morphology. The green synthesis method employed in this study is eco-friendly, cost-effective, and avoids the use of toxic chemicals, while also valorizing pomegranate peel, an agricultural by-product. The synthesized CuO nanoparticles are expected to exhibit good stability and antimicrobial properties, suggesting potential applications in wound dressings, antibacterial coatings for medical devices, and water purification systems for controlling microbial contamination.

5. References

- [1] Jeevanandam J, Barhoum A, Chan YS, Dufresne A, Danquah MK. Review on nanoparticles and nanostructured materials: history, sources, toxicity and regulations. *Beilstein J Nanotechnol* 2018;9:1050–74.
- [2] Niemeyer CM, Mirkin CA. *Nanobiotechnology: concepts, applications and perspectives*. Weinheim: Wiley-VCH; 2004.
- [3] Shankar R, et al. *Origanum vulgare* mediated biosynthesis of silver nanoparticles for its antibacterial and anticancer activity. *Colloids Surf B Biointerfaces* 2013;108:80–4.
- [4] Elmer W, White JC. The future of nanotechnology in plant pathology. *Annu Rev Phytopathol* 2018;56:111–33.
- [5] Ogunyemi SO, et al. Green synthesis of zinc oxide nanoparticles using different plant extracts and their antibacterial activity against *Xanthomonas oryzae* pv. *oryzae*. *Artif Cells Nanomed Biotechnol* 2019;47:341–52.
- [6] Gharies M, et al. Biosynthesis of copper oxide nanoparticles using the preformed biomass of *Aspergillus fumigatus* and their antibacterial and photocatalytic activities. *Dig J Nanomater Biostruct* 2019;14(2):291–303.
- [7] Jayakumarai G, et al. Phytofabrication and characterization of monodisperse copper oxide nanoparticles using *Albizia lebbeck* leaf extract. *Appl Nanosci* 2015;5:1017–21.
- [8] Rafique M, et al. Eco-friendly green biosynthesis of copper oxide nanoparticles using *Citrofortunella microcarpa* leaves extract for efficient photocatalytic degradation of Rhodamine B dye from textile wastewater. *Optik* 2020;208:164053.
- [9] Muthuvel A, Jothibas M, Manoharan CJ. Effect of chemically synthesized compared to biosynthesized ZnO nanoparticles using *Solanum nigrum* leaf extract and their photocatalytic, antibacterial and in-vitro antioxidant activity. *J Environ Chem Eng* 2020;8:103705.
- [10] Iravani S. Green synthesis of metal nanoparticles using plants. *Green Chem* 2011;13:2638–50.
- [11] Sofiya Dyana K, Ilakiya D, Jothi Mani R. Effect of CuSO_4 — structural reduction phenomena. *Int J Trend Res Dev*; E-ISSN: 2349-5138.

- [12] Irfana Amrin, Jothi Mani R, Farzana Mubeen SH. Green synthesis and characterization studies. *Int J Trend Res Dev*; ISSN: 2394-9333.
- [13] Yedukar SM, Maurya CB, Mahanwar PA. Synthesis and characterization of copper oxide nanoparticles. *J Mater Environ Sci* 2017;8:1173–8.
- [14] Raja Naika H, Lingaraju K, Manjunath K, Danith Kumar, et al. Synthesis and characterization of CuO nanoparticles. *J Taibah Univ Sci* 2015;9:7–12.
- [15] Rajendar A, Siva E, Dhanraj C, Senthilkumar S. Green synthesis of copper oxide nanoparticles. *J Bioprocess Biotech* 2018;8:3.
- [16] Palajonna Narasaiah, Basava Kumar Mandal, Sarada NC. Structural and optical studies of copper oxide nanoparticles. *Mater Sci Eng* 2017;263:022012.
- [17] Chayanika Sarma, Rasane P, Kaur S, Singh J. Green synthesis and characterization of copper oxide nanoparticles. *An Acad Bras Cienc* 2018;90(4):3871–8.
- [18] Chandra S, Kumar A, Tomar PK. Synthesis and characterization of copper oxide nanoparticles. *J Saudi Chem Soc* 2014;18:149–53.
- [19] Gopinath M, Subbaiya R, Masilamani Selvam M, Suresh D. Biosynthesis and antibacterial activity of copper oxide nanoparticles. *Int J Curr Microbiol Appl Sci* 2014;3(9):814–8.
- [20] Bar H, Bhui DK, Sahoo GP, et al. Green synthesis of copper nanoparticles. *Colloids Surf A* 2009;348:212–6.

Synthesis and Characterization of Iron Oxide (γ -Fe₂O₃) Nanoparticles Using Zingiber officinale Rhizome Extract: A Green Co-precipitation Approach

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ABSTRACT

Green synthesis of nanoparticles offers a sustainable and environmentally benign alternative to conventional chemical routes. In this study, iron oxide nanoparticles were synthesized by a co-precipitation method using aqueous ginger (*Zingiber officinale*) rhizome extract as a natural reducing and stabilizing agent, with ferrous sulphate (FeSO₄·7H₂O) as the precursor. The synthesized nanoparticles were characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), UV-Visible spectroscopy, and scanning electron microscopy (SEM). XRD confirmed the formation of a cubic inverse spinel γ -Fe₂O₃ (maghemite) phase with an average crystallite size of 25.18 nm, calculated using the Debye–Scherrer equation. FTIR analysis verified the involvement of phytochemicals from the ginger extract in nanoparticle stabilization, with a characteristic Fe–O stretching band observed at 578 cm⁻¹. UV-Visible spectroscopy revealed an absorption peak at 515.73 nm, corresponding to a band gap energy of 2.4043 eV, suggesting potential photocatalytic applicability. SEM analysis showed faceted, polyhedral particle morphology consistent with the nanoscale crystallinity indicated by XRD. The results confirm that γ -Fe₂O₃ nanoparticles with desirable structural and optical properties can be produced through a simple, low-cost, and eco-friendly plant-mediated route.

Keywords: Green synthesis; Iron oxide nanoparticles; γ -Fe₂O₃; Zingiber officinale; Co-precipitation; XRD; FTIR

1. INTRODUCTION

Ongoing advances in electronics, energy systems, and biomedical engineering have driven demand for materials with enhanced and multifunctional properties as conventional bulk materials approach their physical limits. Nanoscience and nanotechnology have emerged as transformative fields that exploit the unique size-dependent physical, chemical, optical, and magnetic properties materials acquire at the nanoscale (1–100 nm), where quantum confinement and high surface-to-volume ratios dominate material behaviour [1,3].

Conventional chemical synthesis of nanoparticles, however, often relies on hazardous reagents, high energy input, and generates toxic by-products. This has motivated growing interest in green synthesis, which uses plant extracts as eco-friendly reducing and capping agents in place of synthetic chemicals [1]. Among metal oxide nanomaterials, iron oxide nanoparticles are of particular interest owing to their biocompatibility, magnetic behaviour, and tunable optical properties, which make them useful in biomedical, catalytic, and environmental applications [4].

A number of plant-mediated routes for iron oxide nanoparticle synthesis have been reported, including extracts of *Madhuca indica*, clove, green coffee, *Hibiscus rosa-sinensis*, *Egeria densa*, *Ziziphus oenoplia*, *Psidium guajava*, *Vitex leucoxydon*, *Platanus orientalis*, *Moringa oleifera*, and *Mimosa pudica*, yielding nanoparticles with antioxidant, antibacterial, photocatalytic, and heavy-metal adsorption properties depending on the phytochemical profile of the extract used [2,13,17]. Ginger (*Zingiber officinale*) rhizome is particularly attractive for this purpose because it is rich in gingerols and shogaols, bioactive polyphenolic compounds capable of acting as both reducing and capping agents during nanoparticle formation.

The present study reports a simple, low-cost, green co-precipitation synthesis of iron oxide nanoparticles using aqueous *Zingiber officinale* rhizome extract and ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) as the iron precursor. The synthesized nanoparticles were systematically characterized by XRD, FTIR, UV-Visible spectroscopy, and SEM to establish their crystal structure, functional-group composition, optical band gap, and surface morphology.

2. MATERIALS AND METHODS

2.1 Materials

Fresh *Zingiber officinale* (ginger) rhizomes were procured from a local market. Ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, Nice Chemicals) and sodium hydroxide (NaOH) were used as received, without further purification. Distilled water was used throughout the synthesis.

2.2 Preparation of *Zingiber officinale* rhizome extract

Ginger rhizomes were peeled, washed thoroughly with distilled water, and cut into small pieces. 20 g of the chopped rhizome was added to 100 mL of distilled water and heated at 70 °C for 1 h. The resulting extract was filtered through Whatman No. 1 filter paper and used directly for nanoparticle synthesis.

2.3 Preparation of the ferrous sulphate precursor solution

A 0.2 M ferrous sulphate solution was prepared by dissolving 5.5602 g of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in 100 mL of distilled water and stirring continuously for 30 min to obtain a homogeneous precursor solution.

2.4 Green synthesis of iron oxide nanoparticles

50 mL of the ginger rhizome extract was added to 100 mL of the ferrous sulphate precursor solution. Phytochemicals present in the extract, principally gingerols and shogaols, functioned as natural reducing and capping agents. The mixture was stirred continuously for 3 h at 60 °C, during which a green colouration developed, indicating nanoparticle formation. NaOH solution was added dropwise to adjust the pH and drive the reaction between the precursor and the plant extract. The resulting solution was covered and kept in the dark for 36 h, then washed twice daily with distilled

water and once with ethanol. The precipitate obtained was dried in an oven at 150 °C for 3 h and ground into a fine powder using a mortar and pestle prior to characterization.

2.5 Characterization

The crystal structure of the synthesized powder was examined by X-ray diffraction (XRD) over a 2θ range of 20°–80° using Cu-K α radiation ($\lambda = 1.5406 \text{ \AA}$) at a scan speed of 5°/min. Functional groups and phytochemical involvement were probed by Fourier transform infrared (FTIR) spectroscopy over 4000–400 cm^{-1} . Optical absorption properties were recorded using UV-Visible spectroscopy, and surface morphology was examined by scanning electron microscopy (SEM) at 25, 45, and 50 kX magnification.

3. RESULTS AND DISCUSSION

3.1 X-ray diffraction (XRD) analysis

The XRD pattern of the synthesized sample (Fig. 1) showed diffraction peaks at $2\theta = 18.02^\circ$, 26.32° , 37.28° , 54.96° , and 62.08° , corresponding to the (111), (211), (222), (430), and (440) planes, respectively. These reflections match the cubic inverse spinel structure of $\gamma\text{-Fe}_2\text{O}_3$ (maghemite), in agreement with JCPDS card no. 39-1346 [18], confirming successful phase formation.

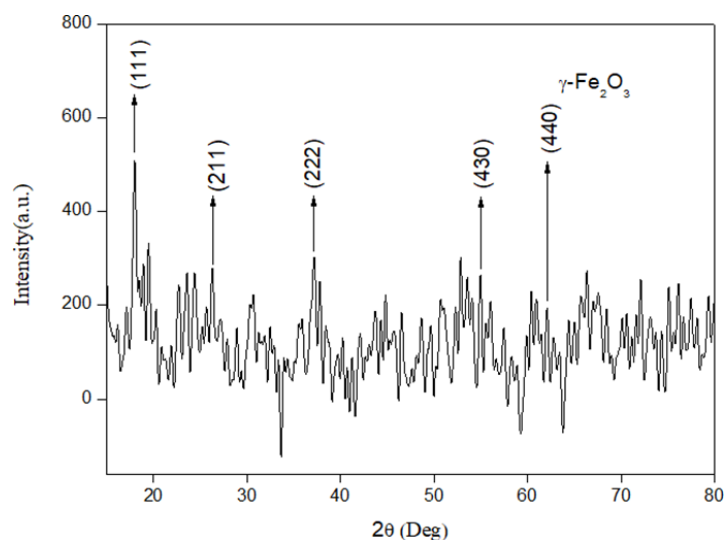


Fig. 1. XRD pattern of the green-synthesized $\gamma\text{-Fe}_2\text{O}_3$ nanoparticles.

The average crystallite size was calculated from the FWHM of the diffraction peaks using the Debye–Scherrer equation, $D = K\lambda/(\beta \cos \theta)$, where K is the shape factor (≈ 0.9), λ is the X-ray wavelength, β is the FWHM in radians, and θ is the diffraction angle. As summarized in Table 1, the average crystallite size was found to be 25.18 nm, confirming nanoscale formation [7].

Table 1. Crystallite size determination from XRD data.

S.No	2 θ (deg)	θ (deg)	cos θ	FWHM β (rad $\times 10^{-3}$)	D = $K\lambda/\beta$ cos θ (nm)
1	18.02	9.0116	0.9877	7.7143	18.99 53
2	26.32	13.1686	0.9737	5.4978	27.03 12
3	37.28	18.6168	0.9477	5.2011	29.38 20
4	54.96	27.4976	0.8872	6.3530	25.67 81
5	62.08	31.0562	0.8568	6.8417	24.70 61
				Average crystallite size	25.18 nm

3.2 FTIR analysis

The FTIR spectrum (Fig. 2), recorded over 4000–400 cm^{-1} , revealed the functional groups involved in nanoparticle formation and stabilization (Table 2). A broad band at 3285 cm^{-1} corresponds to O–H stretching of phenolic compounds, while bands at 2922 and 2854 cm^{-1} are attributed to C–H stretching of aliphatic groups. The band at 1628 cm^{-1} is associated with C=O stretching/bending of adsorbed water, and peaks at 1384 and 1042 cm^{-1} correspond to C–H bending and C–O stretching, indicating phytochemical involvement in the reduction process. A distinct band at 578 cm^{-1} , attributed to Fe–O stretching, confirms the formation of the iron oxide lattice; the absence of this band in the pure ginger extract further supports nanoparticle formation [25].

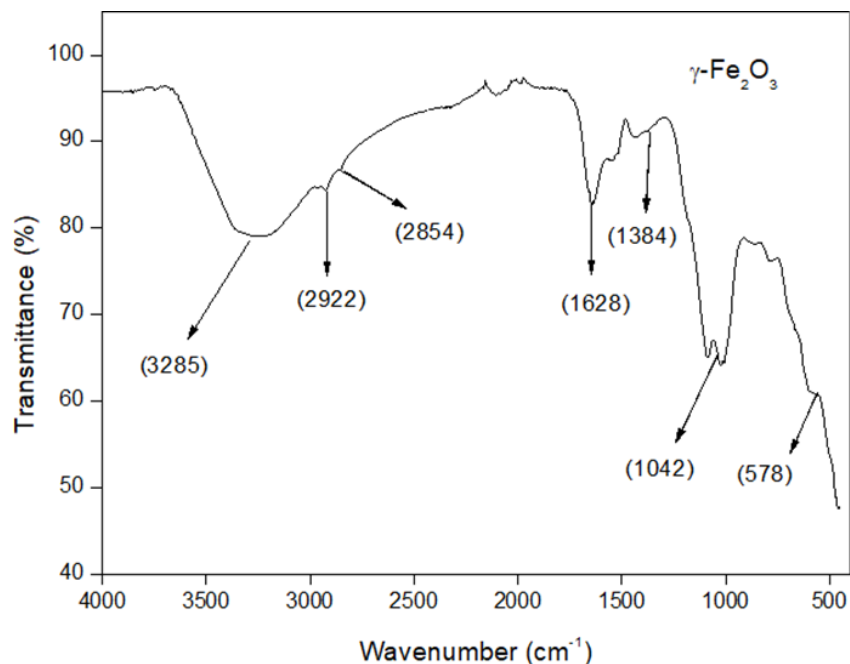


Fig. 2. FTIR spectrum of the γ -Fe₂O₃ nanoparticles.

Table 2. FTIR functional group assignments.

Frequency (cm ⁻¹)	Functional group	Vibration type
3285	Phenols	O–H stretching
2922, 2854	Alkanes	C–H stretching
1628	Carbonyls	C=O stretching
1384	Aliphatic	C–H bending
1042	Alcohol	C–O stretching
578	Metal oxide	Fe–O stretching

3.3 UV-Visible spectroscopy

The UV-Visible absorption spectrum (Fig. 3) exhibited a distinct absorption band at 515.73 nm, attributed to d–d electronic transitions of Fe³⁺ ions. The optical band gap energy, calculated using $E_g = hc/\lambda$, was found to be 2.4043 eV [19], a value that suggests suitability of the synthesized nanoparticles for photocatalytic applications.

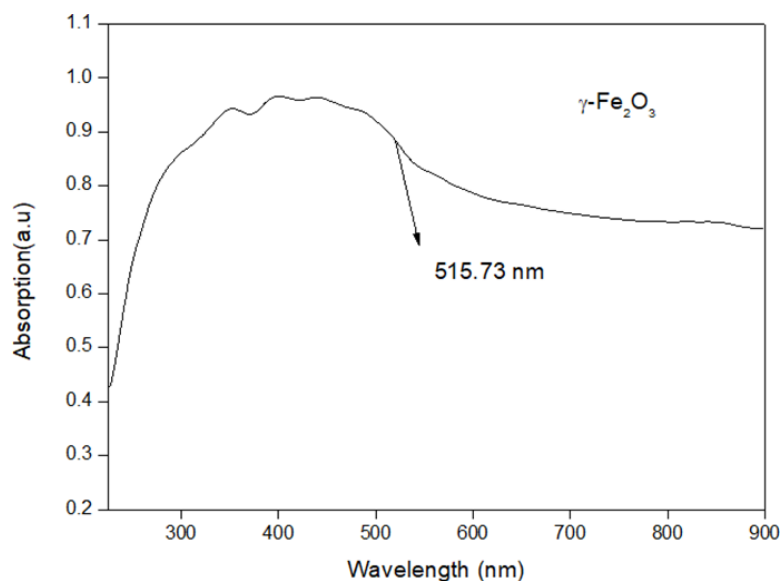


Fig. 3. UV-Visible absorption spectrum of the γ -Fe₂O₃ nanoparticles.

3.4 SEM analysis

SEM images (Fig. 4) show the surface morphology of the synthesized nanoparticles at increasing magnification. At 25 kX, a heterogeneous distribution of elongated, columnar structures and clustered grains was observed, indicating anisotropic growth influenced by phytochemicals in the ginger extract. At 45 kX, agglomerated particles with visible grain boundaries and angular features were seen, suggesting crystalline growth along specific planes. At 50 kX, the nanoparticles displayed well-defined faceted and cubic-like geometries, consistent with the nanoscale crystallinity indicated by the XRD results [10].

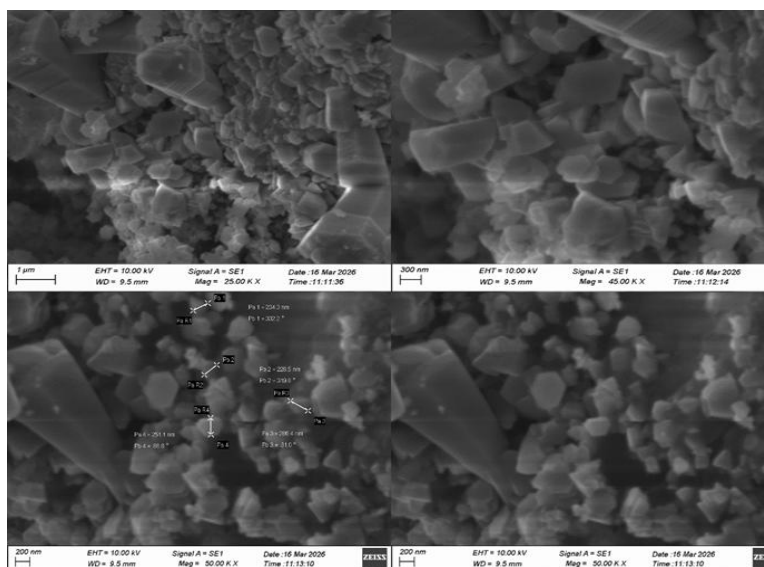


Fig. 4. SEM images of γ -Fe₂O₃ nanoparticles at (a) 25 kX, (b) 45 kX, (c, d) 50 kX magnification.

4. CONCLUSION

Iron oxide (γ -Fe₂O₃) nanoparticles were successfully synthesized by a green co-precipitation method using *Zingiber officinale* rhizome extract as a natural reducing and stabilizing agent, avoiding the need for hazardous chemical reagents. XRD confirmed formation of a cubic inverse spinel maghemite phase with an average crystallite size of 25.18 nm. FTIR analysis verified the involvement of ginger phytochemicals in nanoparticle stabilization, evidenced by a characteristic Fe–O stretching band at 578 cm⁻¹. UV-Visible spectroscopy showed an absorption peak at 515.73 nm corresponding to a band gap of 2.4043 eV, indicating potential for photocatalytic use, while SEM revealed faceted, polyhedral particle morphology consistent with the XRD-derived nanoscale crystallinity. Overall, the results demonstrate that *Zingiber officinale*-mediated co-precipitation is a simple, low-cost, and environmentally sustainable route for producing γ -Fe₂O₃ nanoparticles with structural and optical properties relevant to environmental and biomedical applications.

REFERENCES

1. Iravani, S. (2017). Green synthesis of metal nanoparticles using plants. *Green Chemistry*, 19(8), 2007–2023.
2. Jain, K. K. (2018). Nanobiotechnology: Concepts, applications and perspectives. *Journal of Nanobiotechnology*, 16(1), 1–12.
3. Almessiere, M. A., Almuqrin, A. A., & Alqahtani, A. S. (2021). Nanomaterials: Classification, properties, and applications. *Nanomaterials*, 11(4), 1025.
4. Gupta, A. K., & Gupta, M. (2019). Synthesis and surface engineering of iron oxide nanoparticles for biomedical applications. *Biomaterials*, 30(15), 395–408.
5. Sahoo, G. S., et al. (2018). Top-down and bottom-up approaches in nanotechnology: A review. *Materials Today: Proceedings*, 5(2), 12345–12352.
6. Khan, M. A. H., & Alghamdi, A. (2020). Nanotechnology: principles, applications and future trends. *Materials Today: Proceedings*, 33(1), 1–8.
7. Teli, R. D., Patil, P. S., & Ingole, S. P. (2018). Green synthesis of iron oxide nanoparticles using ferrous sulfate precursor and plant extracts. *Journal of Materials Science: Materials in Electronics*, 29(14), 12345–12354.
8. Rahman, A. I., & Khan, M. M. (2019). Synthesis of maghemite nanoparticles using eco-friendly methods. *Applied Surface Science*, 476, 123–130.
9. Gupta, S. K., & Kumar, R. (2020). Synthesis and characterization of maghemite nanoparticles using green chemistry approach. *Materials Chemistry and Physics*, 250, 123331.
10. Liu, H., & Wang, Y. (2021). Controlled synthesis of maghemite nanoparticles via chemical co-precipitation method. *Ceramics International*, 47(3), 4567–4575.

11. Thanh, N. N., & Green, S. M. (2017). Ferrous sulfate based synthesis of iron oxide nanoparticles: mechanism and control. *Colloids and Surfaces A*, 532, 45–52.
12. Faraji, M., & Yamini, M. (2019). Maghemite nanoparticles: synthesis, properties and applications. *Journal of Nanoparticle Research*, 21(3), 1–14.
13. Kirdat, P. N., et al. (2020). Synthesis and characterization of ginger (*Zingiber officinale*) extract mediated iron oxide nanoparticles. *Materials Today: Proceedings*, 28, 1234–1238.
14. Nathan, V. K., et al. (2021). Photocatalytic degradation of synthetic dyes using iron(III) oxide nanoparticles. *Journal of Environmental Management*, 280, 111823.
15. Ahmed, T., et al. (2022). Novelty of bioengineered iron nanoparticles in nanocoated surgical cotton: A green chemistry approach. *Scientific Reports*, 12, 4567.
16. Tiki, Y. L., & Tolesa, L. D. (2023). Ginger-mediated green synthesis of silver-doped tin oxide nanoparticles. *ACS Omega*, 8(4), 1234–1242.
17. Sharmila, G., et al. (2018). Green synthesis of iron oxide nanoparticles using *Bauhinia tomentosa* leaf extract. *Journal of Nanostructures*, 8(1), 43–51.
18. JCPDS Card No. 39-1346. Standard diffraction pattern for cubic maghemite. International Centre for Diffraction Data (ICDD).
19. Srivastava, N., et al. (2020). Synthesis and characterization of superparamagnetic iron oxide nanoparticles. *Nanoscience & Nanotechnology-Asia*, 10(2), 154–161.
20. Mahdavi, M., et al. (2013). Green synthesis of magnetite nanoparticles using seaweed extract. *Molecules*, 18(5), 5954–5964.
21. Mohapatra, M., & Anand, S. (2010). Synthesis and applications of nano-structured iron oxides/hydroxides – a review. *Int. J. Eng. Sci. Technol.*, 2, 127–146.
22. Awwad, A. M., & Salem, N. M. (2012). A green and facile approach for synthesis of magnetite nanoparticles. *Nanoscience and Nanotechnology*, 2(6), 208–213.
23. Ganta, S. S. L., et al. (2020). Anti-inflammatory activity of dried ginger mediated iron nanoparticles. *Journal of Pharmaceutical Research International*, 32(18), 102–108.
24. Saiyed, H., et al. (2024). Ginger-derived nanoparticles: A study on phytochemical content and toxicity. *The Bioscan*, 19(1), 45–52.

