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Green Synthesis Characterization, Antibacterial Activity of Silver Nanoparticles from *Solanum surattense*

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ABSTRACT

The present study states the green synthesis of Silver nanoparticles from *Solanum surattense* (AgNPs) leaf extract as ecofriendly approach. The formed AgNPs are characterized by using UV-Vis spectrometry, FTIR, SEM and XRD analysis. The antibacterial activity of silver nanoparticle was performed using agar well diffusion assay against bacterial strains which include *E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Bacillus subtilis and Staphylococcus aureus.* The AgNPs from *Solanum surattense* showed highest activity against *Staphylococcus* compared to others.

INTRODUCTION

Nowadays, nanotechnology is expected to grow based on their demand and its wider application deals with the production and stabilization of various types of nanoparticles [1]. The nanosize particles exhibit distinctive properties which include electronic, magnetic, optical, catalytic and medicinal properties due to their large surface to volume ratio [2]. Among the different metals, the AgNPs are very important because of its unique character such as antimicrobial activity against both gram +ve and gram –ve organisms [3]. AgNPs containing ointments and creams are used to thwart infection [4]. Physical and chemical methods are widely used for the synthesis of AgNPs. These man-made approaches are extremely expensive and are associated with environmental toxicity which has led to the development of biological approach [5]. In recent years plant based nanoparticles are receiving much attention as they are less toxic. Biological approaches are ecofriendly, easy, readily scalable and less expensive [6].

Solanum surattense belongs to the family Solanaceae is found in Southeast Asia, Malaysia, Australia and India [7]. It is used to treat leprosy, skin disorder, stomachic, urolithiasis, epilepsy and dyspepsia [8]. The antioxidant, antibacterial and hypoglycemic activities of theses plants are well documented [9]. So far no research has been carried out on the synthesis of AgNPs using *Solanum surattense,* the present study was undertaken to synthesize, characterize and to evaluvate the antibacterial effect of AgNPs from *Solanum surattense*.

MATERIALS AND METHODS

Collection of sample:

Powdered form of *Solanum surattense* leaves were collected from the local market.

Preparation of leaf extract:

25g of powder was soaked in a 500ml Erlenmeyer flask with 100ml of sterile distilled water kept for 24hrs and was filtered.

Synthesis of AgNPs:

10ml of plant extract was added to 100ml of aqueous solution of 2mM silver nitrate. Then the sample was incubated in dark for 24hrs. After 24hrs, the color change was observed as light

brown to dark brown. And this color changed sample was measured for its maximum absorbance using UV spectrometry. The synthesized silver NPs were used for characterization.

CHARACTERIZATION OF AGNPS:

UV-Vis spectral analysis:

The formation of AgNP was verified by UV- Vis spectrometer at the wavelength of 300 to 700nm.

Fourier transform infrared spectrum (FTIR) analysis:

The dried AgNPs were grainded with KBr pellets and measure at the wavelength range from 4000-400cm^{-1}, so as to identify the biomolecules associated with the synthesize NPs.

X-ray diffraction Analysis:

To determine the crystalline nature of the AgNPs. XRD assay was performed by using X-ray diffractometer operated at 30kV and 20mA electric power with CuKa (I=1.54 A^0).

SEM analysis:

The sample was prepared by placing a drop of colloidal solution of AgNPs and carbon coated copper grid followed by drying in air before transforming it into a microscope operated at an accelerated voltage of 130kV.

DETERMINATION OF ANTIBACTERIAL ACTIVITY:

The antibacterial activity of AgNPs synthesized using *Solanum surattense* was determined on Muller-Hinton agar using Kirby-Bauer disc diffusion method. Test organisms (*E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Bacillus subtilis and Staphylococcus aureus*) were spread on the Muller-Hinton agar plates using sterile swabs. Wells were made with the help of a sterile Cork-Borer at aseptic conditions. The synthesized AgNPs at different concentrations (62.5-500µg/ml) were added to the wells. Ampicillin (1mg/ml) was used as a standard. The plates were incubated and the zone of inhibition was recorded.

