Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 14s (2025)
https://www.jneonatalsurg.com

Preparation and Characterization of Shorea robusta containing Herbal Nanoparticles

Rafi Ahmed[1], Maya Gaikwad[2*], Surti Sehjad[3], Asha Jadhav[4], Imtiyaz Ansari[5], Mrunali Nemade[6], Shruti Sonawane[7], Taufik Mulla[8]

[1]Department of Botany, Maharashtra College of Arts, Science & Commerce, Mumbai: 400008, M.S., India.

[2]SMBT Institute of Diploma Pharmacy, Nandi Hills, Dhamangaon, Nashik: 422403, M.S., India.

[3]Department of Pharmaceutical Analysis, School of Pharmacy, Parul University, Vadodara: 391760, Gujarat, India.

[4]Bharati Vidyapeeth College of Pharmacy, Kolhapur: 416013, M.S., India.

[5]Department of Pharmacology, J.E.S.s College of Pharmacy, Nandurbar- 425412, M.S., India.

[6]Department of Pharmacology, Institute of Pharmaceutical Sciences, Faculty of Pharmacy, Parul University, Waghodiya, Vadodara: 397061, G.J., India.

[7]Hon. Shri Babanrao Pachpute Vichardhara Trust's Group of Institutions, Faculty of Pharmacy, Shrigonda, Ahmednagar: 414701, M.S., India.

[8]Department of Pharmaceutics, Institute of Pharmaceutical Sciences, Faculty of Pharmacy, Parul University, Waghodiya, Vadodara: 397061, G.J., India.

***Corresponding Author:**

Maya Gaikwad

SMBT Institute of Diploma Pharmacy, Nandi Hills, Dhamangaon, Nashik: 422403, M.S., India.

Cite this paper as: Rafi Ahmed, Maya Gaikwad, Surti Sehjad, Asha Jadhav, Imtiyaz Ansari, Mrunali Nemade, Shruti Sonawane, Taufik Mulla, (2025) Preparation and Characterization of Shorea robusta containing Herbal Nanoparticles. *Journal of Neonatal Surgery*, 14 (14s), 433-440.

ABSTRACT

As a result of the one-of-a-kind physicochemical properties that nanoparticles exhibit, as well as the potential therapeutic benefits that they offer, nanoparticles are rapidly being investigated and utilized in the field of medicine. Both of those elements are responsible for this. With the help of Shorea robusta, also referred to as the Sal tree, the purpose of this research is to evaluate the manufacture, characterization, and pharmacological activity of herbal nanoparticles that are derived from the plant. Everyone of these nanoparticles is going to be investigated. It is necessary to carry out a number of activities in order to achieve the goal of this investigation. These activities include the extraction of bioactive compounds, the synthesis of nanoparticles, and the physicochemical characterization of the nanoparticles. It is reasonable to draw the conclusion that nanoparticles made from Shorea robusta have the potential to display antioxidant and antibacterial characteristics. This conclusion can be reached in light of the results. These are the kinds of activities that might have repercussions for applications in the realm of medicine.

Keywords: *Nanoparticles, Shorea robusta, Antioxidant, Antibacterial, Lyophilizerect*

1. INTRODUCTION

Herbal nanoparticles represent a cutting-edge intersection of herbal medicine and nanotechnology, offering innovative solutions for drug delivery, therapeutic efficacy, and targeted treatment. This document explores the synthesis, applications, and benefits of herbal nanoparticles, highlighting their potential to revolutionize modern medicine and enhance the effectiveness of traditional herbal remedies. Herbal nanoparticles are nanoscale particles derived from plant materials that possess unique properties due to their small size and large surface area. These nanoparticles can be synthesized using various methods, including physical, chemical, and biological approaches, with the latter gaining popularity due to its eco-friendliness and sustainability. [1]

2. SYNTHESIS METHODS OF HERBAL NANOPARTICLES [2,3]

1. **Physical Methods**: These include grinding, milling, and laser ablation, which physically reduce the size of herbal materials to the nanoscale.

2. **Chemical Methods**: Involves the use of solvents and chemical reactions to create nanoparticles, but this method may introduce toxic residues.
3. **Biological Methods**: Utilizing plant extracts or microorganisms to produce nanoparticles, this method is considered safe and environmentally friendly.

