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# Green Synthesis of Silver Nanoparticles using *Pisonia alba* L. and its Antioxidant Activity

Helenmary Piramila B*[1], Kavitha R[2] and Brijith Oviya M[3]

[1-3] P. G. and Research Department of Botany, Holy Cross College (Autonomous), Affiliated to Bharathidasan University, Tiruchirappalli - 620 002, Tamil Nadu, India

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## Abstract

In the present-day of technological world, people suffer due to various life-threatening diseases. The medicine used to cure these diseases cause ill effects. To overcome these effects, plant-based drugs are in use now-a-days since it has lesser or no side effects. In recent years, silver nanoparticle offers a novel platform to cure various ailments than the crude plant drugs as it specifically targets only the infected cells and not the normal cells. Synthesis of silver nanoparticles using chemicals lead to environmental problems. Hence, an attempt was made to synthesis silver nanoparticles using leaf extracts of *Pisonia alba* an important medicinal plant. The synthesized silver nanoparticles were confirmed by UV-Visible Spectrum, FT-IR, SEM, EDAX and antioxidant activity was performed. The results proves that the synthesized silver nanoparticles can be an effective antioxidant agent.

***Key words*:** *Pisonia alba*, Silver nanoparticles, SEM, EDAX, Antioxidant activity

Use of nanoparticles and the souk for nanoparticles has the potential to rise intensely over the subsequent ten years as additional uses for these materials are established and commercialized. A chief influence will be in the therapeutic and pharmaceutical markets as new actions relying on nanoparticles obtain licenses for use. However, there are many other applications, like consumer goods, where the time taken for the product to reach the market is much less than for the pharmaceutical and medical products. But the nanomaterials companies are still challenged by many tasks and they need to overcome these so that their full potential can be realized. Using nanoparticles (NPs) for drug delivery of anticancer agents has noteworthy advantages such as the ability to target specific locations in the body, the reduction of the complete quantity of drug used, and the potential to reduce the concentration of the drug at non target sites resulting in fewer side effects. Biocompatibility is the first issue for intravenously inserted particles. To stimulate definite carrier-target interactions or formulate specific carrier physicochemical properties to enable selective targeting is the second one [1].

Green synthesis of silver nanoparticles was focused in the present study, since it is ecofriendly. Green synthesis of silver nanoparticles (AgNPs) is an environmentally friendly approach that utilizes biological entities like plant extracts, bacteria, fungi, and algae for the reduction of silver ions into nanoparticles. *Pisonia alba* L. is an important medicinal plant belongs to the family Nyctaginaceae was selected for the present study as it holds a variety of biologically active and pharmacological safe compounds such as phenolic compounds, flavonoids, tannins and alkaloids. In the present investigation, unreported green chemistry route for the synthesis of silver nanoparticles using extract derived from leaf extracts of *Pisonia alba* and their antioxidant activity is described.

## MATERIALS AND METHODS

*Collection of plant materials*

The fresh leaves of *Pisonia alba* L. which possesshigh medicinal value was selected for the synthesis of silver nanoparticles. The leaves of *Pisonia alba* werecollected from Ramnad district (Fig 1-2). The leaveswere cleaned thoroughly in running tap water anddrained off. The fresh samples were subjected to synthesis of silver nanoparticles and boiled at 100°C.

*Preparation of fresh leaves extract and synthesisof silver nanoparticles*

Two grams of fresh leaves were homogenized using 3ml of distilled water in a mortar and pestle. Then, filtered using cheese cloth and used as the extract. The silver nanoparticles were synthesized by treating one ml of plant extract and 9 ml of silver nitrate(1mM) solution for bio reduction process under boiling conditions. Controls were also maintained as:

1) Extract of the sample and
2) Silver nitrate. Change in the colour of the sample indicates the production of silver nanoparticles [2]. The synthesized AgNPs samples were subjected to UV- Vis. spectrum, FT-IR, SEM, EDAX for confirmation and antioxidant activity was assayed by DPPH method

*Characterization techniquesUV-Vis spectral analysis*

***Correspondence to:** Helenmary Piramila B, E-mail: helansoft@gmail.com; Tel: +91 9790169975

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The synthesized silver nanoparticles were confirmed by measuring the wave length of reaction mixture in the UV-Vis spectrum of the Perkin Elmer spectrophotometer at a resolution of 1 nm (from 259 to 432nm) in 2 ml quartz cuvette with 1 cm path length [3].

