



Research Article

ANTIBACTERIAL POTENTIAL OF GREEN SILVER NANOPARTICLES SYNTHESIZED FROM LEAVES AND BARK EXTRACT OF *SIMAROUNBA GLAUCA*

Shital B. Koparde * and D.K. Gaikwad

Department of Botany, Shivaji University, Kolhapur, India

*Corresponding Author Email: shitalkoparde@gmail.com

Article Received on: 04/04/18 Approved for publication: 28/04/18

DOI: 10.7897/2230-8407.09458

ABSTRACT

Green synthesis of silver nanoparticles using the leaves and bark extract of *Simarouba glauca* DC is reported in the present investigation. Synthesized nanoparticles are characterized under UV-Vis spectrophotometer at the range 200-800 nm. The peak showed at 444 to 450 nm for leaves and 462 nm for the bark sample. FESEM studies revealed the nanoparticles synthesized from leaves and bark extract are spherical in shape and size ranging between 30-50 nm and 50-60 nm respectively. These silver nanoparticles showed inhibitory activity against micro-organisms such as *Staphylococcus aureus* and *Pseudomonas aeruginosa*, and exhibits antibacterial potential. Thus these silver nanoparticles might be used in the drug delivery system in pharma and agricultural industries.

Keywords: Antibacterial potential, silver nanoparticles, *Simarouba glauca*, FESEM

INTRODUCTION

Biological synthesis of nanoparticles offers easy and hazardous component free protocol. Among the noble metals, silver is the metal of choice because of its various applications in the different fields like photonics, biological sensing, solar cell surface coatings, electronics, medicine¹¹. Silver nanoparticles recognized as antimicrobial agent and having significant inhibitory effect on microbes present in industrial and medical fields⁵. The several researchers reported the biological synthesis of nanoparticles using plant extract such as *Cassia auriculata*¹, *Plectranthus amboinicus*⁴, *Shorea tumbuggaia*⁸, *Cissus quadrangularis*¹³, *Terminalia chebula*¹⁴. *Simarouba glauca* is important medicinal as well as oil yielding plant, commonly known as 'Laxmitaru' belongs to family Simaroubaceae. This plant have been various pharmaceutical and ethnobotanical uses. According to Joshi and Joshi (2002)⁶ the leaf, fruit, seeds, pulps and bark of *S. glauca* showed the medicinal properties such as antimicrobial, astringent, analgesic, antiviral, tonic and vermifuge. Thus attempt have been made to green synthesis of silver nanoparticles from *S. glauca* and evaluate its antibacterial potential.

MATERIAL AND METHODS

Preparation of leaves and bark extract

Leaves and bark of the *S. glauca* were collected from Department of Botany, Shivaji University Kolhapur. The material were washed with distilled water and dried to make powder. 10 g of leaves and bark powder mixed in 100 ml double distilled water separately and kept in boiling water bath for 15 minutes. The extracts were cooled and filtered using whatman no. 1 filter paper.

Synthesis of Silver nanoparticles

For the synthesis of silver nanoparticles *S. glauca* leaves and bark extract were reacted with silver nitrate. 10 ml of leaves and bark extract added to the 90 ml of silver nitrate solution, and kept in dark condition at room temperature⁹.

UV-vis Spectrophotometer analysis

The colour change in reaction mixture (Silver nitrate solution + leaves extract/ bark extract) was recorded. The bioreduction of silver ions was scrutinized by measuring the Uv-vis spectra of the reaction medium after 24h.

The complete bioreduced sample was centrifuged at 10000 rpm for 15 minutes. Then redispersed the pellet in double distilled water and again centrifuged. For obtaining the silver nanoparticles free from any unwanted residue of biomass, repeated this process of centrifugation for 2-3 times¹².

FESEM analysis

Morphology and size of the synthesized silver nanoparticles were examined by using FESEM images. Used 20 kv voltage for imaging nanoparticles in Field Emission Scanning Electron Microscope. [Model- MIRA 3 LMH].

