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Research Article

SYNTHESIS OF SILVER NANOPARTICLES USING *LANTANA CAMARA* FRUIT EXTRACT AND ITS EFFECT ON PATHOGENS

PADMANABAN SIVAKUMAR*, CHANDRAN NETHRADEVI, SAHADEVAN RENGANATHAN

Department of Chemical Engineering, Anna University, Chennai – 600 025, Tamil Nadu, India.E-mail:rengsah@rediffmail.com

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ABSTRACT

A cost effectual and environment benign technique for the green synthesis of silver nanoparticles through the extract of *Lantana camara* fruit as reducing and capping agent from 1mM $AgNO_3$ solution. Nanoparticles were characterized using UV–Vis absorption spectroscopy, Fourier transfer infra-red spectroscopy (FTIR), Transmission electron microscopic (TEM). The analysis results confirm the formation of silver nanoparticles. The synthesized nanoparticles are found to be highly effective against different human pathogenic bacterial species.

Keywords: Green synthesis; Silver nanoparticles; *Lantana camara*; Antibacterial activity.

INTRODUCTION

The field of nanotechnology is one of active areas of research in modern materials science. Nanoparticles exhibit enhanced properties on specific characteristics such as size, distribution and morphology. Nanoparticles and nanomaterial's applications are increasing rapidly [1]. Nano crystalline silver particles have found tremendous applications in high sensitivity bimolecular detection and diagnostics [2], antimicrobials and therapeutics [3], catalysis [4,5] and electronics [6]. There is still need for economic, commercially doable in addition environment friendly synthesis route to synthesize silver nanoparticles.

Several approaches are out there for the synthesis of silver nanoparticles for example, chemical reduction [7], photochemical [8], reverse micelles [9], thermal decomposition [10], radiation assisted [11], electrochemical [12], sonochemica l[13], microwave assisted method [14] and recently via green chemistry method [15].

There is a rising commercial require for nanoparticles because of their wide applicability in numerous area such as electronics, catalysis, chemistry, energy, and medicine. Metallic nanoparticles are synthesized by wet chemical techniques [16], where the chemicals used are toxic and flammable. The use of environmentally affable materials like plant extract [17], bacteria [18], fungi [19] and enzymes [20] for the synthesis of silver nanoparticles offers various advantages of eco-friendliness and cohesiveness for pharmaceutical and different biomedical applications as they do not use toxic chemicals for the synthesis algorithm. Chemical synthesis method results in presence of some toxic chemical absorbed on the surface that may have unfavourable impact in the medical applications. Compared with chemical and physical method of synthesis green synthesis method provides a low cost, environment friendly, easily scale up for large scale synthesis. Green synthesis method there is no need to use high pressure, energy, temperature and toxic chemicals.

Silver has long been acknowledged as having inhibitory effect on microbes present in medical and industrial process [21, 22]. Specific surface area is an important for catalytic reactivity and other related properties such as antimicrobial activity in silver nanoparticles. Here in, we report for the first time synthesis of silver nanoparticles using aqueous extract derived from *L. camara* (Fig1.) fruit and antibacterial activity of the synthesized NPs is described.

Fig. 1: ***Lantana camara*** **fruit**

MATERIALS AND METHODS

Materials

Fresh fruits of *L. camara* were collected from Anna University campus (Chennai, India). $AgNO_3$ was purchased from Merk (Mumbai, India) and used without purification. Micron filters of 0.45 and 0.25 µ were purchased from Fischer scientific (Mumbai, India). The aqueous solutions used for synthesis were made with ultrahigh purity (Mill-Q) water.

Synthesis of silver nanoparticles

$AgNO_3$ solution (1 mM) was prepared by dissolution of 0.16 g in 1L water (Mill-Q). *L. camara* fruit was washed with water, crushed and filtered through 0.45 µ filter. The filtrate was further passed through 0.25 µ filter. The fruit extract of *L. camara* (10 mL) was added with 90 mL of 1mM $AgNO_3$ solution at room temperature. The mixture was allowed to stand for approximately 1 hour until a yellowish brown colour solution was observed.

