International Journal of
Science Inventions Today
www.ijsit.com
ISSN 2319-5436
Research Article

GREEN SYNTHESIS OF SILVER NANOPARTICLES USING MEDICINAL SAND DUNE PLANT *IPOMOEA PESCAPRAE* LEAF EXTRACT

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ABSTRACT

Ipomoea pes-caprae is conspicuously and regularly represented in the sand dune flora of the Tamilnadu coastal area. In this article, we have described a green synthesis of silver nanoparticles from $AgNO_3$ solution through the leaf extract of *I. pescaprae* plant. *I. pescaprae* leafs were collected and washed by tap water followed by distilled water then the leaves were boiled and filtered. Then 10 mL of plant leaf extract is mixed with 90ml of 1mM solution of silver nitrate solution. Synthesized silver nanoparticles were characterized using UV-visible spectroscopy, Fourier transform infrared spectroscopy (FTIR) and transmission electron microscope. The UV–visible spectra gave surface plasmon resonance for synthesized silver nanoparticles at 420 nm. The TEM gives the size of the silver nanoparticles from 13 to 14nm. The Fourier Transform Infrared Spectroscopy analysis evaluated the presence of different functional groups in capping the silver nanoparticles. Hence, the plant based route could be considered as fast and easy bioprocess of nanoparticles production.

Key words: *Ipomoea pescaprae*, Antimicrobial, Silver nanoparticles, FTIR, UV-spectroscopy, TEM.

INTRODUCTION

In recent years, noble metal nanoparticles have been the subject of focused research due to their unique optical, electronic, mechanical, magnetic, and chemical properties that are significantly different from those of bulk materials (Gavhane *et.al.,* 2012). Various approaches using plant extract have been used for the synthesis of metal nanoparticles. The biosynthetic method employing plant extracts (Dhanalakshmi & Rajendran 2012) has received much attention recently owing to its simplicity, eco-friendliness and economically viable nature, compared to the other existing methods such as using bacteria and fungi (Oza *et.al.,* 2012) and the chemical (El-Kheshen & Gad El-Rab 2012; Igwe & Ugwu 2010) and physical methods used for synthesis of metal nanoparticles. In medicines, silver and silver nanoparticles have a wide application including skin ointments and creams containing silver to prevent infection of burns and open wounds (Duran *et.al.,* 2005), medical devices and implants prepared with silver-impregnated polymers (Becker 1999). In textile industry, silver-embedded fabrics are now used in sporting equipment (Klaus *et.al.,* 1999). Using plant for nanoparticles synthesis can be advantageous over other biological processes by eliminating the elaborate process of maintaining cell cultures (Elumalai *et.al.,* 2010). It can also be suitably scaled up for large-scale synthesis of nanoparticles. Green synthesis of silver nanoparticles has been reported using extracts of various plants such as *Nelumbo nucifera* (Shankar Rai *et.al.,* 2004), *Euphorbia hirta* (Santhoshkumar *et.al.,* 2010), *Ocimum sanctum*(Singhal *et.al.,* 2011), etc

The plants belonging to the genus *Ipomoea* (Convolvulace) consists of more 200 species that widely distributed in tropical and subtropical countries. Some of them are frequently used in flock medicine for the treatment of several diseases (De Souza *et.al.,* 2010). *Ipomoea pes-caprae* is used in flock medicine against inflammation and gastrointestinal disorder and as an analgesic agent (De Souza *et.al.,* 2010). *I. pescaprae* is a traditional medicinal plant used in the treatment of headache and various types of inflammation including jellyfish sting dermatitis (Bandaranayake 2002).

The present study was aimed at the green synthesis of silver nanoparticles using the leaf extract of *I. pescaprae.* The presence of silver nanoparticles is identified by UV-spectroscopy at 420nm. The capping agent of silver was characterized by FTIR. The particle size of the synthesized silver nanoparticles was characterized by TEM analysis.

MATERIALS AND METHODS

Preparation of the plant extract:

I. pescaprae leaves (Figure 1) were collected from pudupettai coastal village, Cuddalore, Tamilnadu. 25g of the leaves were washed several times in the tap water followed by distilled water to remove the dust particles. The leaves were cut into small pieces and boiled in a 500ml Erlenmeyer flask along with 100ml of

distilled water for 10min. After boiling the colour of the aqueous solution changed from watery to yellow colour. The aqueous extract was filtered by using Whatman No. 1 filter paper. And then filtered aqueous leaf extract was stored at -15^{o}C for further research use being usable for one week (Chandran *et.al.,* 2006).

