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Eco-Friendly Synthesis of Silver Nanoparticles using *Ventilago maderaspatana* (GAERTN), their Morphological Characterization

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Abstract : In the present study, silver nanoparticles were synthesized by using ethanol extract of leaves of *V. maderaspatana*. The characterization of AgNPs was done by UV-Vis Spectrophotometer and FT-IR spectroscopy. The morphology and size of the AgNPs was analyzed using SEM and TEM and the elements present in the sample were analyzed by EDAX study. UV-Visible spectra given absorption peak at 431nm confirmed that the particles at nano scale range. FT-IR spectra of AgNPs revealed that the complex nature of the biological materials involved in the synthesis of nanoparticles. SEM analysis of AgNPs showed spherical shaped silver nanoparticles. TEM analysis showed particles within the size of 20 to 50 nm range and EDAX study revealed that presence of elements like C, Cu and Ag. From the result it is concluded that that *V. madearaspatana* leaf extract may be used for eco-friendly synthesis of silver nanoparticles.
Key words : Green synthesis; Silver nanoparticles, *Ventilago maderaspatana.*

Introduction

Nanotechnology is an emerging, rapidly growing field for the purpose of manufacturing new materials at the nanoscale level[1]. Nanoparticles are extremely small in size, ranging from 1-100nm. Nanoparticles are currently used in many technological areas, such as the medical sector for diagnosis, antimicrobial and drug delivery[2].

Different types of nano materials like copper, zinc, titanium[3],magnesium, gold[4],algenate[5]and silver have come up. However, silver nanoparticles are playing a major role in the field of nano medicine. Nanoparticles synthesis is usually carried out by physical, chemical methods and biological methods. Most of them being expensive and /or requiring the use of toxic solvents[6].

Biosynthesis of nanoparticles is low cost, fast, efficient and generally lead to the formation of crystalline nanoparticles with a variety of shapes with size between 1 and 100nm[7].To avoid the toxicity of chemicals, green synthesis was developed. Synthesis of silver nanoparticles is employing either microorganisms or plant extracts has emerged as an alternative approach. *Ventilagoma deraspatana* is a medicinal herb belonging to family Rhamnaceae. Itis traditionally used to treat skin problems, high fever diabetes and also used as digestive carminative[8-9]. Ventione-C compound of *V. maderaspatana* is reported to possess antidiabetic activity[9]. Bark and leaves are used to cure malarial fever[10]. Seeds mixed with milk or/and water has showed antidiabetic activity by taken directly[11].Since the medicinal plant has more medicinal value and no reports are

available on the green synthesis of silver nanoparticles using *V. maderaspatana* leaf extract, the present work was made an attempt to synthesis silver nanoparticles using *V. madraspatana* leaf extract.

Materials and Methods

All chemicals used in the present study, Silver nitrate and ethanol were analytical grade and purchased from Merck, Mumbai, India and Hayman U.K. Medicinal plant *Ventilago maderaspatana* was collected from Kolli Hills a part of Eastern Ghats, Namakkal District, Tamil Nadu, South India. The plant was authenticated as *Ventilagoma deraspatana*(Gaertn.) belonging to the family Rhamnaceae by Dr. S. Soosairaj, Assistant Professor of Botany, St. Joseph College (Autonomous), Tiruchirappalli (Specimen access No. SJCBT2112).

Methods

Preparation of Extract

Fresh leaves of *V. maderaspata*were collected, dried under shadow condition and powdered. Then this powder was used to soxhlet extraction using ethanol.

Biosynthesis of Silver Nanoparticles

Silver nanoparticles were synthesized using ethanol extract of *V. maderaspatana* extract by the method of Vijaykumar[12].Fresh ethanol leaves extract of *V. maderaspatana*(10 ml) was added drop by drop to the 100ml of 0.1M silver nitrate solution and stirred using the magnetic stirrer at 50^0C for 30 minutes. Then the solution was incubated in dark at room temperature for 24 hrs. Changing the colour of solution was observed and recorded.