Antibacterial activity

Antibacterial potential of silver nanoparticles synthesized from leaves and bark extract of *S. glauca* were studied by using agar well diffusion method². Antibacterial activity of silver nanoparticles

were tested against *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The agar plates were inoculated by spreading these bacteria over the entire agar surface. Then 8 mm well was punched and the different concentrations (30µl, 60 µl, 100 µl) of the nanoparticles were loaded in each plate. After 24h of incubation zone of inhibition was recorded. Streptomycin was used as control.

RESULTS AND DISCUSSION

The colour change in 1mM AgNO₃ solution from colourless to blakish brown (fig-1) and reddish brown (fig-2) was noticed after reaction with leaves extract and bark extract respectively. The characteristic surface plasmon absorption peak were observed at 444 to 450 nm for leaves (fig-3) and 462 nm for the bark sample (fig-4).

The Field Emission Scanning Electron Microscope image has shown the synthesized nanoparticles spherical in shape and size ranging between 30-50 nm (fig-5), for nanoparticles synthesized from leaf sample and 50-60 nm (fig-6) for nanoparticles synthesized from bark sample.

Nanoparticles synthesized from leaves and bark of *S. glauca* have potential to inhibit the growth of some bacterial strains such as *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Table-1). Highest activity of the nanoparticles against both the bacteria were seen due to nanoparticles synthesized from the leaves. Antibacterial activity of silver nanoparticles is due to the interaction with the thiol groups in proteins of bacteria and nanoparticles interfere with DNA replication^{3,7}. also nanoparticles disrupt cell membrane and penetrate the bacterial cytoplasm¹⁰. Synthesized nanoparticles from plant *S. glauca* leaves and bark extract showed toxicity to multidrug resistant microorganisms.(Fig- 7and 8).

Table 1: Antibacterial activity of AgNPs

Test Bacteria		Zone of inhibition in millimeter			
		Control	Concentration of AgNPs (µl)		
		Streptomycin	30(µl)	60(µl)	100(µl)
Leaves SNPs	<i>S.aureus</i>	24	11	17	18
	<i>P.aeruginosa</i>	31	14.5	17.6	18.5
Bark SNPs	<i>S.aureus</i>	24	9	12	16
	<i>P.aeruginosa</i>	25	14	17.5	18