Figure 1: Leaves of *ipomoea pes-caprae*

Biosynthesis of Silver Nanoparticles:

1mM of silver nitrate solution was prepared in 100ml flask. 10ml of plant extract was mixed with 90ml of 1mM silver nitrate solution. The appearance of reddish brown colour after 2h indicates the formation of silver nanoparticles. The completion of the reaction was monitored by UV-visible spectroscopy. Then the solution is stored in room temperature for 24 hours for the complete settlement of nanoparticles. After 24 hours, centrifuge the reaction mixture. Discard the supernatant. Add ml of distilled water to the pellet and wash by using centrifugation. The collected pellet dries it in the watch glass and stores the nanoparticles (Gardea torresdey *et.al.,* 2003).

CHARACTERIZATION OF SILVER NANOPARTICLES

UV – Visible Spectroscopy:

The bio-reduction of reaction mixture of the pure silver ions was observed by observing the UV-visible spectroscopy at 200 to 800nm by using 1ml of sample, compared with 1ml of distilled water used as blank.

Transmission electron microscopy of silver nanoparticles synthesis:

The synthesized silver nanoparticles analysis was done using Phillips CM200 field emission gun TEM

machine operating at 200kV. The thin coated of the silver nanoparticles synthesized powder were prepared on a carbon coated copper grid by just dropping a very small amount of the sample on the grid, extra solution was removed using a blotting paper.

FTIR analysis of silver nanoparticles:

Fourier transform infrared spectra for *I. pescaprae* leaf extract powder and silver nanoparticles was obtained in the range 4000 to 400 cm^{-1} with an IR-Prestige –21 Shimadzu FT-IR spectrophotometer, by KBr pellet method.

RESULTS

UV-Visible Spectrum analysis of silver nanoparticles synthesis:

Reduction of silver ions into silver nanoparticles using extract of leaves of *I. pescaprae* was evidenced by the visual change of from yellow to reddish brown due to excitation of surface Plasmon vibrations (Power *et.al.,* 2011; Sathyavani *et.al.,* 2010) in silver nanoparticles as shown in (Figure 2). UV-Vis spectra recorded at different time intervals from aqueous solution of silver nitrate with *ipomoea pes-caprae extrac*t. The samples display an optical absorption band peak at about 428 nm (Figure 3), typical of absorption for metallic Ag nanoclusters, due to the Surface Plasmon Resonance (SPR). Effect of the reaction time on AgNPs synthesis was also evaluated with UV-Visible spectra and it is noted that with an increase in time the peak becomes sharper. The increase in intensity could be due to increasing number of nanoparticles formed as a result of reduction of silver ions presented in the aqueous solution.

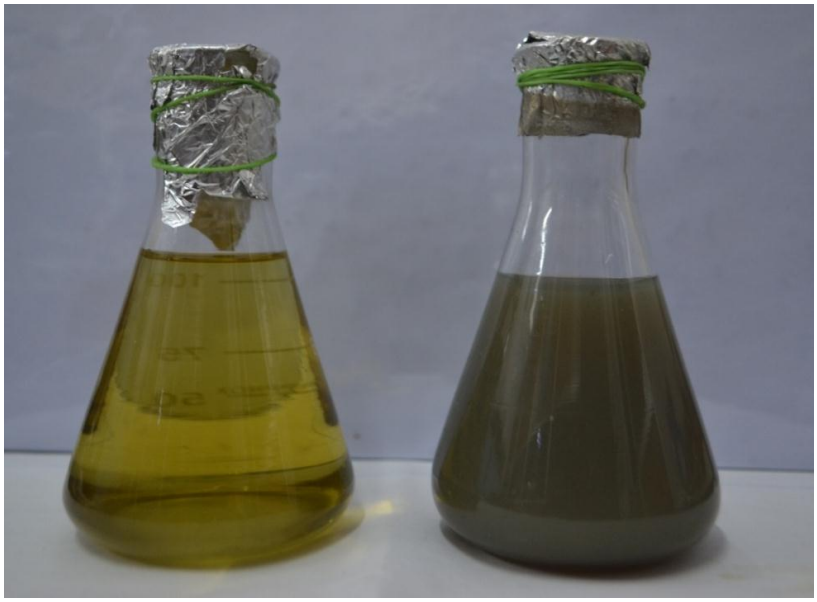

Figure 2: Change of color from yellowish to brownish after adding 1mM $AgNO_3$ to the *ipomoea pes-caprae leaf* extract