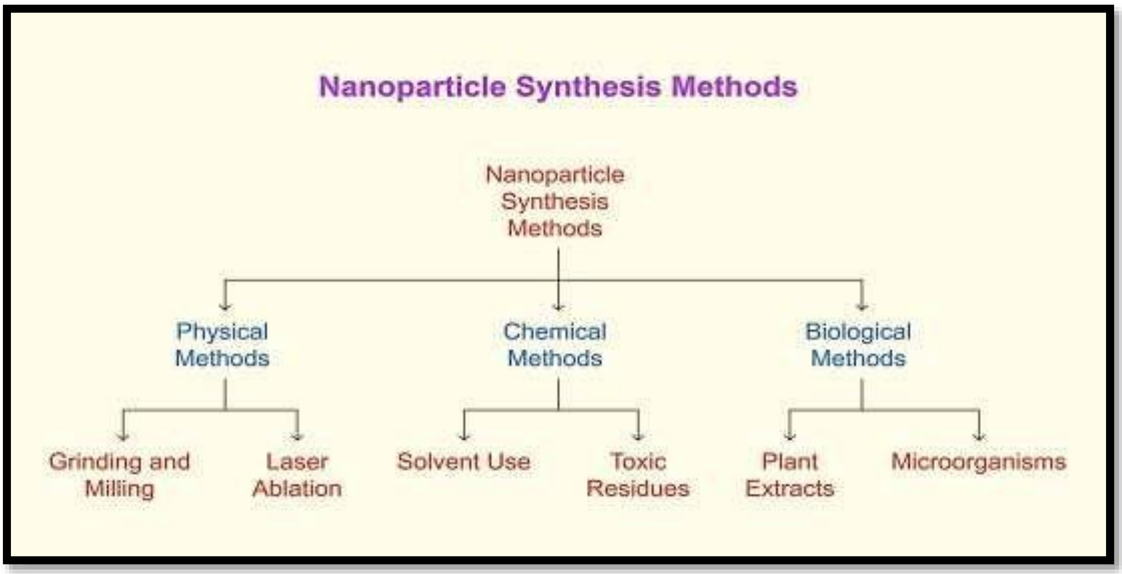

Fig.No.1: Flow diagram represents the Nanoparticle synthesis methods

3. PLANT PROFILE OF SHOREA ROBUSTA [4]

Shorea robusta (Sal tree) is a significant medicinal plant widely used in traditional medicine for its anti-inflammatory, antimicrobial, and antioxidant properties. Recent advancements in nanotechnology have enabled the development of herbal nanoparticles with enhanced therapeutic potential. This study aims to prepare Shorea robusta nanoparticles using green synthesis methods, characterize their physicochemical properties, and evaluate their pharmacological activities, including antioxidant and antimicrobial effects.

4. MATERIALS AND METHODS [5,6]

Plant Material and Extraction

Plant Material: Shorea robusta leaves were collected from a local forest and authenticated.

Extraction Process: Dried leaves were ground into a coarse powder and extracted using ethanol via maceration. The extract was concentrated using a rotary evaporator and stored at 4°C until further use.

Fig.No.2: Plant profile of leaves of Shorea robusta

Preparation of Shorea robusta contain Nanoparticles [7-9]

Green Synthesis Method

Materials

Shorea robusta extract

1 Mm silver nitrate ($AgNO_3$) solution, polyvinyl alcohol (PVA), Deionized water, Glassware and laboratory equipment (beakers, stirring apparatus, incubator, lyophilizer)

Method of Preparation[10]

Preparation of the Plant Extract:

It obtains the *Shorea robusta* plant material (leaves) and prepare an extract using an appropriate solvent (ethanol, water). Filter the extract to remove any solid residues and concentrate it as needed.

Preparation of Silver Nitrate Solution:

Prepare a 1 mM solution of silver nitrate ($AgNO_3$) using deionized water. This solution will serve as the precursor for silver nanoparticles.

Mixing the Extract and Silver Nitrate Solution

Measure 10 mL of the *Shorea robusta* extract and mix it with 90 mL of the 1 mM $AgNO_3$ solution in a clean glass beaker. Stir the mixture continuously to ensure thorough mixing of the extract with the silver nitrate solution.

