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Green Synthesis and Characterization of Silver Nanoparticles using Ehretia Laevis Leaf Extract

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Abstract: *The present study reports the eco-friendly, rapid and cost effective synthesis of silver nanoparticles(AgNPs) using aqueous leaf extract of Ehretia laevis. The phytochemicals present in the extract acts as reducing and stabilizing agents, facilitating the conversion of Ag+ ions into stable AgNPs. The syntesis was confirmed by the appearance of a brown color and a characteristic surface plasmon resonance (SPR) peak in the UV-Visible spectrum around 420 nm. The biosynthesized silver nanoparticles (AgNPs) were subjected to detailed characterization using Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Scanning electron microscopy (SEM) and dynamic light scattering (DLS). The nanoparticles were predominantly spherical with an average size of 15-40nm, crystalline in nature and capped with functional groups derived from plant metabolites. This study demonstrate that Ehretia laevis extractserve as a potential bioreductant for sustainable nanoparticle production with potential applications in antimicrobial and wound healing formulations.*

Keywords: Green synthesis, Ehretia laevis, Silver nanoparticles, UV-Vis, FTIR, XRD, SEM

I. INTRODUCTION

Nanotechnology has emerged as a rapidly advancing field with wide applications in medicine, agriculture, catalyst, and environmental science. Among various nanomaterials, silver nanoparticles(AgNPs) has gained particular attention due to their potent antimicrobial antioxidant, and wound healing properties. Traditional methods of nanoparticle synthesis often involve toxic chemicles and high energy requirement, raising , raising concern regarding environmental sustainability and human safety.

Green synthesis using plant extracts offers an alternative route that is simple, cost effect and eco-friendly. Phytochemicals such as flavonoids, terpenoides, alkaloids and polyphenols present in medicinal plant act as reducing and capping agents for nanoparticles formation.

Herbal medicines have long been recognized for their wound healing properties. Ehretia laevis (Boraginaceae) traditionally used in Indian medicine, possesses, anti-inflammatory antimicrobial, and antioxidant activities attributed to its rich phytochemical profile. However its potential in nanotechnology remains underexplored. This study focuses on the green synthesis of silver nanoparticles using Ehretia laevis leaf extract and their comprehensive physicochemical characterization.

The objective of the present study

- To synthesized silver nanoparticles using Ehretia laevis extract
- To characterized the biosynthesized AgNPs by spectroscopic and microscopic techniques.
- To evaluate potential role of plant metabolites in nanoparticles stabilization.

II. MATERIAL & METHODS

Selection, Collection and Identification of Plant Material

- Ehretia laevis commonly known as khandu chakka is a medicinal herb.
- The leaves collected from tree grown at home. Identification and authentication is to be done by botany department in Amravati university. Phytochemical investigation was done for presence of phytoconstituents.

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- Silver nitrate was procured from chemicals supplier.
- All solutions were prepared using deionized water.

Extraction of leaves of Ehretia laevis Roxb

The leaves of plant ***E. laevis*** **Roxb** were collected from plant at home and identified by expert taxonomist botany department in Amravati university. The leaf extract of plant was prepared as per standard procedure. Fresh leaves were rinsed and cleaned with tap water followed by distilled water (DW). Surface was sterilized using 4% NaOCl solution and finally cleaned with sterile distilled water. Leaves were shade dried at 60^{o}C for 6-7 days, then ground into a fine powder in a mixer grinder and sieved through the muslin cloth. The powder was extracted by soxhlet extraction using ethanol (70%) as solvent.

Green Synthesis of Silver Nanoparticles (AgNPs)

An aqueous solution of 1 mM AGNO3 was prepared. The extract and AgNO3 solution were mixed ina 1:9 ratio(v/v). The reaction mixture was maintained at pH9 and incubated at 40 0C with continuous stirring , The formation of AgNPs was visually observed by the change of solution color from pale yello to dark brown.

Figure : Color change from colorless to dark brown confirms the synthesis of silver nanoparticles

Purification of AgNPs

The colloidal suspension was centrifuged at 15000rpm for 20 mins. The pellet was washed trice with deionized water and ethanol, then redispersed in water for characterization

Characterization Of AgNPs

Characterization was performed using

UV-Visible Spectroscopy: Scanned between 300-700 nm for SPR band

Fourier-transform infrared spectroscopy (FTIR)-Spectra recorded from 4000-400 cm^{-1} using KBr pellets to identify functional groups involved in capping

Zeta potential-Determined particle zize distribution, polydispersity, index(PDI) and surface charge.