RESULTS

UV VISIBLE SPECTROSCOPY ANALYSIS:

A visible color change indicates the formation of AgNPs which was confirmed by UV-Visible spectrometry analysis. AgNPs exhibit maximum absorption in the region of 400 to 500 nm. UV spectroscopy analysis reveled a narrow absorption band at 438nm which is characteristic of monodispersed AgNPs (Figure 1).

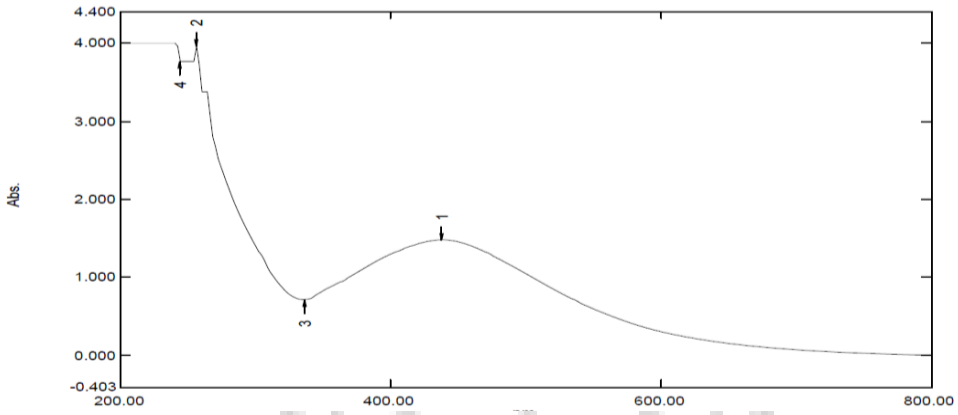

Figure 1: UV- Vis Spectra of AgNPs synthesized from *Solanum surattense*

FTIR (Fourier Transform Infra Red):

The FTIR measurement reveals various functional groups in *Solanum surattense* extract. Prominent IR bands are observed at 3402, 2931, 1604, 1519, 1442, 1381, 1280, 1064, 817, 711, 671 and 609 cm^{-1}. The peak at 2931 indicates C-H stretches due to alkanes, peak at 3402 indicates N-H stretching, peak at 1442 indicates C-C stretching and peak at 1280 indicates C-N stretching (Figure 2).

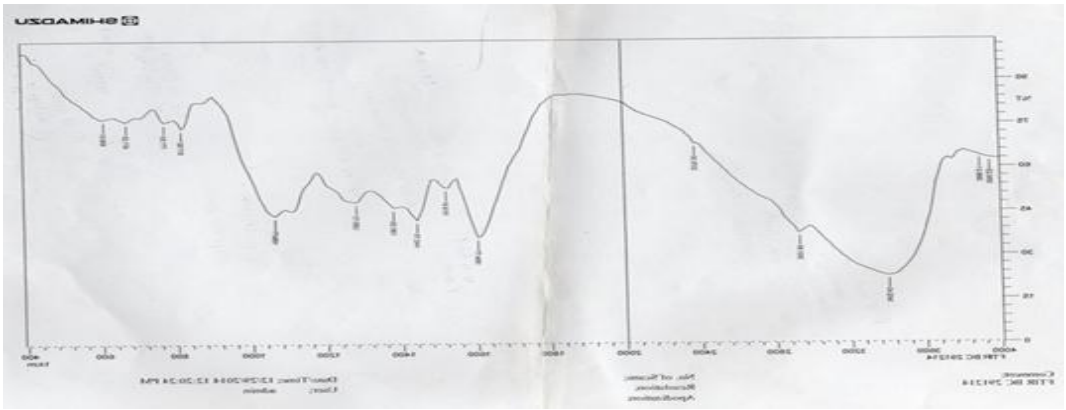

Figure 2: FT-IR spectra of biosynthezied nanoparticles

XRD ANALYSIS :

The XRD pattern of AgNPs is shown in Figure 3. The pattern showed a number of Bragg's reflection that may be indexed on the basis of face centered cubic structure of silver. The crystalline nature of AgNPs was conformed by the XRD pattern.