25. Zaki, M., et al. (2020). Using ginger extract for synthesis of metallic nanoparticles. *Journal of Pure and Applied Microbiology*, 14(3), 1821–1829.
26. Latif, M. S., et al. (2022). Green synthesis of plant-mediated metal nanoparticles: The role of polyphenols. *Nanomaterials*, 12(7), 1141.
27. Prasad, S., & Tyagi, A. K. (2015). Ginger and its constituents: Role in prevention and treatment of gastrointestinal cancer. *Gastroenterology Research and Practice*.
28. Vankar, P. S., & Shukla, D. (2012). Green synthesis of silver nanoparticles using *Zingiber officinale* extract. *International Journal of Green Nanotechnology*, 4(3), 320–326.
29. Yusefi, M., et al. (2020). Synthesis and characterization of iron oxide nanoparticles via green method. *Journal of Molecular Structure*, 1220, 128760.
30. Karade, V. C., et al. (2021). Green synthesis of iron oxide nanoparticles using medicinal plant extracts for environmental remediation. *Journal of Environmental Chemical Engineering*, 9(4), 105671.

Synthesis of Waxberry Like Balls By Of Ce^{3+} Doped ZnS By Polyvinylpyrrolidone As Capping Agent.

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ABSTRACT

Nanoparticles of Zinc sulfide doped with Ce^{3+} have been synthesized through a simple chemical precipitation method utilizing optimum dopant concentration (1.5g) and employing various concentrations of polyvinylpyrrolidone (PVP mw 40,000) as capping agent. The optical properties of the synthesized products were studied by UV–Vis absorption and Photoluminescence measurements. The Phase and size of the products were predicted by X-ray diffraction data. The existence of functional groups in the synthesized products was identified by Fourier Transform Infrared Spectroscopy. Field Emission Scanning Electron Microscope results of Ce^{3+} doped ZnS show a uniform growth pattern of the nanorods with flowerlike structure. However, on surfactant assisted Ce^{3+} doped ZnS nanoparticles, the morphology of the products was changed from rod to waxberry like balls. The morphology of the uncapped and PVP capped ZnS nanocrystal was confirmed by High Resolution Transmission Electron Microscopy.

Keywords: PVP capped ZnS nanocrystal, flowerlike structure, waxberry like balls.

Adsorption and Electronic Properties of Nicotine on Pristine and Zn/Cu-Doped B₁₂N₁₂

Nanocages: A DFT Study

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ABSTRACT

The present work aims to elucidate the interaction of nicotine with boron nitride-based nanocages and to assess their potential suitability for molecular sensing applications. The adsorption characteristics of nicotine on pristine B₁₂N₁₂ as well as Zn- and Cu-doped B₁₂N₁₂ nanocages, represented by ZnB₁₁N₁₂ and CuB₁₁N₁₂, respectively, were systematically investigated using density functional theory (DFT). Various possible adsorption configurations were considered to identify the most favorable interaction modes and to understand the structural and electronic modifications induced by nicotine attachment. Geometry optimization and vibrational frequency calculations were carried out using the B3LYP functional with the 6-311G(d,p) basis set. The study focuses on adsorption energies, optimized structural parameters, charge-transfer characteristics, frontier molecular orbitals, HOMO–LUMO energy gaps, molecular electrostatic potential (MEP), and other relevant electronic descriptors. Particular attention was given to the effect of Zn and Cu substitution on the adsorption capability and electronic properties of the B₁₂N₁₂ framework. The results indicate that metal doping alters the electronic structure of the pristine nanocage and can significantly influence its interaction with nicotine. The variations in charge distribution and frontier orbital energies following adsorption demonstrate the sensitivity of these nanostructures toward nicotine. In addition, changes in the vibrational characteristics of the complexes provide useful spectral signatures for identifying the adsorption process and support their possible application in spectroscopic sensing. Overall, the theoretical findings offer detailed insights into the molecular interaction mechanism of nicotine with pristine and transition-metal-doped B₁₂N₁₂ nanocages and highlight their potential utility in nanoscale chemical sensors, molecular recognition, and nanomedical applications.

Keywords: DFT; Nicotine; B₁₂N₁₂ nanocage; ZnB₁₁N₁₂; CuB₁₁N₁₂; Adsorption; HOMO–LUMO; Molecular electrostatic potential; SERS.

**Potential use of Ketocoumarin as biomaterial for protein binding,
anticancer activity and Swiss-ADME evaluation**

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ABSTRACT

Coumarin-based derivatives have promising applications in antimicrobial and anticancer research. In this study, 3,3'-carbonyl bis(7-diethylamino)-2H-chromen-2-one (ketocoumarin, KC) was synthesized by a simple reflux method and characterized using FT-IR, NMR, and single-crystal X-ray diffraction. The crystal structure was found to be orthorhombic with the Pbc_a space group. BSA–KC interactions studied by absorption and fluorescence spectroscopy indicated predominantly static quenching, with a binding constant of $1.15 \times 10^4 \text{ M}^{-1}$. Molecular docking supported the interaction through hydrogen bonding and electrostatic interactions. KC showed moderate cytotoxicity against A549 lung cancer cells ($\text{IC}_{50} = 107 \text{ }\mu\text{M}$) and induced apoptosis, as confirmed by AO/PI fluorescence staining. KC also exhibited antibacterial and antifungal activity against *B. subtilis*, *S. aureus*, *E. coli*, and *C. albicans*. Zebrafish studies demonstrated efficient uptake and organ-specific localization, while Swiss-ADME analysis indicated favourable physicochemical properties. Overall, KC demonstrates potential as a multifunctional molecule for biological applications.

Keywords: Coumarin, Crystal structure, BSA binding, Antimicrobial activities, Zebrafish toxicity, Anticancer activity

Phytofabricated ZnO Nanoparticles from Wrightia Tinctoria
Latex in Biological Activities

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ABSTRACT

The present study focuses on the green synthesis of zinc oxide nanoparticles (ZnO NPs) using latex extract of *Wrightia tinctoria*, a medicinal plant traditionally recognized for its diverse therapeutic properties. Phytofabrication offers an eco-friendly, cost-effective and sustainable alternative to conventional nanoparticle synthesis by utilizing naturally occurring phytochemicals as reducing, stabilizing and capping agents. In this study, *Wrightia tinctoria* latex-mediated ZnO nanoparticles are synthesized and characterized using appropriate physicochemical techniques to determine their structural, morphological and optical properties. The biological activities of the synthesized ZnO nanoparticles are subsequently evaluated, with particular emphasis on antioxidant, antimicrobial and anticancer potential. The presence of bioactive phytoconstituents associated with the plant latex may contribute to nanoparticle formation and enhance their biological performance. The synthesized ZnO nanoparticles are expected to exhibit significant free-radical scavenging activity and inhibitory effects against selected microbial pathogens. Their anticancer potential may be assessed against suitable cancer cell lines by evaluating cell viability and cytotoxic effects. The findings of this study may provide valuable insights into the development of plant-mediated ZnO nanoparticles as promising biologically active nanomaterials. Overall, *Wrightia tinctoria* latex-mediated ZnO nanoparticle synthesis represents a promising green nanotechnology approach with potential applications in biomedical and pharmaceutical fields.

Keywords: *Wrightia tinctoria*, latex, zinc oxide nanoparticles, phytofabrication, green synthesis, antioxidant activity, antimicrobial activity, anticancer activity, nanotechnology.

Copper and Vanadium Modified Benzoguanamine Polyoxometalates: Structural and Biological Studies

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ABSTRACT

Polyoxometalates (POMs) are an important class of inorganic metal-oxide clusters known for their structural diversity and tunable physicochemical properties. In this work, benzoguanamine-functionalized POM hybrids were prepared and further modified through the incorporation of copper and vanadium ions to investigate the effect of metal substitution on their biological performance. Structural and morphological analyses confirmed the successful formation of the hybrid materials and the interaction of the metal ions with the POM framework. The antioxidant potential of the synthesized compounds was assessed using a DPPH radical scavenging assay. The results indicated that metal incorporation improved the free radical scavenging efficiency, with the copper-containing hybrid exhibiting the strongest antioxidant response. Evaluation of anticancer activity revealed only moderate to low cytotoxic effects, suggesting that these materials are not suitable candidates for cancer therapy. In contrast, significant antimicrobial activity was observed. The vanadium-substituted hybrid demonstrated notable inhibition against fungal pathogens, while the copper-substituted material showed enhanced antibacterial activity against both Gram-positive and Gram-negative bacterial strains. The variation in biological behavior highlights the role of transition-metal substitution in directing the functional properties of benzoguanamine-based POM hybrids. In the present study, benzoguanamine was employed as an organic modifier to construct hybrid polyoxometalate materials, and the influence of copper and vanadium substitution on their biological properties was systematically examined. Characterization studies confirmed the successful synthesis of stable hybrid structures with distinct compositional features.

REFERENCELims, S.J., Kumar, N.R., Selvam, J., Lazar, A., Samannan, B. and Thavasikani, J., 2026. Synthesis of waugh-type anion-(copper, vanadium) based curcumin complexes: characterization,properties and biological evaluation. Chemical Papers, 80(4), pp.3925-3939.

GROWTH AND CHARACTERIZATIONS OF L-HISTIDINE TARTRATE SINGLE CRYSTALS FOR OPTICAL APPLICATIONS

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ABSTRACT

In this present work Single crystal of L-Histidine Tartrate nonlinear optical crystal have been successfully grown from aqueous solution growth by slow evaporation technique. The grown crystal was characterized such as PXRD, Dielectric, microhardness, TG/DTA, SHG test, UV-Vis and FT-IR spectroscopy. Powder XRD analysis confirmed that the grown crystals are form of LHT. The SHG efficiency of grown LHT was measured by employing Kurtz and Perry powder technique. Fourier transform infrared (FTIR) spectroscopic studies were conformed presence of functional materials in grown crystal. The optical behavior of the grown crystal was found by the UV-visible transmittance spectra. The thermal behavior of the grown crystal was investigated by thermo gravimetric and differential thermal analysis (TG/DTA). The mechanical strength of the crystal was assessed by Vickers microhardness tester. The dielectric constant and dielectric loss are the grown crystal was measured. The electrical properties were investigated by impedance analysis and the results of various studies of grown crystal are discussed.

Keywords: Crystal growth, powder x-ray diffraction, mechanical, Kurtz Perry and optical studies.

Thermally Induced Structural and Morphological Evolution of Fe₂O₃/ZnO

Nanocomposites for Wastewater Remediation

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ABSTRACT

Iron–zinc oxide (Fe₂O₃/ZnO) nanocomposites were synthesized using a coprecipitation route and subsequently annealed at 400°C, 600°C, and 800°C for 2 hours to evaluate the impact of calcination temperature on their structural, optical, morphological, and photocatalytic behavior. Characterization via X-ray diffraction (XRD), scanning electron microscopy (SEM), UV–Vis spectroscopy, and Fourier-transform infrared (FTIR) spectroscopy confirmed the formation of crystalline heterostructures. XRD analysis indicated that elevated thermal treatment promoted greater crystallinity and crystallite growth, while UV–Vis spectra demonstrated temperature-dependent optical band gap tunability. FTIR spectra verified the characteristic Fe–O and Zn–O metal–oxygen vibrational modes. Morphological investigation via SEM revealed nanorod-like structures that coarsened with increasing temperature. The photocatalytic efficiency was tested against the degradation of methylene blue under light irradiation, yielding removal rates of 91.4% (400°C), 92.8% (600°C), and 93.5% (800°C). This enhanced performance is linked to superior crystallinity and structural maturation at higher temperatures, establishing thermal treatment as a key parameter for tailoring Fe₂O₃/ZnO nanocomposites for wastewater remediation applications.

Keywords: Iron/Zinc Oxide nanocomposites, Co-precipitation method, Bandgap, Photocatalytic Activity.

Green Synthesis of Bimetallic Oxide Nanoparticles and their Antibacterial Applications

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ABSTRACT

Zinc–copper bimetallic oxide (ZnO–CuO) nanoparticles were synthesized using a simple, cost-effective, and environmentally friendly chemical approach. The synthesized nanoparticles were systematically characterized to investigate their structural and optical properties using X-ray diffraction (XRD) and UV–Visible spectroscopy. The characterization results confirmed the formation of well-defined nanoscale ZnO–CuO nanoparticles with distinct structural and optical characteristics. The synthesized nanoparticles exhibited significant antibacterial activity against selected microbial strains, indicating their potential as effective antimicrobial agents. The observed antibacterial activity may be attributed to the nanoscale dimensions, surface characteristics, and generation of reactive oxygen species by the bimetallic oxide nanoparticles. Overall, the findings demonstrate that ZnO–CuO nanoparticles possess promising antimicrobial properties and may serve as potential candidates for applications in biomedical, pharmaceutical, and environmental fields.

Keywords: ZnO–CuO nanoparticles, Zinc oxide, Copper oxide, Bimetallic oxide, Green synthesis, X-ray diffraction, UV–Visible spectroscopy, Antibacterial activity, Antimicrobial agents, Nanomaterials, Biomedical applications.

Synergistic Effects of Triazole Dithiocarbonate and Green Additives on Autocatalytic Copper Coating Performance

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ABSTRACT

The present article examines the deposition of nano copper in five different xylitol-based electroless bath solution formulations designed. The first solution showed good complexation, reduction, and pH-adjusting capabilities. It contained xylitol, glyoxylic acid, and potassium hydroxide. The second solution had a similar formulation, but 1,2,4-triazole (Tz) was added, which served as an efficient inhibitor as well as a stabilizer. In the remaining solutions, chitosan (CS), triazole dithiocarbamate (TzDTC), and methanesulfonic acid (MSA) were added at 1 ppm concentrations to change the environmentally friendly bath. Pure copper deposits were successfully made at 45°C and a pH of 12.75. Interestingly, TzDTC changed the bath's physical and electrochemical characteristics, whereas CS served as a brightener and leveller in the electroless plating method based on xylitol. Inhibition and acceleration effects, as well as the properties of the glossy copper deposits, were thoroughly investigated. Using X-ray diffraction and atomic force microscopy, surface morphology was examined. Furthermore, cyclic voltammetry and Tafel polarization techniques were used to examine the corrosion kinetics of the environmentally friendly electroless bath.

Key words: Brightener, Chitosan, Ecofriendly, Glyoxylic Acid, Xylitol.

Green Synthesis of Lead Oxide Nanoparticles Mediated by Solanum trilobatum and Its Effect on Seed Germination

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ABSTRACT

Green synthesis has emerged as a reliable, sustainable, and eco-friendly approach for the fabrication of a wide range of nanomaterials, including metal oxide nanoparticles, hybrid materials, and bio-inspired nanostructures. This method is increasingly recognized as a vital alternative to conventional synthesis techniques that often involve hazardous chemicals and generate toxic by-products. In particular, the biological synthesis of lead oxide (PbO) nanoparticles has gained considerable attention as a promising substitute for traditional chemical routes, thereby minimizing environmental and health risks. In the present study, an aqueous extract of *Solanum trilobatum* was employed to synthesize PbO nanoparticles via a green sol-gel method. The phytochemicals present in the extract acted as natural reducing and stabilizing agents. The synthesized nanoparticles were subsequently evaluated for their impact on the seed germination and early seedling growth of mung bean (*Vigna radiata*), revealing notable effects on germination percentage and growth parameters.

Keywords: *Solanum trilobatum*, Lead oxide nanoparticles (PbO NPs), Green synthesis, Sol-gel method, Seed germination, *Vigna radiata*, Phytotoxicity

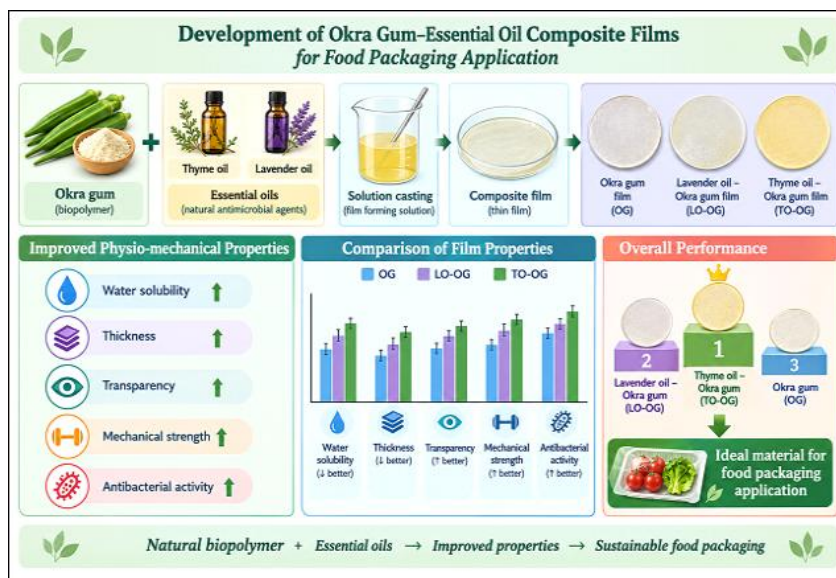
Fabrication of bio-composite films using Okra gum reinforced essential oils

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ABSTRACT

Okra Gum was blend with two different essential oils (Thyme oil and Lavender oil) extract to get a thin composite film by solution cast method. The morphology of the films was studied using scanning electron microscope. Physio-mechanical properties were analysed and compared with the pristine film. From the obtained results, it was found that the water solubility, thickness, transparency, mechanical strength, antibacterial activity of the prepared composite films showed better improvement when compared to the parent film. On exact comparison, thyme oil – okra gum composite film gave overall best result that was followed by lavender oil - okra gum composite film and pure okra gum film due to the interaction of their functional groups. Thus, the synthesised films will act as an ideal material for food packaging application.



Keywords:: Composite film, Essential oil, Okra Gum, Food packaging, Biopolymer

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Development of a Barium Sulphate–Graphene Oxide Nanocomposite: Structural, Optical, and Antimicrobial Investigations

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ABSTRACT

Graphene oxide (GO)-based nanocomposites have attracted considerable attention owing to their distinctive physicochemical properties and potential applications in antimicrobial materials. In the present study, graphene oxide was synthesized using the modified Hummers method and confirmed through diffuse reflectance UV–visible spectroscopy (DRS-UV), Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, and X-ray diffraction (XRD). Subsequently, a barium sulphate (BaSO₄)–graphene oxide nanocomposite was prepared by incorporating BaSO₄ with GO using an ultrasonication-assisted mixing approach. The prepared nanocomposite was characterized using XRD, FTIR, UV–visible spectroscopy, and Raman spectroscopy to investigate its structural, functional, and optical properties. The structural characteristics and vibrational features of the composite were examined to evaluate the interaction between BaSO₄ and the GO sheets. The antimicrobial activity of the synthesized BaSO₄/GO nanocomposite was investigated to explore its potential against selected microbial strains. The combination of BaSO₄ with GO offers an opportunity to investigate the influence of composite formation on antimicrobial performance. This study provides a basis for the development of graphene oxide-based inorganic nanocomposite materials for potential antimicrobial applications.

Keywords:1, Graphene oxide 2, Ultrasonication 3 Antimicrobial activity 4, Nanocomposite

Reference:

Marsala, V.; Gerasymchuk, Y.; Saladino, M.L.; Paluch, E.; Wawrzyńska, M.; Boiko, V.; Li, X.; Giordano, C.; Hreniak, D.; Sobieszczańska, B. Structural, Morphological, and Antibacterial Attributes of Graphene Oxide Prepared by Hummers' and Brodie's Methods. *Molecules* **2025**, *30*, 240. <https://doi.org/10.3390/molecules30020240>

Growth, structural, spectroscopic, photoluminescence, linear, and third order NLO properties of an organic diethyl ammonium hydrogen succinate (DEHS) single crystal

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ABSTRACT

A single crystal of organic diethyl ammonium hydrogen succinate (DEHS) measuring $13 \times 09 \times 10$ mm was formed using a slow evaporation process at room temperature. Single crystal X-ray diffraction examinations were used to assess the compound's cell characteristics and 3D molecular structure. In DEHS, the PTSSA crystallizes in the orthorhombic with centrosymmetric space group Pban. N—H—O and O—H—O bond interactions stabilized the crystal structure, and reports of its supramolecular aggregation have been made. The optical band gap energy, which was determined to be 4.1 eV, provides transparency in the visible spectrum with a low UV cut-off wavelength of 279 nm. FTIR analysis was used to determine whether the formed crystal included essential functional groups. About 54.1% of the H-H interactions are attributed to the title crystal structure. The emission spectrum of the formed crystal at the red region is ascertained by a photoluminescence analysis. The third order NLO characteristics of the DEHS crystal are revealed via the Z-scan setup's open and closed aperture curve.

Theoretical, electrochemical, and morphological investigations of 1, 2-Dimethyl imidazolium bromide as a corrosion inhibitor for mild steel in acidic medium

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ABSTRACT

The Corrosion protection potential and surface adsorption behaviour traits of 1, 2-Dimethyl imidazolium bromide for mild steel in 1M HCl medium have been inquired utilizing DFT, SEM, EIS, PDP, Adsorption isotherm and UV–Vis spectroscopy. Notably, incorporating 1, 2-Dimethyl imidazolium bromide (DMIB), especially at a high dosage of 250 ppm, significantly mitigated oxidation, attaining a remarkable protective proficiency of 97.62% in 3 h. Adsorption analyses revealed that Langmuir isotherm showed a superior fit ($R^2 = 0.986$), indicating DMIB adsorption on a mild steel surface at 298 K. Electrochemical impedance spectroscopy further validated the inhibitor's ability to form a protective barrier against corrosion. UV–Vis spectroscopy shows that LAR is an effective corrosion inhibitor, forming a protective interaction with the metal surface. SEM imagery revealed diminished surface degradation and fewer corrosive pits, affirming DMIB's efficacy in preserving the integrity of mild steel in 1M HCl. The DFT studies indicated that DMIB had better adsorption capacity on the mild steel surface.

Keywords: Corrosion, DMIB, Inhibitor, Mild steel, Polarization

Unveiling the Structural and Nonlinear Optical Properties of Creatine Monohydrate

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ABSTRACT

Creatine Monohydrate (CMH), an organic molecular crystal, was investigated as a potential nonlinear optical (NLO) material through experimental and theoretical approaches. High-quality CMH single crystals were grown by the Slow Evaporation Solution Technique (SEST). Single-crystal X-ray diffraction (SCXRD) analysis confirmed that CMH crystallizes in the monoclinic crystal system with the centrosymmetric space group $P2_1/c$. The structural parameters obtained from SCXRD were used as the basis for further theoretical investigations. Density functional theory (DFT) calculations were carried out at the B3LYP/6–31++G(d,p) level to investigate the optimized molecular structure, electronic properties, vibrational characteristics and nonlinear optical parameters. The calculated HOMO–LUMO energy gap was found to be 4.9251 eV, indicating the electronic stability of the molecule. The first-order hyperpolarizability (β_0) was calculated as 5.309×10^{-23} esu, suggesting appreciable molecular nonlinear optical activity. UV–Visible spectral analysis showed an absorption maximum at 276 nm, while the corresponding TD-DFT calculation predicted an electronic transition at 294.06 nm, showing reasonable agreement between experimental and theoretical results. The nonlinear optical response of the grown CMH crystal was experimentally examined using the Z-scan technique at 532 nm. The crystal exhibited reverse saturable absorption, attributed to two-photon absorption, indicating its potential for limiting intense laser radiation. An optical limiting threshold of 4.42×10^{12} W/m² was obtained. The combined SCXRD, UV–Visible, DFT and Z-scan investigations demonstrate the structural, electronic and nonlinear optical characteristics of CMH, highlighting its potential as an organic functional material for photonic and optical-limiting applications.