XRD- Performed using Cu Ka radiation (ƛ=1.5406A) wth 2 θ scan range of 20-80 0 to analyzed crystallinity and estimate crystalline size.

Nanoparticle Tracking Analysis

At the preliminary level, NTA calculates the particles size by distance travelled by them. Size calculation was based on Stokes Einstein equation, applied to particles with its size. NTA enables separation of the particle population by size

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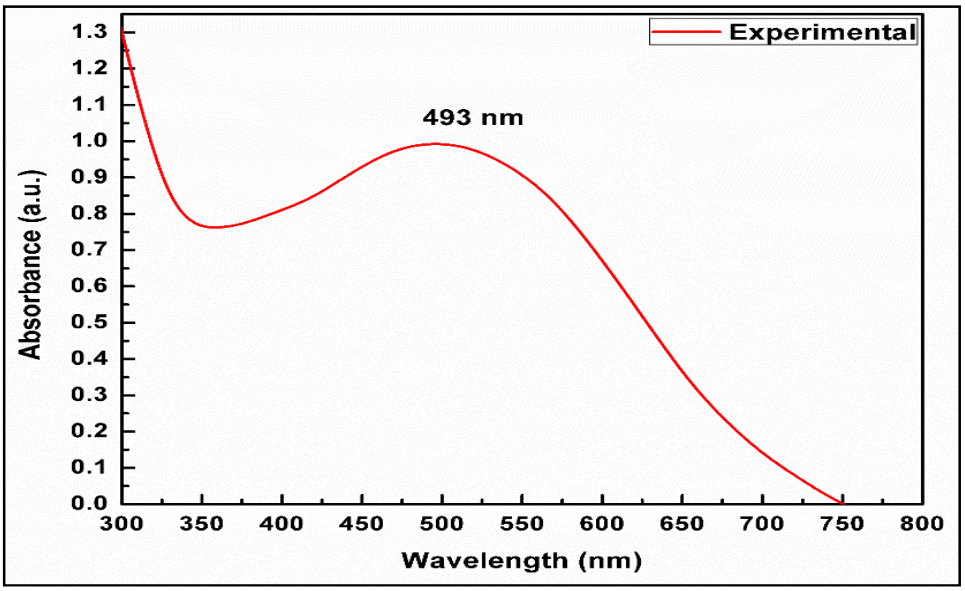
and intensity, microscopically visualizing individual nanoparticles in suspension and simultaneously determining their Brownian motion. For each distribution, data are given as mean (the average particles size measured) and mode (most frequent particle size found) terms.

TEM/SEM with EDS- Morphology and elemental composition of AgNPs were studied

III. RESULT AND DISCUSSION

Characterization of AgNPs

UV-Visible Spectroscopy: Scanned between 300-700 nm for SPR band. spectrum showed a peak at near 493 nm (surface plasmon resonance of AgNPs) confirming AgNPs formation.



FTIR revealed functional groups responsible for reduction and stabilization

The FTIR analysis of AgNPs showed the major peaks at wavenumbers 3354 cm^{-1}, 1674 cm^{-1}, 1505 cm^{-1}, 1443 cm^{-1}, 1410 cm^{-1}, 1376 cm^{-1}, 1089 cm^{-1} which are assigned to the keto compounds, aromatic compounds, phenolic, tertiary alcohol, phosphates and aliphatic chloro compounds. Thus, all probable compounds on the surface of the AgNPs had major contribution of negatively charged functional groups. These imparted net negative charge to the AgNPs and significantly supported the negative value of zeta potential for the AgNPs. There was a significant resemblance observed with the previous reports. The following figure shows comparative spectrum of ***E. laevis*** **Roxb** extract and the AgNPs

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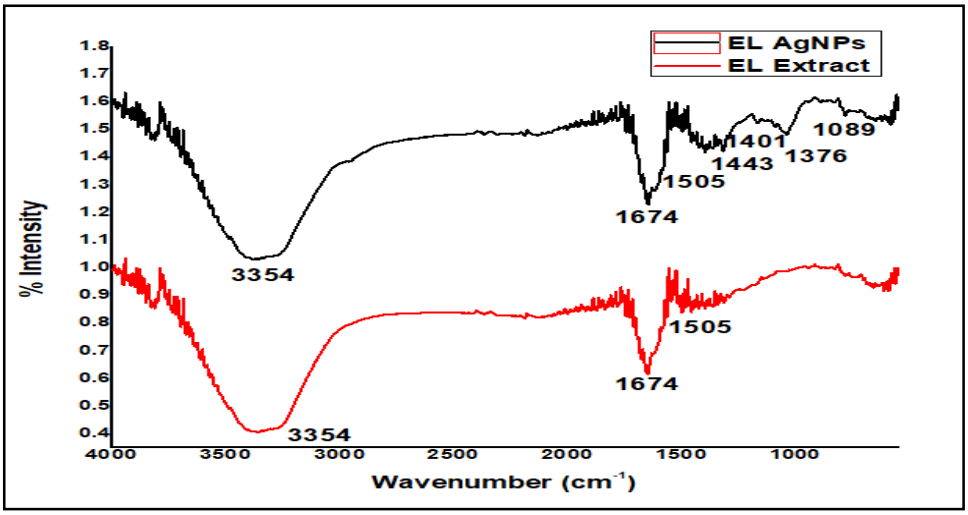