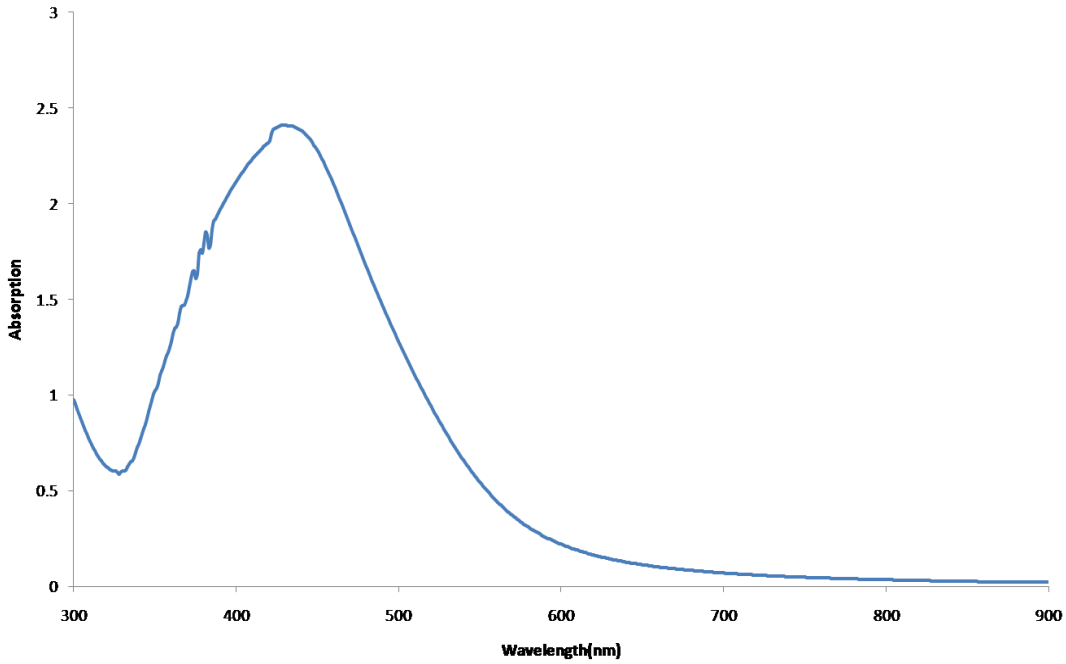

Figure 3: UV–visible absorption spectrum of silver nanoparticles synthesized by treating 1mM aqueous $AgNO_3$ solution with *ipomoea pes-caprae* leaf extract

FTIR analysis of silver nanoparticles synthesis:

The FTIR spectrum (Figure 4) of silver nanoparticles showed strong IR bands characteristic of carboxylic acids (1024.20 cm^{-1}), amines (1624.06 cm^{-1}), alkanes (2920.23 and 2854.65 cm^{-1}), O-H carboxylic acids(2357.01 cm^{-1})and hydrogen bonded alcohols (3286.70 cm^{-1}) functional groups. The FTIR analysis strongly supported the capping behaviour of bioreduced silver nanoparticles synthesized by *I. pescaprae* leaf extract which in turn imparted the high stability of the synthesized silver nanoparticles.

