International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 19s, 2025
https://www.theaspd.com/ijes.php

Biosynthesis and Characterization of Silver Nanoparticles containing Plant Extract Biosynthesis of Silver Nanoparticles

Ankit Sahu[1]*, Govind Soni[2], Revathi A. Gupta[2], Rakesh Kumar Jatav[2]
[1]Research Scholar, Faculty of Pharmacy, Dr. A.P.J. Abdul Kalam University, Indore, Madhya Pradesh, India
[2]Faculty of Pharmacy, Dr. A.P.J. Abdul Kalam University, Indore, (M.P.), Madhya Pradesh, India

ABSTRACT
Silver nanoparticles have diverse biomedical applications due to their exceptional abiological properties. The integration of plant extracts in the synthesis of AgNPs give commendable approach leveraging the reducing and capping potential of phytochemicals. This study focuses on the formulation and characterization of AgNPs synthesized using a hydro-alcoholic extract of Peristrophe bicalyculata *leaves. This study highlights the potential of AgNPs combined with* Peristrophe bicalyculata *extract as a promising natural antimicrobial agent for medical and cosmetic applications.*
Key-words*: Silver Nanoparticles, Formulation, Plant Extract, Anti-microbial Activity*

INTRODUCTION

Silver nanoparticles containing plant extract represent a promising area in nanobiotechnology, combining the antimicrobial properties of silver with the plant extract and their compounds. Green synthesis approach involves using plant extracts as natural reducing agents to convert silver ions into nanoparticles. The phytochemicals in the plant extracts, such as polyphenols, flavonoids, and terpenoids, not only facilitate nanoparticle formation but also enhance stability and biocompatibility. These biosynthesized silver nanoparticles exhibit potent biological activities, making them useful for medical applications, environmental remediation, and food preservation. The integration of plant extracts into silver nanoparticle synthesis underscores the potential of harnessing nature's resources for developing safe and effective nanomaterials. Silver nanoparticles (AgNPs) are renowned for their potent antimicrobial properties, making them ideal for medical applications.[1] This study aims to develop a formulation using AgNPs combined with a hydro-alcoholic extract of *Peristrophe bicalyculata* leaves and evaluate its antimicrobial efficacy.

MATERIAL AND METHODS

Materials

AgNPs Preparation

Silver Nanoparticles were prepared in six different batches using 250 gm of hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) and varying concentration of silver nitrate (1 to 3 mM). The powder of $AgNO_3$ was dissolved in distilled water to make and prepare stock solution of 10mM $AgNO_3$ Solution. From the above solution 1 mM, 2mM and 3 mM solution were prepared. The $AgNO_3$ solutions were then mixed by HAEPBL in the ratio of 1:1 and 1:2 v/v using VF of 50 ml. The VF was then wrapped with aluminum foil and was then heated using water bath at 60^0 C for about 5 hour. After that the mixture of solution was stored in the refrigerator.[2] The optimized formulation AgNPS-F4 was taken for characterization. Figure 1 represents preparation method.

