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Green synthesis of silver nano particles by *Areva lanata* plant stem extract and their anti microbial activities

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ABSTRACT

In the present study, we report an eco-friendly way for the synthesis of silver nano particles using the medicinal plant *Arevalanata*, which is belongs to a family of *Amaranthaceous*, we synthesise silver nano particles by utilizing the reduction property of *Arevalanata* stem extract ,at room temperature. UV-Visible absorption spectroscopy was used to monitor the quantative formation of silver nano particles. Characterization of these particles was done by using Fourier transform infrared spectroscopy (FTIR),scanning electron microscopy (SEM),transmission electron microscopy (TEM) and X-ray diffraction method(XRD). These silver nano particles show strong antibacterial activity towards against *E.coli*, *Staphylococcus aureus*, *Bascilluscereus* and *Pseudomonas aeruginosa*

Keywords: Silver nano particles (Ag-NP), UV-Visiblespectra, FTIR, SEM, TEM, *Arevalanata*.

INTRODUCTION

The growing need of environmental friendly nanoparticles,researchers are using green methods for the synthesis of various metal nano particles. Plant extract have been used as a reducing agent and capping agent for the synthesis of Ag-NP(1),which could be advantageous over photochemical reduction, heat evaporation, ultrasonic methods, chemical reduction method(2),electro chemical reduction(3),radiolysis reduction(4), thermal decomposition(5).

Nanotechnology is defined as a field that applies nano scale principles and techniques to understand and transform to biosystems (living systems and-nonliving systems),which uses biological principles and materials to create new devices and systems integrated from nanoscale(6).

Silver nano particles exhibit new or improve properties depending upon their size, morphology and distribution. Various approaches using plant extract have been used for the synthesis of silver nano particles. AgNP have attracted intensive research interest because of their important applications as antimicrobial, catalytic activity. many research papers reported the synthesis of AgNP using plant extracts such as *Crob leaf* extract(7), *Allmanianadiflora*(8), *Mulberry leaf* extract(9),*Ocimumsanctum*(tulasi)(10), *Deutrometal*(11), *Catharanusroseus*(12),*Diopyros kali leaf*(13), *Chrysanthemum morifoliumramat*(14), *Bryophyllumpinnatum*(15), *Clitoreaternatea flower*(16). *Azhadirachtaindica* (17),*Alternanthera Sessilis*Leaf(18),*Carigold flower*(19) .

In our present study we have synthesized AgNPs using *Arevalanata* plant stem extract for the reduction of Ag^{+1} ions to Ag^0 by adding $AgNO_3$ solution with 24 hours at room temperature. The size of silver nano particles were 32nm and absorption wave lenth at 435nm.They are found to be highly efficient against *E.coli*, *staphylococcus aureus*, *Bascillus cereus* and *Pseudomonas aeruginosa*.

MATERIALS AND METHODS

Collection of plant stem:

The plant stems were collected from the agriculture lands in rural areas of Visakhapatnam Distirct in Andhra pradesh. The stems were washed with tap water for 2-3 times and again several times washed with distilled water to remove dust particles and then dried at room temperature to remove the residual moisture.

Preparation of stem extract:

The dried steams were cut into a small pieces and take 10gm of small pieces into 250ml Erlenmeyer conical flask and add 10ml of double demonized water was added and boiled for 15min at 50⁰C. After cooling, the extract was filtered using Whatmman No. 1 filter paper and stored at 4⁰C for further usage. The colour of the extract was light brown.

Preparation of AgNO₃ solution:

Accurate amount of 1mm silver nitrate solution can be prepared by dissolving 0.0421gm of AgNO₃ in 250 ml of double distilled water and stored in amber colour bottle to prevent auto oxidation of silver (chemicals used were of sigma grade,USA).

preparation of silver nano particles:

90ml of stem extract was added to a 10ml of 1mm silver nitrate solution, the colour of the solution changes from light brown to dark brown colour. Due to formation of silver nano particles. The colour changes arises from the excitation of surface Plasmon vibrations with the silver nano particles.