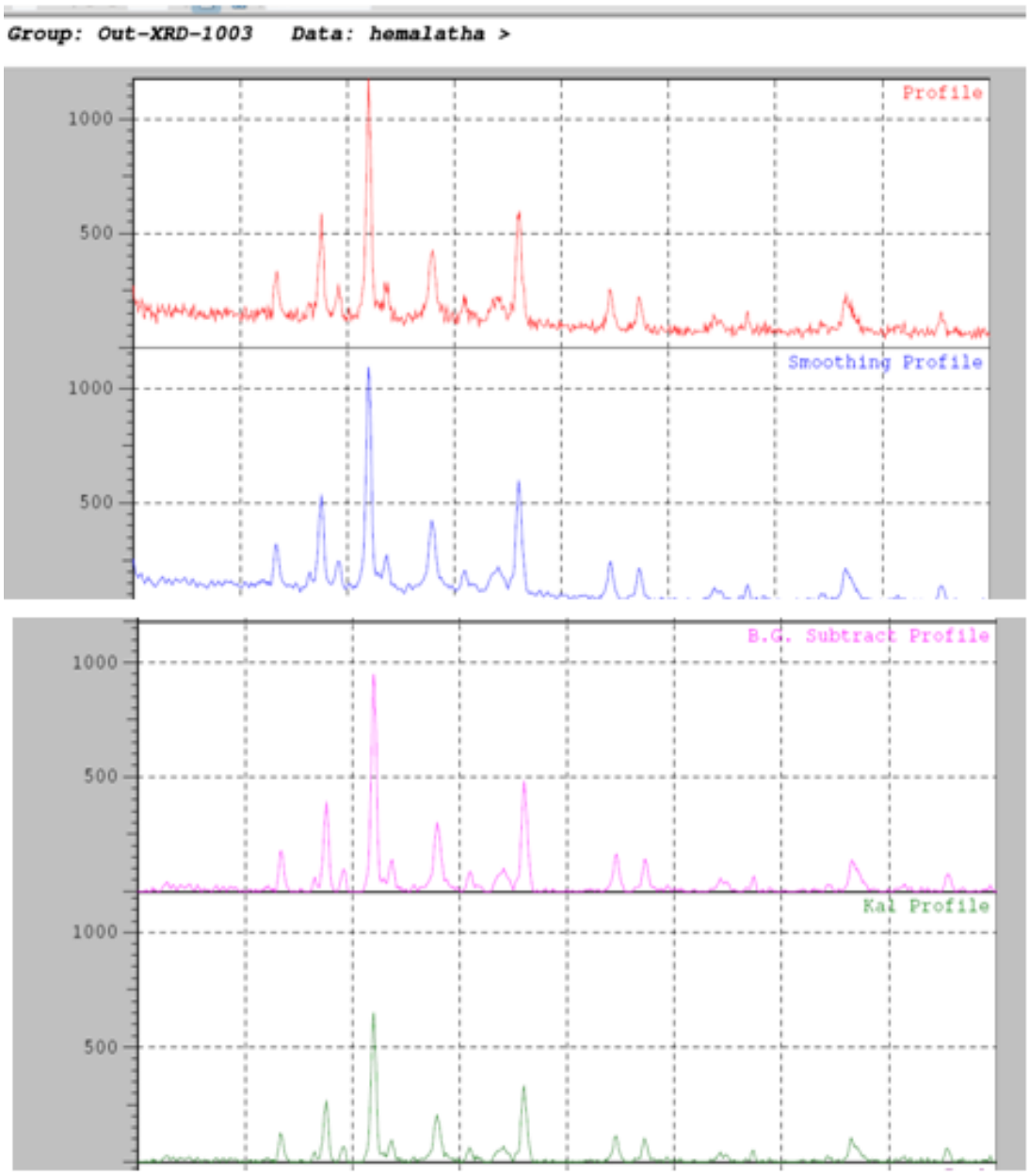

Figure 3: X-Ray Diffraction Pattern

SEM ANALYSIS :

Scanning electron microscopy provides the morphology and size of the AgNPs. Experimental evidence indicated that the diameter of the synthesized AgNPs was about 40 – 60 nm and the shape were spherical which was shown in Figure 4.