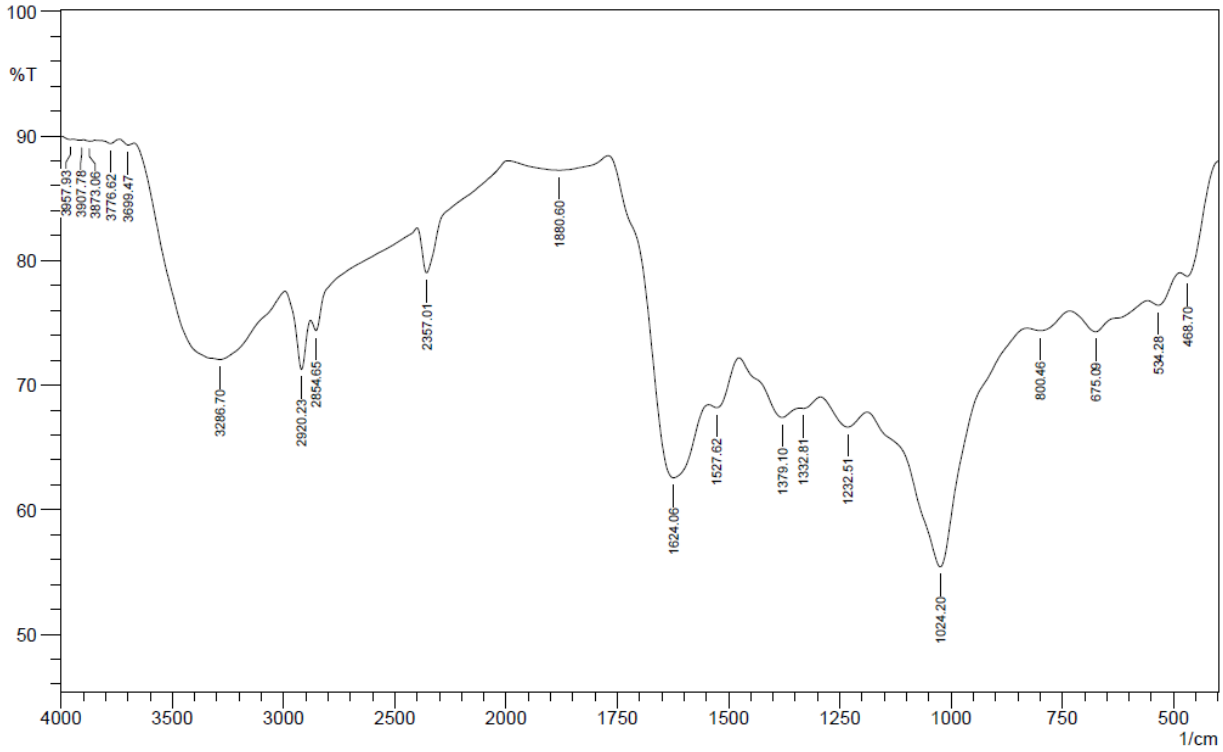

Figure 4: FTIR spectrum of AgNPs synthesized by *Ipomoea pes-caprae* leaf extract

TEM analysis of silver nanoparticles synthesis:

The TEM micrograph indicated that the average particle size of Ag-NPs was 13-14nm. A typical TEM image is presented in Figure 5; monodispersed spherical shaped SNPS of a maximum of 15nm sizes and minimum 13 nm.