Characterization of Biosynthesized Silver Nanoparticles

The optical properties of silver nanoparticles were studied using UV-VIS spectroscopy and FT-IR spectral analysis. Morphological, size and chemical composition of silver nanoparticles was studied using SEM, TEM and EDX.

UV-Vis spectrum: Formation of silver nanoparticles was confirmedby UV-Visible spectroscopy using Perkin Elmer spectrophotometer.

FT-IR Spectroscopy: FT-IR analysis was carried out using Perkin Elmer IR Spectroscopy for the identification of major functional group and their possible involvement in the synthesis of silver nanoparticles.

Scanning Electron Microscopy(SEM): The morphology of the green synthesized silver nanoparticles was analyzed by SEM with EDX using Viga3 Tescan Scanning Electron microscope.

TEM with EDX study: The size, morphology and chemical composition of biosynthesized silver nanoparticles were analyzed by JEOL JEM 2100 High Resolution Transmission Electron Microscope with enables to view lattice resolution of 0.14 nm and point-to-point resolution of 0.19 nm. Thin films of sample were prepared on a carbon coated copper grid by just dropping a very small amount of sample on the grid, extra solution was removed using a blotting paper, and then the film on the TEM grid were allowed to dry by putting it under incubator.

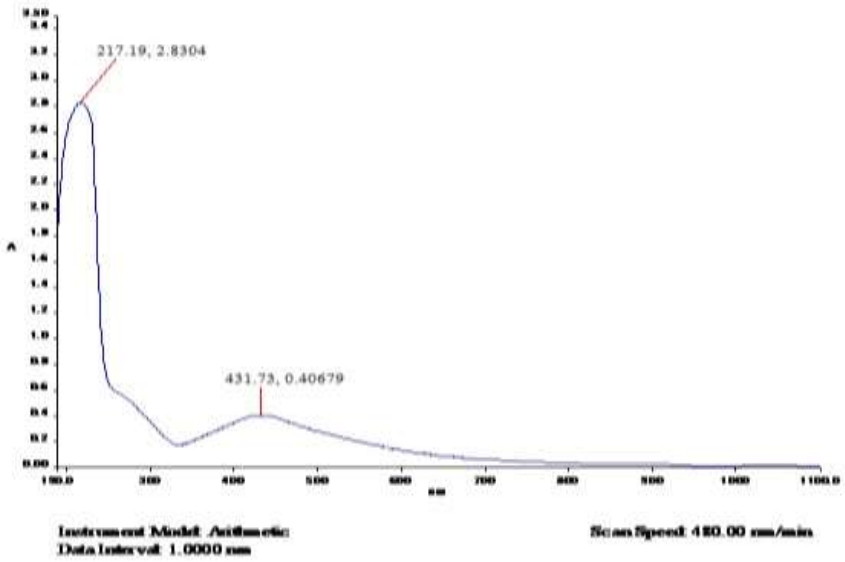
Results and Discussion

The present study was carried out to synthesize Ag NPs eco-friendly using leaf extract of *V. maderaspatana*. Nanoparticles are generally characterized by their size, shape, surface area and dispersity[13]. The colourless silver nitrate solution was turn over the dark brown colour after the addition of leaves extract of *V. maderaspatana* which indicating the formation of silver nanoparticles (fig. 1).

Fig. 1. Biosynthesis of silver nanoparticles using leaves extract of *V. maderaspatana*

A. Ethanol leaves extract of *V. maderaspatana*
B. 0.1M silver nitrate solution
C. Biosynthesized silver nanopartilces

Fig. 2. UV- Vis spectroscopy study of silver nanopartilces synthesized using leaves extract of *V. maderaspatana*



UV-Visible spectra of silver nanoparticles giving a Plasmon resonance band at 431nm (Fig. 2) indicating the conformation of silver nanoparticles. The appearance of the brown colour was due to the excitation of the surface Plasmon vibrations, typical of Ag NPs having γ max values which are in the visible range of 400-500nm[14].It is well known that Ag NPs exhibits a yellowish-brown colour in aqueous solution due to excitation in UV-Visible spectrum depending upon the particle size[15].In general peaks at longer wavelength indicate an increase in particle size whereas peaks at shorter wavelength represent smaller particle size[16-17]. The reduction was ascribed to the phenolics, terpenoids, polysaccharides, and flavones compounds present in the extract[18].