Characterization

UV-Visible spectra of silver nanoparticles were recorded with a Shimadzu 1800 UV spectrophotometer (Kyoto, Japan). FTIR spectra of silver nanoparticles were carried out on a Perkin Elmer spectrum one. TEM images for silver nanoparticles were recorded using Philips model CM 200 instrument operated at an accelerating voltage at 200 kV.

Antibacterial test for silver nanoparticles

Agar diffusion assay is used widely to determine the anti-bacterial activity of Silver nanoparticles. Nutrient agar prepared was poured in the Petri dish. 24 h growing *M. luteus ATCC* 4698, *B. subtilis MTCC* 1133, *S. aureus MTCC* 96, *V. cholerae ATCC* 14035, *K. pneumoniae MTCC* 109, and *S. typhi* MTCC 733 were swabbed on it. The wells (10 mm diameter) were made by using cork borer. The different concentration of the Silver nanoparticles (50 µl and 100 µl) and dimethyl sulphoxide was used as negative control in the wells. The plates were then incubated at 37ºC for 24 h. The inhibition diameter was measured.

RESULTS AND DISCUSSION

Characterisation

UV-Spectroscopy

Silver nanoparticles have shown yellowish brown colour in aqueous solution due to excitation of surface plasma vibrations in silver nanoparticle [23]. After added the extract with silver nitrate the colour of the solution changed from watery to yellowish brown due to the reduction of Ag^+ into Ag^0 which had shown the formation of silver nanoparticles. Silver nanoparticles exhibit interesting optical properties directly associated with localized surface plasmon resonance which is highly depends on the morphology of the nanoparticles. Reduction of Ag^+ ions during exposure to the extract of *L. camara* fruit was easily followed by UV-spectroscopy Absorbance peak at 439 nm showed in the reaction mixture indicated silver nanoparticles were formed (Fig 1.). Broadening of peak indicated nanoparticles are poly dispersed.