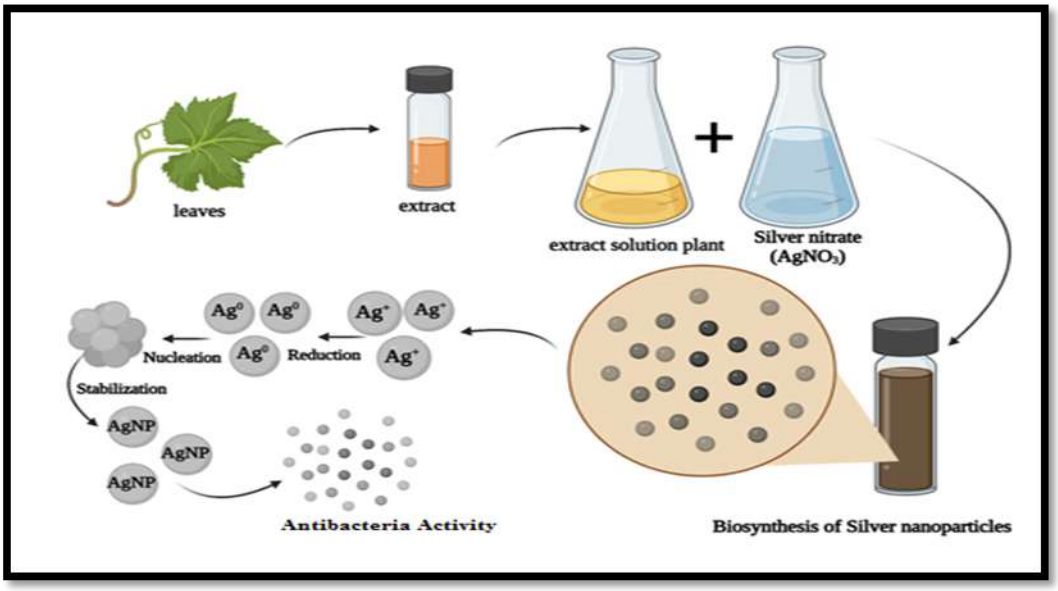

Figure 1: Preparation of Silver Nanoparticles of Plant Extract

Characterization of AgNPs

Visual Appearance: After addition of hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) to silver nitrate solution.[3]

UV-Visible Spectroscopy

UV-Visible Spectroscopy of the optimized silver nanoparticles containing hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) was performed and the maximum absorption recorded. 1ml of sample was placed in a 10 ml standard flask and diluted with ethanol. Then UV visible spectra were collected in the 200-400 nm region, with ethanol serving as a blank.[4]

X- Ray Diffraction Studies

XRD was used to analyse the phase and crystalline structure of silver nanoparticles containing a hydroalcoholic extract of *Peristrophe bicalyculata* (R.) Nees leaves (HAEPBL) using X-ray diffractometer.[5]

Scanning Electron Microscopy (SEM)

Silver nanoparticles containing a hydro-alcoholic extract of *Peristrophe bicalyculata* (R.) Nees leaves (HAEPBL), as well as SEM combined with EDX was determined. The surface morphology of silver nanoparticles containing hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) was examined. [6]

Energy Dispersive X-Ray (EDX) Analysis

EDX of silver nanoparticles containing a hydro-alcoholic extract of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) was done. [7]

Fourier Transform Infrared Spectroscopy

It was determined using apparatus FTIR. Version 10.4, Perkin Elmer.[7]

RESULTS AND DISCUSSION

Visual Appearance

After addition of hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL), $AgNo_3$ color changed to brown within 2 minutes which indicates the process of Ag^+ to Ag^0 nanoparticles occurs and formation of naoparticles. (Figure 2).

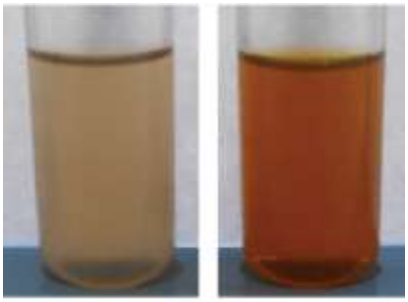

Figure 2: Formulated HAEPBL-AgNPs [Optimized Formulation- AgNPs-F4]

UV-Visible Spectroscopy

UV-Visible Spectroscopy of the optimized HAEPBL-AgNPs i.e., AgNPs-F4 (Figure 3) was performed and the maximum absorption was found at 305 nm and this is due to interaction of the light with surface of the silver nanoparticle. This interactions indicates the existence of surface Plasmon resonance i.e., SPR. The UV spectra have been shown in Figure 3.

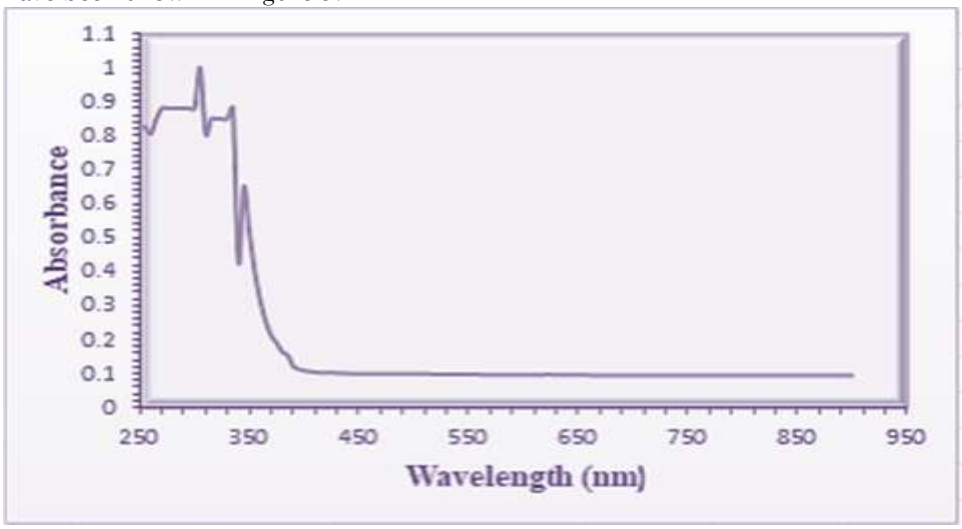

Figure 3: UV Spectra of Optimized Silver Nanoparticles.