FT-IR spectroscopy measurement was carried out to identity of the possible involvement of the major functional groups for synthesis of silver nanoparticles. Biological component are known to interact with metal salts via these functional groups and mediate their reduction to nanoparticles[19]. The spectra of biosynthesized Ag nanoparticles are represented in fig. 3. FT- IR spectrum showed several spectrums indicating the complex nature of the biological materials. The bands appear at 3914.60, 3766.23, 3462.82, 2361.18, 2078.40, 1636.22, 1379.17 and 672. 39 cm^{-1} were assigned to stretching vibration of -OH alcohols or -NH amines, Phophric acid and ester stretch or combination of C-H stretch, alkynes, C=C stretch, C-H rock, C=O or aromatic CH, aromatic CH and CH alkene bends or C-Br or C-Cl, respectively (Barbara H. Stuart). The present investigation was explained that the formation of silver nanoparticles may be due to the presence of antioxidants in medicinal plant *V. maderaspatana* by the reduction of silver ions (Ag+) in to nanoparticles (Ag0). Presence of antioxidant activities in the *V. maderaspatana* was proved by Damayanthand Satyavati[20].

Fig. 3. FT - IR study of silver nanoparticles synthesized using leaf extract of *C. madurensis*

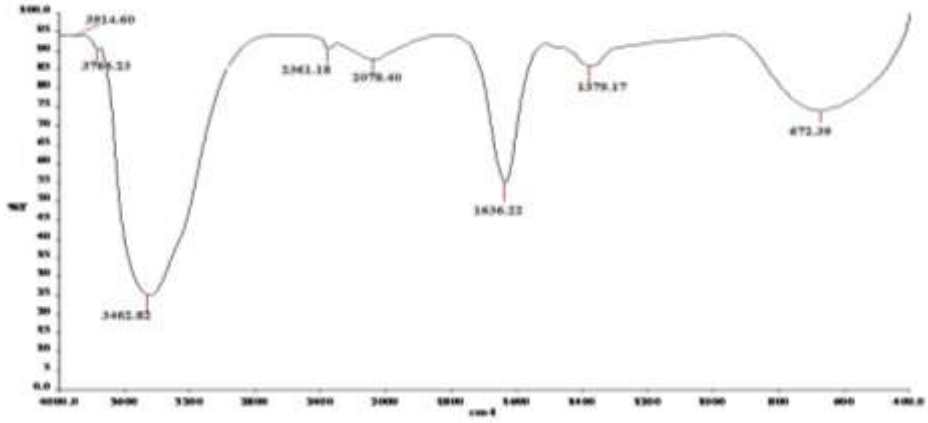
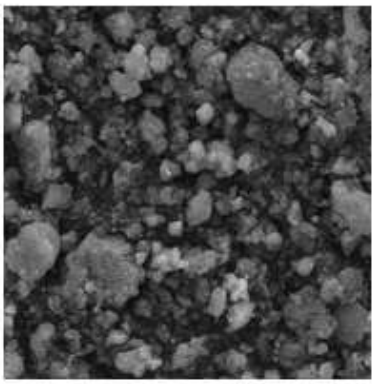
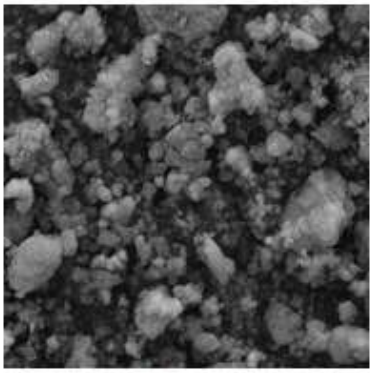