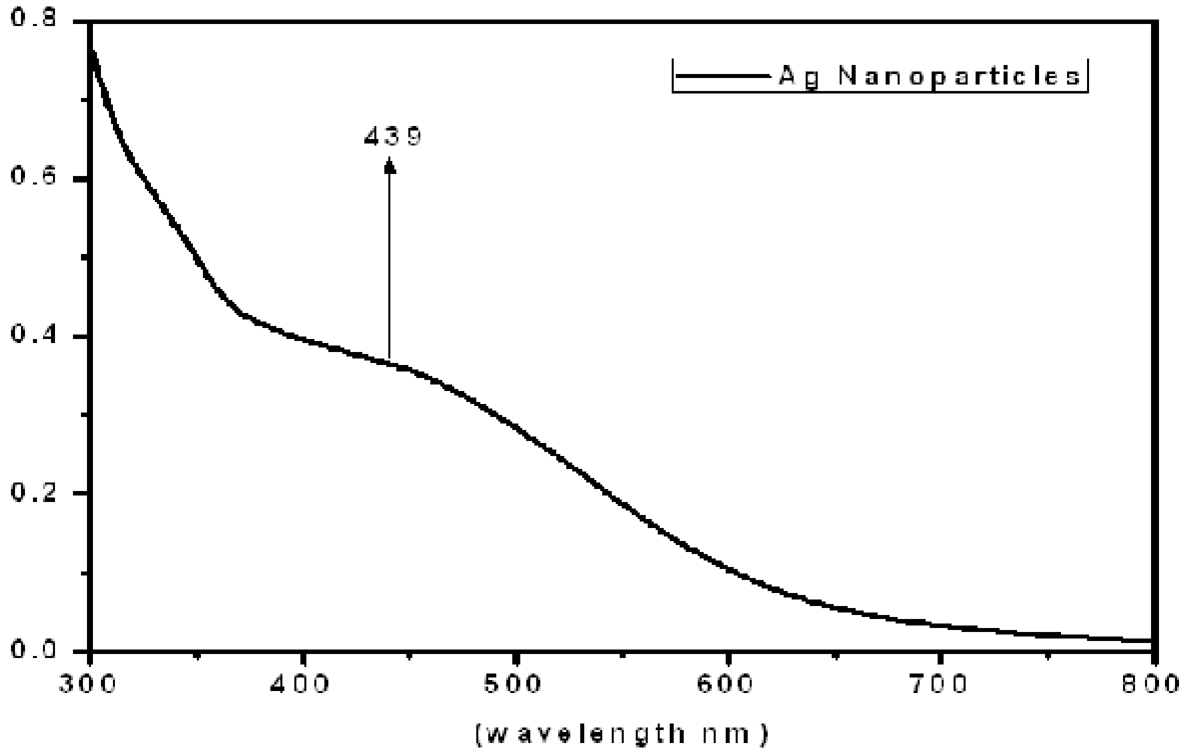


Fig.2: UV Spectroscopy analysis for the formation of silver nanoparticles at 439 nm.

FTIR Spectroscopy

Phytochemical analysis [24] of *L. camara* fruit extract reveals the aqueous extract contains carbohydrates, glycosides and flavonoids. The Ag^+ reduction was based on these three molecules [25]. The larger amount of flavonoids present in aqueous fruit extract may act a major role in Ag^+ reduction reaction [26]. FTIR spectrum was used to analyse the functional group present in the *L. camara* fruit extract. The synthesized silver nanoparticle is confirmed by changes occurred in the FTIR spectrum after synthesis. The FTIR spectrums of fruit extract and silver nanoparticles, are represented(Fig 3., Fig 4.). The figure shows that the peak at 3423 cm^{-1} reveals water and OH absorption frequency [27] and 2924 cm^{-1},2854 cm^{-1} are confirm the stretching vibration of C-H and 2345 cm^{-1},2373 cm^{-1}, 2047 cm^{-1} are represent the asymmetric stretching of C-H [28] and 1636 cm^{-1} correspond to carbonyl specific absorption and 1111 cm^{-1}, 1019 cm^{-1} are confirm the C=O and C-OH stretching [27].The FTIR values are shows reduction and capping of silver ion may be the presence of polyols. Particularly the peak at 1636 cm^{-1} of extract changed to 1638 cm^{-1} of after synthesis reveals the reduction of silver ion to silver nanoparticles.