*Fourier transform –infra red (FT-IR) analysis*

The characterization of functional groups on thesurface of AgNPs by the extracts was investigated byFT-IR analysis (Shimadzu) and the spectra wasscanned in the range of 4000–400 cm−1 range at aresolution of 4 cm−1 at Holy Cross College, Tiruchirappalli. The sample was prepared by dispersing the AgNPs uniformly in a matrix of dryKBr, compressed to form an almost transparent disc.KBr was used as a standard [4].

*SEM and EDAX spectroscopy*

The synthesized nanoparticles of *Pisonia alba* were allowed to dry under room temperature and resultant crystals were subjected to SEM at National College, Tiruchirappalli for characterization of surface, area and number of the nanoparticles. The size and thearea of SEM results was analyzed using SPIP software and the results were presented [5]. Scanning Electron Microscopy - Zeiss machine was used for the synthesized silver nanoparticle shape and size analysis. The prepared sample was placed on a carbon layered copper grid. Using blotting paper, the excess amount of solution was removed. Then the grid was then permitted todry by placing the grid beneath a mercury lamp for 5 minutes. EDAX spectrum was done on Zeiss Machine.

*Total antioxidant activity DPPH radical scavenging assay*

The effect of nanoparticle on DPPH radical was estimated using the method of [2]. A solution of 0.135 mM DPPH (2,2-diphenyl- 1-1picrylhydrazyl) in methanol was prepared and one ml of this solution was mixed with one ml synthesized AgNPs of *Pisonia alba.* The solution was mixed well and incubated in dark for 30 min and measured at 517 nm [6].

$$\text{DPPH scavenged (\%)} = \frac{\text{Abs control-Abs sample}}{\text{Abs control}} \times 100$$

Where;
Abs control = absorbance of DPPH radical + methanol
Abs sample = absorbance of DPPH radical + synthesized AgNPs solution / standard

*Total antioxidant activity DPPH radical scavenging assay*

The effect of nanoparticle on DPPH radical was estimated using the method of [7]. A solution of 0.135 mM DPPH (2,2-diphenyl- 1-1picrylhydrazyl) in methanol was prepared and one ml of this solution was mixed with one ml synthesized AgNPs of *Pisonia alba.* The solution was mixed well and incubated in dark for 30 min and measured at 517 nm [8].

## RESULTS AND DISCUSSION

*Biosynthesis and characterization of silver nanoparticles*

An aqueous leaf extract of *Pisonia alba* L. was used for the synthesis of silver nanoparticles. The appearance of pale yellow to yellowish brown colour due to the interaction between the silver ions and biomolecules in the leaf extract in the reaction solution indicates the formation of silver nanoparticles, as in control no colour change was observed (Fig 3). The colour is the characteristic of the surface plasmon resonance (SPR) of silver nanoparticles.

Fig 1 *Pisonia alba* L.

Fig 2 *Pisonia alba* flower

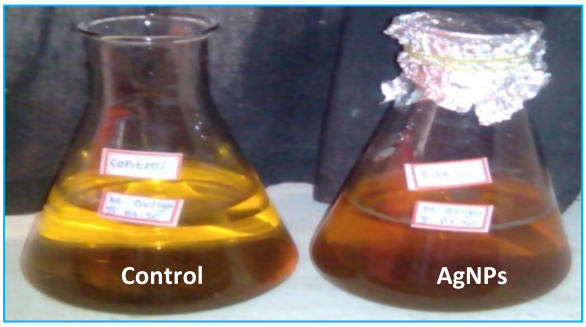


Fig 3 Silver nanoparticles synthesized from Leaf extract of *Pisonia alba* L.