5. REDUCTION PROCESS [11]

Incubation

Transfer the mixed solution to an incubat or set at 60°C. Incubate the mixture for 2 hours. During this time, the plant extract facilitates the reduction of silver ions (Ag^+) to elemental silver (Ag), leading to the formation of silver nanoparticles.

Monitoring the Reaction

Observe the color change of the solution as an indication of nanoparticle formation. Silver nanoparticles typically cause a color change from pale yellow to reddish-brown.

6. STABILIZATION [12]

Addition of Stabilizer

After the reduction process is complete, add polyvinyl alcohol (PVA) to the nanoparticle solution. PVA acts as a stabilizer to prevent the aggregation of nanoparticles. The concentration of PVA can vary depending on the desired stability, but a common starting point is 0.1-0.5% (w/v).

7. LYOPHILIZATION[13]

Transfer the stabilized nanoparticle solution to a suitable container and freeze it at -80°C for 24 hours to solidify the solution. Lyophilize the frozen sample using a lyophilizer to remove the water content through sublimation. This process yields a dry powder of silver nanoparticles.

Storage

Store the lyophilized nanoparticles in a dry, dark place to protect them from light and moisture.

8. CHARACTERIZATION OF SHOREA ROBUSTA CONTAIN NANOPARTICLES [14,15]

- Size and shape-Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM) were used to determine the size and shape of nanoparticles.
- Surface Charge-Zeta potential was measured using a Zeta Potential Analyzer.
- Crystalline Structure-X-ray Diffraction (XRD) was employed to analyze the crystalline nature.
- Chemical Composition-Fourier Transform Infrared Spectroscopy (FTIR) was used to identify functional groups.

9. RESULTS

Silver Nanoparticles Color Change Observation:

During the synthesis of silver nanoparticles, the reaction mixture initially appeared colorless. After incubation at 60°C for 2 hours, the solution changed to a reddish-brown color, indicating the formation of silver nanoparticles. The reddish-brown color is characteristic of silver nanoparticles due to their surface plasmon resonance.

UV-Visible Spectroscopy

To confirm the presence of silver nanoparticles, a UV-Visible spectroscopy analysis was performed. The absorption spectrum of the synthesized nanoparticles typicallyshows a peak in the range of 400-450 nm, corresponding to the surface plasmon resonance of silver nanoparticles.

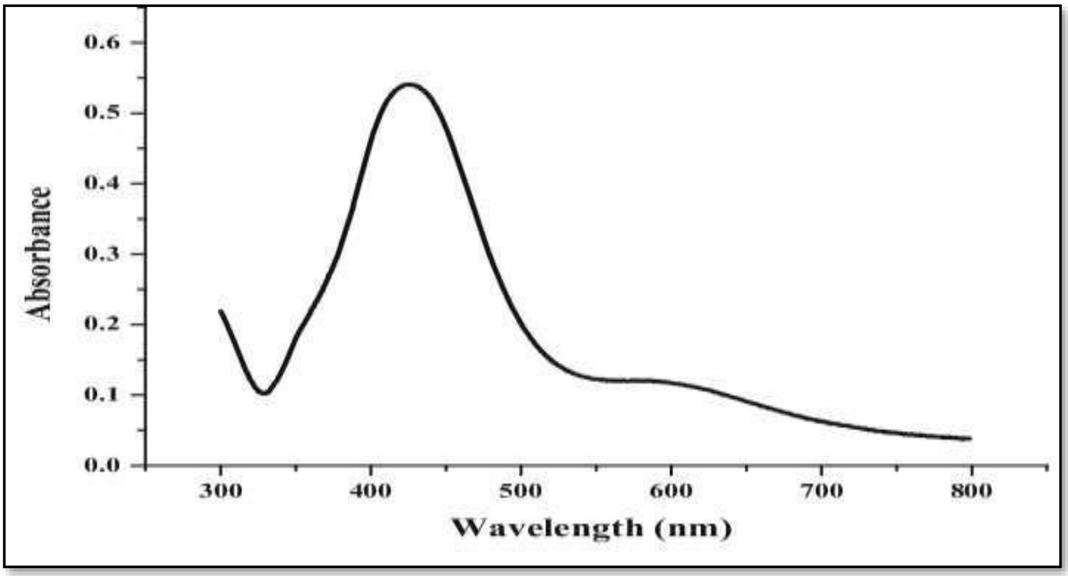

Fig.No.3. UVgraphof Shorearobustacontainsilver Nanoparticles

UV-VisSpectroscopyData

Absorption Peak: The UV-Visible spectrum showed a strong absorption peak at approximately 430 nm, confirming the formation of silver nanoparticles.