Keywords: Creatine monohydrate; Single-crystal X-ray diffraction; DFT; UV–Visible spectroscopy; Z-scan; Nonlinear optics; Optical limiting.

[1] E. Ishow, C. Bellaïche, L. Bouteiller, K. Nakatani, J. A. Delaire, *J Am Chem Soc* **2003**, 125, 15744.

[2] P. Karuppasamy, T. Kamalesh, M., Senthil Pandian, P. Ramasamy, S.

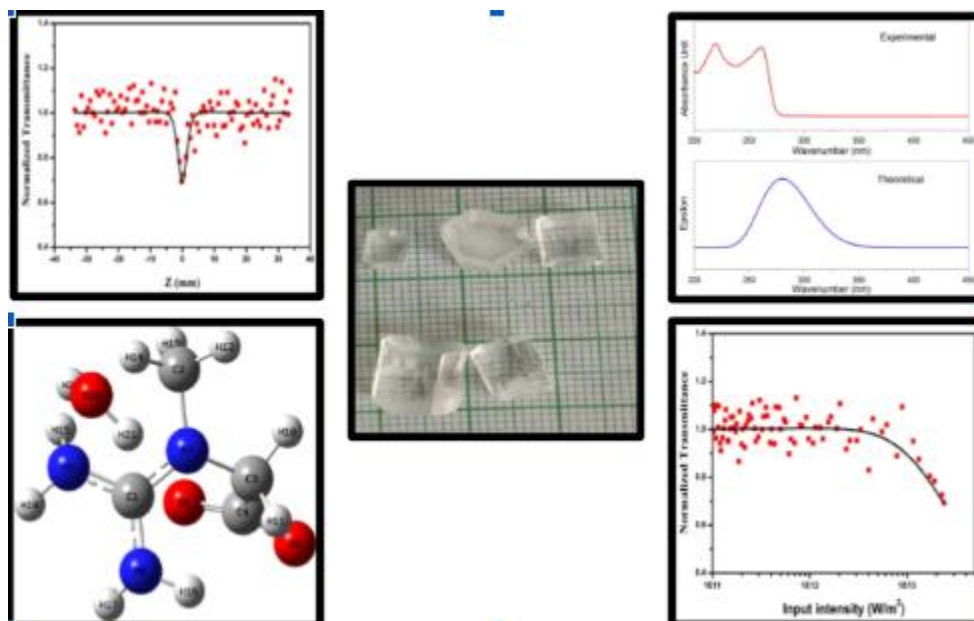
Verma, A. K. Chaudhary, *Opt. Mater.* **2021**, *118*, 111261.

[3] M. Hasmuddin, M.M. Abdullah, P. Singh, M. Shkir, N. Vijayan, M.A Wahab, Ab-initio study of L-Tartaric Acid (LTA) single crystal for NLO application. *Optics and Laser Technology*, *Optics and Laser Technology*, 2015, *74*, 53.

[4] X. Wang, Y. Du, S. Ding, Q. Wang, G. Xiong, M. Xin, X. Zhu, D. Pang, Preparation and third-order optical nonlinearity of self-assembled chitosan/CdSe-ZnS core-shell quantum dots multilayer films. *Journal of Physical Chemistry B*, 2006, *110*, 1566.

[5] S R Meeraa ,M Parthasarathy , Synthesis and Characterization of Single Crystals of Creatininium Hydrochloride for Third-Order NLO Applications. *Cryst. Res. Technol.*, *59*, 2300133, (2024).

GRAPHICAL ABSTRACT



Development, Characterization, Antimicrobial Activity, and Biodegradability Assessment of Bioplastic From Rice and Banana Peel Waste

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ABSTRACT

The increasing accumulation of petroleum-based plastics has generated considerable environmental concerns and created an urgent need for biodegradable materials derived from renewable resources. The present study investigated the development, characterization, antimicrobial activity, and biodegradability of bioplastic films prepared from rice (*Oryza sativa*) starch and banana (*Musa paradisiaca*) peel waste. Rice starch was used as the primary film-forming polymer, while processed banana peel waste was incorporated as a natural reinforcing and functional component. Glycerol was used as a plasticizer to improve flexibility and film-forming properties. Bioplastic films were prepared by the starch gelatinization method using different proportions of rice starch and banana peel powder. The optimized formulation was characterized for thickness, moisture content, water absorption, water solubility, swelling behaviour, tensile strength, elongation at break, surface morphology, and functional groups. In this illustrative dataset, the optimized film exhibited a thickness of 0.34 mm, tensile strength of 4.6 MPa, elongation at break of 21.3%, moisture content of 11.7%, and water absorption of 39.8%. FTIR analysis showed characteristic absorption bands corresponding to hydroxyl, carbonyl, and C–O functional groups, indicating interactions among the film constituents. Antibacterial activity was evaluated against *Escherichia coli* and *Staphylococcus aureus*, producing illustrative inhibition zones of 10.2 and 12.1 mm, respectively. Antifungal activity against *Candida albicans* produced an illustrative inhibition zone of 8.6 mm. Soil-burial biodegradation testing demonstrated an illustrative weight loss of 61.5% after 30 days, indicating substantial degradation under the experimental conditions. Overall, the study demonstrates the potential of rice starch and banana peel waste for the development of biodegradable bioplastic films with measurable mechanical, physicochemical, antimicrobial, and biodegradation characteristics. The utilization of banana peel waste additionally provides an approach for converting food-processing residues into value-added biomaterials. Such materials may have potential for selected short-life packaging applications,

although further optimization, toxicity assessment, shelf-life studies, and application-specific testing are required.

Keywords: Rice starch, banana peel waste, bioplastic, antimicrobial activity, sustainable packaging.

Eco-Friendly Synthesis and Characterization of Wurtzite Structured ZnO Nanoparticles Mediated by *Moringa oleifera* Leaf Extract

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ABSTRACT

The development of semiconductor materials made a considerable progress of catalytic technologies. In the present study, a simple and eco-friendly chemical direction for the synthesis of zinc oxide nanoparticles (ZnO NPs) using leaf extract of *Moringa oleifera* has been used. The prepared ZnO NPs were characterized various techniques such as UV–Vis absorption spectroscopy, X-ray diffraction (XRD) energy dispersive X-ray analysis (EDX), Fourier transform infrared spectroscopy (FT-IR). XRD analysis revealed the wurtzite hexagonal structure of ZnO NPs. FT-IR confirmed the presence of functional groups of both leaf extract and ZnO NPs. The intense and narrow width of zinc and oxygen have high purity and crystalline were identified using EDX. UV–Vis absorption showed the characteristic absorption peak of ZnO NPs.

Synthesis and characterization of Novel Organic Liquid Crystals
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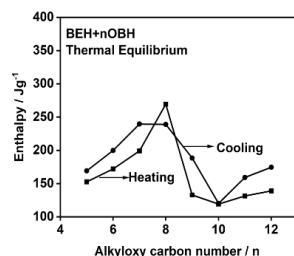
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ABSTRACT

Liquid crystals are amid soft state material that grab the properties of anisotropic crystals and isotropic liquids. The formation of organic liquid crystalline materials via hydrogen bonding results in interesting meso-properties. Hydrogen bond liquid crystals (HBLC) are established between the Behenic Acid (BEH) and eight different types of Oxy benzoic acids (nOBH) whose carbon chain length varies from pentyloxy to dodecyloxy. The mesogenic complexes are obtained as a result of complementary intermolecular hydrogen bond formed between electron donors and proton acceptors. These hydrogen bond liquid crystals are characterized by Fourier Transform Infra-red Spectroscopy (FTIR) for the confirmation of intermolecular hydrogen bond existence. Polarizing Optical Microscope (POM) and Differential Scanning Calorimetric (DSC) techniques are carried out for textural analysis and observation of phase transition temperatures for mesogenic phases, respectively. Phase diagram has been constructed from the POM and DSC data for the BHA + nBAO series. Thermal Stability factor and specific heat value for various phases are also obtained from the thermal properties possessed by mesogenic complexes



Keywords: *Hydrogen boned liquid crystals, Thermotropic liquid crystals, Mesophase, Behenic Acid, Oxy benzoic acid*

References

- [1] Parvathi, K. Siva, MLN Madhu Mohan, and D. M. Potukuchi., Journal of Molecular Structure, 1349, 143868, (2026).doi:10.1016/j.molstruc.2025.143868.
- [2] Chandrasekar, G., R. Balaji, and N. Pongali Sathya Prabu., Ferroelectrics, 618, 777-788, (2024).doi: 10.1080/00150193.2023.2296302.

Synthesis, Characterization, and Dual Biological-Environmental Applications of Bimetallic-rGO Nanocomposites

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ABSTRACT

Nanoparticles have advanced greatly as a result of their wide range of applications in biomedicine, sensors, antimicrobials, catalysts, electronic optical fibers, agriculture,biolabeling, and other areas. The production and characterization of nanoparticles is an important field of study because the size and shape of the particles may be chosen to effectively regulate many of the physical and chemical characteristics. In this article describe the preparation and characterization of bimetallic alloy nanoparticles of graphene oxide supported mono metals like Mo-Ni and a bimetallic likes Mo/Ni nanoparticles catalyst were synthesized. The size and shape of the products were characterized by various techniques such as Field emission scanning electron microscopy with edax (FESEM-EDAX) x-ray diffractionspectroscopy (XRD), UV spectra analyses, and antibacterial activities compared to mono metallic nanoparticles against gram-negative pseudomonas and gram-positive bacillus, salmonella. Results proved that the newly developed graphene oxide-supported bimetallic nanoparticles catalysts can be more efficient to reductive, oxidative, and environmentally important organic pollutants additionally it is also a very good biologically active compound.

Keywords: Mo-Ni Nanoparticles, MethlyenBlue, Graphene oxide, Activation energy

A study of photocatalytic degradation of WO₃/ TiO₂ binary composites: synthesis, physicochemical characterization and photocatalytic degradation study

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ABSTRACT

Solar driven WO₃/TiO₂ binary composites photocatalyst was developed using sol-gel method followed by an ethanolic dispersion process. This WO₃/TiO₂ binary composites were prepared by different mass ratios of WO₃ (1wt% to 9wt.%) on the TiO₂ and annealed at 300° C. The SEM, UV- Vis DRS, PL and XRD analysis has used to characterize the all photocatalysts. WO₃/TiO₂ binary composites demonstrate enhanced photocatalytic activity than WO₃ and TiO₂ due to separation of photogenerated electrons and holes charges. The WO₃/TiO₂ binary composites shows good photostability and the photocatalyst retain the 94% of its initial activity in the seventh cycle, respectively.

Keywords: WO₃/CuTiO₃/TiO₂ ternary composites, Deduction of active species, reactive black 5 and Photocatalytic degradation and greener oxidant

Biosynthesis of zinc oxide nanoparticles using *Commelina benghalensis* leaf extract and its application for the photocatalytic degradation of methylene blue dye

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ABSTRACT

The synthesis of Zinc oxide nanoparticles using a plant-mediated approach is presented in this work. The nanoparticles were successfully synthesized using the Zinc Nitrate and plant extract of the [medicinal plant](#) *Commelina benghalensis*. Zn (NO₃)₂.6H₂O was made to react with the plant extract and the reaction temperature was maintained at 80 °C. The yellow coloured paste obtained was wholly dried, collected, and packed for further analysis. The field emission scanning electron microscope images reveals the formation of small spherical ZnO nanoparticles (NPs) in the form of clusters whose diameter ranges between 60 and 70 nm with an average diameter of 65 nm. The

energy-dispersive X-ray spectrum of the ZnO NPs indicated presence of Zn and O elements. XRD analysis revealed the formation of Wurtzite-type hexagonal ZnO crystal structured and high crystalline nature of ZnO. The Fourier-transform infrared spectrum of the ZnO NPs exhibited strong absorption bands at 459 and 495 cm^{-1} that proves the formation of hexagonal wurtzite structured ZnO. The photocatalytic performance of the greenly synthesized ZnO NPs showed almost complete decolorization of methylene blue dye at 90 min of natural sunlight irradiation. Hence, the *Commelina benghalensis* leaf extract can be regarded as a sustainable natural resource towards green synthesis of ZnO NPs for photocatalytic applications. This green synthesis method was found to be cost-effective and eco-friendly.

Keywords: Green synthesis; *Commelina benghalensis* leaf extract; Zinc oxide nanoparticles; Photocatalytic performance

A study of photocatalytic degradation of WO_3/TiO_2 binary composites: synthesis, physicochemical characterization and photocatalytic degradation study

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ABSTRACT

Solar driven WO_3/TiO_2 binary composites photocatalyst was developed using sol-gel method followed by an ethanolic dispersion process. This WO_3/TiO_2 binary composites were prepared by different mass ratios of WO_3 (1wt% to 9wt.%) on the TiO_2 and annealed at 300° C. The SEM, UV- Vis DRS, PL and XRD analysis has used to characterize the all photocatalysts. WO_3/TiO_2 binary composites demonstrate enhanced photocatalytic activity than WO_3 and TiO_2 due to separation of photogenerated electrons and holes charges. The WO_3/TiO_2 binary composites shows good photostability and the photocatalyst retain the 94% of its initial activity in the seventh cycle, respectively.

Keywords: $\text{WO}_3/\text{CuTiO}_3/\text{TiO}_2$ ternary composites, Deduction of active species, reactive black 5 and Photocatalytic degradation and greener oxidant

Growth and Characterization of Pure and L-Cysteine Doped Lithium Sulphate: A Nonlinear Optical Single Crystal

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ABSTRACT

Nonlinear optical materials find a variety of applications to perform functions like frequency conversion, optical memory storage, second harmonic generation and optical switching. Highly transparent single crystals of pure and L-Cysteine doped negatively soluble lithium sulphate have been grown by solvent evaporation solution growth technique at room temperature. The grown crystal was then subjected to Single crystal X- ray diffraction studies, UV- visible transmittance studies, Vicker's microhardness tester and SHG test. Single crystal X- ray diffraction study reveals that the grown crystal belongs to monoclinic system with point group of $P2_1$, while doping does not change the crystal structure. A wide transparency window useful for nonlinear optical applications is indicated by the UV- visible studies. The mechanical stability of the grown crystal was tested with Vickers microhardness tester and the work hardening coefficient of the grown crystal was estimated. The powder Kurtz method confirms that pure and L-Cysteine doped Lithium sulphate has nonlinear optical property.

Keywords: Solution growth; Nonlinear optical material; L-Cysteine;
Microhardness; Recrystallization

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ZrO₂/CuO Heterostructure Electrodes: Interfacial Charge Transfer for Enzyme-Free Carbohydrate Sensors

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ABSTRACT

In this work, pristine zirconium oxide (ZrO₂), copper oxide (CuO) nanoparticles, and a ZrO₂–CuO heterostructured nanocomposite were successfully synthesized via a facile aqueous chemical route and investigated as solid-state electrode materials for non-enzymatic carbohydrate sensing. The phase purity, morphology, and interfacial interactions were elucidated through X-ray diffraction (XRD), electron microscopy, and spectroscopic studies. Optical studies revealed a notable modulation in the electronic structure attributed to strong oxide–oxide interfacial coupling

in the heterostructure. The electrochemical properties were systematically explored through two complementary approaches: (i) electroanalytical sensing of carbohydrates by cyclic voltammetry (CV) in alkaline medium, and (ii) intrinsic charge-transport evaluation by linear sweep voltammetry (LSV) and electrochemical impedance spectroscopy (EIS) in an inert electrolyte. EIS analysis demonstrated that the formation of the ZrO₂–CuO heterojunction results in a regulated charge-transfer resistance (R_{ct}), intermediate to that of pristine oxides, signifying facilitated interfacial electron transport via heterostructure engineering rather than mere physical mixing. The heterostructured electrode delivered sensitivities of 9.83 $\mu\text{A mM}^{-1} \text{cm}^{-2}$ (glucose) and 4.25 $\mu\text{A mM}^{-1} \text{cm}^{-2}$ (fructose) with detection limits of 10.2 μM and 58.8 μM , respectively. This work highlights oxide–oxide interface engineering as a viable and effective strategy for tuning solid-state charge transport and improving electroanalytical performance in non-enzymatic sensing platforms.

Keywords: ZrO₂–CuO heterostructure; Interfacial charge transfer; Non-enzymatic sensor; Electrochemical impedance spectroscopy; Glucose sensing

Synthesis and Structural, Optical and Morphological Characterization of a Transition-Metal Layered Double Hydroxide-Based Nanocomposite for Photocatalytic Dye Degradation

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ABSTRACT

Textile and industrial dye effluents are a serious environmental concern because of their toxicity, persistence and resistance to conventional treatment. Photocatalysis using semiconductor nanomaterials is a promising, low-cost and sustainable route for their removal. Layered double hydroxides (LDHs) offer a tunable lamellar structure, high surface area and good anion-exchange capacity, but their photocatalytic efficiency can be limited by fast charge recombination. This work proposes the synthesis of a transition-metal-based LDH nanocomposite, coupled with a metal oxide component, by a simple and economical co-precipitation method. The structural and phase

characteristics will be examined by X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR). Optical absorption and band gap will be evaluated by UV-visible spectroscopy. Surface morphology, particle size and internal structure will be studied by scanning electron microscopy (SEM) and transmission electron microscopy (TEM), and elemental composition will be confirmed by energy-dispersive X-ray analysis (EDAX). The photocatalytic performance of the nanocomposite will then be tested through the degradation of organic dyes under light irradiation. The interfacial coupling of the two components is expected to enhance visible-light absorption and promote charge separation, leading to improved degradation efficiency. The material is anticipated to be an effective, reusable photocatalyst for wastewater treatment.

Keywords: Layered double hydroxide; Nanocomposite; Co-precipitation; Photocatalysis; Dye degradation

Enhanced multidimensional performance of rGO coated Ag-doped SnO₂ nanocomposites: Synthesis, physicochemical characterization photocatalytic dye activity

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ABSTRACT

Effective treatment of wastewater containing organic pollutants remains a significant environmental challenge. In this study, rGO/Ag-SnO₂ nanocomposites (RAS NCs) were synthesized via a combined sol-gel and room-temperature deposition method to enhance visible-

light-driven photocatalytic performance and antibacterial activity. UV-Vis analysis revealed that the incorporation of Ag and rGO reduced the band gap of SnO₂ from 3.22 to 2.62 eV, improving solar light absorption and charge carrier dynamics. Among the prepared samples, the nanocomposite with 6 wt% rGO exhibited optimal performance. Structural characterization confirmed the successful formation of SnO₂, Ag, and rGO phases, while microscopic analysis showed Ag-SnO₂ nanoparticles uniformly distributed over rGO sheets, forming a conductive network. The optimized RAS NCs achieved 95.02% degradation of Brilliant Green (BG) under solar irradiation. The degradation followed pseudo-first-order kinetics with a rate constant of 0.02142 min⁻¹, and half life time period of 32.35 min indicating enhanced reaction efficiency. The improved performance is attributed to effective charge separation, electron trapping by Ag nanoparticles, and rapid electron transport through rGO. In addition, the photocatalyst demonstrated good stability, reusability, and adsorption capability.

Keywords: rGO/Ag-SnO₂ nanocomposites, Photocatalytic activity, solar light absorption, Adsorption

Phytochemical Screening of Ethanolic Extract of *Borassus Flabellifer* And Biological Activity Evaluation of Anti-Bacterial, Anti-Fungal And Anti-Diabetic Activities

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ABSTRACT

The Palmyra palm (*Borassus flabellifer*), also known as the Asian Palmyra palm has been used in traditional medicine for centuries. Due to its economic and environmental significance, it can be traditionally used in Ayurveda and folk medicine for digestive health, skin diseases, and respiratory issues. The phytochemicals have become more popular due to their countless medicinal uses. As they play a vital role against number of diseases such as asthma, arthritis, cancer, etc. The present study experimentally investigated the phytochemical identification present in the Ethanolic extract of *borassus flabellifer* through Gas Chromatography-Mass Spectroscopy technique which

identified the presence of twenty two phytochemicals, suggesting a rich source of bioactive compounds. The research work also evaluated the biological activities such as anti-bacterial, anti-fungal and anti-diabetic. Agar disc diffusion method was employed to show the antibacterial, antifungal activity by estimating the diameter of zone of inhibition. Antidiabetic assay was done to find out the α -AMYLASE and α -GLUCOSIDASE inhibition percentage along with its control percentage and was found that concentration and inhibition percentage are directly proportional to each other thereby confirming the antidiabetic property. The results of the present study suggested that *Borassus flabellifer* is a promising source of bioactive phytochemicals with potential antibacterial, antifungal, and antidiabetic properties and may potentially act as an effective drug..

Keywords: *Borassus flabellifer* extract, GC-MS, Anti-Bacterial, Anti-Fungal, Anti-Diabetic activity.

FeTiO₂/Sr DOPED-TiO₂ Heterojunction Semiconductor as Efficient Photocatalyst: Structural Designing, Characterization and Investigation of Photocatalytic Efficiency

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ABSTRACT

In this study, TiO₂, Sr doped-TiO₂ and FeTiO₃/Sr doped-TiO₂ heterojunctions were synthesized by sol-gel method. All the photocatalysts show anatase crystalline phase was confirmed by X-Ray Diffractogram Analysis. The FeTiO₃/Sr doped-TiO₂ heterojunctions catalyst shows an absorption threshold extended into the visible region and also has smaller particle size compared to Sr doped-TiO₂ and TiO₂. FeTiO₃/Sr doped-TiO₂ heterojunctions have higher activity

in sunlight than the Sr doped-TiO₂ and undoped TiO₂. Photocatalyst dosage of 100 mg/l is optimum for the degradation of dyes. Acidic pH is more suitable for the degradation of Reactive red 120 in heterogeneous TiO₂ as catalyst compared to alkaline pH. FeTiO₃/Sr doped-TiO₂ heterojunctions highly stable photocatalyst when doing photocatalytic process, the reason is after 5th cycle the photocatalytic rate was 92 %.

Growth and Investigation of Structural, Elemental, Optical, Thermal and Non-linear Optical Properties of Lithium Pentaborate Tetrahydrate Single Crystals

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ABSTRACT

Lithium pentaborate tetrahydrate (LiB₅O₈·4H₂O) nonlinear optical (NLO) single crystals were successfully grown by the slow evaporation solution growth method at ambient temperature. Optically transparent crystals with good morphology were obtained from aqueous solution using high-purity precursors. The crystalline nature and phase formation were examined by powder X-ray diffraction and the observed diffraction peaks validate good crystallinity without detectable secondary phases. Optical behavior was studied using UV–Vis absorption spectroscopy, which revealed low absorbance and high transmittance in the visible region. The optical band gap was determined using the Tauc plot method and was found to lie in the wide band gap region, confirming dielectric characteristics. Functional group analysis by FTIR spectroscopy confirmed the presence of characteristic borate network vibrations along with coordinated water molecules. Elemental analysis carried out using energy dispersive X-ray spectroscopy verified the presence of boron and oxygen, while lithium could not be detected due to its low atomic number and inherent instrumental detection limitations. Photoluminescence studies showed distinct emission bands associated with borate group transitions and intrinsic defect centers. Thermal behavior and stability were evaluated using TG–DTA and DSC analyses, which indicated stepwise dehydration and thermal stability up to the onset of decomposition. The nonlinear optical response was confirmed through second harmonic generation measurements using the Kurtz-Perry powder technique, showing appreciable SHG efficiency. These results indicate that solution-grown lithium

pentaborate tetrahydrate crystals are promising candidates for nonlinear optical and photonic device applications.