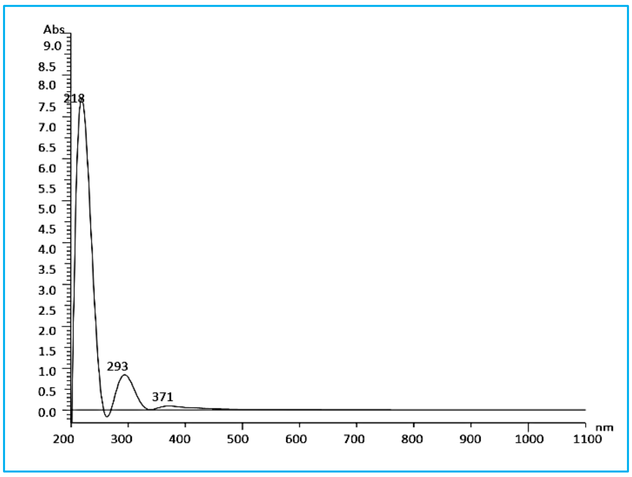


Fig 4 UV spectrum of leaf extract of *Pisonia alba* L.

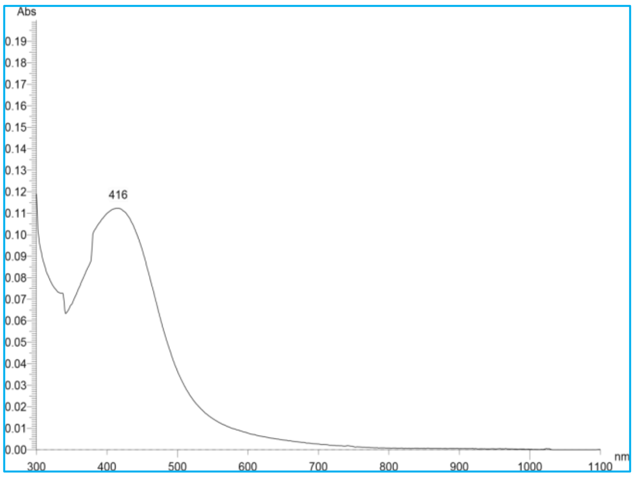


Fig 5 UV spectrum of silver nanoparticles synthesized by Leaf extract of *Pisonia alba* L.

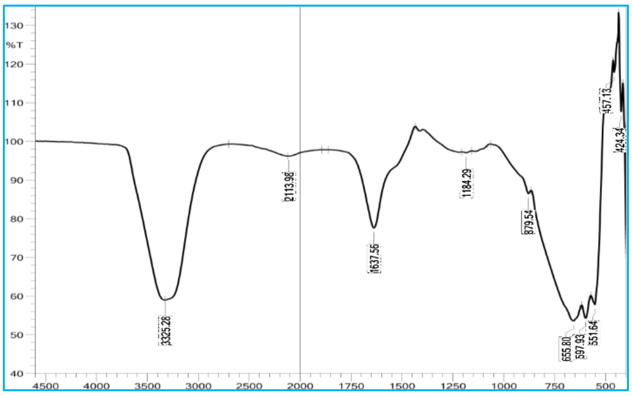


Fig 6 FTIR spectrum of Leaf extract of *Pisonia alba* L.

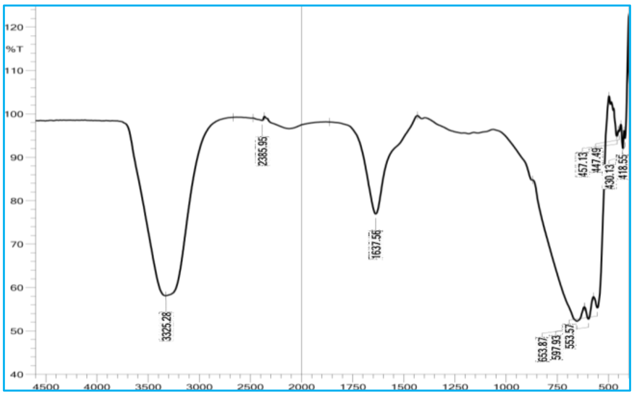


Fig 7 FTIR spectrum of silver nanoparticles synthesized by leaf extract of *Pisonia alba* L.