Stem Extract of *Arevalanata*



Preparation of Silver nano particles

RESULTS AND DISCUSSION

UV-VISIBLE SPECTRAL STUDY:

UV-Visible spectral study was carried out by using Shimadzuuv-2203double beam spectrophotometer. The surface Plasmon vibrations of silver nano particles produced a peak at near 435nm. The wave length range which used in UV-Visible spectrophotometer is 200-800nm.

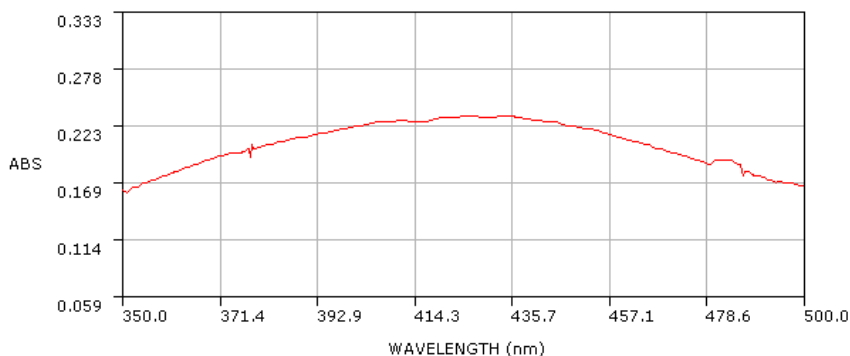


Figure1: UV-Visible spectrum of nano silver

FTIR SPECTRAL STUDY:

FTIR spectra were obtained with IR-prestige-21 Shimaduz, FTIR Spectrophotometer, using Kbr pellet method. The FTIR spectrum of silver nano particles, which are formed by stem extract of *Arevalanata* .the measurements and spectrum, was shown in figure2.The band at 3555cm^{-1} corresponds to $-\text{OH}$ stretching hydrogen bonded alcohols and phenols. The peak at 3363cm^{-1} corresponds to amine functional groups. The peak at 1784cm^{-1} corresponds to symmetric stretching of carbonyl group, the bands observed at 1465cm^{-1} , 1383cm^{-1} corresponds to $-\text{CH}$ stretching. The peak at 1306cm^{-1} indicates geminal methyl groups. From the above analysis , carbonyl and hydroxyl groups involved in reduction of silver ion.

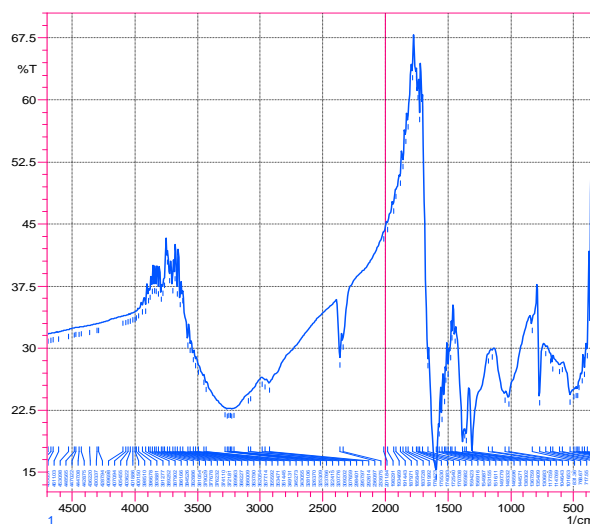


Figure2: FTIR spectrum of synthesized silver nano particles

XRD-SPECTRUM ANALYSIS:

XRD analysis, by using X-Pert promechine from the X-Ray analysis we confirm the crystalline structure of silver nanoparticle.the XRD pattern showed number of Braggs reflections was indicated by the face centered cubic structure of silver. The peak values are exhibited at 28.02, 32.32, 38.14, 46.3, 55.14, 58.08, 63.26, 67.46 and 77.3.the maximum peak value was obtained at 32.32 degree. The data obtained was matched with the data base of Joint Committee on Powder Diffraction Standards (JCPDS) file No. 04-0783 .the average size of silver nano particles was calculated by using Debye-Scherrer equation.

$$D = K\lambda / \beta \cos \theta$$

Where D = the crystallite size of AgNPs particles

λ = the wavelength of x-ray source (0.1541 nm) used in XRD

β = the full width at half maximum of the diffraction peak.