X- Ray Diffraction Studies

In XRD the structure and crystalline nature of the silver nanoparticles were determined. The X-ray diffraction (XRD) patterns of the optimized HAEPBL-AgNPs i.e., AgNPs-F4 showed three diffractions peaks at 2θ =38.2, 33.4 and 64.6^0 as shown in Figure 4.

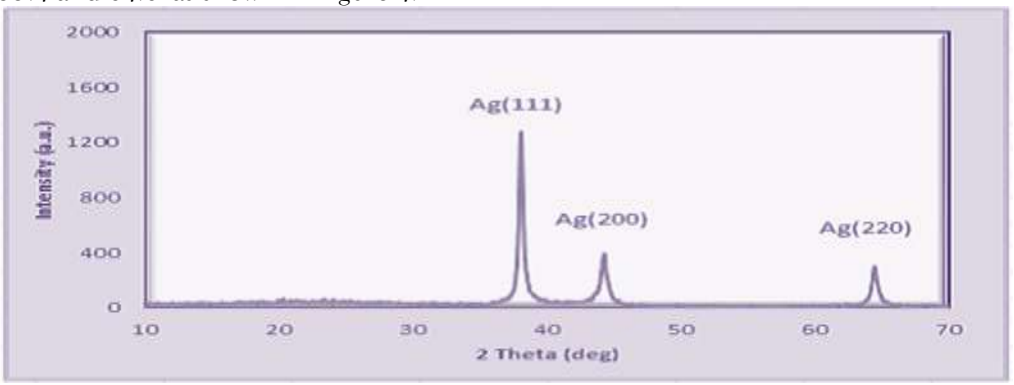

Figure 4: XRD Pattern of HAEPBL-AgNPs

Scanning Electron Microscopy (SEM)

AgNPs using hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) further confirmed AgNPS as shown in figure 5.

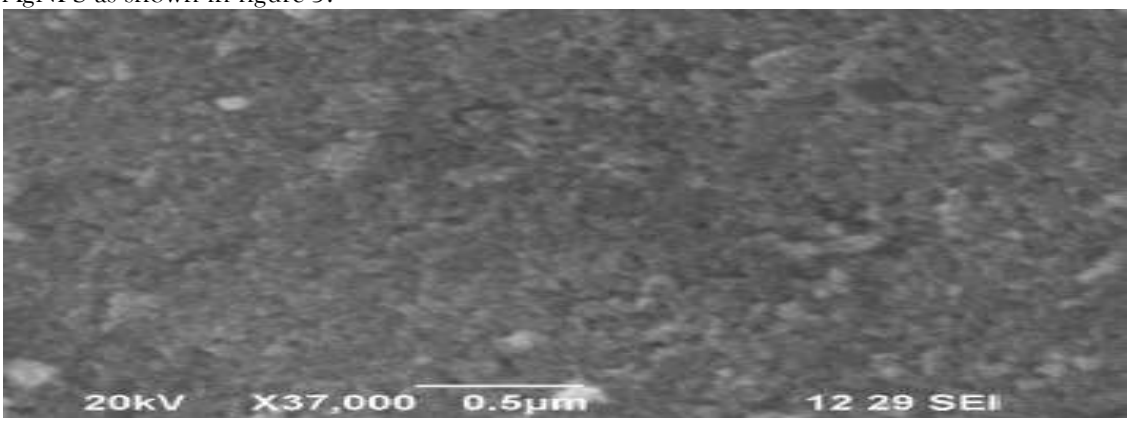

Figure 5: SEM of HAEPBL-AgNPs

Energy Dispersive X-Ray (EDX) Analysis

EDX analysis determines and confirms the formation of $AgNO_3$ as shown in figure 6.

