

Green Synthesis of Silver Nanoparticles from *Physalis Angulatta* : Synthesis And Antimicrobial Activity



Chemistry

KEYWORDS : AgNPs; XRD; AFM; Green-Silver; *Physalis Angulatta*

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ABSTRACT

The biosynthesis of nanoparticles has been proposed as a cost effective and environmental friendly alternative to chemical and physical methods. Plant mediated synthesis of nanoparticles is a green chemistry approach that interconnects nanotechnology and plant biotechnology. In the present study, synthesis of silver nanoparticles (AgNPs) or (Green-Silver) has been demonstrated using extracts of *Physalis Angulatta* reducing aqueous silver nitrate. The AgNPs were characterized by Ultraviolet-Visible (UV-vis) Spectrometer, X-ray Diffraction Analysis (XRD), Scanning Electron Microscopy (SEM). showed spherical particles with an average size. The XRD pattern showed the characteristic Bragg peaks of (111), (200), (220) and (311) facets of the face center cubic (fcc) silver nanoparticles and confirmed that these nanoparticles are crystalline in nature. The silver phyto nanoparticles were isolated from these herbal leaves and tested for antimicrobial activity. The test cultures included in this study were a *E.Coli*, *Colletotrichum musae*. The maximum inhibitory effect using 3mM silver nitrate against the microbes were obtained.

INTRODUCTION

Nanotechnology concerns with the development of experimental processes for the synthesis of nanoparticles of different sizes, shapes and controlled dispersity [1]. The application of nanoscale materials and structures, usually ranging from 1 to 100 nm, is an emerging area of nanoscience and nanotechnology. Silver nanoparticles (Ag NPs) have rapidly increased due to their unusual optical, chemical, electronic, photo-electrochemical, catalytic, magnetic, antibacterial, and biological labeling properties [2]. Silver nanoparticles were used in broad range of applications like biomedical [3], drug delivery [4], food industries [5], agriculture [6], textile industries [7], water treatment [8] as an antioxidant [9], antimicrobial [10], anti-cancer [11], cosmetics [12], ointments [13], and larvicides [14-15], the present manuscript deals with the investigation on the effect of *Physalis Angulatta* leaf broth concentration in reduction mechanism of silver ions in to silver nanoparticles and their size.

MATERIALS AND METHODS

A. MATERIALS

The synthesis of silver nanoparticles *Physalis Angulatta* was collected from the Vazhaithoppu, Anaikaraipatti, Madurai. The extract was used for reducing and capping agent. Silver nitrate as purchased from Merck Limited, India. The culture of microorganisms were procured from the department of sericulture, Tamil Nadu Agriculture University, Coimbatore, Tamil Nadu.

B. METHODS

1) PREPARATION OF THE EXTRACT

Extract have been prepared by using fresh leaves of *Physalis Angulatta* weighing 20grams. Washed thoroughly thrice in distilled water, cut into fine pieces, transferred into a 500ml Erlenmeyer flask with 100ml of distilled water and boiled for 10 minutes at 80 c, then filtered and collected the plant extract.

2) SYNTHESIS OF NANOPARTICLES

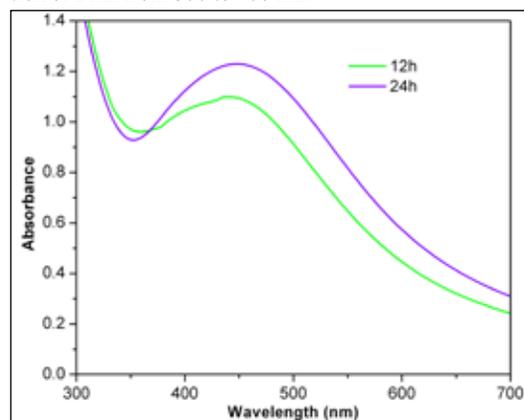
1mM aqueous solution of Silver nitrate (AgNO_3) was prepared and used for the synthesis of silver nanoparticles. 10 ml of *Physalis Angulatta* leaf extract was added into 90 ml of aqueous solution of 1 mM Silver nitrate for reduction into Ag^+ ions and kept at room temperature for 20 hours. UV-Vis spectroscopy. Then the solution is stored in room temperature. After 20 hours centrifuge the reaction mixture, discard the supernatant. Add 1ml of distilled water to the pellet and wash by using centrifugation, Collected the pellet by using acetone, Dry in the watch glasses and store the nanoparticles.