K = the Scherrer constant with value from 0.9 to 1.

θ = the Bragg angle.

From the above equation the average size of silver nano particles is 32.24nm.

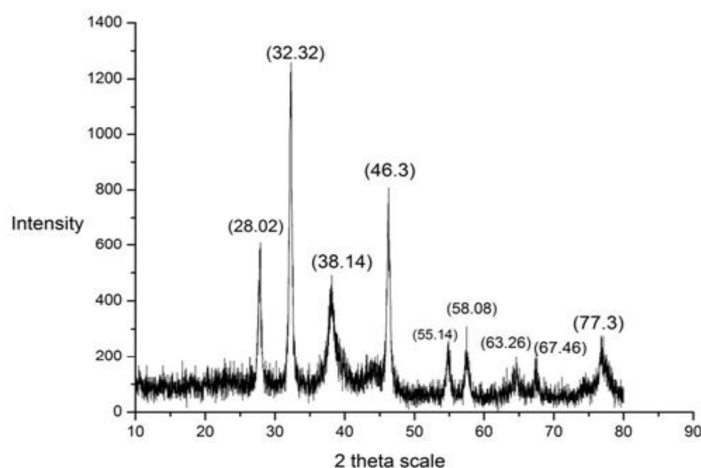


Figure 3: XRD spectrum of silver nano particles

SEM ANALYSIS:

SEM analysis of silver nano particles was done by using JSM-6610lv machine. The scanning electron microscopic images indicated the spherical nature of AgNP and also morphology of the synthesized silver nano particles were identified. The AgNP were uniformly distributed on the surface of the film. Thin films of the samples were prepared by dropping a very small amount of the sample on glass plates and then allowed to dry at room temperature. Silver nano particles were spherical in shape with size range 20µm. The size of nano particles of SEM images is 1.736µm and 1.423µm. The large size particles may be due to the aggregation of the smaller ones.

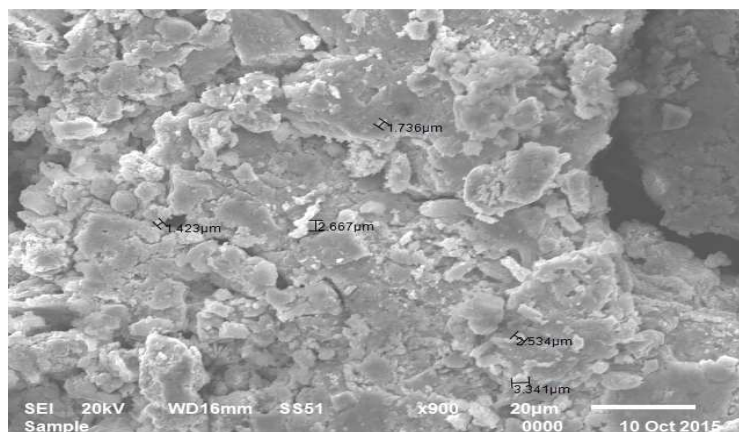


Figure4: SEM images of silver nano particles

TEM ANALYSIS:

The micrograph showed that they are well-disperse nano particles and size ranging from 50 nm. The morphology of nano particles is essentially spherical.

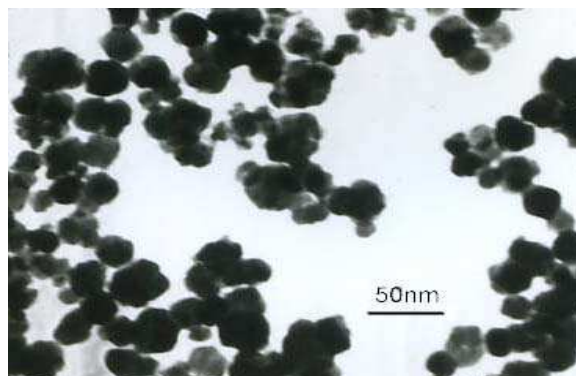


Figure5:TEM image of silver nano particles

EDX SPECTRUM ANALYSIS:

The EDX spectrum of silver nano particles formed by *Arevalanata* stem extract confirms by the formation of nano silver particles. The spectrum show a strong absorption peak at 3kv related to silver nano particles, due to the surface Plasmon resonance. Below 3kv carbon and oxygen peaks are also observed. From EDX spectrum analysis, silver having 64.80%. (table1)

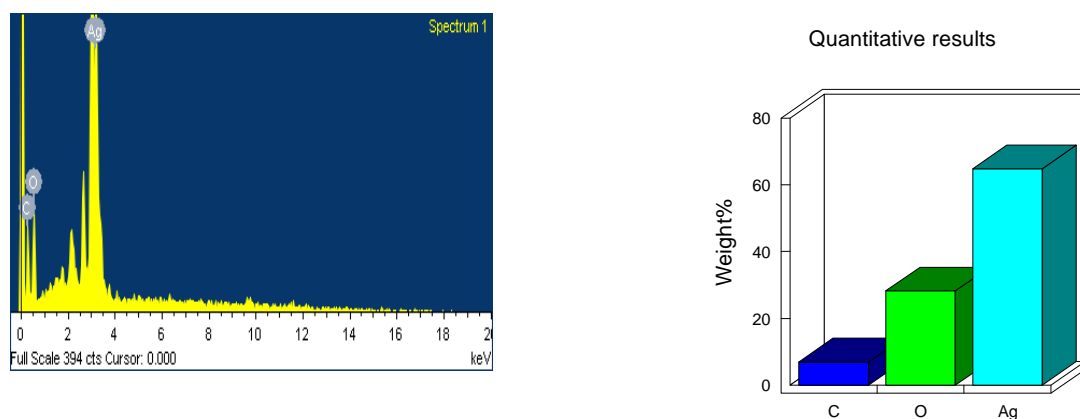


Figure 6: EDX image of silver nanoparticles

Table1: Elemental analysis of silver nano particles

Element	App Conc.	Intensity Corr.	Weight%	Weight% Sigma	Atomic%
C K	4.18	1.3302	6.98	0.78	19.72
O K	4.57	0.3596	28.23	2.00	59.89
Ag L	26.91	0.9228	64.80	1.91	20.39
Totals			100.00		

ANTIMICROBIAL ACTIVITY:

The anti bacterial activity of synthesized silver nano particles was tested against disk diffusion method. The particles show good bacterial activity against *E.coli*, *Staphylococcus aureus*, *Bascillus cereus* and *Pseudomonas aeruginosa*. Among this *Bascillus cereus* show good activities.

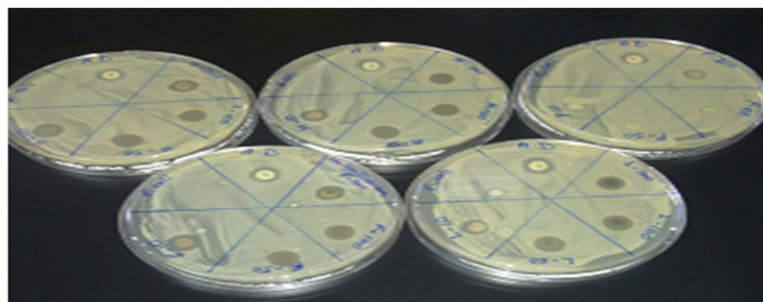


Figure7: Anti bacterial activity of silver nano particles

CONCLUSION

In the present investigation we observed that silver nano particles synthesized from *Arevalanata* stem extract exhibited in dark brown colour in aqueous solution due to excitation of Surface Plasmon Vibrations. The absorption maximum observed at 435nm. The SEM results reveals that average size of silver nano particles synthesized from *arevalanata* stem extract was found as spherical shape and 20 μ m in size range. The average size of silver nano particles was 32nm, which was confirmed by XRD. the anti bacterial activity was good against *Bascillus cereus*.

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