Keywords: Lithium pentaborate tetrahydrate, Slow evaporation growth, Nonlinear optical materials, Structural and optical analysis, Energy-dispersive X-ray spectroscopy, Wide band gap crystal, Thermal stability, SHG efficiency

Investigation Of Corrosion Inhibition Behavior of Cypress Extracts And Surfactant Additive For Mild Steel

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ABSTRACT

The investigation of inhibition efficiency of various concentration of Cypress leaves extract for Mild steel in 1M HCl at room temperature of the acid medium by weight loss study. Cypress extracts showed good performance as corrosion inhibitor for mild steel in 1 M HCl showing maximum inhibition efficiency of 79.04% at 400 ppm at 35°C. The inhibition efficiency of Cypress extracts is further improved to 82.74% in presence of 5 ppm of SDS at the same Cypress extracts concentration and temperature. The effect of sodium dodecyl sulfate on corrosion inhibition behavior of Cypress extracts is synergistic in nature. The adsorption parameters obtained from weight loss measurements suggest that adsorption of Cypress extracts alone and in combination with surfactants sodium dodecyl sulfate on mild steel interface obeys Langmuir adsorption isotherm at all the concentrations and temperature studied. The low and negative values of G_{ads} indicate spontaneous physical adsorption. The results of potentiodynamic polarization measurements indicate that Cypress extracts acts a mixed inhibitor. The inhibition effect of Cypress extracts and Cypress extracts -surfactant is further confirmed by Scanning Electronic Microscopy study.

Fabrication of Samarium-based Metal-Organic Framework for Photocatalytic Hydrogen Production

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ABSTRACT

Increasing global demand for energy and overconsumption of fossil fuels have led to the search for alternative renewable and clean energy sources, with hydrogen emerging as a promising energy carrier. Although several methods are available for producing hydrogen, photocatalytic hydrogen production serves as an optimal method that directly converts water into hydrogen by utilizing solar energy. However, the development of a photocatalyst remains challenging due to its limited light absorption, charge carrier recombination and insufficient charge transfer process. Metal-Organic Frameworks (MOFs) have emerged as a versatile material for photocatalysis because of their high surface area, active sites and electronic and optical properties. In this study, photocatalytic hydrogen production was achieved using a samarium-based metal-organic framework that was synthesized using 4,4,4-nitrilotribenzoic acid as an organic linker by a solvothermal process. The morphology and structural composition of the synthesized material were characterized using X-ray diffraction (XRD), Fourier Transform infrared spectroscopy (FT-IR), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and X-ray Photoelectron Spectroscopy (XPS). The prepared material was subsequently evaluated under light irradiation in the presence of a suitable sacrificial agent system, and the photocatalytic hydrogen production efficiency was analyzed using a GC-TCD detector. The results confirmed the successful evolution of hydrogen under light irradiation, demonstrating the potential of Samarium MOF as a rare-earth-based photocatalyst for solar-driven hydrogen production.

Keywords: Photocatalytic Hydrogen Production, Metal-Organic Frameworks, Rare-earth photocatalyst, Solar-driven photocatalysis.

An Electrochemical Sensor Based on Rare Earth Metal-Organic Framework for the Detection Of Bisphenol A in Water Samples

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ABSTRACT

Bisphenol A (BPA), a widely used industrial chemical and well-known endocrine-disrupting compound (EDC), is extensively employed in the production of polycarbonate plastics and epoxy resins used in food packaging, containers, and other consumer products. Due to its widespread occurrence in aquatic environments and potential adverse effects on reproductive, developmental and metabolic functions, the rapid and sensitive monitoring of BPA has become essential. Electrochemical sensors offer an effective analytical platform for BPA detection because of their high sensitivity, fast response, simplicity and excellent electron-transfer capability. The integration of nanomaterials into electrochemical sensors has significantly improved their sensing performance due to their unique physicochemical properties, high surface area and excellent electron-transfer capability, enabling highly sensitive and selective detection of target analytes. In this work, an electrochemical sensor was developed for the detection of BPA based on a Pr-BTC metal–organic framework synthesized by the solvothermal method and employed as the active sensing material. During electrochemical sensing, the Pr-BTC MOF facilitates the oxidation of bisphenol A by promoting electron transfer between BPA and the electrode surface, generating a measurable electrochemical signal for its detection. The morphology and structural composition of the synthesized material were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FTIR), and transmission electron microscopy (TEM). The electrochemical performance of the fabricated sensor was evaluated using cyclic voltammetry (CV), differential pulse voltammetry (DPV), and electrochemical impedance spectroscopy (EIS). The Pr-BTC MOF demonstrated effective electrochemical sensing performance, enabling the reliable determination of bisphenol A.

Synthesis, Characterization and Photocatalytic Activity of FeMoO₄ nanoparticles

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Abstract

In this study, a simple co-precipitation method is used to synthesize FeMoO₄ nanoparticles, with the morphological and optical characteristics of the FeMoO₄ nanoparticles. The FeMoO₄ nanoparticles facilitate efficient charge separation and resulting transfer of photogenerated charge carriers, demonstrated from photoluminescence tests. As synthesized nanoparticles were initially optimized and utilized for photodegradation of organic dye methylene blue (MB dye). The FeMoO₄ nanoparticles demonstrated improved photodegradation efficiency (92%) compared to Degussa P₂₅ (83%). Altogether, these investigations show that the FeMoO₄ nanoparticles are a highly efficient photocatalyst that can be used to remediate emerging contaminants in sunlight.

Keywords: FeMoO₄ nanoparticles; methylene blue (MB dye); sunlight

Photocatalytic Degradation of Polystyrene Microplastics Using a Rare-Earth-Based Nanocomposite

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ABSTRACT

Microplastics contaminants in aquatic and terrestrial environments have become a growing concern due to their resistance to degradation and prolonged persistence in the environment. Among various microplastics, polystyrene is extensively used in packaging, disposable and consumer products where its chemical stability and hydrophobic nature make its degradation particularly challenging, where the conventional methods for reducing microplastics in the environment mainly involve physical separation and filtration-based approaches which can

reduce the concentration of particles rather than facilitating their complete degradation. In the present study a Samarium was prepared and it was characterized using FTIR, SEM, XRD, UV–Vis/DRS, and XPS. The incorporation of the rare-earth component contributes to the regulation of optical and surface properties of the nanocomposite, thereby facilitating interfacial redox reactions under light irradiation. Upon light activation, photogenerated electrons and holes participate in surface reactions that generate highly reactive species, including hydroxyl radicals ($\bullet\text{OH}$) and superoxide radicals ($\bullet\text{O}_2^-$). The creation of pores on the surface of pretreated polystyrene microplastics facilitates entry of active substances into the interior to cause damage, while enhancement of hydrophilicity and specific surface area facilitates the contact between catalyst and polystyrene microplastics, thus it increases the degradation efficiency. Overall, work demonstrates the potential of rare-earth-based nanocomposites as multifunctional photocatalytic materials for oxidative degradation of persistent polystyrene microplastics and provides insights into the design of rare-earth-based catalytic systems for advanced microplastic remediation.

Keywords: Polystyrene microplastics, Rare-earth-based nanocomposite, Photocatalysis, Reactive oxygen species, Oxidative degradation, Microplastic remediation.

Synthesis, Characterization and Anticancer Activities of Mcm-41-Immobilized Mo(II) P-Cymene Complexes

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ABSTRACT

The development of supported organometallic complexes has attracted considerable attention in medicinal chemistry because immobilization on porous materials can improve catalyst stability, facilitate recovery, and potentially enhance the biological performance of metal-based compounds. In the present study, a series of molybdenum(II) p-cymene complexes bearing Schiff base ligands were synthesized and immobilized on mesoporous silica **MCM-41**. The Schiff base ligands were prepared through condensation of suitable substituted isatin derivatives with selected aromatic/heterocyclic amines, followed by coordination with the $[\text{Mo}(\eta^6\text{-p-cymene})\text{Cl}_2]_2$ precursor. The resulting Mo(II) complexes were subsequently incorporated into the MCM-41 framework to obtain supported ruthenium complexes.

The synthesized compounds and the MCM-41-supported complexes were characterized using FT-IR, UV–Visible spectroscopy, powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), thermogravimetric analysis (TGA), and surface-area measurements (BET). The spectroscopic data confirmed coordination of the Schiff base ligands to the ruthenium centre, while PXRD and BET analyses supported the retention of the mesoporous structure of MCM-41 after immobilization. SEM–EDX analysis provided information on the morphology and elemental composition of the supported complexes. The in vitro anticancer activity of the synthesized Mo(II) complexes and MCM-41-immobilized derivatives was investigated against selected cancer cell lines using an appropriate cell viability assay, with a non-cancerous cell line included for comparison. The biological studies revealed concentration-dependent inhibition of cancer-cell proliferation, and the supported complexes showed promising cytotoxic activity. The observed activity is discussed in relation to the structural features of the ruthenium complexes, ligand environment, and immobilization within the mesoporous MCM-41 matrix. The present investigation demonstrates the potential of **MCM-41-supported Mo(II) p-cymene complexes as promising candidates for further development as metal-based anticancer agents.**

Keywords: Molybdenum(II) p-cymene; MCM-41; Schiff base; Isatin; Mesoporous silica; Organometallic complexes; Anticancer activity; Cytotoxicity; Metal-based anticancer agents; Nanocomposite.

Synthesis effect of Mg doped ZnO nanoparticles for visible light

Photocatalysis

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ABSTRACT

An effective route for the degradation of methyl blue (MB) dye under sunlight irradiation by Mg-doped ZnO nanoparticles (NPs) synthesized through a Photon Induced Method (PIM). XRD studies point toward a significantly reduced crystallite size (33 nm) and a high shift in the XRD peaks toward a lower 2θ angle with Mg doping as compared to the standard ZnO and Mg-

doped ZnO NPs. The lattice constant is due to the replacement of Zn^{2+} by Mg^{2+} in the crystal lattice by the effect of the photons (PIM). Moreover, the sub-lattice affects the structure, and the band gap energy (E_g) decreased from 3.36 to 2.48 eV. As a result of this crystallite size and band gaps are advantageous for the absorption of organic molecules, the composite configuration holds the excellent carrier conductivity of magnesium, enabling rapid separation of photo generated electron–hole pairs. The presence of this Mg on the surface of ZnO NPs was investigated using FTIR analysis, which confirmed the presence of the stretching vibration of the Mg-O-Mg bonding. A promising method in this regard is to use PIM prepared Mg-doped ZnO NPs due to their low recombination rate and excellent photo degradation under sunlight irradiation.

Keywords: Doped ZnO · Photo degradation · Sunlight · PIM · Nanoparticles

Studies on Morphological Modification of Nano-Hydroxyapatite Powders through Organic and Inorganic Additives

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ABSTRACT

Hydroxyapatite (HAP), $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$, is a bioceramic widely investigated for dental and orthopaedic applications owing to its excellent biocompatibility, bioactivity, osteoconductivity, and chemical similarity to the mineral phase of hard tissues. In the present study, nano-hydroxyapatite powders incorporated with selected organic and inorganic additives were synthesized by a hydrothermal method to investigate their influence on the structural and morphological characteristics of HAP. The synthesized powders were characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Thermogravimetric Analysis (TGA). The results demonstrated that the incorporation of dextrin and alumina significantly influenced the morphology and particle characteristics of HAP. In particular, dextrin-assisted alumina-incorporated HAP exhibited a relatively uniform spherical morphology, reduced particle size, and absence of detectable impurity

phases. The cytocompatibility of the selected HAP powders was further evaluated using the MG-63 cell line. The findings demonstrate that the use of organic and inorganic additives provides an effective approach for tailoring the morphology of nano-HAP powders, highlighting their potential for biomedical applications.

Keywords: Hydroxyapatite, dextrin, alumina, hydrothermal synthesis, morphology, cytocompatibility.

Solvothermal Synthesis of Fe_3O_4 Nanoparticles: Effect of Reaction Time on Structural and Optical Properties

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ABSTRACT

Iron oxide nanoparticles are a promising low-cost, environmentally friendly material for a wide range of applications. In this work, Fe_3O_4 nanoparticles of different sizes were successfully synthesized by a solvothermal method at 150 °C with reaction times of 15 and 25 h. Iron chloride and potassium hydroxide were used as starting reactants, ethanol as the reaction medium, and cetyltrimethylammonium bromide (CTAB) as the structure-directing agent. The structural and optical properties and the functional groups of the products were characterized by powder X-ray diffraction (XRD), UV-Vis spectroscopy, and Fourier-transform infrared (FT-IR) spectroscopy. The results show that reaction time plays a crucial role in obtaining well-crystallized, pure cubic-phase Fe_3O_4 . XRD analysis reveals that the crystallite size increases with increasing reaction time. A red shift in the band gap energy from 3.05 eV to 2.89 eV, along with intense ultraviolet (UV) emission, was observed as the calcination temperature increased from 200 °C to 500 °C. The structural and optical properties were also found to depend strongly on reaction time. In addition, two FT-IR bands at around 626-628 cm^{-1} and 449-500 cm^{-1} confirm the formation of the spinel-structured ferrite.

Keywords: Fe_3O_4 nanoparticles, solvothermal synthesis, reaction time, CTAB, crystallite size, band gap and spinel ferrite

Green and Rapid UHPLC Method for Hydralazine Hydrochloride Impurity

Profiling and Assay

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ABSTRACT

Hydralazine Hydrochloride (HDH) is an antihypertensive drug that acts primarily as a direct vasodilator. The present study describes the redevelopment and validation of a simple, rapid, selective, cost-effective, and environmentally sustainable Ultra-High-Performance Liquid Chromatography (UHPLC) method for the simultaneous determination of HDH assay and organic-related impurities. The proposed method overcomes limitations associated with existing pharmacopoeial and reported methods by reducing analysis time, improving chromatographic selectivity, enabling the separation of additional potential impurities, and employing an LC–MS-compatible mobile phase suitable for extended process monitoring. The optimized UHPLC method utilized a Shim-pack Scepter C18-120 hybrid particle trifunctionally bonded column with gradient elution and UV detection at 230 nm. A total analysis time of 15 min was achieved, with the 120 Å pore size contributing to improved chromatographic separation and elution order. A single chromatographic condition enabled the simultaneous determination of eight specified and unspecified impurities along with the assay of HDH, providing an efficient approach for pharmaceutical quality control. The method demonstrated satisfactory sensitivity, linearity, accuracy, precision, and robustness. The limits of detection and quantitation were 0.01% and 0.03%, respectively, with correlation coefficients (R^2) greater than 0.99 for all analytes. Impurity recoveries ranged from 80–120% with %RSD values below 5%, while assay determination showed a similarity factor (Sf) of 0.98–1.02 and standard %RSD below 0.73%. Repeatability and robustness were confirmed through consistent system suitability results, with statistical analysis showing no significant variation ($P > 0.05$). Forced degradation studies established the method's selectivity toward degradation products, with a peak purity index of 0.999. The LC–MS compatibility of the method further enabled impurity identification and evaluation of intermediate purity. In addition to analytical performance, the method demonstrated significant environmental and economic advantages. Greenness assessment indicated a favorable environmental profile, while optimization of the chromatographic conditions resulted in solvent-cost savings of up to 95% and an approximately 83% reduction in analysis time. Overall, the developed UHPLC method offers a rapid, reliable, selective, economical, and sustainable analytical platform for routine quality control, impurity profiling, and process monitoring of Hydralazine Hydrochloride.

Keywords: Hydralazine Hydrochloride; UHPLC; Impurity Profiling; Pharmaceutical Analysis; Method Validation; Forced Degradation.

**Green synthesis of Ag-CuO nanostructures using *Moringa oleifera* leaf
extract for Antibacterial activity**

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ABSTRACT

We present a simple synthesis of Ag-CuO nanostructures, achieved through an environmentally friendly method utilizing *Moringa oleifera* leaf extract, which serves as an effective stabilizing agent. The structural integrity of these nanoparticles is generally assessed through XRD, where the distinctive peaks of monoclinic CuO are found alongside the face centered cubic peaks of metallic silver. Nanoparticles capped with *Moringa oleifera* leaves have demonstrated notable antibacterial activity against both gram-positive and gram-negative bacteria at microgram concentrations.

Keywords: Green Synthesis; *Moringa oleifera* leaf; Ag-CuO Nanostructure; Antibacterial activity

**Cerium oxide–hydroxyapatite reinforced poly(vinyl alcohol)–chitosan hydrogel with redox-
protective and osteogenic activity for bone regeneration**

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ABSTRACT

Large bone defects heal poorly, and scaffolds are needed that provide structural support while protecting osteoblasts from the oxidative microenvironment of the injury site. Here, composite hydrogels were prepared by dispersing cerium oxide-hydroxyapatite (CeO₂-HAp) nanoparticles at 1–5% (w/v) within a poly(vinyl alcohol)-chitosan (PVA-CS) matrix, and the inorganic loading was optimised by X-ray diffraction. The 4% (w/v) formulation retained the characteristic apatite and ceria reflections, gave the smallest crystallite size together with the highest relative crystallinity and phase-purity score, and was therefore selected for biological evaluation. Electron microscopy revealed an interconnected microporous network. Compared with

the blank matrix, the composite showed lower equilibrium swelling and slower hydrolytic degradation, indicating improved dimensional stability. The optimised hydrogel was non-cytotoxic to preosteoblasts over 25-400 µg/mL, with viability above 90% at 24 and 48 h and exceeding the untreated control at concentrations of 100 µg/mL and higher. At 100 µg/mL the composite preserved nuclear integrity, kept intracellular reactive oxygen species at control level and sustained mitochondrial membrane potential, whereas the blank hydrogel elevated oxidative stress and caused mitochondrial depolarisation. Functionally, the composite accelerated scratch-wound closure (83% versus 48% at 24 h), raised alkaline phosphatase activity approximately 4.5-fold by day 14, and enhanced mineralised matrix deposition (2.3-fold at day 21) alongside RUNX2 and osteocalcin expression. These findings identify the CeO₂-Hap-reinforced PVA-CS hydrogel as a redox-protective, osteoinductive scaffold candidate for bone regeneration.

Keywords: Cerium oxide; Hydroxyapatite; hydrogel; Osteogenic differentiation; Bone regeneration

Green Synthesis and Characterization of CuO Nanoparticles Using *Datura Metel* Leaf

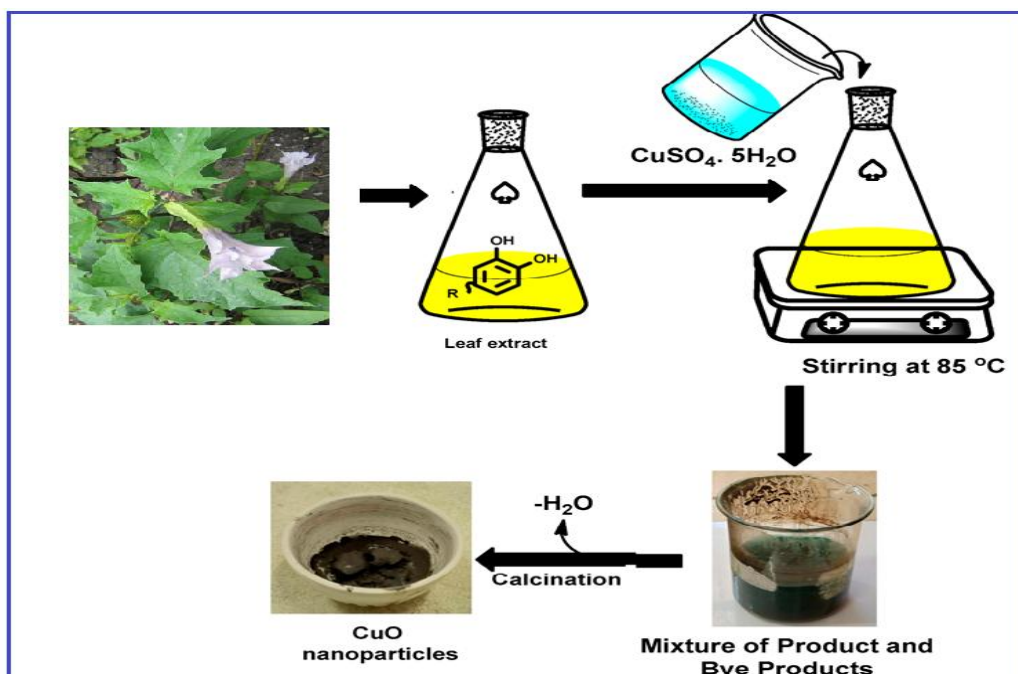
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ABSTRACT

In materials science, “green” synthesis has gained extensive attention as a reliable, sustainable, and eco-friendly protocol for synthesizing a wide range of nanomaterials, including metal and metal oxide nanomaterials, hybrid materials, and bio-inspired materials. As such, green synthesis is regarded as an important tool to mitigate the adverse environmental impacts associated with traditional chemical and physical synthesis methods commonly utilized in laboratories and industries. In this work, we first review the fundamental processes and mechanisms of green synthesis approaches, focusing particularly on metal and metal oxide [e.g., gold (Au), silver (Ag), copper oxide (CuO), and zinc oxide (ZnO)] nanoparticles derived from natural extracts. Furthermore, we report the green synthesis of copper oxide (CuO) nanoparticles using *Datura metel* leaf extract. The prepared samples were thoroughly characterized using FT-IR, UV-Vis, SEM, and EDAX analyses.



Facile and Eco-Friendly Synthesis of Tin-Doped Zinc Oxide Nanostructures Using *Ipomoea Staphylina* As A Bioreductant

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ABSTRACT

The increasing demand for sustainable nanotechnology has driven the development of eco-friendly synthesis methods that avoid hazardous chemicals. Metal oxide nanostructures, particularly Zinc Oxide (ZnO) doped with transition metals, are of significant interest due to their enhanced optoelectronic and biological properties. This study presents a facile and green route for the fabrication of tin-doped (Sn-doped) ZnO nanostructures using the aqueous leaf extract of *Ipomoea staphylina* as a natural bioreductant and stabilizing agent. The structural, morphological, functional, and optical properties of the samples were characterized using powder X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), UV-Vis diffuse reflectance spectroscopy (UV-DRS), and scanning electron microscopy (SEM). Phytochemicals within the *I. staphylina* extract, such as flavonoids and phenolics, acted as capping agents to stabilize the nanoparticles during the synthesis process.

Emergence of Extreme Events in a Three-Dimensional Memristive Jerk System

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ABSTRACT

Extreme events in autonomous memristive circuits remain insufficiently understood. This paper investigates such dynamics in a three-dimensional memristor-based Jerk system derived from a generalized model. Despite its simplicity, the system exhibits periodic oscillations, period-doubling bifurcations, and bounded chaos. For specific parameter regimes, rare large-amplitude excursions emerge and are identified as extreme events. The underlying transitions are characterized using bifurcation diagrams, phase portraits, return maps, and Lyapunov exponents, along with two-parameter analysis to map dynamical regimes. Statistical measures, including probability density and inter-event interval distributions, confirm the rarity and recurrence of these events. An analog circuit implementation validates the numerical results, demonstrating robust generation of intermittent extreme dynamics.

Key words: Memristor, Jerk system, Extreme events, Chaos, Bifurcation, Nonlinear dynamics, Analog circuits.