3) ANALYSIS OF SILVER NANOPARTICLES:

a) UV-Vis Spectra analysis:

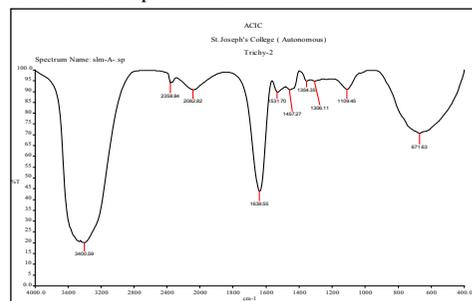
The reduction of pure Ag^+ ions was monitored by measuring

the UV-Vis spectrum of the reaction medium at 20 hours after diluting a small aliquot of the sample into distilled water. UV-Vis spectral analysis was done by using UV-Vis spectrophotometer UV-2450 (Shimadzu) taking 1ml of the sample, compared with 1 ml of distilled water used as blank. UV-Vis spectral analysis has been one by using An Elico spectrophotometer at a resolution of 1 nm from 300 to 700 nm.



b) FTIR Analysis:

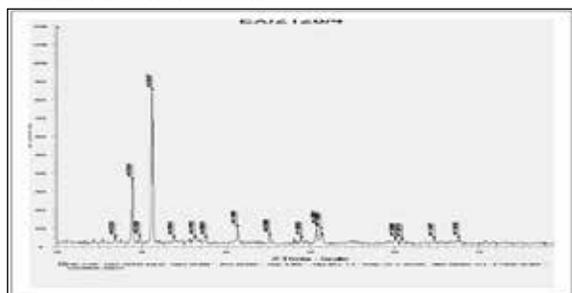
Perkin-Elmer spectrometer FTIR Spectrum in the range $4000-400 \text{ cm}^{-1}$ at a resolution of 4 cm^{-1} was used. The sample was mixed with KCl procured from Sigma. Thin sample disc was prepared by pressing with the disc preparing machine and placed in Fourier Transform InfraRed [FTIR] for the analysis of the nanoparticles.



c) XRD Analysis:

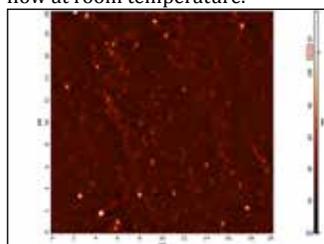
X-ray diffraction (XRD) analysis of drop-coated films of silver nanoparticles in sample was prepared for the determination of the formation of silver nanoparticle by an X'Pert Pro X-ray diffractometer operated at a voltage of 40kv and a current of

30mAnwith Cu K α radiation.

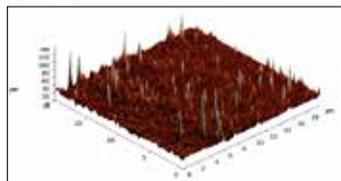


d) Atomic Force Microscope Analysis

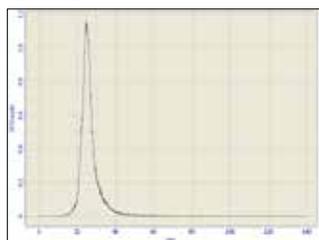
Surface topology of the formulated silver nanoparticles was studied by atomic force microscopy (AFM) analysis (Figure 5a, b). The micrographs clearly indicate that the Purified SNP in suspension was also characterized their morphology using a VEeco diNanoscope 3D AFM (Atomic Force Microscope). A small volume of sample was spread on a well-cleaned glass cover slip surface mounted on the AFM stub, and was dried with nitrogen flow at room temperature.