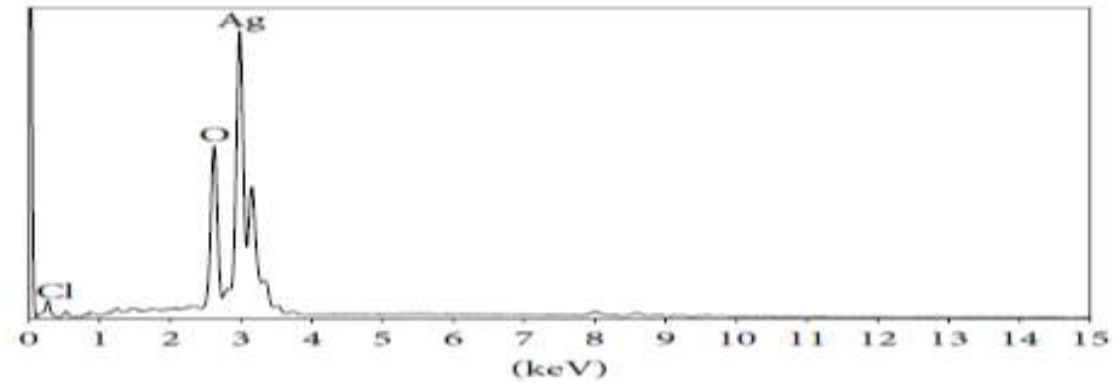

Figure 6: Elemental Analysis of HAEPBL-AgNPs

Fourier Transform Infrared Spectroscopy

Figure 7 reports the FTIR of formulated silver nanoparticles.

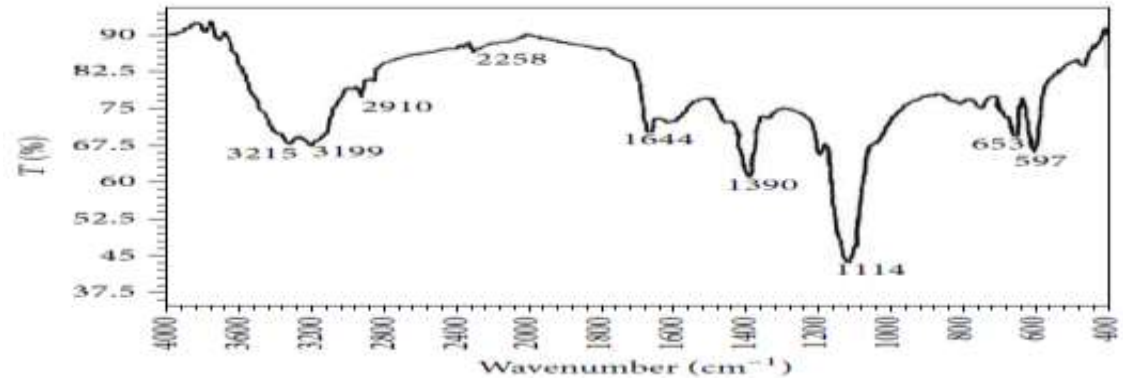

Figure 7: FTIR Spectrum of HAEPBL-AgNPs

CONCLUSION

This study demonstrates the successful development of an AgNP formulation with enhanced antimicrobial properties, leveraging the synergistic effects of *Peristrophe bicalyculata* extract. The formulation shows potential for safe and effective topical applications.

REFERENCES

1. Akhter MS, Rahman MA, Ripon RK, Mubarak M, Akter M, Mahbub S, Al Mamun F, Sikder MT. A systematic review on green synthesis of silver nanoparticles using plants extract and their bio-medical applications. Heliyon. 2024;10(11): 18-22.
2. Sharifi-Rad M, Elshafie HS, Pohl P. Green synthesis of silver nanoparticles (AgNPs) by Lallemantia royleana leaf extract: their bio-pharmaceutical and catalytic properties. Journal of Photochemistry and Photobiology A: Chemistry. 2024;448:115318.
3. Bhusal M, Pathak I, Bhadel A, Shrestha DK, Sharma KR. Synthesis of silver nanoparticles assisted by aqueous root and leaf extracts of Rhus chinensis Mill and its antibacterial activity. Heliyon. 2024;10(13):36-39.
4. Dandekar M, Lote S, Dandekar P. Synthesis and Evaluation of Silver Nanoparticles from Dragon Fruit Peel Extract. International Journal of Drug Delivery Technology. 2025; 15(1):126-31.
5. Abbood HAR, Zain alabden S. Detection of combination effect of silver nanoparticles prepared with Pimpinella anisum and some antibiotics on some pathogenic bacteria. International Journal of Drug Delivery Technology. 2019; 39 (3): 460-464.
6. Khan A, Suyal J, Chakraborty I, Ghildiyal P, Singh A. Orange Peel Extract Silver Nanoparticles: Formulation and Characterization for Potential Anticancer Activity. International Journal of Drug Delivery Technology. 2025;15(1):168-74.
7. Machado S, Pacheco JG, Nouws HPA, Albergaria JT, Delerue-Matos C. Characterization of green zerovalent iron nanoparticles produced with tree leaf extracts. Sci Total Environ. 2015; 533:76–81.