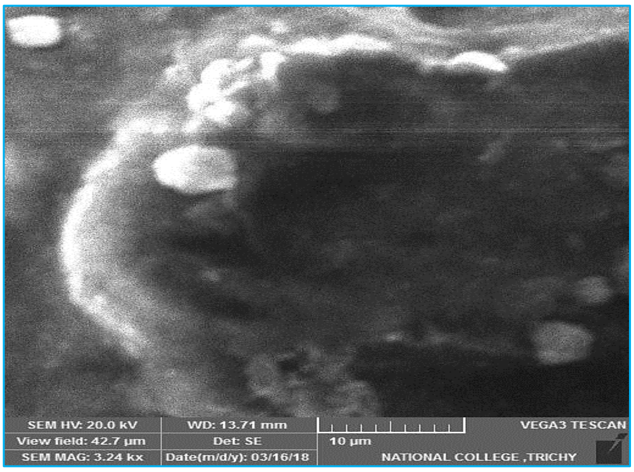


Fig 8 SEM image of leaf extract of *Pisonia alba* L.

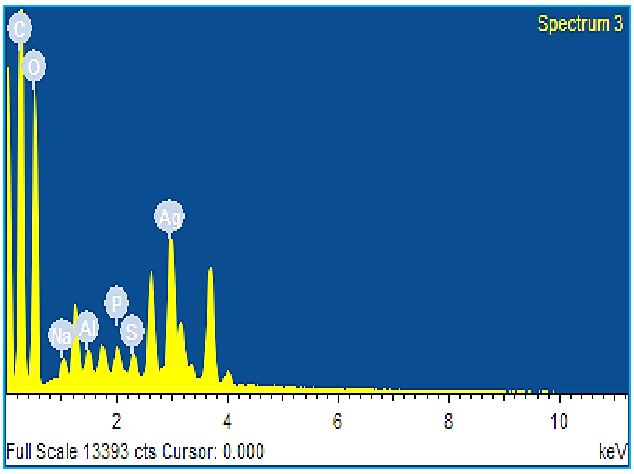


Fig 9 EDX spectrum of leaf extract of *Pisonia alba* L.

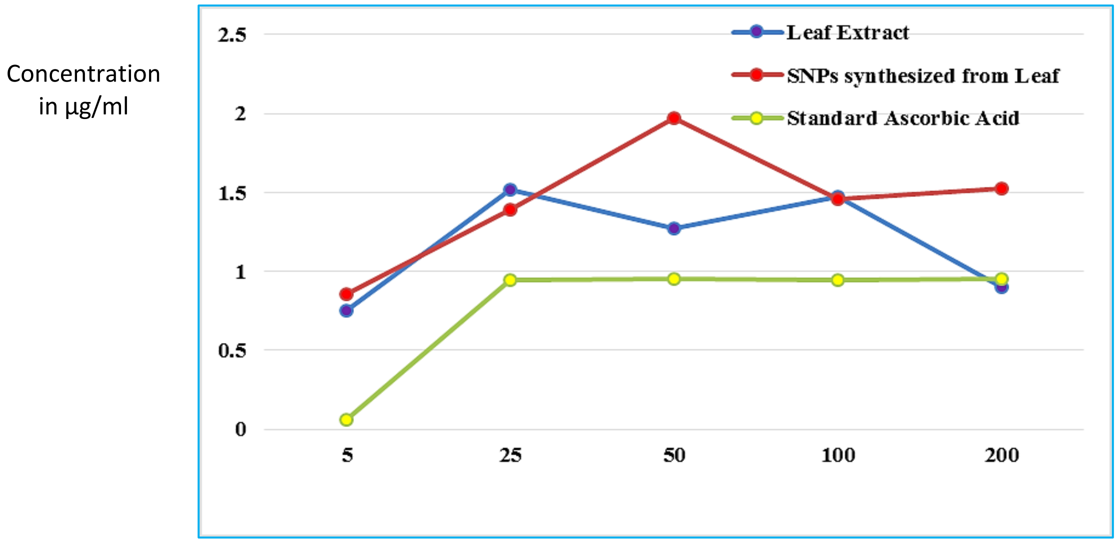


Fig 10 Free radical scavenging activity (DPPH assay)