Figure 1 (1) AgNO₃ solution (2) Leaves extract (3) Synthesized AgNPs

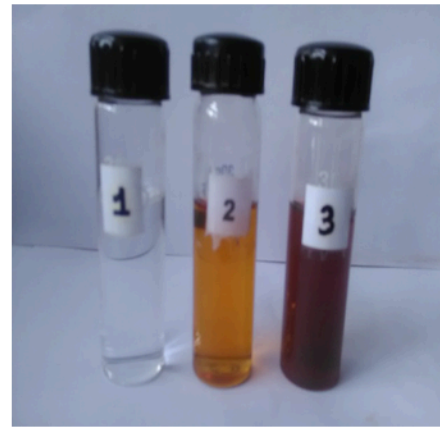


Figure 2 (1) AgNO₃ solution (2) Bark extract (3) Synthesized AgNPs

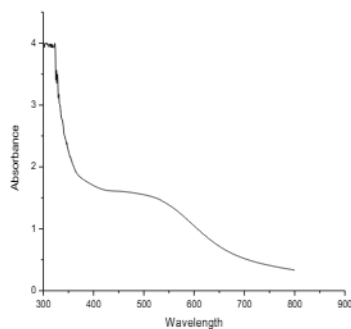


Figure 3 UV- Vis absorption spectra
leaf sample

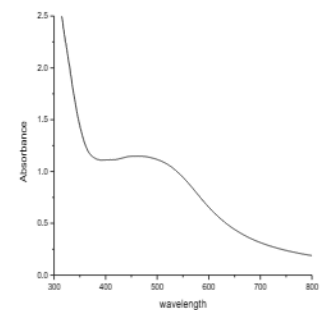


Figure 4 UV- Vis absorption spectra
bark sample

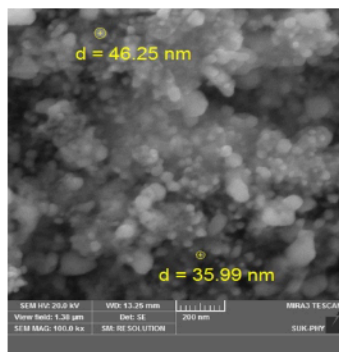


Figure 5 FESEM micrograph of leaf silver nanoparticles.

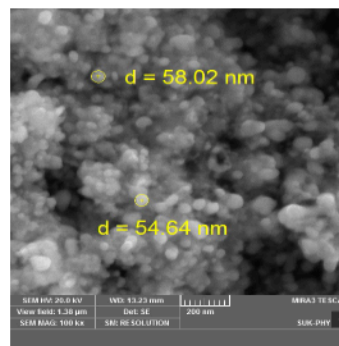
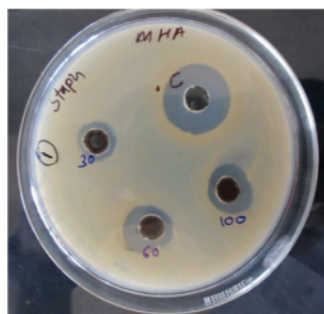
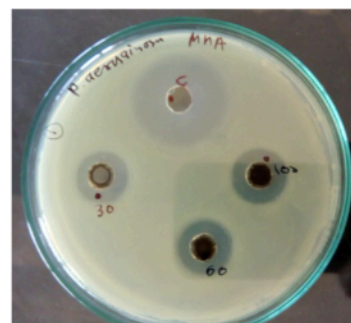


Figure 6 FESEM micrograph of bark silver nanoparticles.

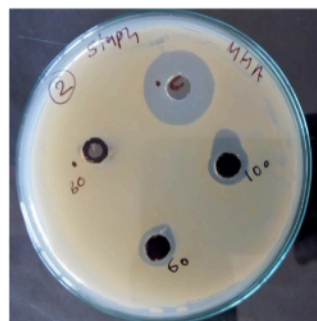


Staphylococcus aureus

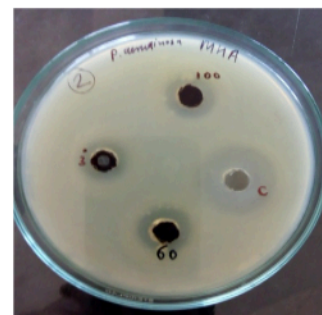


Pseudomonas aeruginosa

Figure 7- Antibacterial activity of leaves AgNPs



Staphylococcus aureus



Pseudomonas aeruginosa

Figure 8- Antibacterial activity of Bark AgNPs

CONCLUSION

In the present study, an ecofriendly process of silver nanoparticles synthesis was evaluated by using plant *Simarouba glauca* and these nanoparticles showed significant antimicrobial activity, indicating its applications in the field of pharmaceutical and pesticide industries.

ACKNOWLEDGMENT

I thank to Department of Botany, Shivaji University Kolhapur for providing the required facilities for research work and UGC-BSR for financial support.