Fig. Comparative spectrum of *E. laevis* Roxb mediated AgNPs and plant extract as a control

Zeta Potential analysis

The zeta potential analysis showed a major peak with the average zeta potential of -7.72 mV with the standard deviation of 10.1 mV. This indicated the synthesis of stable AgNPs using ***E. laevis* Roxb** extract. The zeta potential value was in the range of stability i.e. -30 mV to +30 mV. The size analysis using zetasizer predicted the average size of ***E. laevis* Roxb** mediated AgNPs as 82.84 nm. The size determined by zetasizer and NTA were comparatively similar. The polydispersivity index value of 0.193 and the single moderately broad peak formation indicated that the synthesized AgNPs were less polydispersed.

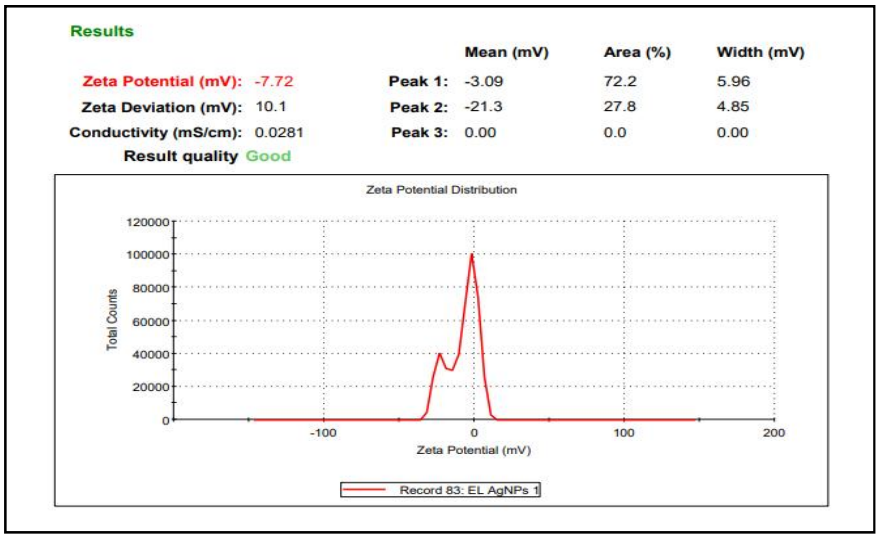

Fig. Size determination using zetasizer indicated synthesis of AgNPs with average size of 82.84 nm

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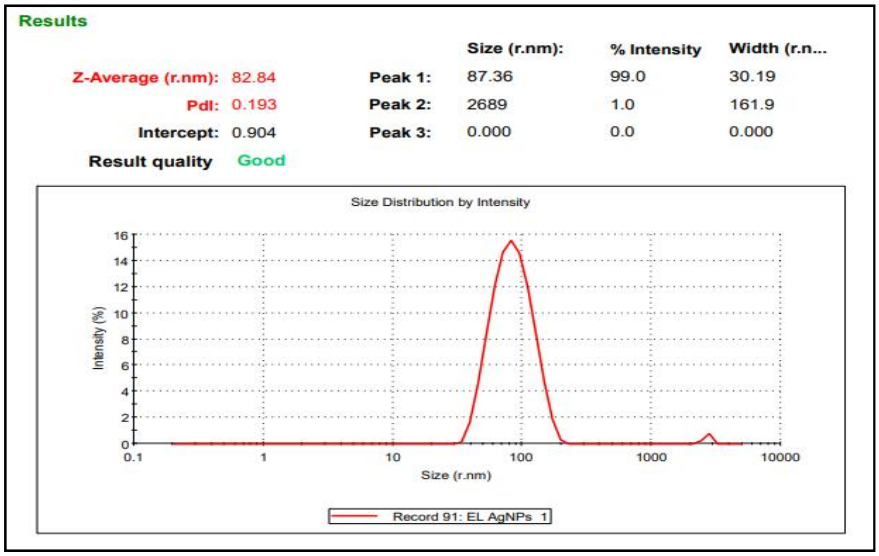

Fig. Size determination using zetasizer indicated synthesis of AgNPs with average size of 82.84 nm

NTA analysis confirmed the synthesis of nanosized AgNPs ranging from 1-100 nm. The average size was shown as 126.5 nm (diameter), with standard deviation 24.7 nm. Distribution graph showed that the higher number of NPs in the range of 60-120 nm. The concentration of AgNPs was found to be 1.26 X 10^9 particles /ml.