The reduction of silver ion to silver nanoparticles was reflected in spectral data obtained using UV- Visible Spec. The peak observed at 416 nm in the leaf extract indicated the presence of silver nanoparticles and but in control peak observed at 218 and 293nm (Fig 4-5). The reduction of silver ions and the formation of silver nanoparticles showed one of the best bioreduction method to synthesis silver nanoparticles. The present study is also supported that, the synthesized silver nanoparticles show a yellowish-brown color in aqueous leaf extract solution due to excitation of surface plasmon vibrations in silver nanoparticles [9]. Reduction of silver ions to silver nanoparticles could be followed by a color change and UV-Visible spectrum. The advancement in conversion reaction of silver ions to silver nanoparticles was followed by a colour change and spectroscopic techniques [10-11].

FTIR spectrum of silver nanoparticles showed the band between 3325.28 $cm^{-1}$ corresponds to O-H stretching H-bonded alcohols and phenols. The peak at 2385.95 $cm^{-1}$ corresponds to N-H tertiary amines. The peak at 1637.56 $cm^{-1}$ showed a stretch for C-H bond, peak at 1184.29 $cm^{-1}$ showed the bond stretch for N-H whereas the stretch for Ag-NPs were found around 500-550 $cm^{-1}$ (Fig 6-7). In particular, the 1184.29 $cm^{-1}$ band arose most probably from the C–O group of polyols such as hydroxy flavones and catechins. The total disappearance of this band after the bio-reduction might be due to the fact that the polyols were mainly responsible for the reduction of silver ions, whereby they themselves got oxidized to unsaturated carbonyl groups leading to a broad peak at 1637.56cm$^{-1}$ for reduction of silver [12-13].

SEM analysis shows that the green synthesized silver nanoparticles of *P. alba* was spherical in shape (Fig 8). These results are on par with the study of Shankar *et al*. [14]. Using EDAX Spectroscopy presence of Ag, C and O were confirmed in the green synthesized AgNPs. An optical absorption band peaking at 3KeV exhibited by the synthesized silver nanoparticles is the characteristic of the absorption of metallic silver nano-crystallites. Metallic silver nanoparticles typically show an optical absorption peak at 3 keV due to the surface plasmon resonance [15]. The nanoparticles synthesized from leaf sample showed strong signals from the silver atoms and signals from Al, Na, P and S atoms (Fig 9).

Silver nanoparticles of *Pisonia alba* showed $IC_{50}$ value at 50 µg/ml when compared with control (leaf extract 100 µg/ml) and standard (ascorbic acid 200 µg/ml) (Fig 10). The occurrence of phenols in the plant plays a key role in controlling antioxidants and are also major constituents of phenolic compounds. It has phenolic groups which are accountable for higher antioxidant activity. The results of this study revealed that the silver nanoparticles from leaf of *Pisonia alba* can be used as a source of natural antioxidants and as a possible diet supplement or in pharmaceutical production [165-17].

## CONCLUSION

Green synthesized silver nanoparticles using *Pisonia alba* L. was characterized by UV-Visible Spectroscopy, FT-IR, EDAX and SEM revealed that the nanoparticle is of spherical in shape. The DPPH analysis showed that the AgNPs synthesized showed antioxidant activity IC50 at 50 µg/ml. The present findings reveal that, the silver nanoparticles of *P. alba* would be probable candidate for developing antioxidant drugs after thorough analysis like bioassay, cytotoxic studies.

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