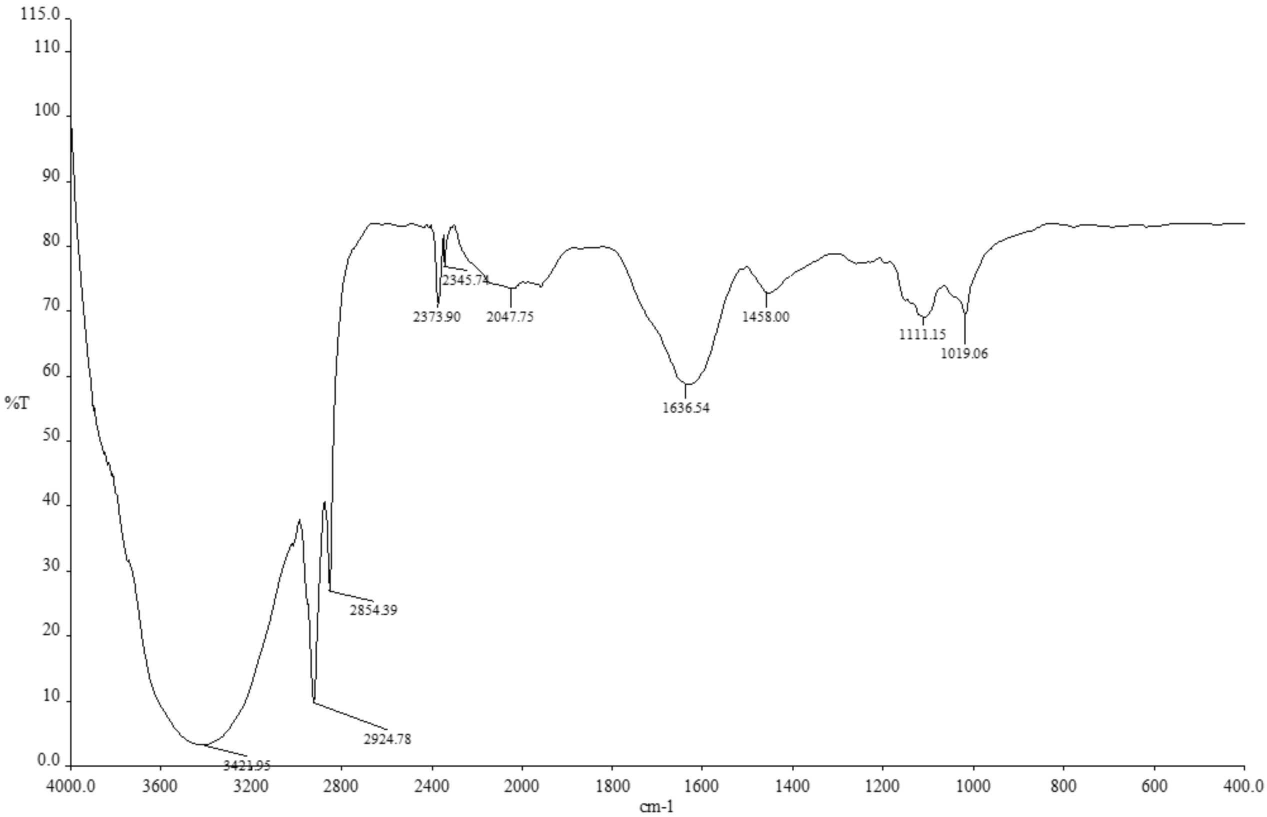


Fig. 3: FTIR Analysis for raw *Lantana Camara* fruit extract.