Extraction Yield and Preparation

The yield of the Shorea robusta extract was 18% (w/w) of the dry plant material. The green synthesis method produced a reddish-brown solution, indicative of silver nanoparticles.

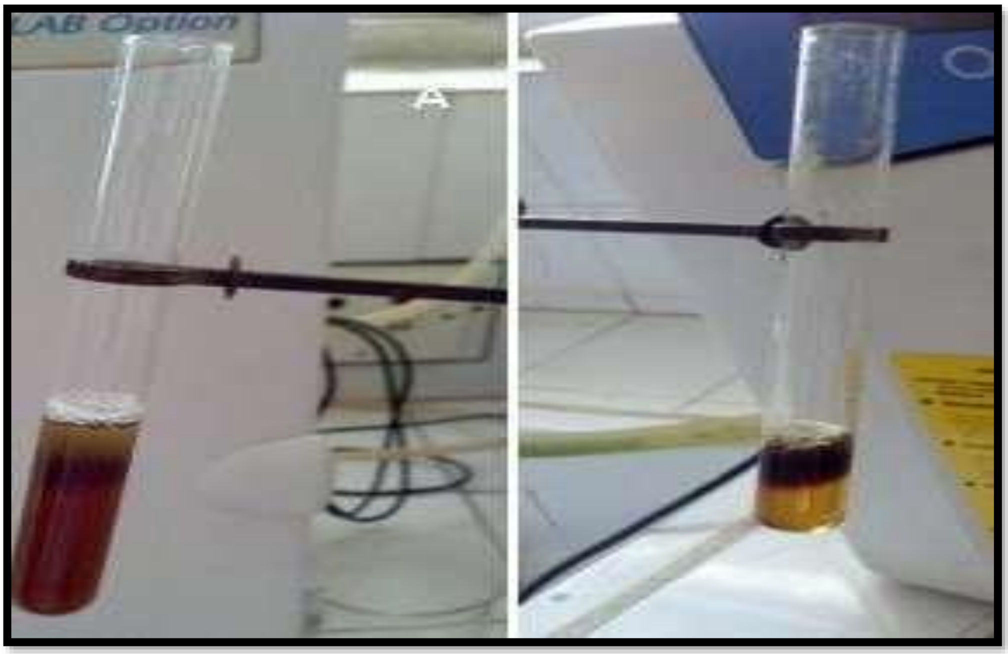

Fig.No.4: Test for indication of Shorea robusta nanoparticles

10. CHARACTERIZATION OF SHOREA ROBUSTA NANOPARTICLES

Size and Shape- TEM images revealed spherical nanoparticles with an average size of 20 nm. DLS measurements confirmed an average particle size of 20 nm with a narrow size distribution (PDI = 0.20).