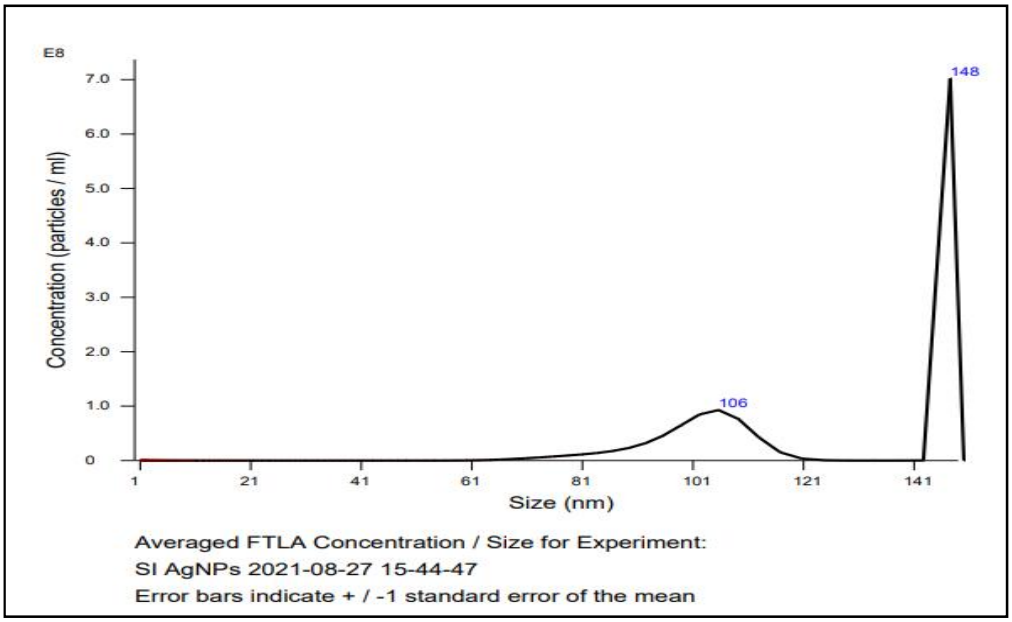

Fig. Nanoparticle Tracking Analysis of *E. laevis* Roxb mediated AgNPs showed average size of 126.5 nm and concentration as 1.39 X 10^9 particles/ml

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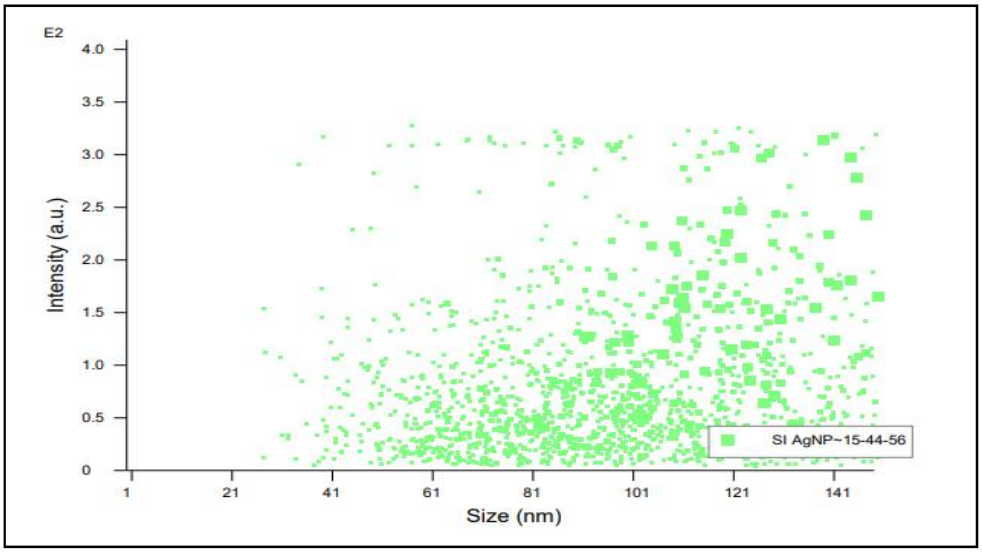