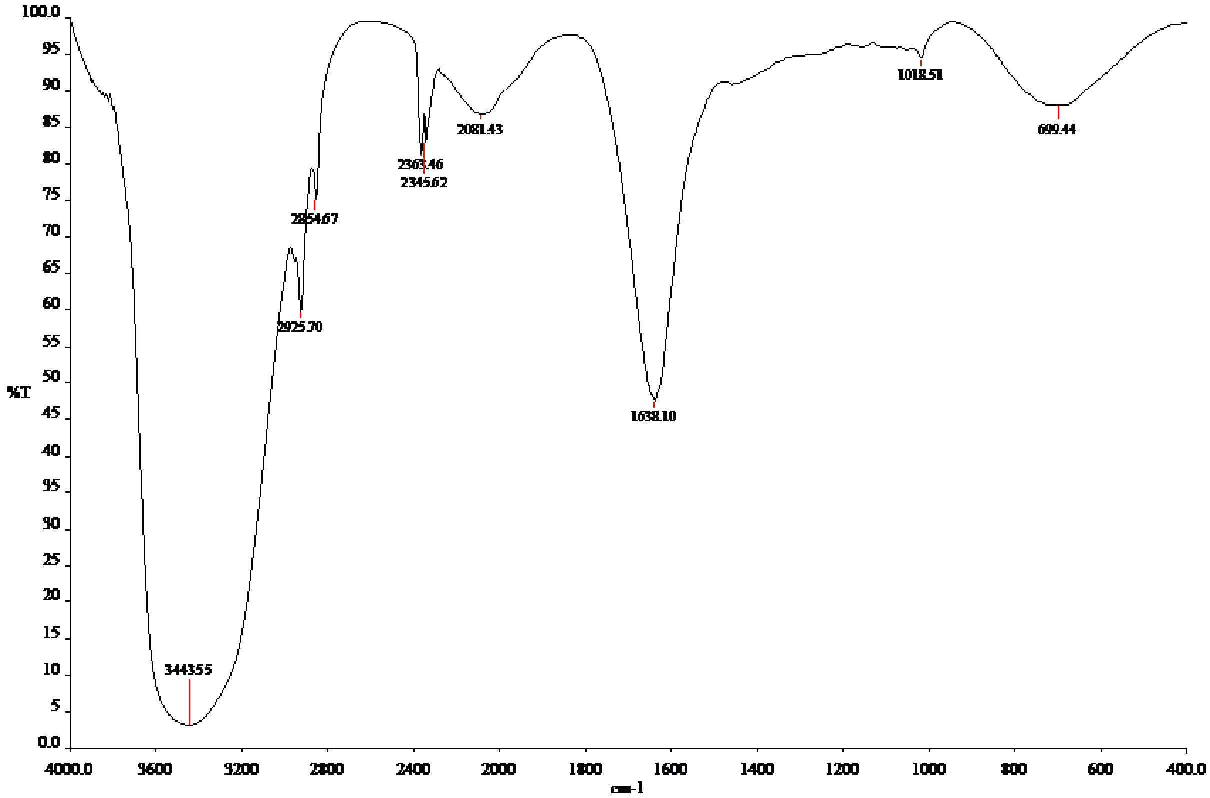


Fig. 4: FTIR spectra for after synthesis of silver nanoparticles.

TEM microscopy

TEM was used to view the morphology and size of silver nanoparticles. A typical TEM image is shown in fig. The TEM image illustrate silver nanoparticles are spherical in shape (Fig 5.). The spherical shape silver nanoparticles are having size between 12.55 to 12.99 nm these size of silver particle confirms the nanoparticles.

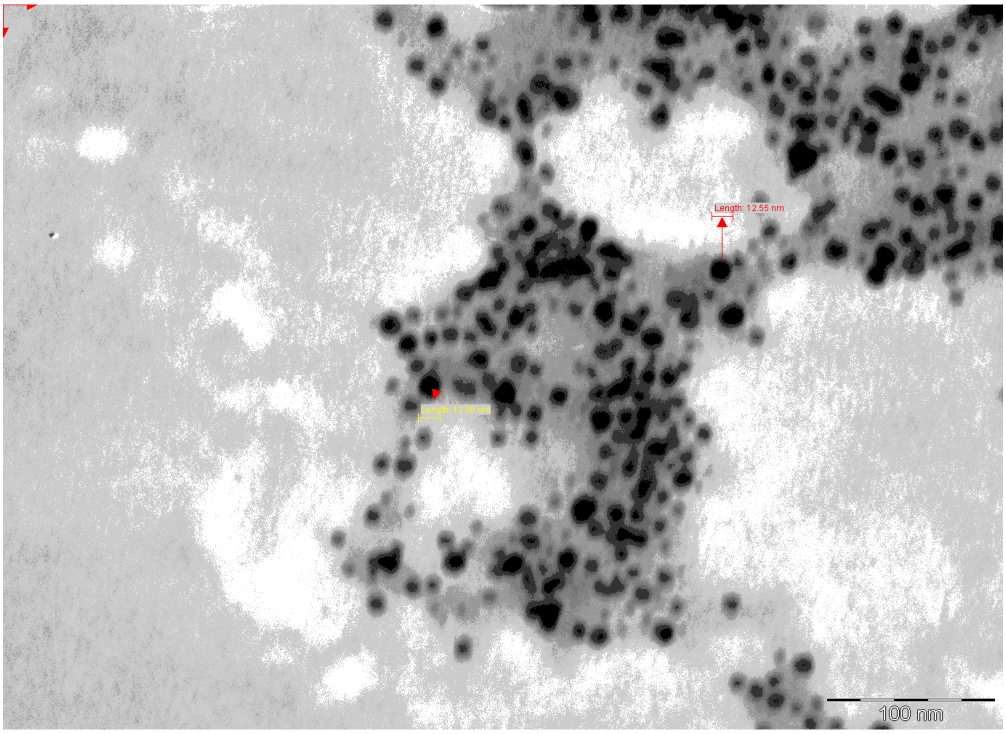
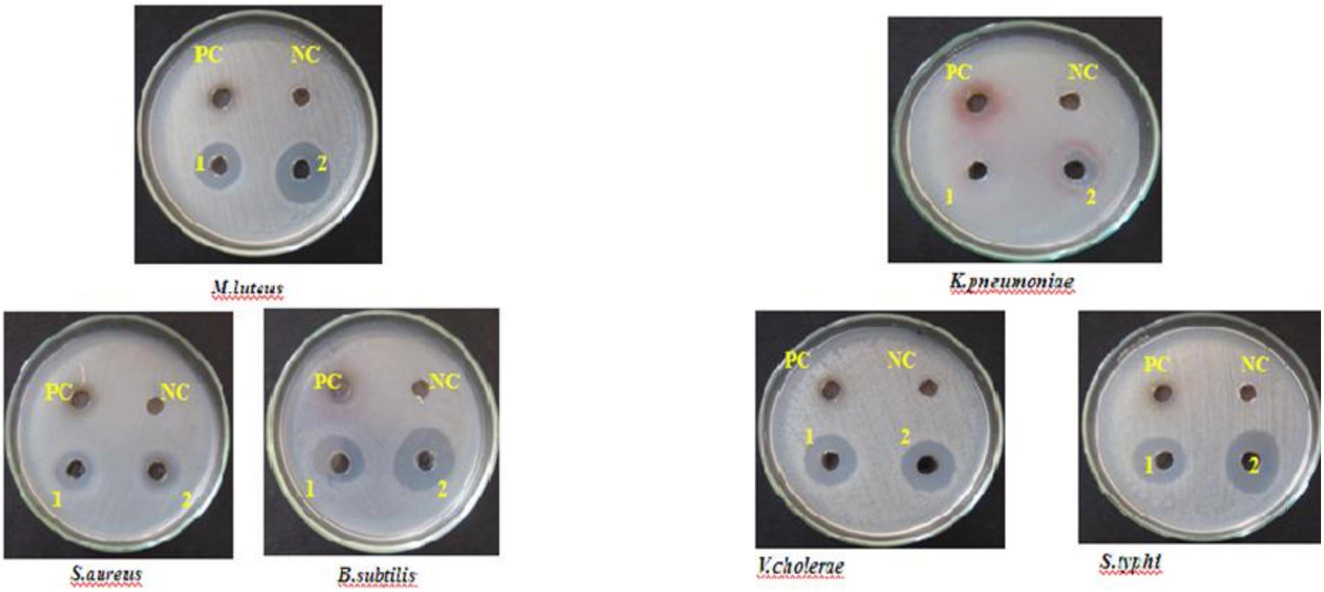