REFERENCES

1. Asra P, Roy A, and Rao S. Biosynthesis and characterization of Silver Nanoparticles from *Cassia auriculata* L. Leaf extract and in vitro evaluation of antimicrobial activity. International Journal of Applied Biology and Pharmaceutical Technology, 2012; 3(2): 222-228.
2. Balouiri M, Sadiki M, Ibsouda SK. Methods for in vitro evaluating antimicrobial activity, A review. Journal of Pharmaceutical Analysis, 2015; 71-79.
3. Barth JV, Costantini G and Kern K. Engineering atomic and molecular nanostructures at surfaces. Nature- International Journal of science, 2005; 29: 671-679.
4. Devi N, Dheeban S, Femin, W and Paramasivam, T. Antimicrobial efficacy of green synthesized Silver Nanoparticles from the medicinal plant *plectranthus*

- amboinicus* (Lour.) Spreng. International Journal of Pharmaceutical Review Sciences and Research, 2012; 12 (1): 164-168.
5. Jose RM, Jose LE, Alejandra C, Katherine H, Jaun, BK, Jose TR and Miguel JY. The bacterial effect of silver nanoparticles. Nanotechnology, 2004; 16: 2346-2353.
 6. Joshi S and Joshi S. Oil tree- *Simarouba glauca* DC. University of Agricultural Sciences, Bangalore and Indian council of Agricultural Research, New Delhi, India. 2002 ; 86.
 7. Kaliappan ND, and Viswanathan PK. Pharmacognostical studies on the leaves of *Plectranthus amboinicus* (Lour) Spreng. International journal of green pharmacy, 2008; 2:182-184.
 8. Lingarao M, Savithramma N, Rukmini K and Suvarnalathadevi P. Antimicrobial activity of Silver Nanoparticles synthesized by using medicinal plants. International Journal of Chem Tech Research, 2011; 3 (3): 1394-1402.
 9. Meenakshisundaram M and Sivaranjani K. Biological synthesis of silver nanoparticles using *Ocimum basilicum* leaf extract and their antimicrobial activity. International Research journal of Pharmacy, 2013; 4 (1): 225-229.
 10. Samanta T, Roymahapatra G, Porto WF, Seth S and Ghorai SN. N, N'-Olefin functionalized bis-imidazolium gold (I) salt is an efficient candidate to control keratitis- associated eye infection. *PLOS ONE*, 2013; 8 (3):e58346
 11. Sudhalakshmi Y, Banu F, and Gopalakrishnan S. Green Synthesis, and antimicrobial activity of silver Nanoparticles from the medicinal plant *Vernonia amygdalina* Delile. Indian Journal of Nanoscience, 2013; 1: 32-35.
 12. Thilagam A, Tamilselvi Chandrasekaran B, and Rose C. Phytosynthesis of silver nanoparticles using medicinal and dye yielding plant of *Bixa orellana* L. leaf extract. Journal of Pharmaceutical and scientific Innovation, 2013; 2 (4): 9-13.
 13. Vanaja M, Gnanajobitha G, Paulkumar K, Rajeshkumar S, Malarkodi C and Annadurai G. Phytosynthesis of silver nanoparticles by *Cissus quadrangularis* L. Influence of physicochemical factors. Journal of Nanostructure in Chemistry, 2013; 3:17.
 14. Yadav S, Deepika Khar Roop K, Mohd M, and Ansari S. *Terminalia chebula* Retz Fruit extract mediated synthesis of silver Nanoparticles and their antimicrobial effect. The Global Journal of Pharmaceutical Research 2013; 2 (1): 1619-1626.

Cite this article as:

Shital B. Koparde and D.K. Gaikwad. Antibacterial potential of green silver nanoparticles synthesized from leaves and bark extract of *Simarouba glauca*. Int. Res. J. Pharm. 2018;9(4):42-45
<http://dx.doi.org/10.7897/2230-8407.09458>

Source of support: UGC-BSR, Conflict of interest: None Declared

Disclaimer: IRJP is solely owned by Moksha Publishing House - A non-profit publishing house, dedicated to publish quality research, while every effort has been taken to verify the accuracy of the content published in our Journal. IRJP cannot accept any responsibility or liability for the site content and articles published. The views expressed in articles by our contributing authors are not necessarily those of IRJP editor or editorial board members.