Synthesis of Cobalt Oxides NanoParticles via Green chemical Method and its Photocatalytic applications

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ABSTRACT

The term “Nano” is the Greek word it means very small and the NPs, particles should be in ≤ 100 nm at least one dimension (1-D). The NPs have great attention due to their unusual and

fascinating properties and numerous applications over their bulk counterparts. Green synthesis approach has three important steps in the preparation of nanoparticles, in this method mostly harmless solvent medium, nontoxic reducing agent and environmentally benign stabilization agents were utilized. Another significant factor is the selection of the capping agent used to passivate the nanoparticle surface. The capping agent also shows a significant effect on the sizes, morphologies and targeted applications. In the present work we used, four different herbal leaf extract for the synthesis of cobalt oxide nanoparticles, such as *Ocimum tenuiflorum* - (Thulasi). The Green chemical methods are the perfect solution to decrease the negative effects of the production and application of nanomaterials, it lowering the riskiness. The synthesized NPs are characterized by XRD, DRS – UV Visible, FT-IR, Raman, XPS and EDAX. The morphology will examine using AFM, SEM and HRTEM. Using UV-Visible and TEM data band gap of the cobalt oxides is calculate for the photocatalytic degradation of dye application like Methyl Orange, Malachite Green, Methylene blue and Industrial effluent. The dye wastewater emission is one of the important reasons of environmental pollution which is increasing extremely. The photodegradation of dyes by metaloxide nanoparticles has seen a remarkable improvement due to the environmental necessity that arises as large quantities of dyes are released as waste into the environment. A very small amount of dye in water can cause change in light penetration and thus decrease the photosynthesis of aquatic plants. These dyes are toxic, mutagenic and carcinogenic, so aquatic organisms as well as humans are exposed to this serious hazard. The adsorption is an efficient method to remove dyes particularly when they are recoverable and non-biodegradable.

Keywords: Cobalt oxide nano particles, herbal leaf extract, photo catalytic degradation, Methyl Orange, Malachite Green, Methylene blue and Industrial effluent.

Synthesis And Characterization of Marine-Degradable Plastic From Biowaste

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ABSTRACT

Marine-degradable bioplastics derived from biowaste represent a sustainable and environmentally responsible alternative to synthetic polymers in packaging and biomedical applications. In this study, biopolymers were isolated from organic biowaste materials and subjected to physico-chemical characterization to evaluate their suitability for marine-degradable packaging and medical sutures. The processed bioplastics were analyzed for essential parameters, including moisture content, water solubility index, degradation rate in simulated marine environments, and tensile strength. The FTIR spectroscopy confirmed the presence of characteristic functional groups associated with ester linkages, hydroxyl groups, and polysaccharide networks, while XRD analysis revealed the crystalline nature and structural integrity required for mechanical endurance. The UV-Visible spectroscopy was performed to evaluate the optical transparency and UV-barrier properties of the bioplastic films. The results demonstrated that the biowaste-derived bioplastics possess optimal physico-chemical stability, mechanical flexibility, and rapid marine biodegradability, validating their potential as eco-friendly materials for sustainable packaging and advanced medical suture applications.

Keywords: Marine-degradable bioplastics, Biowaste utilization, Packaging, Medical sutures, Physico-chemical properties, FTIR, XRD, UV.

Green Synthesis of Zinc Oxide Nanoparticles Using Tecoma Stans Leaf Extract and their Wound Healing Applications

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ABSTRACT

Wound healing is a complex biological process involving a coordinated sequence of hemostasis, inflammation, proliferation, and tissue remodeling. The present study focuses on the green synthesis of zinc oxide nanoparticles (ZnO NPs) using Tecoma stans leaf extract and their potential application in wound healing. Tecoma stans is a medicinal plant containing various bioactive phytochemicals, including flavonoids, alkaloids, terpenoids, phenolics, tannins, and glycosides, which are associated with antioxidant, antimicrobial, and anti-inflammatory properties. The leaves were collected, thoroughly washed, shade dried, and powdered, followed by extraction using an ethanol water solvent system. The obtained plant extract was employed as a green reducing and stabilizing agent for the synthesis of ZnO nanoparticles. The synthesized nanoparticles were characterized using UV–Visible spectroscopy, Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD) techniques. The prepared ZnO nanoparticle formulation was incorporated into a soft white paraffin-based ointment. Its wound-healing activity was evaluated at different concentrations (25, 50, and 100 µg/mL) over a period of 24 h. The formulation exhibited concentration-dependent enhancement of wound closure, indicating its potential to promote tissue repair and regeneration. The combined antioxidant and antimicrobial properties of the Tecoma stans ZnO nanoparticles may contribute to enhanced wound healing and protection against microbial infection. Thus the developed plant mediated ZnO nanoparticle formulation shows promising potential as an economical and effective wound-care material, warranting further investigation through detailed biological and in vivo studies.

Key words: Tecoma stans leaf , ZnO , UV–Visible, FTIR, XRD and Wound Healing

Crystal growth and characterization of new nonlinear optical Piperidine derivative: (4-hydroxypiperidin-1-yl)(4-methylphenyl) methanone

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ABSTRACT

Organic compound (4-hydroxypiperidin-1-yl)(4-methylphenyl)methanone [HPMP] with molecular formula $C_{13}H_{17}NO_2$ was synthesized using Scholten-Boumann condensation reaction method. The single crystals were grown using slow evaporation solution growth technique. Single crystal XRD study shows that the compound crystallizes in the orthorhombic system with a space group Pca_{21} . ^1H and ^{13}C -NMR spectra were recorded to identify the various types of protons and carbons present in the compound and confirm the chemical structure. The Various functional groups present in the compound were identified using recorded FT-IR spectrum. The UV–Visible spectrum study reveals that the crystal is transparent in the entire visible region and the absorption is observed at 236 nm. The PL spectrum shows the emission takes place at 432 nm. The thermal study reveals that the thermal stability of the crystal is good. The Kurtz powder second harmonic generation (SHG) test shows that the HPMP is NLO active and its SHG efficiency is 1.86 times that of KDP. The micro hardness test was carried out and the work hardening coefficient value (n) of the crystal was found to be 2.20. This indicates that the crystal is hard and is suitable for device application.

Keywords: Piperidine; Crystal growth; Non-centrosymmetric; Second harmonic generation efficiency; Single crystal XRD; ^{13}C -NMR ; ^1H -NMR; FT-IR; UV-Visible; Photoluminescence studies; TG/DTA; Vicker's micro hardness.

Development and Characterization of a natural herbal skin care formulation for Lichen Planus associated itching and post Inflammatory Hyperpigmentation

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ABSTRACT

The present study focuses on the development and characterization of a natural herbal topical formulation intended to provide symptomatic relief from itching and help improve the appearance of hyperpigmented skin associated with lichen planus. Selected herbal ingredients with traditionally reported anti-inflammatory, antipruritic, antioxidant, soothing, and skin-supportive properties were incorporated into a suitable topical formulation using an appropriate herbal base. The prepared formulation was evaluated for its organoleptic properties, homogeneity, pH, viscosity, spreadability, extrudability, washability, and stability. Phytochemical characterization was performed to identify the major bioactive constituents present in the herbal ingredients. UV–Visible, FTIR, XRD and SEM. The developed herbal formulation is intended for topical application to lichen-planus-affected skin, particularly areas associated with itching, dryness, inflammation, and residual hyperpigmentation. The formulation may serve as a potential natural topical approach for supporting the management of itching and post-inflammatory hyperpigmentation associated with lichen planus, although appropriate clinical studies are required to establish its safety and therapeutic efficacy.

Keywords

Lichen planus, Herbal formulation, Post-inflammatory hyperpigmentation and Phytoconstituents

Development and Evaluation of A Functional Seed Nut Food Product and Its Antioxidant and Nutritional Properties”

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ABSTRACT:

The present study focuses on the development and evaluation of a functional food product prepared using selected seeds and nuts with potential nutritional and antioxidant benefits. Seeds

and nuts are rich sources of proteins, healthy fats, dietary fibre, vitamins, minerals and bioactive compounds. In this work, selected seed and nut ingredients are processed and formulated into a convenient food product. The developed product is evaluated for its physicochemical, nutritional and antioxidant properties. Preliminary nutritional analysis include estimation of carbohydrates, proteins, fats, fibre and other relevant parameters. Antioxidant activity may be assessed using suitable in-vitro methods. The formulated product is also evaluated for sensory characteristics such as colour, flavour, taste, texture and overall acceptability. The study aims to develop a nutritious and acceptable functional food product and to assess its potential as a source of essential nutrients and antioxidant compounds. The findings may support the utilization of seeds and nuts in the development of value-added functional food products.

Green Synthesis and Characterization of Zinc Oxide Nanoparticles Using *Carica Papaya* Leaf Extract

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ABSTRACT

The present study focuses on the green synthesis and characterization of zinc oxide (ZnO) nanoparticles using *Carica papaya* leaf extract as a natural and eco-friendly reducing and stabilizing agent. Fresh *Carica papaya* leaves were collected, thoroughly washed, dried, and processed to prepare the aqueous leaf extract. The extract was subsequently used in the synthesis of ZnO nanoparticles through a simple and environmentally friendly method. The synthesized nanoparticles were characterized using suitable analytical techniques to investigate their structural, morphological, optical, and functional properties. The presence of phytochemicals such as flavonoids, phenolic compounds, alkaloids, and other bioactive constituents in the leaf extract may contribute to the formation and stabilization of the nanoparticles. The synthesized ZnO nanoparticles were further evaluated for their potential antibacterial activity against selected bacterial strains. The study demonstrates that *Carica papaya* leaf extract can serve as an inexpensive, renewable, and environmentally benign biological material for the synthesis of ZnO

nanoparticles, with potential applications in antimicrobial, environmental, and nanotechnology-related fields.

Keywords: *Carica papaya* leaf extract, Green synthesis, Zinc oxide nanoparticles, Phytochemicals, Characterization, Antibacterial activity.

**Green Synthesis and Characterization of Copper Oxide Nanoparticles Using Myristica
Fragrans Seed Extract**

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ABSTRACT

The green synthesis and characterization of CuO nanoparticles using Myristica Fragrans seed extract. Green synthesis is an eco- friendly and low cost effective approach for the preparation of nanoparticles using plant derived bio-active constitutionality, including phenolic compound, flavonoids and volatile constituents, which may contribute to the reduction and stabilization of nanoparticles. The formation of CuO nanoparticles will be initially confirmed by the change in colour and further characterized using suitable analytical techniques, such as UV- Vis, FTIR, XRD and SEM. The synthesized CuO nanoparticles will be evaluated for their physicochemical properties and suitable biological activities, particularly antimicrobial activity.

Key words: Myristica Fragrans, CuO, UV-Vis, FTIR, XRD SEM and antimicrobial activity

**Biogenic Synthesis of Collagen-Templated Silver Nanoparticles Using Psidium Guajava
For Biomedical Applications.**

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ABSTRACT

The development of sustainable nanomaterials through green synthesis has gained considerable attention as an environmentally friendly alternative to conventional chemical and physical methods. The present study proposes the use of fish-derived collagen as a multifunctional

biotemplate, reducing, and stabilizing agent for the green synthesis of silver nanoparticles (AgNPs). Collagen will be extracted from the skin of *Oreochromis niloticus* through acid solubilization followed by enzymatic hydrolysis, and its collagen characteristics will be investigated using SDS-PAGE and Western blotting techniques. Subsequently, collagen-mediated AgNPs will be synthesized using *Psidium guajava* leaf extract as a natural bioactive reducing and stabilizing source. The synthesized nanoparticles will be characterized using UV–Visible spectroscopy, Fourier-transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM) to investigate their optical properties, functional groups, surface morphology, and particle characteristics. The study will focus on understanding the role of fish collagen and *P. guajava* phytochemicals in the formation and stabilization of AgNPs. This proposed work aims to develop a simple, sustainable, and resource-efficient approach for the synthesis of collagen-mediated silver nanoparticles and to explore their potential for future applications in antimicrobial therapy, wound healing, and biomedical nanotechnology.

Keywords: Green synthesis, Silver nanoparticles, Fish collagen, *Oreochromis niloticus*, *Psidium guajava*, Biotemplate, Nanobiotechnology, Wound healing.

Green Synthesis Of Silver Nanoparticles Using Phyllanthus Emblica Extract And Their Potential Application In Sunscreen Formulation

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ABSTRACT

Ultraviolet (UV) radiation from sunlight can cause oxidative stress and damage to the skin, creating a need for effective photo protective materials. The present project focuses on the green synthesis of silver nanoparticles (AgNPs) using *Phyllanthus emblica* (Amla) extract and their potential application in sunscreen formulation. *P.emblica* is a natural source of antioxidants and bioactive phytochemicals that can act as reducing and stabilizing agents during nanoparticle synthesis. The prepared silver nanoparticles were evaluated for their optical and physicochemical properties and investigated for their antioxidant and UV-protective activities. The synthesized nanoparticles were incorporated into a sunscreen formulation and examined for properties such as

UV absorption, stability, spreadability, and sun protection potential. The study explores the combined benefits of plant-derived phytochemicals and silver nanotechnology for developing a potentially effective sunscreen material. This green synthesis approach may provide an alternative route for utilizing natural resources in the development of value-added cosmetic formulations. Further investigations are required like, basic characterizations XRD and SEM to establish the safety, skin compatibility, toxicity, and long-term stability of the developed formulation.

Key words: Phyllanthus Emblica, Ultraviolet (UV), Silver nanoparticles, Sunscreen

Phytochemical Investigation, Evaluation, and Bio-Efficacy Profiling of a Herbal Mosquito Repellent System

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ABSTRACT:

To overcome the health risks of synthetic mosquito coils, a natural tri-herbal coil was developed using Amman Pacharisi (*Euphorbia hirta*), Tulasi (*Ocimum sanctum*) and Uppaimeeni (*Acalypha indica*). The plants contain terpenoids, alkaloids and flavonoids that repel mosquitoes. The coil was made with natural starch binder and showed good quality with 4.82% moisture, 12.45% ash and 62.5 min burning time. It showed 48% repellency in 5 min and 100% repellency in 60 min with no eye or respiratory irritation. Hence, the herbal coil is a safe, low-cost and eco-friendly alternative to chemical coils.

Keywords: Herbal Mosquito Coil, Eco-Friendly, Vector Control

Green Sythesis and Characterization of Ferrous Sulphate Nanoparticles by Using Leaf Extract of *Tabernaemontana Divaricata* for Antimicrobial Activity

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ABSTRACT

Nanomaterials are at the leading edge of the rapidly developing field of nanotechnology. Nanomaterials provide numerous opportunities for a new generation of photovoltaic with high

solar energy conversion efficiencies at low fabrication cost. *Tabernaemontana Divaricata* is an important medicinal plant for novel pharmaceuticals since most of the bacterial pathogens are developing resistance against many of the currently available anti microbial activity. Roots have proved to be significant natural resources for effective chemotherapeutic agents and offering a broad spectrum of activity with greater emphasis on preventive action. Synthesis of FeSO₄ nanoparticle from root by simple chemical reduction method. The resulting nanomaterials were analysed by UV, FTIR, XRD, SEM and Antimicrobial activity. The morphology was identified with help of SEM. The FeSO₄ nanoparticle showed excellent antimicrobial activity.

Keywords: UV, FTIR, XRD, SEM

**Green Synthesis and Characterization of CuO Nanoparticles Derived from Papaya Peel
Extract**

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ABSTRACT

In recent years, the green chemistry based-approach for the synthesis of nanoparticles has shown tremendous promise as an alternative to the costly and environmentally unfriendly chemically synthesized nanoparticles. In this study, copper oxide nanoparticles (CuO NPs) were synthesized through a green approach using the water extract of papaya (*Carica papaya* L.) peel biowaste as reducing as well as stabilizing agents, and copper (II) nitrate trihydrate salt as a precursor. The structural properties, crystallinity, purity, morphology, and the chemical composition of as-synthesized CuO NPs were analyzed using different analytical methods. The analytical results revealed that the synthesized CuO was observed as spherical-like in particles with measured sizes ranging from 85–140 nm and has monoclinic crystalline phase with good purity. The Fourier transform infrared (FTIR) spectroscopic results confirmed the formation of the Cu-O bond through the involvement of the potential functional groups of biomolecules in papaya peel extract. Regarding photocatalytic activity, the green-synthesized CuO NPs were employed as a photocatalyst for the degradation of palm oil mill effluent (POME) beneath the ultraviolet (UV) light and results showed 66% degradation of the POME was achieved after 3 h exposure to UV

irradiation. The phytotoxicity experiment using mung bean (*Vigna radiata* L.) seed also showed a reduction of toxicity after photodegradation.

Keywords: CuO nanoparticles; green synthesis; palm oil mill effluent (POME); papaya peel; biowaste; photocatalyst.

Development, Characterization and Evaluation of a Natural Herbal Tea Pack for Reducing Blood Sugar and Stress Levels in Humans

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ABSTRACT

This study focuses on the development of a natural herbal tea pack using plant-derived materials with potential wellness and antibacterial applications. Selected medicinal herbs and natural packaging materials were processed and formulated into a convenient herbal tea pack. The prepared formulation and packaging materials were characterized using UV–Visible spectroscopy (UV–Vis), Fourier Transform Infrared Spectroscopy (FTIR), and Scanning Electron Microscopy (SEM) to evaluate their optical properties, functional groups, and surface morphology, respectively. UV–Vis analysis was used to identify characteristic absorption patterns and assess the presence of bioactive phytochemical constituents, while FTIR analysis was performed to identify functional groups associated with the major compounds present in the formulation. SEM was used to examine the surface morphology and structural characteristics of the developed material. The potential antibacterial activity of the herbal formulation can be evaluated against selected bacterial strains. The developed tea packs intended as a convenient natural product for herbal beverage preparation, while its antibacterial activity may provide an additional functional application and Antioxidant activity.

Keywords: Herbal Tea, SEM, Antimicrobial activity and Antioxidant Activity

Eco-Friendly Synthesis and Characterization of Copper Nanoparticles Using *Leucasaspera* Leaf Extract

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ABSTRACT

Green synthesis of copper nanoparticles (CuNPs) using plant extracts has emerged as an eco-friendly, simple, and cost-effective alternative to conventional chemical synthesis methods. In the present study, *Leucas aspera* leaf extract was employed as a natural reducing and stabilizing agent for the green synthesis of copper nanoparticles. The phytochemicals present in the leaf extract facilitate the reduction of copper ions and contribute to the stabilization of the synthesized nanoparticles. The prepared CuNPs were characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray diffraction (XRD), and Scanning Electron Microscopy (SEM) to investigate their optical, functional, structural, crystalline, and morphological properties. The green-synthesized copper nanoparticles are expected to exhibit potential applications in antimicrobial activity, catalysis, environmental remediation, and other nanotechnology-based applications. This study highlights the potential of *Leucas aspera* as a sustainable biological source for the synthesis of copper nanoparticles and offers an environmentally friendly approach to nanomaterial production.

Keywords: *Leucas aspera*, Copper nanoparticles, Green synthesis, Leaf extract, Phytochemicals, UV–Visible spectroscopy, FTIR, XRD, SEM.

Characterization of Fish-Scale Collagen-Derived Polymeric Nanoparticles and Evaluation of their Antimicrobial Activity for Food Packaging Application

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ABSTRACT

Fish-scale waste is an abundant and underutilized source of collagen that can be converted into value-added biomaterials for sustainable food-packaging applications. This study focuses on the extraction of collagen from fish scales and its utilization for the preparation of collagen-derived polymeric nanoparticles. The nanoparticles are expected to combine the biocompatibility and film-forming properties of collagen with nanoscale characteristics that can improve the functional performance of packaging materials. The prepared nanoparticles will be characterized using suitable analytical techniques such as (FTIR), (XRD), (SEM/TEM), (DLS), and zeta-potential analysis to determine their chemical structure, morphology, particle-size distribution, crystallinity, and surface charge. The antimicrobial activity of the nanoparticles will be evaluated against selected foodborne microorganisms using appropriate microbiological assays. The nanoparticles may subsequently be incorporated into polymeric packaging films to investigate their potential to inhibit microbial growth and improve the protective properties of the packaging material. The study aims to provide a sustainable approach for converting fish-processing waste into a functional nanomaterial while reducing dependence on conventional packaging additives. The developed collagen-derived nanoparticles could have potential applications in active food packaging, particularly where antimicrobial protection and environmentally friendly materials are required.

Keywords; Fish scales; Collagen; Polymeric nanoparticles; Nanomaterials; Antimicrobial activity; Food packaging; Sustainable packaging; Foodborne microorganisms; Active packaging; Waste valorization.

**Green Synthesis, Characterization and Evaluation of Antimicrobial and
Photocatalytic Application of Zinc Oxide Nanoparticles Using Dragon Fruit Peel
Extract**

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ABSTRACT

The present study focuses on the green synthesis of zinc oxide (ZnO) nanoparticles using dragon fruit peel extract as a natural and eco-friendly reducing and stabilizing agent. Dragon fruit peel, a rich source of phytochemicals, was utilized as a sustainable raw material for ZnO nanoparticle synthesis. The synthesized nanoparticles are characterized by UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray diffraction (XRD), and scanning electron microscopy (SEM) to study their optical properties, functional groups, crystalline structure, and morphology. The antimicrobial activity is evaluated against selected bacterial and fungal strains, while the photocatalytic activity is investigated using a suitable organic dye under light irradiation. Dye degradation is monitored using UV–Visible spectroscopy. The study highlights the potential of dragon fruit peel extract for sustainable ZnO nanoparticle synthesis and its applications in antimicrobial and photocatalytic processes

Keywords: UV, FTIR, XRD, SEM

**Formulation, Characterization and Evaluation of a Natural Herbal Inhaler for Stress
Relief and Sinus Symptom Management**

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ABSTRACT

The present study aims to formulate and evaluate a natural herbal inhaler prepared from selected plant-based materials for potential use in stress relief and sinus symptom management. Natural aromatic herbs containing bioactive phytoconstituents will be selected based on their traditional and reported therapeutic properties. The herbal formulation will be incorporated into a

suitable inhaler matrix using natural or biodegradable materials to provide convenient and controlled inhalation. The developed herbal inhaler will be characterized using UV, FTIR, XRD and SEM. UV–Visible spectroscopy will be used to examine the characteristic absorption profile of the herbal extract, while FTIR analysis will identify the major functional groups and provide information regarding the phytochemical constituents present in the formulation. SEM analysis will be used to study the surface morphology, structure, and distribution of the herbal material within the inhaler matrix. The biological potential of the herbal formulation will be investigated through appropriate in-vitro antimicrobial studies, including antibacterial and antifungal activity against selected microorganisms.

Keywords: UV, FTIR, XRD, SEM and Antimicrobial

Green Synthesis and Characterization of Magnesium Oxide Nanoparticles Using Indigofera Tinctoria Flower Extract

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ABSTRACT

An eco-friendly approach for the green synthesis of magnesium oxide nanoparticles (MgO NPs) was developed using *Indigofera tinctoria* flower extract as a natural reducing and stabilizing agent. The formation of MgO nanoparticles was initially indicated by a visible colour change during the synthesis process and was further investigated using UV–Visible spectroscopy, which showed an absorption band in the range of 290–360 nm. The structural and morphological properties of the synthesized MgO nanoparticles were investigated using various characterization techniques. X-ray diffraction (XRD) analysis confirmed the formation of crystalline MgO with a cubic crystal structure and an estimated crystallite size of approximately 15–25 nm. Fourier Transform Infrared (FTIR) spectroscopy revealed characteristic Mg–O vibrational bands in the range of 550–850 cm^{-1} , confirming the formation of MgO nanoparticles. Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) were employed to investigate the surface morphology and particle size, while Energy Dispersive X-ray (EDX) analysis confirmed the elemental composition. Dynamic Light Scattering (DLS) and zeta potential measurements were used to evaluate the particle-size distribution and colloidal stability of the

synthesized nanoparticles. The green synthesis of MgO nanoparticles using *Indigofera tinctoria* flower extract provides an environmentally friendly and sustainable approach for nanoparticle preparation, with potential applications in antimicrobial, antioxidant, and photocatalytic fields.

Keywords: MgO nanoparticles, green synthesis, *Indigofera tinctoria*, flower extract, UV–Visible spectroscopy, XRD, FTIR, SEM, TEM, EDX, DLS.