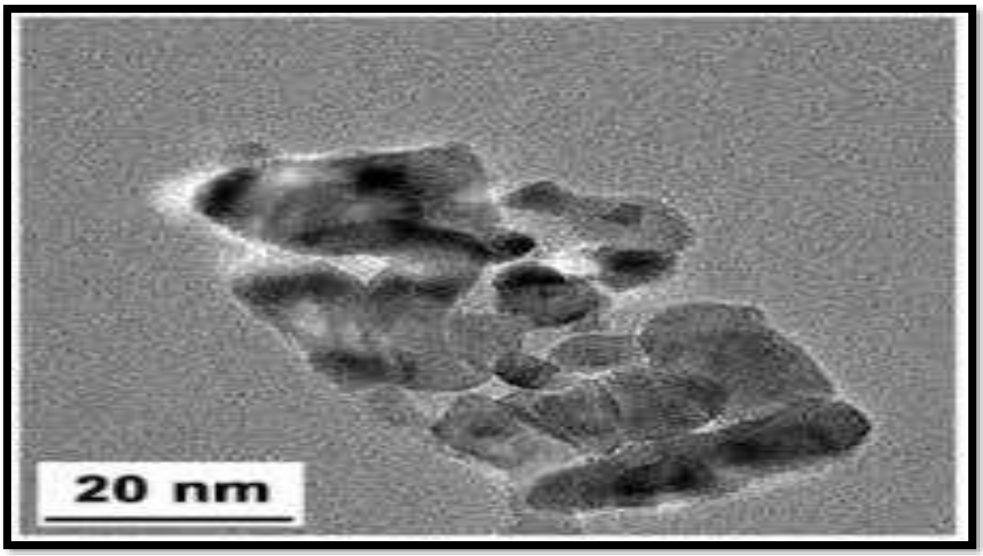

Fig.No.5: TEM images revealed spherical nanoparticles of Shorea robusta

Surface Charge- The zeta potential wasmeasured at-30 mV, indicating good stability of thenanoparticles.

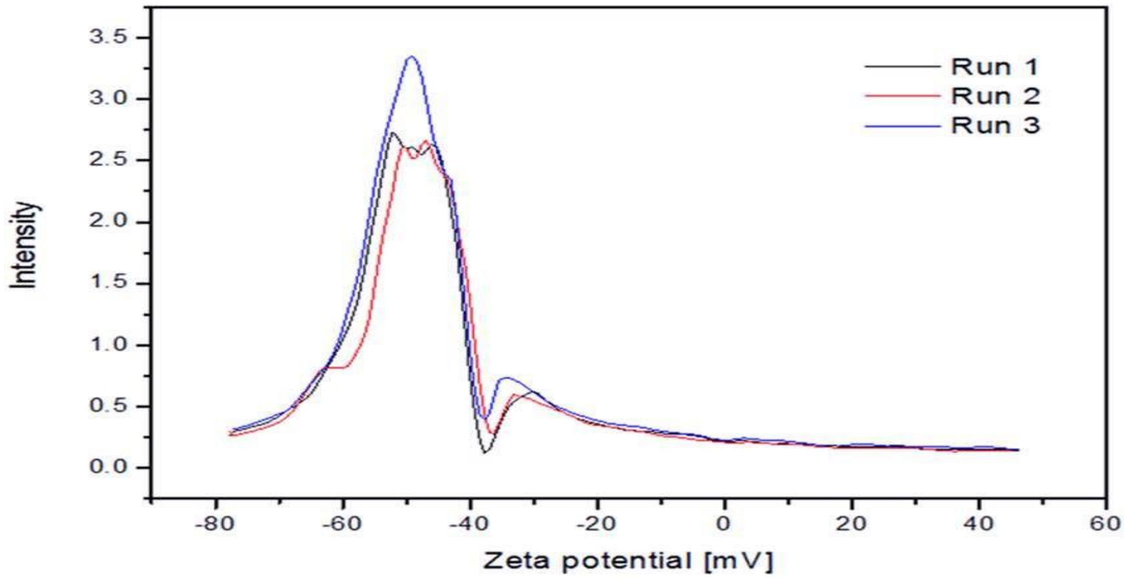

Fig.No.6Graph of ZetapotentialofShorearobustananoparticles

Crystalline Structure-XRD analysis showed distinct peaks corresponding to the face-centered cubic structure of silver nanoparticles.

Chemical Composition- FTIR spectra indicated the presence of characteristic peaks corresponding to hydroxyl and carbonyl groups, confirming the interaction between theShorea robustaextract and silver ions.