AFM-2D



AFM-3D



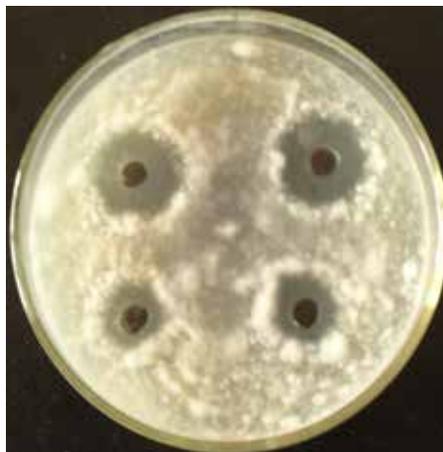
Average in 26 nm

Antimicrobial Analysis:

The inhibition rate of 25 μ l-100 μ l of *Physalis Angulatta* extract nanoparticles against *E.Coli* it increased from 8 mm to 16 mm, against it increased from 8 mm to 15 mm and against *Colletotrichum musaeres* respectively.



Antibacterial activity



Antifungal activity (E. Coli) (Colletotrichum musae)

Table: 1 Antimicrobial activity of leaf extracted silver nanoparticle .

| S.N . Name of the Microorganism | Antibacterial activity of Silver Nanoparticles (μ l) | Zone of inhibition (mm) |
|---------------------------------|---|-------------------------|
| 1 E.Coli | 25, 50, 100 | 8, 14, 16 . |
| 2 Colletotrichum musae | 25, 50, 100 | 8,13,15 |

RESULT AND DISCUSSION:

The *Physalis Angulatta* plant leaf extract have been seen by the UV-Vis spectroscopy and found that UV-Vis spectrograph of the colloidal solution of silver nanoparticles has been recorded as a function of time by using a quartz cuvette with water as reference. Maximum absorbance was seen at 450 nm, indicating that the formation of spherical silver nanoparticles in majority or anisotropic particles whose appearance and ratio increases with time. The AFM analysis shows Uniformly distributed silver nanoparticles on the surface of the cells are observed. the nanoparticles were some spherical shape with varying ranged from 9 to 30 nm. most of them combined with only few of them were scattered in bound to the surface of the cells, because those dispersing in the solution may also deposit onto the surface of the cells

The FTIR spectra indicates various functional groups present at different positions. The appearance of peaks in the characteristic of proteins/enzymes/Carbohydrate that have been found to be responsible for the reduction of metal ions when using the plant extract for the synthesis of silver nanoparticle, the FTIR peaks of O-H stretch, free hydroxyl (3400 cm⁻¹) stretching of alcohol, alkanes (2358 cm⁻¹), amide (1629 cm⁻¹) due to carbonyl stretch vibrations in the amide linkage of the proteins, C-C stretch (in-ring) aromatics or aliphatic amine (1457cm⁻¹) and (671) is resemblance to alkene .The FTIR spectroscopy study has confirmed that the hydroxyl group of alcohol or phenol, carbonyl group of amino acid residues and peptides of proteins has a stronger ability to bind metal. An XRD pattern obtained for the silver nanoparticles shown in Fig.5 shows a number of Bragg reflections corresponding to the (38.1-111), (44-200) and (64-220) Bragg reflections of silver (identified in the diffraction pattern) agree with those reported for silver nanocrystals . The XRD pattern thus clearly shows that the silver nanoparticles are crystalline in nature. The AFM analysis of the synthesized silver nanoparticles was made and typical AFM image which confirms the spherical shape of the particles and again the tendency for particles to aggregate 26 nm. The inhibition rate in antimicrobial activity is increased with the concentration of silver nanoparticl. The plant extract for the synthesis of silver nanoparticles were used for antimicrobial action of

silver ions is closely related to their interaction with thiol (sulfohydroxyl) groups (16-20), carbohydrate (20-22) and protein (22-26).

CONCLUSION

It is concluded that the extract of *Physalis Angulatta* capable of producing silver nanoparticles. The homogeneity of size and shape together with the safety of these nanoparticles, the capability of rendering antimicrobial efficacy and proved to be active against the microbes. The importance of nanoparticles especially of metallic origin is immensely beneficial and new applications for these nanomaterials is constantly being discovered and reported.

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