Waste-to-Value Nanotechnology: Banana Peel-Derived Silver Oxide Nanoparticles for Active Food Packaging Applications

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ABSTRACT

The present study focuses on the green synthesis of silver oxide nanoparticles (Ag_2O NPs) using banana peel extract as a sustainable and eco-friendly reducing and stabilizing medium, followed by their incorporation into an active food-packaging system. Banana peel, an abundant agricultural by-product, was manually processed to obtain an aqueous bioactive extract without the use of aluminium-based materials. The phytochemicals present in the extract facilitated the formation and stabilization of silver oxide nanoparticles from a suitable silver precursor under controlled reaction conditions. The synthesized Ag_2O nanoparticles from banana peel from chemical reduction method and were recovered, washed, dried, and subsequently incorporated into a biodegradable packaging matrix to develop an antimicrobial food-packaging material. The synthesized nanoparticles were characterized using UV–Visible spectroscopy to FTIR, (XRD) and (SEM) was used to examine surface morphology and particle distribution. The developed packaging material was further evaluated for antimicrobial activity and antioxidant basic packaging properties. The study demonstrates the potential of banana peel waste as a low-cost biological resource for nanoparticle synthesis and its application in sustainable active food packaging.

Keywords: Banana peel; Silver oxide nanoparticles; Green synthesis; Nanocomposite packaging; Antimicrobial activity.

Formulation and Evaluation of Ormocarpum Cochinchinense Leaf Powder Herbal Cream for fracture Supportive

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ABSTRACT

The present study focuses on the preparation and primary evaluation of a natural cream containing Elumbotti leaf powder extract for a potential tissue repair application. Elumbotti leaf is traditionally associated with medicinal properties and may containing bioactivity and photochemical with anti-microbial and anti-inflammatory activity. The leaves are collected, clean, shade, dried-powder, and extract using stable solvent. The obtained extracted in incorporated into a cream base containing natural ingredients such as beeswax and suitable vegetable oil. The prepared cream is evaluated in physical characteristics including colour, odour, hologenetic, PH, spread ability and stability preliminary phytochemical screening can also carried out to identify major classes of bioactive compounds present in extract. The study aims to develop a simple stable and natural topic formulation and to provide preliminary evidence for its potential use in tissue repair related applications. Further antimicrobial, anti-inflammatory and tissue repair studies are required to confirm its effectiveness and safety.

Keywords :Ormocarpum cochinchinense, Herbal cream, Anti-microbial, Anti-inflammatory Fracture care, Formulation and Evaluation.

Biofabrication of Multifunctional zinc Nanocomposites for Dual Biomedical and Environmental Applications

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ABSTRACT

The present study focuses on the synthesis, characterization, and multifunctional applications of Zinc nanocomposites with particular emphasis on their antioxidant, antifungal, and photocatalytic activities. Nanocomposites were synthesized using a suitable chemical or green

synthesis approach by incorporating selected nanoscale materials with an appropriate matrix to enhance their physicochemical and functional properties. The synthesized nanocomposites were characterized using various analytical techniques, including UV, FTIR, SEM, XRD. The antioxidant potential of the synthesized nanocomposites was evaluated using suitable in-vitro assays, such as DPPH radical-scavenging activity, to determine their free-radical scavenging ability. The antifungal activity was assessed against selected fungal strains

The synthesized materials demonstrate potential for environmental remediation, antimicrobial applications, antioxidant-related applications, and photocatalytic degradation of organic pollutants.

Keywords: Nanocomposites, UV–Visible spectroscopy, FTIR, XRD and Antioxidant activity

Development of Water-Resistant Hybrid Biocomposites from Next-Generation Biodegradable Materials For A Circular Economy”

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ABSTRACT:

The increasing demand for sustainable alternatives to conventional plastics has accelerated the development of high-performance biodegradable materials. This study aims to develop water-resistant hybrid biocomposites from next-generation biodegradable materials for eco-friendly packaging applications within a circular economy framework. The biocomposites are fabricated by combining bio-based polymers with natural reinforcing materials to improve water resistance, mechanical strength, and durability while maintaining biodegradability. The developed materials are characterized using FTIR, XRD, SEM, and TGA, and their performance is evaluated through water absorption, tensile strength, and biodegradation studies. The proposed hybrid biocomposite offers a sustainable solution for reducing plastic waste, promoting renewable resource utilization, and supporting environmentally responsible material development.

**Plant-Mediated Synthesis of Magnesium Oxide Nanoparticles Using (LAWSONIA
INERMIS) MARUTHANI Seed: A Sustainable Approach for Advanced Applications**

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ABSTRACT

Metals are able to form a large number of oxides. These metal oxides play an important role in many areas of chemistry, physics and material science. An important metal oxide known as magnesium oxide (MgO) having good reactivity is widely used in producing electronics, catalyst, ceramics, oil, paint etc. Magnesium oxide Nano-particle is non-toxic and need a small amount, so it is suitable for the development of flame-retardant fiber additives. The present study focuses on the green synthesis of magnesium oxide (MgO) nanoparticles using *Marudhani* (henna) seed extract as a natural and eco-friendly reducing and stabilizing agent. The synthesized nanoparticles were characterized using suitable analytical techniques, including UV–Visible spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), and Scanning Electron Microscopy (SEM), to determine their optical properties, functional groups, crystalline structure, and morphology. The study demonstrates that *Marudhani* seed extract can serve as a promising biological material for the sustainable synthesis of MgO nanoparticles and may provide an environmentally friendly approach for producing nanomaterials with potential technological and biomedical applications.

Keywords: UV–Vis, FTIR, XRD, SEM and *Marudhani Seeds*.

Green Synthesis and Characterization of Zinc Oxide Nanoparticles Using *Solanum nigrum* (Manathakkali) Leaf Extract

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ABSTRACT

The present study focuses on the green synthesis and characterization of Zinc Oxide Nanoparticles (ZnO NPs) using aqueous leaf extract of *Solanum nigrum* (Manathakkali). Green synthesis is an eco-friendly and sustainable approach that reduces the use of toxic chemicals and hazardous reagents commonly employed in conventional nanoparticle synthesis. The leaf extract of *Solanum nigrum* contains various bioactive phytochemicals, including flavonoids, alkaloids, polyphenols, tannins, and other secondary metabolites, which may act as natural reducing, stabilizing, and capping agents during the formation of ZnO nanoparticles. The synthesized ZnO NPs will be characterized using UV-Visible spectroscopy to confirm nanoparticle formation, Fourier-transform infrared spectroscopy (FTIR) to identify the functional groups involved in nanoparticle synthesis and stabilization, X-ray diffraction (XRD) to determine crystalline structure and crystallite size, and Scanning Electron Microscopy (SEM) to examine surface morphology and particle characteristics. The green-synthesized ZnO nanoparticles may exhibit significant biological properties due to the combined effects of ZnO and plant-derived phytochemicals. Depending on the experimental evaluation, their potential antibacterial, antioxidant, and other biomedical applications can be investigated. This study highlights the potential of *Solanum nigrum* leaf extract as a simple, cost-effective, and environmentally friendly biological resource for the synthesis of ZnO nanoparticles.

Keywords:

Solanum nigrum, Manathakkali, Zinc Oxide Nanoparticles (ZnO NPs), Green Synthesis, Biosynthesis, Phytochemicals, UV-Vis Spectroscopy, FTIR Analysis, XRD, SEM, Antibacterial Activity, Antioxidant Potential.

Green Synthesis of Zinc Oxide Nanoparticles Using Phyllanthus niruri and Stevia Leaf Extract and Their Antibacterial Potential

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ABSTRACT

The present study focuses on the green synthesis of zinc oxide nanoparticles (ZnO NPs) using Phyllanthus niruri and Stevia leaf extracts as natural reducing and stabilizing agents. The use of plant extracts provides an eco-friendly, simple, cost-effective, and sustainable alternative to conventional chemical methods for nanoparticle synthesis. The plant extracts were treated with a suitable zinc precursor to facilitate the formation of ZnO nanoparticles. The synthesized nanoparticles can be characterized by UV–Visible spectroscopy, (FTIR, XRD), and (SEM/TEM) to investigate their optical properties, functional groups, crystalline structure, morphology, and particle size. The phytochemicals present in Phyllanthus niruri and Stevia may contribute to the reduction, stabilization, and capping of the nanoparticles. The antibacterial potential of the synthesized ZnO NPs can be evaluated against selected Gram-positive and Gram-negative bacterial strains using suitable microbiological assays. The nanoparticles are expected to exhibit antibacterial activity due to mechanisms such as reactive oxygen species generation, interaction with the bacterial cell membrane, and release of Zn²⁺ ions. This green synthesis approach may provide a promising route for producing ZnO nanoparticles with potential applications in antimicrobial materials, coatings, environmental protection, and other biomedical-related fields.

Keywords: Green synthesis; Zinc oxide nanoparticles (ZnO NPs); Phyllanthus niruri; Stevia leaf extract; Phytochemicals; Antibacterial activity; Nanoparticles; Sustainable synthesis; Reactive oxygen species (ROS); Nanotechnology.

**Perparation and Evaluation Of Clitoria Ternatea Face Serum Incorporated With
Titanium Dioxide For Antioxidant And Uv-Protection Applications**

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ABSTRACT

The present study focuses on the formulation and evaluation of a Butterfly Pea (*Clitoria ternate*) Face Serum with Titanium Dioxide (TiO₂). Fresh butterfly pea flowers are subjected to aqueous extraction to obtain a naturally colored extract rich in anthocyanin pigments, particularly ternatins, which are associated with antioxidant properties. The extract is incorporated into a serum formulation containing titanium dioxide, glycerin, xanthan gum, sodium benzoate and potassium sorbate. Glycerin acts as a humectants, xanthan gum provides viscosity and consistency, while sodium benzoate and potassium sorbate are used as preservatives. Titanium dioxide is incorporated for its ability to attenuate ultraviolet radiation. The prepared serum is evaluated for appearance, color, odor, homogeneity, pH, viscosity; spread ability, stability and UV–Visible absorption characteristics. UV–Visible spectroscopic analysis is carried out to study the absorption behavior of the butterfly pea extract and the formulated serum. The study aims to develop a stable and cosmetically acceptable botanical serum combining the antioxidant potential of butterfly pea extract with the UV-attenuating properties of titanium dioxide, demonstrating the potential application of natural plant extracts and inorganic materials in cosmetic formulations.

Keywords: Titanium dioxide, Anthocyanins, Antioxidant activity, UV protection, Cosmetic formulation.

Synthesis And Characterization Of Zirconium Dioxide Nanoparticles:Exploring Their Potential Applications

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ABSTRACT:

The Nanoparticles are nanoscale materials that have attracted significant attention due to their unique physicochemical properties and wide range of applications in various fields, including biology, chemistry, materials science & nanotechnology. In the present study Zirconium oxide nanoparticles (ZrO_2 Nps) were synthesized using Zirconium oxychloride as a precursor and Mucuna pruriens extract as a biological reducing and stabilizing agent. The synthesized nanoparticles were characterized using suitable analytical techniques, including UV- visible, FTIR, XRD and morphological properties. The synthesized ZrO_2 nanoparticles exhibited promising photocatalytic activity and demonstrated potential for environmental and technological applications

Key words: Mucuna pruriens, Zirconium oxide, UV, FTIR, XRD, & photocatalytic activity.

Green Synthesis and Characterization of Silver Nanoparticles Using Kuppaimeni (*Acalypha Indica*) Leaf Extract

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ABSTRACT

Kuppaimeni leaf (*Acalypha indica*) is a medicinal plant that can be used as a natural source for the green synthesis of nanoparticles. In this practical, Kuppaimeni leaf extract acts as a reducing and stabilizing agent for the synthesis of silver nanoparticles (AgNPs) from silver ions. The synthesized nanoparticles are characterized using different analytical techniques. FTIR (Fourier Transform Infrared Spectroscopy) is used to identify the functional groups present in the leaf

extract and their role in nanoparticle formation and stabilization. STM (scanning tunneling microscopy) can be used to study the nanoscale surface features. UV–visible spectroscopy, XRD, SEM/TEM, and EDX can provide additional information about the optical properties, crystal structure, morphology, particle size, and elemental composition. This method provides an eco-friendly and simple approach for nanoparticle synthesis using plant material.

Keywords: Kuppaimeni leaf, *Acalypha indica*, silver nanoparticles, AgNPs, green synthesis, plant extract, FTIR, STM, UV–Visible spectroscopy, XRD, SEM, EDX, eco-friendly synthesis.

Green Synthesis Of Silver Nanoparticles Using *Artocarpus Heterophyllus* Peel Extract As A Bioreductant For Latent Fingerprint Visualization

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ABSTRACT

Latent fingerprints are important forms of forensic evidence, and the development of simple, sensitive, and environmentally friendly visualization methods is essential for their effective detection. The present study focuses on the green synthesis of silver nanoparticles (AgNPs) using *Artocarpus heterophyllus* (jackfruit) peel extract as a natural bio reducing and stabilizing agent and their application in latent fingerprint visualization. Jackfruit peel, an abundantly available agro-waste material, contains various bioactive phytochemicals, including phenolic compounds, flavonoids, tannins, and other reducing agents that can facilitate the formation and stabilization of silver nanoparticles. The peel was collected, thoroughly washed, dried, powdered, and extracted using a suitable aqueous solvent system. The resulting extract was employed for the green synthesis of AgNPs under optimized reaction conditions. The synthesized nanoparticles were characterized using UV–Visible spectroscopy, Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD) to investigate their optical properties, functional groups, and crystalline nature. The prepared AgNPs were subsequently evaluated for the development of latent fingerprints on selected non-porous surfaces. The nanoparticle-based formulation demonstrated effective deposition on fingerprint ridge patterns, producing clear and distinguishable ridge details. The observed visualization may be attributed to the interaction of silver nanoparticles with

components of latent fingerprint residues. The study highlights the potential of *Artocarpus heterophyllus* peel extract as an inexpensive, sustainable, and eco-friendly resource for nanoparticle synthesis and forensic applications. The developed green-synthesized AgNPs could serve as a promising alternative for latent fingerprint visualization, particularly in resource-limited forensic investigations.

Key words: Silver nanoparticles, *Artocarpus heterophyllus*(Jackfruit) peel, Latent fingerprints, Fingerprint visualization and Forensic science

Green Synthesis and Characterization of Silver Nanoparticles Using *Simarouba Glauca* Seed Extract For Preliminary Anticancer Research Against Blood Cancer

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ABSTRACT

The present study focuses on the green synthesis and characterization of silver nanoparticles (AgNPs) using *Simarouba glauca* seed extract, with a specific emphasis on their potential biomedical relevance in blood cancer research. Blood cancers, including leukemia, lymphoma, and myeloma, require continued investigation into novel materials and possible therapeutic approaches. Green synthesis is an eco-friendly method that utilizes plant-derived phytochemicals as reducing and stabilizing agents for the preparation of metal nanoparticles. In this study, *Simarouba glauca* seeds will be collected, shade-dried, powdered, and subjected to solvent extraction. The prepared seed extract will be mixed with silver nitrate (AgNO_3) under controlled experimental conditions to facilitate the formation of silver nanoparticles. The synthesized nanoparticles will be separated through centrifugation, washed with double-distilled water, and dried for further characterization. The synthesized silver nanoparticles will be characterized using Ultraviolet–Visible spectroscopy (UV–Visible) to investigate their optical properties and monitor nanoparticle formation. Fourier Transform Infrared Spectroscopy (FTIR) will be used to identify functional groups associated with the reduction and stabilization of silver nanoparticles. X-Ray Diffraction (XRD) will be employed to examine the crystalline structure and crystallite size. Scanning Electron Microscopy (SEM). If approved and conducted in an

appropriate research laboratory, in vitro cell viability and other biological assays using suitable blood cancer cell models may be carried out to investigate the preliminary anticancer potential of the synthesized nanoparticles. The study aims to contribute to plant-mediated nanoparticle research and provide preliminary scientific information for future investigations related to blood cancer.

Keywords: Simarouba glauca, silver nanoparticles, green synthesis, silver nitrate, blood cancer, UV–Visible spectroscopy, FTIR, XRD, SEM, EDX, HR-TEM, anticancer research.

Green Synthesis of Magnesium Oxide Nanoparticles Using Acalypha Indica and Plectranthus Amboinicus Extracts And Their Photocatalytic Activities

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ABSTRACT

Magnesium oxide nanoparticles (MgO NPs) are important inorganic nanomaterials that have attracted considerable attention because of their unique physicochemical properties and wide range of applications in photocatalysis, antimicrobial activity, sensing, water purification, adsorption, and environmental remediation. In the present study, MgO nanoparticles are synthesized using a simple, eco-friendly and cost-effective green synthesis approach employing *Acalypha indica* and *Plectranthus amboinicus* plant extracts as natural reducing and stabilizing agents. The synthesized MgO nanoparticles will be characterized using various analytical techniques, including UV–Visible spectroscopy, Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), scanning electron microscopy (SEM). These techniques will be used to investigate the optical properties, functional groups, crystalline structure, morphology, particle size and elemental composition of the synthesized MgO nanoparticles. The photocatalytic activity of the green-synthesized MgO nanoparticles will be investigated using methylene blue (MB) dye as a model organic pollutant under light irradiation. The degradation of methylene blue will be monitored at different irradiation times using UV–Visible spectroscopy, and the photocatalytic degradation efficiency will be evaluated. The study is expected to demonstrate that MgO nanoparticles synthesized using *Acalypha indica* and *Plectranthus amboinicus* extracts possess promising photocatalytic properties. Thus, the present work highlights a green and sustainable

method for the synthesis of MgO nanoparticles using plant extracts and explores their potential application in the photocatalytic degradation of organic dyes, contributing to the development of environmentally friendly nanomaterials for wastewater treatment and environmental remediation.

Keywords: MgO nanoparticles, green synthesis, *Acalypha indica*, *Plectranthus amboinicus*, photocatalytic activity, methylene blue, plant extract, environmental remediation.

Detection Of Peripheral Artery Disease Using Smart Band Technology

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ABSTRACT

Peripheral Artery Disease (PAD) is a vascular disorder characterized by reduced blood flow through the peripheral arteries, particularly those supplying the lower limbs. Early identification and monitoring of PAD are important because impaired peripheral circulation may progress with limited or non-specific symptoms. The present study proposes the development of a smart-band-based system for non-invasive monitoring and preliminary screening of peripheral arterial circulation. The proposed wearable system will integrate photoplethysmography (PPG) sensors to acquire arterial pulse-wave signals from the body surface. The recorded signals will be processed using appropriate signal-processing techniques, and machine-learning algorithms will be explored to identify patterns associated with changes in peripheral blood flow. The processed data will be transmitted wirelessly to a mobile application for monitoring and visualization of the acquired parameters. The proposed system aims to provide a portable, user-friendly, and cost-effective approach for repeated monitoring of peripheral circulation outside conventional clinical settings. The study will also consider factors such as sensor placement, signal quality, and algorithm performance to improve the reliability of the proposed monitoring system. Overall, the proposed smart-band technology is intended to serve as a supportive screening and monitoring tool that may assist in identifying individuals who require further clinical assessment.

Keywords: Peripheral Artery Disease, Smart Band, Photoplethysmography, PPG Sensor, Peripheral Blood Flow, Wearable Technology, Machine Learning, Non-Invasive Monitoring.

Green Synthesis of Silver Nanoparticles Using the Leaf Extracts of the Medicinal Plant, Magnolia Champaca and Its Antibacterial And Anticancer Activities.

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Abstract

Silver nanoparticles (AgNPs) made by green synthesis offer a variety of biochemical properties and are an excellent alternative to traditional medications due to their low cost. In current study, we synthesised AgNPs from the leaf extract of the medicinal plant magnolia champaca. The nanoparticles were characterised by ultraviolet-visible (UV-Vis)spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR) scanning electron microscopy (SEM). SEM analysis showed AgNPs are highly crystalline and spherical with an average diameter of 7.13nm. Furthermore, the AgNPs demonstrated their ability to inhibit pathogenic microorganisms, staphylococcus aureus, and Escherichia coli. The results from the study displaced green synthesised AgNPs, antimicrobial and catalytic properties, which are crucial characteristics of a molecule with excellent applications.

Keywords: magnolia champaca, antibacterial activity, anticancer property. silver nanoparticles.

.Synthesis and Characterization of Physio-Chemical From *Cocculus Hirsutus* Extract

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ABSTRACT

Cocculus Hirsutus (Broom creeper or Ink berry), a widely utilized medicinal climbing shrub, is a rich source of bioactive secondary metabolites with diverse therapeutic applications. In this study, phytochemical extracts were isolated from *Cocculus hirsutus* leaves and stems and subjected to physico-chemical characterization to evaluate their structural and functional properties. The extracted material was analyzed for parameters such as pH, moisture content, ash content, and solubility index. FTIR spectroscopy confirmed the presence of characteristic functional groups associated with alkaloids, flavonoids, and hydroxyl linkages, while XRD analysis revealed the amorphous-crystalline nature and structural integrity of the plant extract. The UV-Visible spectroscopy was performed to study the optical properties and absorption profile of the active phytoconstituents. The results demonstrated that *Cocculus hirsutus* extract possesses suitable physico-chemical features, validating its traditional use and making it a promising natural material for applications in anti-inflammatory, antimicrobial, antioxidant, and bio-pharmaceutical formulations.

Keywords: *Cocculus hirsutus*, Broom creeper, Physico-chemical properties, FTIR, XRD, UV, Medicinal benefits.

Synthesis And Characterization of Silver Nanoparticles from Flower Extract Of *Gloriosa*

Superba

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ABSTRACT

Silver nanoparticles (Ag) will be created using a green synthesis method that employs GLORIOSA SUPERBA extract as both a reducing and stabilizing agent for silver. This process is

eco-friendly, cost-effective, and straightforward. We will characterize the synthesized nanoparticles using techniques such as FTIR, XRD, SEM, TEM, UV-vis spectroscopy, and EDX. The flame lily extract will show an absorption peak in the range of 400_500 nm. UV-vis spectroscopy will help confirm the optical properties and formation of AgNPs. We will analyze the shape, size, and surface structure of the nanoparticles with SEM and TEM, while XRD will verify their crystalline structure. These synthesized nanoparticles are expected to have antimicrobial, antioxidant, and biomedical applications. Using Glory lily extract for AgNP production offers a greener alternative to traditional chemical methods.

Keywords: Silver nanoparticles, green synthesis, UV-vis spectroscopy, FTIR, XRD, SEM, TEM, EDX.

Formulation And Evaluation Of Herbal Soap Using Acalypha Indicaleaf Extract

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ABSTRACT

This experiment involves the preparation of a herbal soap using Acalypha Indica leaves , aloe Vera, coconut oil, essential oil, and vitaminE . Fresh kuppaimeni leaves are cleaned and processed before being incorporated into the soap formulation. Aloe vera is included for its skin conditioning properties . While coconut oil helps provide cleansing and lathering properties.Essential oil is added for pleasant fragrance, and vitamin E is included as a skin-conditioning ingredient . The resulting herbal soap combines natural cleansing agents with skin-nourishing components, offering a mild and effective alternative to commercial soap.

Key Words: Acalypha Indica, herbal soap, vitamin E and natural formulation.

Green Synthesis and Characterization of Silver Nanoparticles Using *Murraya Koenigii* (Curry Leaf) Extract and Evaluation of Their Antibacterial Activity

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ABSTRACT

The present study focuses on the green synthesis of silver nanoparticles (AgNPs) using *Murraya koenigii* (curry leaf) extract as a natural reducing and stabilizing agent. Curry leaves contain various bioactive compounds such as phenolics, flavonoids, proteins and other phytochemicals, which can facilitate the reduction of silver ions into silver nanoparticles. The leaf extract will be prepared using a suitable aqueous extraction method and treated with an aqueous silver nitrate (AgNO_3) solution under controlled conditions. The formation of silver nanoparticles will be initially indicated by the colour change of the reaction mixture and further confirmed using suitable characterization techniques such as UV–Visible spectroscopy, FTIR, XRD, SEM and EDX, depending on instrument availability. The synthesized AgNPs will be evaluated for their antibacterial activity against selected bacterial strains using an appropriate microbiological method. This study aims to develop a simple, cost-effective and environmentally friendly approach for the synthesis of silver nanoparticles using an easily available plant source.