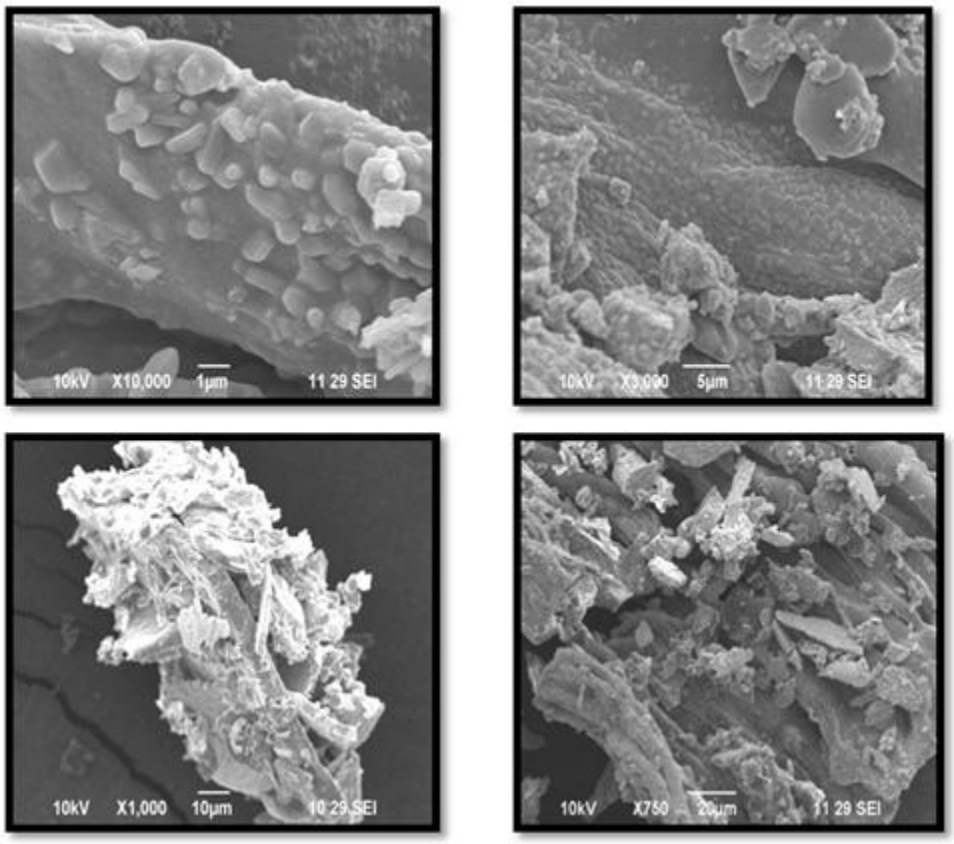

Figure 4: Scanning Electron Microscopy of silver nanoparticles

ANTIBACTERIAL EFFECT:

The antibacterial effect of biogenic AgNPs, was examined against gram negative- *E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa,* and gram positive - *Bacillus subtilis and Staphylococcus aureu.* The nanoparticles showed zone of inhibition against all the bacteria used in this study. A maximum zone of inhibition was found to be 20 mm for *Staphylococcus aureus,* whereas for other bacterial strains, the zone of inhibition was found to be 13 mm, 9 mm, 14 mm and 11 mm. For Ampicillin the zone of inhibition found to be 28 mm. The result indicates that the synthesized AgNPs from *Sollanum surattense* extract show antibacterial activity both in gram positive and negative bacteria (Table 1).

Table 1: Anti bacterial activity of Silver nanoparticles from *Solanum surattense*

ORGANISMS	ZONE OF INHIBITION (mm)				STANDARD DRUG (Amp) 10mg/ml
	500µg	250µg	125µg	62.5µg	
E.coli	13	8	5	3	20
Klebsiella pneumoniae	9	7	4	3	19
Psuedomonas aeruginosa,	14	10	8	4	22
Bacillus subtilis	11	7	5	3	21
Staphylococcus aureus	20	17	14	10	28