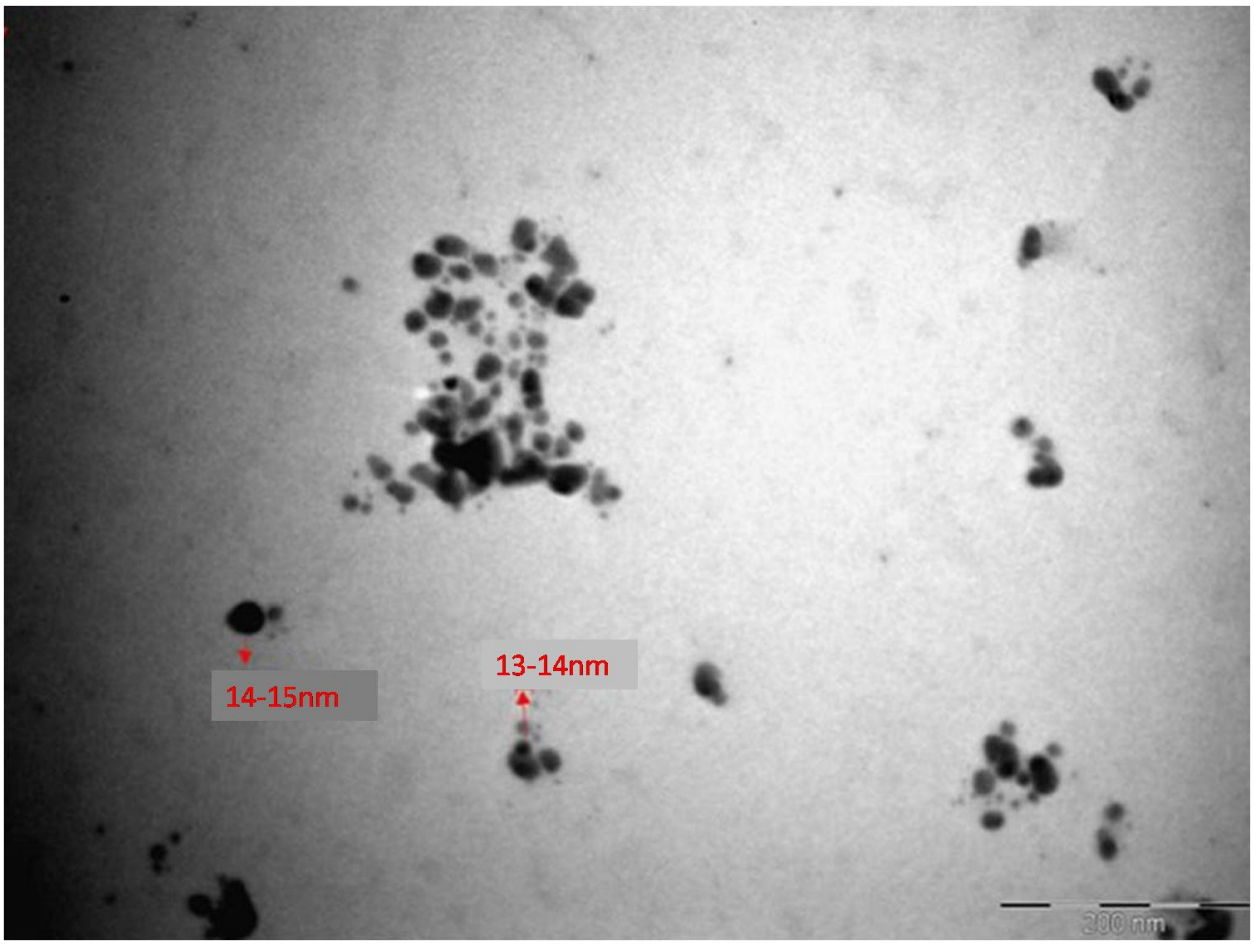

Figure 5: TEM images of synthesized silver nanoparticles showed the average size of 13nm spherical shaped particles

DISCUSSION AND CONCLUSION

The detailed study on green synthesis of silver nanoparticles by the leaves of *I. pescaprae* was carried out in this work. The result shows that *I. pescaprae* could be used for the synthesis of Ag NPs from $AgNO_3$. Reduction of silver ion into silver particles during exposure to the plant extract could be followed by change silver nanoparticles exhibit dark yellowish- brown colour in an aqueous solution due to the surface Plasmon resonance phenomenon. After adding the silver nitrate solution to the plant extract the changes occur after two hours. The UV-visible spectroscopy shows the absorbance peak at 420nm. The TEM image showed relatively spherical shape nanoparticles formed with diameter range 13-15nm. Similar phenomenon was reported by (Dwivedi & Gopal 2010). FT-IR analysis, the carboxylic group and amine group are the functional groups capped the silver nanoparticles (Krishnaraj *et.al.,* 2010).

We have developed a fast, eco-friendly, and convenient green method for the synthesis of silver nanoparticles from silver nitrate using *I. pescaprae* leaf extract. *I. pescaprae* leaf extract is found suitable for

the green synthesis of silver nanoparticles within 2 hours. Spherical, polydisperse AgNPs of particle sizes ranging from 5 to 40 nm with an average size of 18 nm are obtained. So, *I. pescaprae* is a good source for eco-friendly synthesizing silver nanoparticles. *I. pescaprae* has high level of medicinal value (Manigauha *et.al.,* 2010). So, that this plant mediated synthesis of silver nanoparticles are very useful in the field of medicine and cosmetic industries.

Ethical issues:

The authors declare no ethical issues.

Conflict of interest statement:

We declare that we have no conflict of interest.

Acknowledgement:

The Authors are thankful to the authorities of Annamalai University for their support and encouragement.

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