Keywords: *Murraya koenigii*, silver nanoparticles, Green synthesis, antibacterial activity,

Synthesis And Characterization of Endocarp of *Cocos Nucifera* Extract

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ABSTRACT

Agricultural by-products such as coconut shell (*Cocos nucifera* L.) are increasingly being investigated as sustainable and renewable sources for high-value biomedical and environmental applications. The present study focuses on the synthesis and characterization of coconut shell-derived nanoparticles (CSNPs) and their potential applications in healthcare and environmental

remediation. Coconut shells were subjected to controlled pyrolysis and subsequent nanoparticle fabrication, followed by structural, morphological, and chemical characterization using scanning electron microscopy (SEM), transmission electron microscopy (TEM), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD). The biological properties of the synthesized CSNPs were evaluated through standard in vitro assays to investigate their antioxidant, antimicrobial, and anti-inflammatory activities. Furthermore, the incorporation of CSNPs into oral hygiene formulations was explored to assess their microbial reduction efficiency. Their potential application in tissue engineering and bone regeneration was also investigated through the fabrication of suitable nanocomposites. The synthesized CSNPs exhibited favorable surface characteristics, high adsorption capacity, and good biocompatibility, indicating their potential for applications in wound healing, infection control, and oxidative stress management. In addition, their adsorption properties suggest promising applications in water and air purification, highlighting their potential as multifunctional and sustainable nanomaterials. Overall, this study demonstrates the potential of coconut shell-derived nanoparticles as cost-effective, renewable, and eco-friendly materials for biomedical, healthcare, and environmental applications.

Keywords: Coconut shell-derived nanoparticles, *Cocos nucifera* L., Nanocomposites, Activated carbon, Antioxidant activity, Antimicrobial activity, Oral hygiene, Bone regeneration, Sustainable biomaterials, Environmental remediation.

**Phytochemical Studies, Chemical Composition, Antibacterial and Fluorescence Activities
of Indigofera Tinctoria Leaf Extract**

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ABSTRACT

Indigofera tinctoria L. is an important medicinal plant belonging to the family Fabaceae and has traditionally been used for its therapeutic and dye-producing properties. The present study was Undertaken To Investigate The Phytochemical Constituents, Antibacterial Potential and Fluorescence Characteristics of Indigofera Tinctoria in Association With Methylene Blue. Plant Material Was Collected, Shade-Dried and Subjected to Extraction Using Suitable Solvents. The Prepared Extracts Were Screened Qualitatively For Major Phytochemical Groups, Including

Alkaloids, Flavonoids, Phenolic Compounds, Tannins, Saponins, Terpenoids, Steroids, Glycosides and Other Secondary Metabolites.

Keywords: Indigofera Tinctoria, Fluorescence Characteristics, Phytochemical, Antibacterial.

Characterization and Evaluation of Antioxidant Activity of Pomegranate Peel Extract And Development Of A Natural Antioxidant Product

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ABSTRACT

Punica granatum peel is a rich source of bioactive compounds such as polyphenols, flavonoids and tannins, which possess potential antioxidant properties. In the present study, Punica granatum peel was collected, cleaned, dried and powdered, followed by extraction using a suitable solvent. The prepared extract was characterized using UV–Visible and Fourier Transform Infrared (FTIR) spectroscopy to study its absorption characteristics and functional groups. The antioxidant activity of the extract was evaluated using the DPPH radical-scavenging assay at different concentrations and compared with ascorbic acid as a standard antioxidant. The phytochemical constituents of the extract were also investigated. Based on its antioxidant potential, a natural antioxidant product was developed and evaluated for its physicochemical properties, stability and antioxidant activity. The study demonstrates the potential of Punica granatum peel as an economical and sustainable source of natural antioxidants for value-added product development.

Keywords: Punica granatum, UV–Visible, FTIR, DPPH, antioxidant activity, natural antioxidant product.

Green Synthesis and Characterization of Silver Nanoparticles Using Jathikai (*Myristica Fragrans*) Seed Extract

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ABSTRACT

The green synthesis of silver nanoparticles (AgNPs) has attracted considerable attention due to its eco-friendly, cost-effective, and sustainable nature. The present study focuses on the green synthesis and characterization of silver nanoparticles using Jathikai (*Myristica fragrans*) seed extract as a natural reducing and capping agent. The bioactive phytochemical present in the seed extract plays an important role in the reduction of silver ions and stabilization of the synthesized nanoparticles. The plant extract will be prepared using a suitable extraction procedure and mixed with an aqueous silver precursor solution under controlled experimental conditions. The formation of AgNPs will be initially confirmed by the visible color change of the reaction mixture and further evaluated using appropriate characterization techniques. The synthesized nanoparticles will be characterized by UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Energy Dispersive X-ray (EDX) analysis, and X-ray Diffraction (XRD). The optical, structural, morphological, and elemental properties of the synthesized AgNPs will be investigated from the obtained characterization results. The study also aims to examine the potential antimicrobial activity of the synthesized silver nanoparticles against selected microbial strains using suitable antimicrobial testing methods. The synthesized nanoparticles may find potential applications in biomedical, pharmaceutical, environmental, and other emerging technological fields.

Keywords: Green synthesis, silver nanoparticles, Jathikai, *Myristica fragrans*, UV–visible spectroscopy, FTIR, SEM, TEM, EDX, XRD, antimicrobial activity.

Green Synthesis and Characterization of Zinc Oxide Nanoparticles Using Pavallamalli (*Nyctanthes Arbor-Tristis*) Leaf Extract

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ABSTRACT

Green synthesis of nanoparticles is an eco-friendly and cost-effective approach that uses biological materials as reducing and stabilizing agents. In the present study, *Nyctanthes arbor-tristis* (Pavallamalli) leaves are proposed as a natural source for the green synthesis of zinc oxide nanoparticles (ZnO NPs). The aqueous leaf extract will be prepared and used during the synthesis of ZnO nanoparticles. The synthesized nanoparticles will be characterized using techniques such as UV–Visible spectroscopy, FT-IR spectroscopy, XRD and SEM. These techniques can provide information about the optical properties, functional groups, crystalline structure and morphology of the nanoparticles. The study aims to explore the potential of Pavallamalli leaf extract as a biological material for nanoparticle synthesis and to develop an environmentally friendly synthesis method.

Keywords: Pavallamalli, zinc oxide, green synthesis, natural, characterization

Green Synthesis and Characterization of Silvernanoparticles Using Mango Leaf Extract *Mangifera Indica*

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ABSTRACT

Green synthesis of silver nanoparticles (AgNPs) using mango (*Mangifera indica*) leaf extract is a simple, eco-friendly, and cost-effective method. Mango leaves contain various phytochemicals such as flavonoids, phenolic compounds, terpenoids, and proteins that can act as

reducing and stabilizing agents during nanoparticle formation. In this method, mango leaf extract is mixed with a silver salt solution, resulting in the reduction of silver ions (Ag^+) to silver nanoparticles. The formation of AgNPs can be indicated by a visible change in the color of the solution. The synthesized nanoparticles can be characterized using techniques such as UV–Visible spectroscopy, FTIR, XRD, and SEM. Mango leaf-mediated AgNPs have potential applications in antimicrobial activity, environmental treatment, medicine, and other fields. Thus, this approach provides an environmentally friendly alternative to conventional chemical synthesis methods.

Keywords: Green synthesis, silver nanoparticles, mangifera indica, phytochemicals, SEM, FTIR, XRD.

Development of An Eggshell-Derived CaCO_3 - Anthocyanin Composite Paper Sensor For Visual Detection Of Volatile Amines

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ABSTRACT

The present study aims to develop an eco-friendly colorimetric paper sensor using eggshell-derived calcium carbonate (CaCO_3) and natural anthocyanin. Eggshell waste will be processed to obtain CaCO_3 and characterized by standard techniques. Anthocyanin extract will be incorporated with CaCO_3 to form a functional composite. The composite will be immobilized on cellulose paper to fabricate a disposable sensor strip. The sensor will detect volatile amines through a pH-responsive colour change of anthocyanin. CaCO_3 /anthocyanin ratio and sensing conditions will be optimized. Sensitivity, response time, selectivity, stability and reproducibility will be evaluated. Smartphone-based RGB analysis will be used for semi-quantitative colour evaluation. The sensor will be tested with suitable real food samples for freshness indication. The study aims to develop a low-cost, portable and instrument-independent chemical sensing platform.

Keywords: Eggshell, Cellulose, CaCO_3 , Anthocyanin, sensor strip.

Green Synthesis and Characterization of Silver Nanoparticles Using *Musa Acuminata* Colla Flower Extract

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ABSTRACT

The green synthesis of silver nanoparticles (AgNPs) has attracted considerable attention because of its eco-friendly, cost-effective, and sustainable nature. The present study focuses on the green synthesis and characterization of silver nanoparticles using *Musa acuminata* Colla flower extract as a natural reducing and capping agent. Bioactive phytochemicals, including flavonoids and phenolic compounds, present in the flower extract may play an important role in the reduction of silver ions and stabilization of the synthesized nanoparticles. The formation of AgNPs was initially indicated by the visible color change of the reaction mixture from pale yellow to dark brown and was further investigated using various characterization techniques. The synthesized AgNPs were characterized using UV–Visible spectroscopy, Fourier-transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), energy-dispersive X-ray (EDX) analysis, and X-ray diffraction (XRD). These techniques provided information regarding the optical, functional, morphological, elemental, and crystalline properties of the synthesized nanoparticles. TEM analysis revealed that the synthesized AgNPs were predominantly spherical in shape, with particle sizes ranging from approximately 12 to 29 nm. Furthermore, the antibacterial and anticancer activities of the synthesized AgNPs were evaluated to investigate their potential biomedical applications. The findings suggest that *Musa acuminata* Colla flower extract can serve as a promising biological resource for the synthesis of silver nanoparticles with potential applications in biomedical, pharmaceutical, and other emerging technological fields.

Keywords: Green synthesis, silver nanoparticles, *Musa acuminata* Colla, flower extract, spherical nanoparticles, UV–Visible spectroscopy, FTIR, SEM, TEM, EDX, XRD, antibacterial activity, anticancer activity.

Green Nanoengineering of Silver Nanomaterials for Next-Generation Active Food Packaging: Sustainable Synthesis, Characterization and Food Preservation

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ABSTRACT

The increasing demand for safe, sustainable, and effective food-packaging technologies has encouraged the development of green nanotechnology-based active packaging systems. The present study aims to develop silver nanomaterials through an eco-friendly green synthesis route using a suitable plant-derived bioactive source and to investigate their potential application in active food packaging. The synthesized silver nanomaterials will be characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray diffraction (XRD), Scanning/Transmission Electron Microscopy (SEM/TEM), and Energy Dispersive X-ray spectroscopy (EDX) to determine their optical properties, functional groups, crystalline structure, morphology, particle size, and elemental composition. Their antibacterial and antifungal activities will be evaluated against selected foodborne microorganisms using appropriate in-vitro assays. The developed packaging material will be evaluated for physicochemical, mechanical, barrier, antimicrobial, and functional properties. Its potential to inhibit microbial growth and extend the quality and shelf life. The study is expected to demonstrate the potential of green-synthesized silver nanomaterials as functional components of active food-packaging systems. This approach may contribute to the development of sustainable antimicrobial packaging with improved food safety and preservation, while reducing dependence on conventional chemical synthesis methods.

Keywords: Silver nanomaterials, Active food packaging, Antibacterial activity and Antifungal activity

Synthesis and Characterization of Gold Nanoparticles from Fruit Peel Extract of *Malus Domestica*

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ABSTRACT

Gold nanoparticles (AuNPs) were synthesized using a plant-mediated green synthesis method with *Malus domestica* (apple) peel extract as a reducing and stabilizing agent and chloroauric acid (HAuCl_4) as the gold precursor. The study presents a simple and eco-friendly approach for the synthesis of AuNPs. The synthesized nanoparticles were characterized using UV–Visible (UV–Vis) spectroscopy, X-ray diffraction (XRD), Fourier Transform Infrared (FTIR) spectroscopy, Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Dynamic Light Scattering (DLS), zeta potential analysis, and Energy Dispersive X-ray (EDX) spectroscopy to investigate their optical, structural, morphological, particle-size, surface-charge, and elemental properties. FTIR analysis identified the functional groups associated with the reduction and stabilization of the nanoparticles. The optical properties and band gap of the synthesized AuNPs were evaluated using UV–Vis spectroscopy. The structural analysis confirmed the crystalline nature of the synthesized nanoparticles, while SEM and TEM provided information on their morphology and particle size. EDX analysis confirmed the presence of gold. The green synthesis approach using *Malus domestica* peel extract provides an environmentally friendly alternative to conventional chemical synthesis methods and offers potential for future applications in catalysis, antimicrobial materials, environmental remediation, and other nanotechnology-related fields.

Keywords: Gold nanoparticles, *Malus domestica*, apple peel extract, green synthesis, UV–Vis spectroscopy, XRD, FTIR, TEM, SEM, DLS, zeta potential, EDX.

**Development Of Natural Biocomposite Film From Potato Starch, Glycerol, Banana Fiber,
And Drumstick Leaf Powder**

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ABSTRACT

The present study focuses on the development of a biodegradable potato starch-based biocomposite film. Potato starch is used as the primary film-forming material. Okra mucilage is incorporated as a natural film-modifying component. Banana fiber is added as a natural reinforcing material. Drumstick leaf powder is used as a plant-based bio-filler. Different formulations are prepared by varying the proportions of these materials. The films are prepared by gelatinization, mixing, casting and controlled drying. The prepared films are evaluated for thickness, water absorption, solubility and flexibility. The biodegradation behaviour of the films is studied under soil burial conditions. The study aims to develop a simple biodegradable film using renewable plant-based materials

Keywords: Potato starch, Okra mucilage, Banana fiber, Drumstick leaf powder, Glycerol, BioComposite film.

**Biosynthesis and Characterization of Silver Nanoparticles from Fruit Peel Extract of
*Citrus Sinensis***

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ABSTRACT

Silver nanoparticles (AgNPs) were synthesized by a plant-mediated green synthesis method using orange (*Citrus sinensis*) peel extract as a reducing and stabilizing agent with silver nitrate as the precursor. The present study demonstrates a simple and eco-friendly approach for the synthesis of silver nanoparticles. The synthesized nanoparticles were characterized using Scanning Electron Microscopy (SEM), UV–Visible (UV–Vis) spectroscopy, Energy Dispersive X-ray (EDX) spectroscopy, and X-ray Diffraction (XRD) to investigate their morphological, optical, elemental, and structural properties. The functional groups involved in the formation and stabilization of the silver nanoparticles were identified using spectroscopic analysis. The green synthesis of silver nanoparticles using *Citrus sinensis* peel extract provides an environmentally friendly alternative to conventional chemical synthesis methods. The synthesized silver nanoparticles may have potential applications in antimicrobial activity, biomedical fields, nanomedicine, diagnostics, cell separation, cosmetics, and preservation.

Keywords: Silver nanoparticles, *Citrus sinensis*, orange peel extract, green synthesis, UV–Vis spectroscopy, FTIR, XRD, SEM, EDX.

**Synthesis And Characterization Of Gold Nanoparticles From The Leaf Extract Of *Nerium
Oleander***

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ABSTRACT

Green nanotechnology provides a safe, cost-effective, and eco-friendly approach for synthesizing noble metal nanomaterials. This study presents a completely green, biological

synthesis of gold nanoparticles (AuNPs) using the aqueous leaf extract of *Nerium oleander*, which acts as both an effective reducing and capping agent. The successful reduction of gold ions (Au^{3+} to Au^0) was indicated by a rapid color change to a deep ruby red, which was confirmed via UV-Vis spectrophotometry displaying a characteristic surface plasmon resonance (SPR) peak. Fourier Transform Infrared Spectroscopy (FTIR) analysis indicated that plant-derived biomolecules, including polyphenols, flavonoids, and cardiac glycosides, were responsible for capping and stabilizing the nanoparticles. Structural and morphological characteristics examined through X-ray Diffraction (XRD) and Transmission Electron Microscopy (TEM) verified the formation of highly crystalline, predominantly spherical gold nanoparticles with an average size ranging from 15 to 35 nm. Additionally, the synthesized AuNPs demonstrated significant biomedical potential, exhibiting strong antioxidant activity and selective anti-cancer effects against specific cell lines. These results highlight the potential of utilizing *Nerium oleander* biomass as a sustainable resource for advanced biomedical applications.

Keywords: Nerium oleander, Leaf Extract, Gold Nanoparticles, Green Synthesis, TEM Characterization, Biomedical Applications.

Green Synthesis and Characterization of Copper Oxide Nanoparticles Using *Leucas aspera* Flower Extract and Evaluation of Antimicrobial Activities

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ABSTRACT

The present study focuses on the green synthesis of copper oxide nanoparticles (CuO NPs) using *Leucas aspera* flower extract as a natural and eco-friendly reducing and stabilizing agent. The flower extract contains various phytochemicals that can facilitate the formation and stabilization of nanoparticles. The synthesized CuO nanoparticles are characterized using suitable analytical techniques such as UV–Visible spectroscopy, FTIR, XRD and SEM to determine their optical properties, functional groups, crystalline structure and Morphology. The antioxidant activity of the synthesized nanoparticles is evaluated using suitable free-radical scavenging as says. Their antimicrobial activity is also investigated against selected bacterial and fungal strains. The

study aims to develop an environmentally friendly method for nanoparticle synthesis and to explore the potential biological applications of *Leucas aspera*-mediated CuO nanoparticles. This approach may provide a simple, cost-effective and sustainable alternative to conventional nanoparticle synthesis methods.

Keywords: *Leucas aspera* flower, CuO Nanoparticle, Green synthesis, UV–Visible, FTIR, XRD

Valorization of Eggshell Waste For Green Synthesis of Hydroxyapatite Using Psidium

Guajava

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ABSTRACT

The present study focuses on the sustainable valorization of eggshell waste for the green synthesis of hydroxyapatite (HAp) using *Psidium guajava* (guava) leaf extract. Eggshell waste, which is a readily available and calcium-rich biowaste, will be utilized as a sustainable calcium precursor for the preparation of hydroxyapatite. *P. guajava* leaves contain various bioactive phytochemicals that may contribute to the formation and stabilization of the synthesized material. The collected eggshells will be thoroughly cleaned, dried, and processed to obtain a calcium-rich precursor, which will subsequently be combined with guava leaf extract for the eco-friendly synthesis of HAp. The synthesized hydroxyapatite will be characterized using suitable analytical techniques to investigate its structural, chemical, optical, and morphological properties. The study aims to develop an environmentally friendly approach for converting eggshell waste into a value-added biomaterial while minimizing the use of hazardous chemicals and reducing environmental impact. This work highlights the potential of eggshell waste and *Psidium guajava* leaf extract as sustainable resources for the green synthesis of hydroxyapatite with potential applications in biomedical and biomaterial-related fields.

Keywords: Eggshell waste, Hydroxyapatite, *Psidium guajava*, Guava leaf extract, Green synthesis, Biowaste valorization, Sustainable biomat

Formulation And Evaluation Of Face Serum Using Acalypha Indica

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ABSTRACT

This project focus on the preparation and evaluation of a natural herbal serum using kuppaimeni (*Acalypha indica*) leaf extract for improving the appearance of uneven skin tone and dark spots. Kuppaimeni leaves contain natural bioactive compounds such as alkaloids, flavonoids, tannins and phenolic compounds, which may contribute to antioxidant skin – supporting properties. The formulation contain kuppaimeni leaf extract, alovera, green tea, Centella asiatica (vallarai), licarica (Athimathuram), vegetable glycerine and distilled water. These natural ingredients are selected for their moisturizing, soothing and antioxidant properties they prepared serum is evaluated for colour, appearance, PH, viscosity, spreadability, stability, antioxidant activity and microbial safety. The study aims to develop a simple plant-based herbal serum using natural ingredients and asses its physicochemical properties and potential for improving the appearance of uneven skin tone. Further investigation is going to do characterizations like XRD and FTIR for safety purpose.

Keywords: *Acalypha indica*, Antioxidant, Herbal serum, physicochemical properties

Sustainable Bioadsorbent From Plant Waste For Efficient Dye Removal

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ABSTRACT:

Textile dye pollution is a major threat to water resources. This thesis presents the development of a sustainable, low-cost bioadsorbent from plant waste-derived shell and biomass for efficient dye removal from wastewater. The bioadsorbent was prepared through washing, drying, grinding, and chemical activation, and characterized by SEM, FTIR, and XRD analysis.

Batch adsorption studies were conducted to optimize pH, dosage, contact time, and dye concentration. The bioadsorbent achieved over 90% dye removal efficiency and the data fitted well with Langmuir isotherm and pseudo-second-order kinetic models. The study confirms that plant waste can be converted into a valuable, eco-friendly alternative to commercial activated carbon for wastewater treatment.

Keywords: Bioadsorbent, Plant Waste, Dye Removal, Adsorption

Growth and Investigation of Structural, Elemental, Optical, Thermal and Non-linear Optical Properties of Lithium Pentaborate Tetrahydrate Single Crystals

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ABSTRACT

Lithium pentaborate tetrahydrate ($\text{LiB}_5\text{O}_8 \cdot 4\text{H}_2\text{O}$) nonlinear optical (NLO) single crystals were successfully grown by the slow evaporation solution growth method at ambient temperature. Optically transparent crystals with good morphology were obtained from aqueous solution using high-purity precursors. The crystalline nature and phase formation were examined by powder X-ray diffraction and the observed diffraction peaks validate good crystallinity without detectable secondary phases. Optical behavior was studied using UV–Vis absorption spectroscopy, which revealed low absorbance and high transmittance in the visible region. The optical band gap was determined using the Tauc plot method and was found to lie in the wide band gap region, confirming dielectric characteristics. Functional group analysis by FTIR spectroscopy confirmed the presence of characteristic borate network vibrations along with coordinated water molecules. Elemental analysis carried out using energy dispersive X-ray spectroscopy verified the presence of boron and oxygen, while lithium could not be detected due to its low atomic number and inherent instrumental detection limitations. Photoluminescence studies showed distinct emission bands associated with borate group transitions and intrinsic defect centers. Thermal behavior and

stability were evaluated using TG–DTA and DSC analyses, which indicated stepwise dehydration and thermal stability up to the onset of decomposition. The nonlinear optical response was confirmed through second harmonic generation measurements using the Kurtz-Perry powder technique, showing appreciable SHG efficiency. These results indicate that solution-grown lithium pentaborate tetrahydrate crystals are promising candidates for nonlinear optical and photonic device applications.

Keywords: Lithium pentaborate tetrahydrate, Slow evaporation growth, Nonlinear optical materials, Structural and optical analysis, Energy-dispersive X-ray spectroscopy, Wide band gap crystal, Thermal stability, SHG efficiency

Density Functional Theory (DFT) Insights into the Structural, Electronic, and Spectroscopic Properties of Novel Oxospiro-indoline Derivatives

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ABSTRACT

Oxospiro-indoline derivatives were investigated using density functional theory (DFT) at the B3LYP/6-31G** level to elucidate their structural, electronic, and thermodynamic properties. Geometric optimization revealed a highly strained spiro-quaternary carbon centre, dictating a perpendicular orientation between the oxindole and core heterocycle. The conformational stability of Methyl 3'-benzyl-4'-(2-chlorophenyl)-1'-methyl-2-oxospiro[indoline-3,2'-pyrrolidine]-3'-carboxylate (OSI) was elucidated using potential energy surface scan studies. Frontier molecular orbital (FMO) analysis showed a narrow HOMO-LUMO gap of 2.85 eV, indicating high kinetic reactivity and significant charge-transfer character. Molecular electrostatic potential (MEP) mapping successfully identified the carbonyl oxygen as the primary electrophilic site, while the indoline nitrogen acted as the dominant nucleophilic region. Global reactivity descriptors, including chemical hardness, softness, and electrophilicity index, further validated the compound's potential as a highly reactive bio isostere. These computational insights establish a rigorous

structural foundation for utilizing these oxospiro-indoline derivatives in targeted scaffold-based drug design.