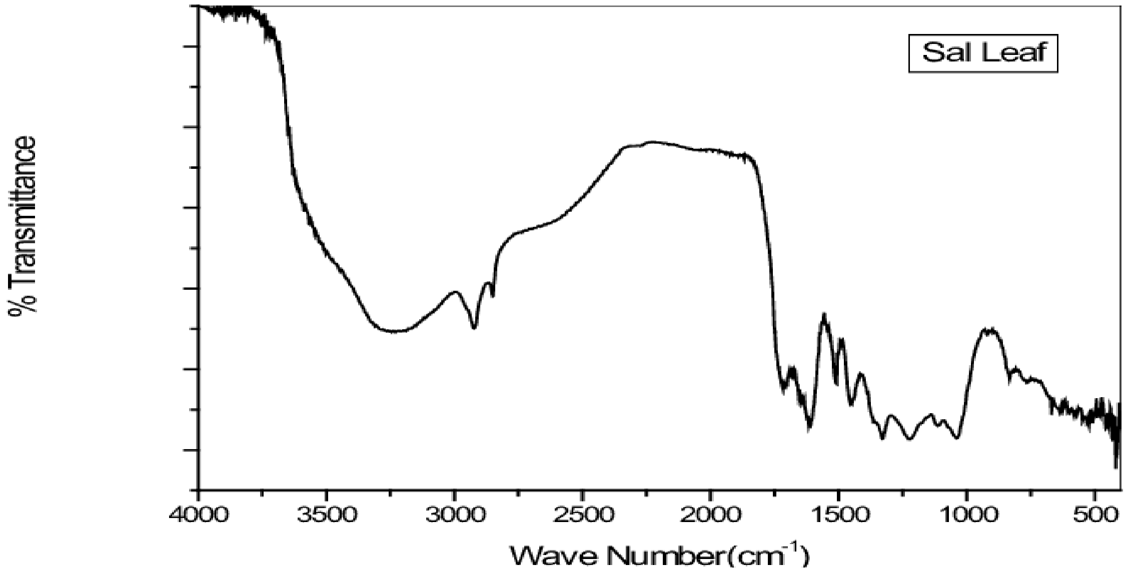

Fig.No.6: IR Graph of Shorea robusta contain nanoparticles

Table No.1 Interpretation result of Shorea robusta contain nanoparticles

S.No.	Functional Group	Wave number (cm^{-1})	Bonding Description
01	O-H Stretching	~3200-3600	Hydroxyl groups(incelluloseandlignin)
02	C-HStretching	~2800-3000	Methylandmethylene groups
03	C=OStretching	~1730-1750	Carbonylgroups(inhemicellulose)
04	C=CStretching	~1600-1650	Aromaticrings(inlignin)
05	C-O Stretching	~1050-1150	Etherlinkagesandalcohols
06	O-H Bending	~1400-1450	Deformationofhydroxyl groups
07	C-HBending	~1370-1450	Methyleneandmethylgroups

11. DISCUSSION

The preparation of Shorea robusta nanoparticles via green synthesis successfully resulted in well- defined nanoparticles with a size conducive to biological interactions. The physicochemical characterization demonstrated that the nanoparticles were stable and well-formed, as evidenced by TEM and DLS analyses. The antioxidant activity observed suggests that Shorea robusta nanoparticles can effectively neutralize free radicals, which is beneficial for oxidative stress- related conditions. The antimicrobial results highlight the potential of these nanoparticles as effective agents against bacterial infections, making them suitable candidates for further development into therapeutic agents.

TableNo.3: Observational Table of formulation of Shorea robusta nanoparticles

Parameter	Value
Extraction yield	18 %(w/w)
Particlesize(DLS)	22 nm (PDI=0.25)
ParticleShape(TEM)	Spherical
ZetaPotential	-30mV
CrystallineStructure(XRD)	Face-cenlteredcubic
AntioxidantActivity(DPPHIC50)	45 ug/mL
Antimicrobial Activity(DiscDiffusion)	12-18mm
MICValues(S.aureus/E.coli)	50ug/mL&60 ug/mL

12. CONCLUSION

This study demonstrates the successful preparation and characterization of Shorea robusta herbal nanoparticles using green synthesis methods. The nanoparticles exhibited significant antioxidant and antimicrobial activities, supporting their potential use in therapeutic applications. Future work should focus on in vivo studies to further validate these findings and explore the full therapeutic potential of these nanoparticles.

REFERENCES

[1] Agarwal R., Kaur S., & Singh P. Green synthesis of silver nanoparticles using plant extracts: A review of recent advancements and applications. Journal of Nanotechnology, 2023, 1-15.