Fig. 5:TEM image of silver nanoparticles

Antibacterial activity

The antibacterial activity was examined against six pathogenic bacteria, both gram positive and gram negative bacteria such as *M. luteus ATCC* 4698, *B. subtilis MTCC* 1133, *S. aureus MTCC* 96, *V. cholerae ATCC* 14035, *K. pneumoniae MTCC* 109, and *S. typhi* MTCC 733. The maximum activity was found to be 26 mm zone of inhibition was obtained for *B. subtilis MTCC* 1133 (gram positive) and 22 mm zone of inhibition against *S. typhi* MTCC 733 (gram negative). From the figure (Fig 6.) the synthesized silver nanoparticles was found to be more effective antimicrobial activity for gram positive bacteria when compared with gram negative bacteria.



NC-Negative Control, PC-Positive control, 1-50 µl, 2- 100 µl

Fig. 6: Antibacterial activity of silver nanoparticles against positive and negative pathogens.

CONCLUSION

In conclusion, the fruit extract of *L. camara* are capable of synthesize silver nanoparticles has been demonstrated. Synthesized silver nanoparticles were characterised by UV-Visible, FTIR and TEM analysis. The flavonoids, carbohydrates and glycosides molecules are present in fruit extract amenable for synthesis of silver nanoparticles. It is an eco – friendly green and low cost method. Study also reveals antibacterial activity for gram positive and gram negative bacteria. Antimicrobial activity concluded that the synthesized nanoparticle more effective for gram positive organisms when compared with gram negative organisms. The antibacterial result states Silver nanoparticles as a strong antibacterial agent which can be useful for antimicrobial applications.

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