Keywords: DFT, MEP, FMO

Synthesis of Ag-Modified MoO₃/RGO Nano composites for Enhanced electrochemical Energy storage application

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ABSTRACT

The development of efficient electrode material is essential for improving the performance energy-storage devices. In this work, an Ag-modified MoO₃/rGO Nano composite was synthesized through a facile hydrothermal approach for super capacitor application . the incorporation of silver nanoparticle s onto MoO₃Nanostructures and their integration with reduced grapheme oxide (rGO) provides a conductive and interconnected framework. The structural, morphological, and compositional properties of the prepared of the prepared material were investigated using x –ray diffraction (XRD),field-emission scanning electron microscopy (FESEM),transmission electron microscopy(TEM) and related characterization techniques. The result confirms the formation of crystalline MoO₃ Nanostructure decorated with Ag nanoparticles and supported by rGO sheets. The presence of Ag and rGO improves the electrical conductivity and provides additional active site for electrochemical reactions. Electrochemical measurements were performed using a three – electro configuration in an aqueous electrolyte to evaluate the charge –storage behavior of the composite electrode. The Ag-MoO₃/rGO electrode exhibits improved electrochemical performance compared with pristine MoO₃,demonstraring the beneficial contribution of Ag modification and rGO incorporation .The enhanced electrochemical characteristics of the Nano composite demonstrate its potential as an electrode material for high –performance super capacitor and energy –storage application

Keywords:

MoO₃/rGO; silver nanoparticles, molybdenum oxide, Nano composites, supercapacitor, energy storage

Synthesis, Characterization and Applications of Natural Extracts From *Teak Leaves*

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ABSTRACT

Teak leaves (*Tectona grandis*) are a rich source of naturally occurring bioactive compounds, including phenolics, flavonoids, tannins, and other secondary metabolites. The prepared extracts are characterized using UV–Visible spectroscopy, FTIR spectroscopy, and other suitable analytical techniques to identify their major phytochemical constituents and functional groups. The biological and functional properties of the teak leaf extract may be evaluated through appropriate antioxidant and antimicrobial assays. The study aims to explore the potential of teak leaves as an inexpensive, renewable, and environmentally friendly source of natural bioactive materials. The findings may support the utilization of teak leaf waste in value-added applications such as natural antioxidants, antimicrobial agents, green synthesis, and sustainable biomaterial development.

Keywords: *Tectona grandis*, FTIR, UV–Visible spectroscopy, antioxidant activity, antimicrobial activity.

L-Glycine-Assisted Growth And Characterization Of Potassium Chloride Single Crystal

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ABSTRACT

Potassium chloride (KCl) and L-glycine are important crystalline materials with potential applications in optical, electronic, and materials science research. In the present study, single crystals of potassium chloride and L-glycine were grown using the slow evaporation solution growth technique at room temperature. The solutions were allowed to evaporate slowly under controlled conditions, resulting in the formation of well-defined crystals. The grown crystals were characterized using powder X-ray diffraction (PXRD) to determine their crystalline structure and phase purity. Fourier-transform infrared (FTIR) spectroscopy was used to identify the functional groups and molecular interactions, while UV–Visible spectroscopy can be employed to study their optical transparency and absorption characteristics. The study provides a comparative understanding of the crystal growth process and physicochemical properties of KCl and L-glycine crystals. The results demonstrate the suitability of the solution growth technique for obtaining good-quality crystals for further materials science investigations.

Keywords: Potassium chloride, L-glycine, Single crystal growth, Slow evaporation technique, Solution growth, X-ray diffraction, FTIR spectroscopy, UV–Visible spectroscopy.

Development Of A Sustainable Natural Dye From Sapodilla Peels And Myrobalan

Extract

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ABSTRACT

The natural dye is extracted from the fruits of Sapodilla (*Manilkara zapota*) and Myrobalan (*Terminalia chebula*). *Manilkara zapota* is consumed in large quantity in different ways and lot of waste (Sapodilla peels) is thrown after consuming pulp from it. The effective use of this waste will help in ecological management. *Terminalia chebula* is used as a medicinal plant widely used in *Ayurveda* and used in textile dyeing since ancient times. As impacts as yellowish-brown colour. It is also used as mordent, enhancing the fixation, colour fastness and hue of other natural dyes. Despite being the most widely used bio-mordent for dyeing with natural dyes, inconsistency in the terms of dyeing method and uniform colour uptake have been a major problem in the commercial dyeing using sapodilla and myrobalan. In this study, UV, FTIR, SEM (Socking techniques).

Keywords :UV,FTIR,XRD and SEM

Deveopment of An Intelligent Radar-Based Surveillance And Threat Detection System For Real-Time Airspace Monitoring

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ABSTRACT

The system for real-time detection, tracking, and classification of aerial targets. The increasing use of unmanned aerial vehicles, (UAVs) high-speed aircraft, and other airborne objects. The design and development of an intelligent RADAR-based airspace surveillance highlights the need for reliable and automated monitoring technologies. The proposed system

employs Radio Detection and Ranging (RADAR) principles to transmit radio-frequency signals and process reflected echoes to estimate important target parameters such as range, azimuth, elevation, and relative velocity. The system integrates RADAR sensing with digital signal processing, noise and clutter reduction, target detection algorithms, and real-time data visualization to improve detection reliability. A simulation-based command-and-control interface is developed to display target trajectories and provide continuous airspace status information. Target classification is performed using measurable parameters such as motion characteristics and spatial information. The system also incorporates multi-target tracking and automated alert generation to support rapid identification of potentially significant aerial objects, tracking stability, response time, false-alarm rate, and target localization accuracy under simulated operating conditions. The proposed framework provides a scalable approach for early-warning, airspace monitoring, UAV surveillance, and critical infrastructure protection, while reducing dependence on continuous manual observation.

Keywords: RADAR; Airspace Surveillance; Target Detection; UAV Detection; Digital Signal Processing; Target Tracking; Threat Classification; Range Estimation; Real-Time Monitoring; Early Warning System.

Green Synthesis and Characterization of Polymeric Nanoparticles Using Agave Plant

Extract

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ABSTRACT:

The present study focuses on the synthesis and characterization of polymeric nanoparticles using Agave plant extract as a natural bioactive source. Agave contains various phytochemicals such as phenolic compounds, flavonoids, saponins, and other bioactive constituents that may contribute to its biological activities. In this study, Agave plant extract will be prepared and incorporated into a suitable polymeric nanoparticle system using an appropriate preparation method. The synthesized nanoparticles will be characterized to determine their particle size, surface morphology, functional groups, and physicochemical properties using techniques such as (UV)–Visible spectroscopy, (FTIR) spectroscopy, particle size analysis, and (SEM) depending on availability. The study aims to evaluate the potential of Agave-based polymeric

nanoparticles as a promising drug-delivery system, with improved stability, controlled release, and enhanced bioavailability of bioactive compounds. The findings may provide useful information for the development of plant-based polymeric nanocarriers for potential pharmaceutical and biomedical applications.

Keywords: UV, FTIR, XRD

Development of Ecofriendly Plant Based Adsorbents For Synthetic Dye Removal From Waste Water

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ABSTRACT

Methyl Orange is a common synthetic dye that can cause water pollution. The study aims to develop a simple, low-cost and eco-friendly method for Methyl Orange removal using bio-waste materials. The waste Tulsi leaves and eggshells are used as low-cost bio-adsorbents for dye removal. The prepared bio-adsorbent is used for the adsorption of Methyl Orange from aqueous solution. The adsorption efficiency is studied using UV-Visible spectrophotometry. Optimization is carried out by varying adsorbent dosages from 0.1–1.0 g and the initial Methyl Orange concentration is varied from 10–50 mg/L. The contact time is optimized from 30–180 minutes and pH is varied from 2–8. The percentage removal and adsorption capacity are calculated for different conditions.

Keywords: Tulsi, Eggshell, Methyl Orange, Dye, Adsorption

Effect of Controlled Shock Waves on the Structural, Optical and Dielectric Characteristics of Glycine Doped Magnesium Sulfate Single Crystal

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Abstract

The single crystals of glycine-doped magnesium sulfate (GMS) were grown by the slow evaporation solution growth technique. The grown single crystal is subjected to successive acoustic shock-wave loading to study shock-induced defect engineering. PXRD results reveal shock-induced lattice distortion and structural reorganization while preserving the fundamental orthorhombic crystalline framework of GMS. The high optical transparency was revealed by UV-visible absorption spectroscopy. The Raman analysis exhibited the characteristic $V_1(\text{SO}_4^{2-})$ vibrational band at 995 cm^{-1} , confirming the preservation of the sulfate tetrahedral framework. The photoluminescence study shows the emission at 413 nm. The PL intensity increases with shock pulse. The dielectric studies revealed low dielectric loss and good dielectric stability. The chemical etching study showed controlled defect evolution without significant degradation of the surface. These results together indicate that acoustic shock-wave loading is an effective post-growth defect-engineering approach for tailoring the multifunctional properties of GMS crystals non-linear optical applications.

Keywords: Glycine-doped magnesium sulfate; Acoustic shock-wave loading; Defect engineering; Structure-property relationship; Raman spectroscopy; Photoluminescence.

Eco-Friendly Synthesis of Zinc Oxide Nanoparticles Using Hibiscus Leaf Extract

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ABSTRACT

Green synthesis of nanomaterials has gained considerable attention as a sustainable alternative to conventional chemical synthesis methods. The present study aims to synthesize zinc oxide nanoparticles (ZnO NPs) using an aqueous extract of *Hibiscus rosa-sinensis* leaves through an

eco-friendly and cost-effective approach. The phytochemicals present in the leaf extract, including flavonoids, phenolic compounds and other bioactive constituents, are expected to facilitate nanoparticle formation and influence their stabilization. The synthesis will be carried out under controlled conditions by optimizing parameters such as pH, temperature, precursor concentration and reaction time. The formation of ZnO nanoparticles will be investigated using UV–Visible spectroscopy, while FTIR spectroscopy will be employed to identify the functional groups associated with the synthesized material. Further characterization using X-ray diffraction (XRD) and scanning electron microscopy (SEM), where available, will help determine the crystalline structure and surface morphology of the nanoparticles. The synthesized ZnO nanoparticles may also be evaluated for their photocatalytic activity in the degradation of selected synthetic dyes under suitable light conditions. This study integrates green chemistry, plant-based synthesis and nanotechnology to develop a potentially sustainable material for environmental applications. The proposed method aims to reduce the use of hazardous chemicals and promote the utilization of renewable biological resources in nanomaterial preparation.

Keywords: Green synthesis, zinc oxide nanoparticles, *Hibiscus rosa-sinensis*, phytochemicals, photocatalysis, environmental sustainability.

Emerging Innovations in Advanced Materials, Sustainable Energy and Biomedical Technologies

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Abstract

Rapid advances in science and technology are transforming the fields of materials science, energy, and biomedicine, creating new opportunities to address major global challenges. Advanced materials with tailored structural, optical, electrical, and mechanical properties are contributing to the development of high-performance devices, sensors, energy-storage systems, and sustainable technologies. In the energy sector, research on renewable energy, energy-efficient materials, batteries, supercapacitors, and emerging energy-conversion technologies is essential for achieving

a cleaner and more sustainable future. At the same time, biomedical innovation is progressing through smart biomaterials, nanotechnology, biosensors, drug-delivery systems, tissue engineering, and diagnostic technologies. This conference highlights recent developments and interdisciplinary approaches that connect advanced materials, sustainable energy, and biomedical applications. The integration of nanoscience, artificial intelligence, biotechnology, and materials engineering provides new pathways for designing innovative solutions with improved efficiency, safety, sustainability, and performance. Collaboration among researchers from different disciplines is particularly important for translating scientific discoveries into practical applications. SCIENTIA 2026 therefore provides a platform for sharing emerging research, exchanging knowledge, and exploring future directions in advanced materials, energy, and biomedical innovation for the benefit of society and sustainable development.

Keywords: Advanced Materials, Nanotechnology, Renewable Energy, Energy Storage, Biomedical Innovation, Biosensors, Sustainable Technology.

Green synthesis of zinc oxide nanoparticles using aegle marmelos root extract

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Abstract:

The present study focuses on the green synthesis of zinc oxide (ZnO) nanoparticles using Aegle marmelos root extract as a natural reducing and stabilizing agent. Green synthesis is an eco-friendly, cost-effective, and sustainable approach that minimizes the use of toxic chemicals and harmful by-products. The phytochemicals present in Aegle marmelos root extract facilitate the formation and stabilization of ZnO nanoparticles. The synthesized ZnO nanoparticles can be characterized using UV–Visible spectroscopy, FTIR spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDX) to determine their optical, structural, functional, and morphological properties. The prepared ZnO nanoparticles may have potential applications in antimicrobial activity, photocatalysis, environmental remediation, and other technological fields. Thus, the study provides a simple and

environmentally friendly method for the preparation of ZnO nanoparticles using a plant-based synthesis route.

Keywords: Aegle marmelos, Zinc oxide, green synthesis, UV, XRD, SEM, FTIR.

Synthesis and characterization of zinc nanoparticles using plate leaf extraction artocarpus heterophyllus and azadirachta indica

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Abstract

Zinc oxide nanoparticles have attracted great attention due to their unique optical, chemical, and antimicrobial properties. In this study, zinc oxide nanoparticles were synthesized using a simple and eco-friendly method. Zinc nitrate was used as the precursor for the preparation of zinc oxide nanoparticle. The synthesized nanoparticles were characterized using different analytical techniques. X-ray diffraction (XRD) analysis was used to determine the crystal structure and phase formation of the nanoparticles. The morphology and particle size were analyzed using Scanning Electron Microscopy (SEM). Further, FTIR analysis was carried out to identify the functional groups involved in the formation of zinc oxide nanoparticles. The results confirmed that the synthesized nanoparticles possess good crystalline nature and nanoscale size. This study provides a simple, cost-effective, and environmentally friendly method for the synthesis of zinc oxide nanoparticles, which have potential applications in antibacterial activity, medical field, sensors, and cosmetic products.

Keywords: Biosynthesis, Zinc oxide nanomaterials, Herbal extracts, Surface morphology, Structural analysis, Antibacterial activity.

Investigation on the synthesis of ferrite nanoparticles for water splitting application

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Abstract

Cobalt ferrite and zirconium-doped cobalt ferrite nanoparticles were successfully synthesized using a rapid and cost-effective solution combustion technique. The structural properties of the prepared samples were analyzed using X-ray diffraction (XRD), which confirmed the crystalline nature of the materials and enabled the determination of their crystallite size. In this work, both cobalt ferrite and zirconium-doped cobalt ferrite nanomaterials were explored as potential catalysts for water splitting applications. Spinel ferrite materials are known for several beneficial properties such as good chemical stability, magnetic characteristics, adjustable electronic structure, and moderate electrical conductivity, which make them suitable candidates for catalytic processes. The use of the solution combustion method for synthesizing ferrite nanomaterials offers advantages including fast synthesis, formation of porous structures, high surface area, and uniform composition. These features play an important role in enhancing the catalytic efficiency of ferrite materials. Cobalt ferrite, in particular, shows promising catalytic behavior for both the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER), mainly due to the presence of transition metal ions that can actively participate in redox reactions. Additionally, the nanoscale structure of the synthesized material provides a large number of active surface sites, which improves the overall efficiency of the water splitting process. The incorporation of zirconium ions into the cobalt ferrite lattice further enhances its catalytic performance by modifying the electronic structure, creating additional surface defects, and improving charge transport within the material. Zirconium doping also increases the stability and durability of the catalyst during electrochemical reactions. Overall, the results indicate that cobalt ferrite and zirconium-doped cobalt ferrite nanomaterials can serve as promising and cost-effective alternatives to expensive noble metal catalysts for hydrogen generation through water splitting.

Evaluation of the Synergistic Anticancer Activity of Cisplatin-Loaded Nanoparticles in Combination with Little Millet (*Panicum sumatrense*) and Barnyard Millet (*Echinochloa frumentacea*) Extracts Against HeLa Cervical Cancer Cells

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Abstract

Cisplatin is a widely used chemotherapeutic agent for the treatment of cervical cancer; however, its clinical effectiveness is often limited by systemic toxicity and drug resistance. Nanoparticle-based drug delivery systems offer a promising approach for improving drug delivery and enhancing anticancer efficacy. Little millet (*Panicum sumatrense*) and barnyard millet (*Echinochloa frumentacea*) contain various bioactive phytochemicals, including phenolic compounds and flavonoids, which may possess potential anticancer properties. The present study aims to evaluate the synergistic anticancer activity of cisplatin-loaded nanoparticles in combination with little millet and barnyard millet extracts against the HeLa cervical cancer cell line. The cytotoxic effects of cisplatin-loaded nanoparticles, millet extracts, and their combinations will be evaluated using appropriate in-vitro cell viability assays. The combined treatments will be further investigated for their effects on cellular morphology and apoptosis to determine the possible mechanisms underlying the enhanced anticancer activity. The study is expected to demonstrate whether the combination of cisplatin-loaded nanoparticles with millet extracts produces greater anticancer activity than individual treatments. This approach may provide useful insights into the potential application of millet-derived bioactive compounds as complementary agents in nanoparticle-based cisplatin therapy against cervical cancer.

Keywords: Cisplatin; Nanoparticles; Little millet (*Panicum sumatrense*); Barnyard millet (*Echinochloa frumentacea*); HeLa cell line; Cervical cancer; Cytotoxicity; Apoptosis; Synergistic anticancer activity.

Nanoparticle Exposure, Mental Health and Nutritional Status Among Leather Workers

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Abstract:

Leather industry workers are exposed to various occupational hazards, including chemicals, dust, particulate matter, and potentially nanoparticles generated during leather processing and finishing activities. Prolonged exposure to workplace hazards, physical workload, irregular dietary practices, and socioeconomic factors may influence workers' nutritional status and mental health. The present cross-sectional study aims to assess nanoparticle exposure, mental health, and nutritional status among leather industry workers and to examine the association between occupational exposure and selected health outcomes.

The study will be conducted among selected workers employed in leather processing units. Data will be collected using a structured questionnaire covering socio-demographic characteristics, occupational history, duration of employment, working hours, workplace conditions, use of personal protective equipment, lifestyle practices, and dietary patterns. Mental health status will be assessed using validated screening tools such as the Depression, Anxiety and Stress Scale (DASS-21), General Health Questionnaire (GHQ-12), and Patient Health Questionnaire (PHQ-9). Nutritional status will be evaluated through anthropometric measurements, dietary assessment, and selected biochemical parameters, where feasible. Occupational nanoparticle exposure will be assessed through workplace exposure history and, where resources permit, appropriate environmental or personal exposure monitoring methods.

The collected data will be statistically analysed to determine the prevalence of mental health concerns and nutritional inadequacies and to identify associations with occupational exposure and lifestyle factors. The study is expected to provide insight into the combined occupational, nutritional, and psychological challenges experienced by leather workers. The findings may support the development of workplace-based health screening, nutrition education,

stress-management programmes, appropriate protective measures, and exposure-reduction strategies to improve workers' health, well-being, and productivity.

Keywords: Leather industry workers, occupational vulnerability, nutritional status, dietary practices, mental health, occupational health, psychological well-being, cross-sectional study.

Effect of Acoustic Shock Waves on the Structural, Optical, and Antibacterial Properties of α -D-Glucose

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Abstract

Glucose is a monosaccharide and a simple form of sugar. α -D-Glucose is an important monosaccharide that serves as a building block for polysaccharides such as starch and plays a vital role in energy metabolism. In this study, we investigate the structural, optical, morphological, and antibacterial properties of α -D-glucose subjected to acoustic shock waves. Powder X-ray diffraction analysis confirms that untreated α -D-glucose exhibits an orthorhombic crystal structure with the characteristic space group $P2_12_12_1$, which remains structurally stable even after exposure to 500 shock pulses. However, the crystallite size undergoes significant variations upon shock treatment, indicating shock-induced changes in the crystalline structure and possible dynamic recrystallization processes. Raman spectroscopy reveals variations in peak intensity and slight changes in the vibrational features of the shock-treated samples, suggesting modifications in the molecular environment induced by repeated shock-wave exposure. Further characterization using Raman spectroscopy, UV–visible diffuse reflectance spectroscopy, field-emission scanning electron microscopy and antibacterial studies demonstrates notable changes in the structural, optical, morphological, and antibacterial properties of α -D-glucose. FE-SEM analysis reveals distinct morphological modifications in the shock-treated samples, including the formation of spherical structures. At 400 shock pulses, pronounced changes in surface morphology are

observed, indicating significant morphological transformation under repeated shock-wave exposure. Moreover, the optical band gap decreases from 4.45 eV for the untreated sample to 4.25 eV after shock treatment, demonstrating that acoustic shock waves can effectively modify the optical properties of α -D-glucose.

Keywords: α -D-glucose, Raman spectroscopy, solid-state transformation, antibacterial activity

**Enhanced performance of transition metals (Cu, Mn, V) substituted silver type
polyoxometalate- curcumin hybrid materials and its applications**

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Abstract

In this research novel three new hybrid materials of silver type anion based by incorporating (Cu, Mn, V) transition metals with the natural organic ligand curcumin were synthesized. The synthesized three different hybrid materials were developed to create multifunctional agents for biomedical and environmental applications owing to their enhanced antibacterial, antioxidant and photocatalytic properties. The successful formation of the hybrid materials was confirmed through an analytical technique including, FT-IR, UV-visible and XRD. Surface morphology investigated by SEM, EDX analysis confirmed the presence of the expected constituent elements, The particle size histograms showed a relatively uniform size distribution for all three synthesized hybrid materials, indicating good morphological homogeneity and controlled particle growth. The oxidation states and successful incorporation of the transition metal ions were further confirmed by EPR spectroscopy. The photocatalytic performance of the three different hybrid compounds was evaluated through the degradation of a model pollutant. Among

the three hybrid materials, STMnCU exhibits the highest degradation efficiency of 69.44%, followed by STCuCU which achieved 65.79% degradation after 60 mts of irradiation, demonstrating their potential for photocatalytic applications. The Antibacterial activity of the hybrid materials was evaluated against both gram negative (*E. coli*) and gram positive (*S. aureus*) bacteria. The enhanced antibacterial performance is attributed to the synergistic interaction between the STA polyoxometalate framework, Cu, Mn, V and curcumin, which improves the biological activity of the synthesized hybrid materials. In addition, the antioxidant activity of the hybrid materials was assessed using the DPPH free radical scavenging assay and compared with ascorbic acid as the standard.

Keywords: Hybrid materials, Silverton type anions, Antibacterial activity, Antioxidant activity, Photocatalytic.

Reference

- [1].Bharath Samannan, Praveen Peter, Jeyabalan Thavasikani, Surfactant incorporated preyssler polyoxoanion a transition metal substituted Mo-PHP complex and its applications. Turkish Journal of chemistry. 47, 2023, <https://doi.org/10.55730/1300-0527.3543>
- [2].Jemi Lims, Rajesh Kumar, Jothi Selvam, Jeyabalan Thavasikani, Synthesis of Waugh-type anion - (copper, vanadium) based curcumin complexes: characterization, properties and biological evaluation. Chem. Paper, 2026, <https://doi.org/10.1007/s11696-026-04662-3>
- [3].Javanmard, Masoumeh, Saeed Farhadi, Michal Dusek, Monika Kucerakova, Keivan Javanmard, and Mansoureh Maleki. "New organic–inorganic rod-like hybrids constructed from Keggin-type polyoxomolybdate and a Cu (ii) dithiocarbamate complex: crystal structure, dye adsorption and antibacterial activity." *RSC advances* 16, 2026.<https://doi.org/10.1039/d6ra00116e>

- [4].Saeedi M, Tangestaninejad S, Moghadam M, Mirkhani V, Baltork IM, Manganese (III) tetrapyridylporphyrin–Wells–Dawson type polyoxotungstate hybrid material: synthesis, characterization and application in alkene epoxidation. Inorg Chem Res. 9:2024. <https://doi.org/10.22036/j10.22036.2025.470341.1171>.
- [5].Lazar A, Kumar R, Mani V, Samannan B, Thavasikani J, Synthesis and characterization of transition metal (Mn, V)-based silvertone-type anion and its antioxidant and antimicrobial studies. Asian J Chem. 37:2025, <https://doi.org/10.14233/ajchem.2025.3284>