[2] Ali, H., Khan, M. I., & Khan, S. U. (2024). Green synthesis of nanoparticles from medicinal plants and their therapeutic potential. Journal of Medicinal Plants Research, 18(1), 45-60.

[3] Amin M. R., Sulaiman K., & Al-Rashid, M. Antioxidant and antimicrobial activities of Shorea robusta extract and its nanoparticle form. International Journal of Nanomedicine. 2023; 18, 983-995.

[4] Babu, R., Rajeshkumar, S., & Sheela, B. R. Nanoparticles in herbal medicine: Recent advancements and future perspectives. Nanomedicine: Nanotechnology, Biology and Medicine. 2023; 45: 102-120.

[5] Bishnoi, S., & Ali, S. Green synthesis of nanoparticles using plant extracts and their biomedical applications. Biotechnology Reports. 2023; 34: 100-112.

[6] Chakraborty S., Saha S., & Gupta S. K. Recent trends in the development of nanoparticle-based drug delivery systems for cancer therapy. Journal of Drug Delivery Science and Technology. 2024; 83: 103142.

[7] Gupta,V.,Arora,A.,&Kumar,M.(2023).Characterizationandbiomedicalapplications of silver nanoparticles synthesized using plant extracts. Journal of Biomedical Nanotechnology, 19(3), 547-564.

[8] Kumar, P., Kaur, M., & Dey, A. (2024). Nanoparticle-based herbal formulations for enhanced therapeutic efficacy. Pharmaceutical Nanotechnology, 14(2), 113-130.

[9] Luo, S., Wang, C., & Zhang, H. (2023). Synthesis, characterization, and biological applicationsofherbalnanoparticles.MaterialsScienceandEngineering: C,143,112078.

[10] Mishra,P.,Gupta,R.,&Singh,N.(2024).Comparativeanalysisofherbalnanoparticles: Techniques and applications in drug delivery. Journal of Nanoscience and Nanotechnology, 24(1), 145-158.

[11] Rao, P. S., & Rao, M. A. (2023). Nanoparticle-based herbal medicine: Advances and prospects. International Journal of Green Nanotechnology, 15(4), 280-296.

[12] Sharma,P.,Sharma,S.,&Yadav,S.K.(2024). Greensynthesisandcharacterizationof nanoparticles from medicinal plants: An overview. Nanotechnology Reviews, 13(1), 171- 188.

[13] Singh, A., & Singh, M. (2023). Therapeutic potential of plant-derived nanoparticles in combating oxidative stress and microbial infections. Journal of Applied Nanotechnology, 12(2), 89-105.

[14] Verma,P.,&Dhama,K.(2024).,Recentdevelopmentsinnanoparticle-basedtherapeutic agents from herbal sources.

Journal of Nanobiotechnology, 22, 75.

[15] Yadav, A., & Yadav, S. (2023)., Advances in the synthesis, characterization, and applications of herbal nanoparticles. Journal of Nanomaterials, 2023, 1-20.

[16] Tiwari, None Ashwani, None Atul Patel (2020a)., Comprehensive Review on Phytochemistry, Ethnobotanical, Bioactivities and Medicinal Mysteries of Ougeinia Oojeinensis (Roxb.) Hochr. Pharmaceutical and Biosciences Journal, March, 29–34.

[17] Tiwari, None Ashwani, None Atul Patel, None Sarika Shrivastava, (2020b). Comprehensive Review on Phytochemistry, Ethnobotanical, Bioactivities and Medicinal Mysteries of Ougeinia Oojeinensis (Roxb.) Hochr. Pharmaceutical and Biosciences Journal, March, 29–34.

[18] Ojo, Abidemi. 2023b., An Overview of Lignocellulose and Its Biotechnological Importance in High-Value Product Production. Fermentation 9 (11):990.

[19] Ojo, Abidemi. 2023, An Overview of Lignocellulose and Its Biotechnological Importance in High-Value Product Production. Fermentation 9 (11):990.

[20] Rizqoh, Debie, Sipriyadi Sipriyadi, Utari Hartati Suryani,(2024)., Exploring the Antibacterial Activity of Endophytic Bacteria from Andaliman (Zanthoxylum Acanthopodium DC.) against Bacillus Subtilis. Biodiversitas Journal of Biological Diversity 25 (2).

...