Fig. 4. SEM photograph of silver nanoparticles synthesized using leaves extract of



A

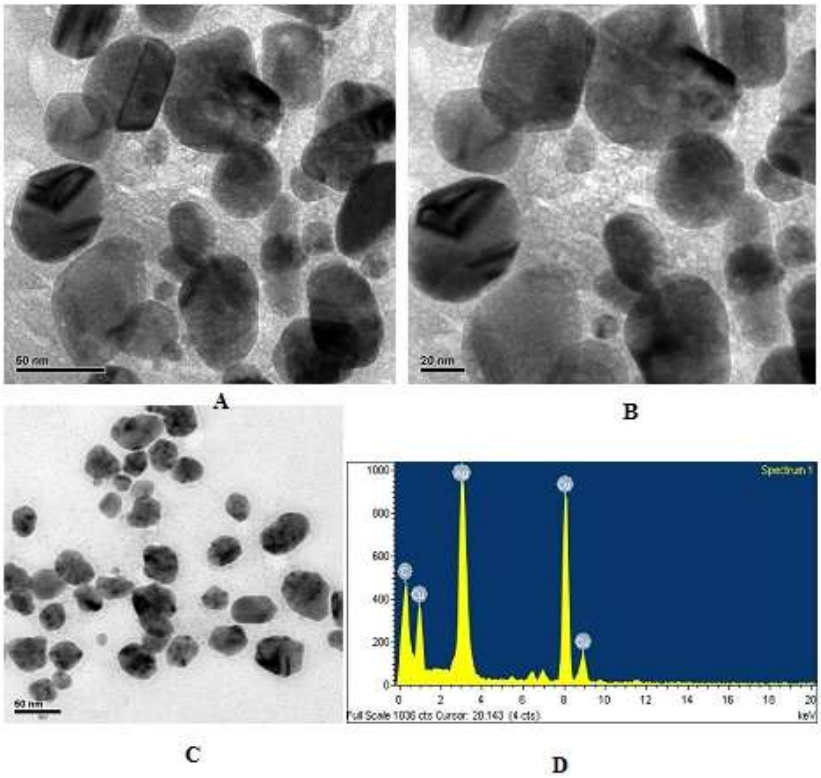


B

C

A and B. Morphological photograph of silver nanoparticles
C. Photograph shows the presence of silver nanoparticles

M and EDAX photograph of silver nanoparticles synthesized using leaves extract of *V. ma*



A and C. Showed 50nm sized silver nanoparticles
B. Showed 20nm sized silver nanoparticles
D. EDAX photograph of synthesized silver nanoparticles

From the SEM images it can be observed that particles are spherical in shape and uniform distribution (Fig. 4). Layer particles of Ag NPs are formed due to aggregation of nanoparticles which might be induced by the evaporation of solvent during sample preparation. This could have contributed for the variation in particle size[11].For more evidence of silver in nano scale level, the size and shape were analyzed using TEM (Fig. 5). In general, the nanoparticles were spherical in shape with varying sizes ranging from 20 to 50 nm (Fig. 5).

Conclusion

From the study it is concluded that, the leaf extract of *V. maderaspatana* has potential to synthesis the silver nanoparticles eco-friendly. Nanoparticles synthesis using this plant extractsare simple, cost effective and eco-friendly method. Biosynthesis process of silver nanoparticles using plant extract, reduction of silver ions into silver nanoparticles may be due to the presence of bioactive compounds that has potential to antioxidant activity. Synthesized silver nanoparticles using leaf extract of *V. maderaspatana* were spherical in shape with the size ranging from 20 to 50 nm. Thus the biosynthesized silver nanoparticles using leaf extract of *V. maderasapatana* has potential application in the pharmaceutical and biomedical field.

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