DISCUSSION

Plant mediated synthesis of nanoparticles is better than physical and chemical methods. The synthesis, characterization and antibacterial activity of AgNPs from *Sollanum surattense* was reported in the present study. The color change was observed by adding silver nitrate solution to the plant extract and was due to the excitation of surface Plasmon vibration of AgNPs [10]. The reduction of silver is confirmed by UV spectral analysis. A strong peak at 438 nm for *Solanum surattense* AgNPs confirm the formation of AgNPs. This is similar to the characteristic peak obtained for AgNPs prepared by *Sterculia foetida* [11]. FTIR spectroscopy is used to determine the chemical composition of the AgNPs. The FTIR spectrum recorded for the synthesized nanoparticles revealed a strong band at 3402, 2931, 1604, 1064, and 817 cm^{-1}. The XRD was used to confirm the crystalline nature of the nanoparticles. The SEM analysis reveals the spherical shape of the nanoparticle formed from *Sollanum surattense.* The anti-bacterial activity of AgNPs synthesized by plant extract was used against various pathogenic organism such as gram negative *E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa,* and gram positive - *Bacillus subtilis and Staphylococcus aureu*s using the well diffusion method. The synthesized AgNPs were found to have more antibacterial activity against *Staphylococcus aureu*s and the zone of inhibition was recorded as 20 mm. The silver nanoparticles exhibit maximum antibacterial activity compared to other salts due to their large surface area which provide better contact with organisms. Silver nitrate is used as an anti-septic agent for many decades [12]. The antibacterial activity of AgNPs is through the electrostatic attraction between negatively charged cell membrane of microorganism and positively charged nanoparticles [13]. Shrivastava reported

that a major mechanism through which AgNPs exerts antibacterial activity was either by anchoring or penetrating the bacterial cell wall and modulating cellular signaling by dephosphorylaing the peptide substrate on tyrosine residues [14].

CONCLUSION

For the first time the synthesis of AgNPs was made by biological method using *Solanum surattense*. The synthesized AgNPs were confirmed by its dark brown color and are crystalline in nature. The size and shape of the so formed AgNPs were observed as spherical in shape with 40-60 nm in size. These AgNPs showed antibacterial activity against several microbes like *E. coli*, *Klebsiella*, *Pseudomonas*, *Bacillus* and *Staphylococcus.*

REFERENCES

1. Mukunthan KS, Elumalai EK, Pater TN, Ramachandra murty V. Asian pacific J.of Tropical biomedicine. 2011; 270-274.
2. Catauro M, Raucci MG, De Gaaetano FD, Marrota A. J Mater sci Mater Med. 2004; 15:7.
3. Shrivastava S, Bera T, Roy A, Singh G, Ramachandrarao, Dash D. Nanotechnology.2007; 18:9.
4. Becker RO. Met based drugs. 1999; 6: 297-300.
5. Elumalai K, Prasad TNVKV, Kambala V, Nagajyothi PC, David E. Archives of Applied Science Research. 2010; 2(6): 76-81.
6. Khan Z, Hussain JI, Hashmi AA. Coll. Surf. B: Biointerf. 2012; 95:229.
7. Mathew KM. The flora of the Tamil nadu Carnadic, Vol. III, Part I&II. The Rapinat Herbarium, St, Joseph's College, Tiruchirapalli. India. 1983; 1061-1064.
8. Saviol YK. Illustrated Manual of Herbal Drugs used in Ayurveda. Ind. Council Medical Research. 1996;310.
9. Prempeh ABA, Menah- Attipoe J. Analgestic activity of crude aqueous extract of the root bark of *Zanthocarpium Xanthoxyloides*. Ghana Med J. 2008; 8: 79-84.
10. Dubey SP, Lahtinen M, Sarkka H, Sillanpaa M. Bioprospective of *Sorbus aucuparia* leaf extract in development of silver and gold nano collaids. Collaids and Surfaces B:Biointerfaces. 2010;80:26-33.
11. Shivakumar Singh P, Vidyasagar GM. Green synthesis, characterization and antimicrobial activity of Silver nanoparticles by using *Sterculia foetida* L. young leaves aqueous extract.International journal of Green Chemistry and Bioprocess.2014;4(1):1-5
12. Lansdown. A.B.J. Wound care.2002;11:125.
13. Dibrov D, Dzioba J, Gosink KK, Hase CC. Antimicrob Agents Chemother.2002;46:2668.
14. Shrivastava S, Bera T, Roy A, Singh G, Ramachandrarao, Dash D. Nanotechnology.2007; 18:225103.