Fig. Particle size distribution of *E. laevis* Roxb mediated AgNPs showing higher distribution below 100 nm

Mechanism of Green synthesis

The polyphenolic compounds and flavonoids present in Ehretia laevis likely to reduced Ag+ to Ag0 , while protein and polysacharrides acted as stabilizing agent, preventing aggregation

IV. CONCLUSION

The study successfully demonstrated the eco-friendly synthesis of silver nanoparticles using aqueous extract of Ehretia laevis. The biosynthesized AgNPs were spherical, crystalline and stable with particle sizes in the nanometric range. FTIR confirmed the involvement of plant metabolits in nanoparticle capping. The study highlights the potential of Ehretia laevis as a green source for nanoparticle production, paving the way for applications in antimicrobial and wound healing formulations

REFERENCES

[1]. Alam G., Singh M. P., Singh A.Wound Healing Potential of Some Medicinal Plants. 2011, Vol 9, issue1,136-145.

[2]. Chopde V, Kamble D, Application of green silver nanoparticles synthesized using leaf extract of Tridax procumbens for preparation of clinical antimicrobial bandage.Int. J. Pharm. Investigation, 2021; 11(1):10-13

[3]. Dhenge, S., Khandare, K.,Efficacy of local application of khanduchakka (ehretia laevis roxb) ghrita in dushtavrana a-case report. Int. Ayurveda Medical Jou.2016.,Vol 4, Issue 12,3726-3731.

[4]. Dinesh K P, Bodagala P, Palanirajan V K, Saravanan G. Formulation and evaluation of voriconazole ophthalmic solid lipid nanoparticles in situ gel.Int. Jou. of Pharmaceutical investigation. 2018,IP:117.211.189-225.;

[5]. Garg, P., Deep, A., Wound healing potential of herbal drugs:a mini review. Int. J. of Pharmaceutical and Interdiciplinary sciences. 2015;1(3), 1-13.

[6]. Gupta H, Aqil M, Khar R. K, Ali A, Bhatnagar A, Mittal G., Nanoparticles laden in situ gel of levofloxacin for enhanced ocular retention.Drug Deliv. 2013; 20(7); 306-309.

[7]. Jyothirmai, N., Nagaraju, B., Suresh kumar J., Evaluation of anti-inflammatory and anti-bacterial activity of different solvent extracts of ehretia laevis roxb. J. Pharma Sci. & Res. 2016; Vol. 8(8); 715-720.

[8]. Kabiri, M., Kamal, S. H., Pawar, S. V., et.al., A stimulus responsive, in situ forming, nanoparticle-laden hydrogel for ocular drug delivery. Drug delivery and Translational

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[9]. Kumar B, Vijayakumar M, Govindarajan R, Pushpangadan P. Ethnopharmacological approaches to wound healing- exploring medicinal plants of India. J Ethnopharmacol. 2007; 114; 107-130

[10]. Kumarasamyraja,D. Neganathan N.S. and Manavalan R. . A review on medicinal plants with potential wound healing activity. Int J Pharm Sci. 2012; 2(4): 105-111.

[11]. 11)LI Li., PENG Yong., YAO ia., XU i-jia., WULAN Ta-na., LIU Yong., SHI Ren-bing., XIAO Pei-gen. Chemical Constituents and Biological Activities of Plants from the Genus Ehretia Linn.Chinese Herbal Medicine, 2010, 2(2); 106-111.

[12]. Mohd. H. K., Hanan ,S., Saraswathi , R. Formulation and Evaluation of herbal gel of Pothos Scandents Linn. Asian Pacific Journal of Tropical Medicine.2010, 988-992.

[13]. Murudkar, K., Bande, D., Chandak, A., Antimicrobial activity and minimum inhibitory concentration of Ehretia Laevis leaves extracts against different microorganisms. World jou. of Pharm. Res. 2018., Vol 7, Issue 12, 691-697.

[14]. Padmini Ravikumar, Rashmi Mallya, Developement and Evaluation of a polyherbal topical formulations. JPR: BioMedRx; An Int Journal 2013, Vol I, Issue 7, 637-640

[15]. Patel N., A., Patel, M., Patel, Rakesh., Formulation and evaluation of polyherbal gel for wound healing. Intl. R. J of Pharmaceuticals.2011; Vol 01, Issue 01,15-20