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Research Article

BIOSYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES FROM THE PEEL OF *AMORPHOPHALLUS CAMPANULATUS* (YAM)

***Manjula, P. and S.P. Sevarkodiyone**

Post Graduate and Research Department of Zoology, Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi- 626124, Tamil Nadu, India

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ABSTRACT

The present study was undertaken to evaluate the efficacy of extracts prepared from the peel of *Amorphophallus campanulatus*. The UV-Vis absorption spectrum of silver nanoparticles in peel extract of *Amorphophallus campanulatus* showed maximum absorbance at 420 nm. The XRD pattern showed different intensity peaks in the whole of 2ɵ values ranging from 10-90^0. SEM study demonstrated that the average size was from 50nm. The EDAX Spectrum signal was observed at 3Kev. The other spectral signals such as O, K, Ca, Ag, Si, Cl, and Al were noticed in the EDAX Spectrum. The FTIR spectrum of synthesized silver nanoparticles showed alkyl halides, alkanes, amides and alcohols as different functional groups.

Keywords: Silver nanoparticles, Green synthesis, Characterization, *Amorphophallus campanulatus.*

INTRODUCTION

In general, particles with a size less than 100 nm are referred to as silver nanoparticles (NPs). Recently, Nanoparticles have been employed in therapeutic applications to target specific sites, such as lung tissue, as well as in cancer therapy and vaccinations (Thorley and Tetley, 2013). Previously it was reported that plant extracts that contain different constitutes like polysaccharides, antioxidant metabolites, phenolic compounds and flavonoids have been used for the biosynthesis of nanoparticles (Ponarulselvam *et al*., 2012). There are two methods employed for the nanoparticle synthesis such as "Top down" and "Bottom up" process. Generally in the "Top down" process bulk materials are broken down into small particles at the nanoscale with various techniques like grinding, milling that means the nanoparticles are produced by size reduction from a starting material (Meyers *et al*., 2006). In "Bottom up" process the nanoparticles are built by joining atoms, molecules and smaller particles (Hutchison, 2008). Silver nanoparticles are found to be effective as anti- inflammatory, anti-angiogenesis, antiviral, anti-platelet activity and against cancer cells which makes them vital (Sotiriou and Pratsinis, 2010). The leaf extracts of plants such as *Azadirachta indica* (neem), *Pelargonium graveolens* (rose geranium), *Medicago sativa* (alfalfa), *Emblica officinalis* (Amla), *Cinnamomum camphora* (camphor laurel) synthesis of silver nanoparticles (Prakash *et al.*, 2013).

Hence the present study was aimed to synthesize and characterize the nanoparticles from the peel of *Amorphophallus campanulatus.*

MATERIALS AND METHODS

Synthesis of silvernanoparticles

Aqueous peel extract of *Amorphophallus campanulatus* was prepared by placing 10g of chopped fresh peel in a 250-ml Erlenmeyer flask and filled with 100 ml of sterile double distilled water up to 60ºC in a water bath. The crude extract was passed through Whitman filter paper (No.1), and the filtrates (=aqueous peel extract) were stored at 4° C and used within 3 days. Ten milliliter of aqueous leaf extract was treated with 90 ml of prepared 1mM aqueous Ag NO_3 solution in an Erlenmeyer flask and incubated in dark at room temperature. The aqueous solution of 1mM of Ag NO_3 was greatly reduced from Ag+ to Ag^0 by aqueous peel extract leading to change of pale yellow to dark brown resulting in synthesis of Ag NPs.

*Corresponding author: Research Scholar, Post Graduate and Research Department of Zoology, Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi-626124, Tamil Nadu, India, Email: mkmanjula93@gmail.com.

Characterization of synthesized silver nanoparticles

UV-Vis spectra was monitored for reaction time on Shimadzu UV- 2450, Japan, at a resolution of 1nm between 300 and 800nm. To determine the nature and size of the synthesized Ag NPs, X-ray diffraction (XRD) was performed. For this, the reacting mixture was centrifuged (20,000xg, 15 min, 40º C). The powder form of the sample was recovered and coated on the XRD grid, the spectra were recorded at a voltage of 40 Kev.The diffracted intensities were recorded from 10° to 90° at 2θ angles. Dried powder of the AgNPs was subjected to analyze the presence of possible functional groups for the reduction of Ag^{+}ions resulting in formation of AgNPs using Fourier Transform Infrared (FTIR) Spectroscopy (Schimadzu, Japan). FT-IR spectra were recorded at 1 cm^{-1} resolution. Morphology using FEI Quanta 200 Scanning Electron Microscope at accelerating voltage of 20 Kev.

RESULTS AND DISCUSSION

The color of the extract changed to dark brown color after one day indicated the production of silver nanoparticles in the reaction mixture (Figure 1). The UV-Vis absorption spectrum of silver nanoparticles synthesized from peel extract of *Amorphophallus campanulatus* showed maximum absorbance at 420 nm (Figure 2). The UV-Vis spectrum recorded of silver nanoparticles synthesized from root of *Svensonia hyderobadensis* (Walp) has strong absorbance peaks at 320 nm. The peaks indicated from the particles are poly-dispersed (Linga Rao, and Savithramma, 2013).

The synthesized Ag nanoparticles using *Amorphophallus campanulatus* peel extract was further confirmed by the characteristic XRD pattern with different intensity peaks in the whole of 2ɵ values ranging from 10-90^{0}. The average estimated` particle size of the sample was 5nm.The size of the nanoparticles through the Scherer equation is given by $t= 0.9\lambda/ \beta\ cos\theta$ where, λ =1.5A^{0}, β=Full width Half Maximum (FWHM) ɵ=Bragg's Angle, t=mean of the nanoparticles. The synthesized silver nanoparticles were in the form nano crystals, as evidenced by the peaks at 2ɵ values 28.5^{o}, 32.5^{o}, 38.5^{o}, 46.5^{o}, 55.5^{o}, 58^{o}, 62^{o} and 77^{o}.The synthesized Ag nanoparticles using *Ananas comosus* (Pineapple) extract from the characteristics of XRD spectrum of the sample four intense peaks in the whole spectrum of 2ɵ values ranging from 20^{0} to 80^{0}.The evidenced by the peaks at 2ɵ values of 38.45^{0}, 44.48^{0}, 64.69^{0} and 77.62^{0} as reported by Ahmad and Sharma (2012).

SEM micrographs of nanoparticle obtained from the filtrate showed are hexagonal shaped AgNPs. The formation of silver nanoparticles as well as their morphological dimensions in the SEM study demonstrated that the average size was 50 nm (Figure 4). Dinesh *et al*. (2012) and Lee *et al*. (2004) observed spherical shaped nanoparticles size ranged from 20-30nm synthesized from *Glycyrrhiza glabra* (Licorice).

FTIR has spectrum obtained for *Amorphophallus campanulatus* displays a number of absorption peaks, images (Figure 5) obtained 468.67cm^{-1} compounds of alkyl halides band is C -Br stretch, 532.32 compounds of alkyl halides bond is C-Br stretch, 1033.77 cm^{-1} compounds of alkyl halides bond is C-F stretch,1384.79 compounds of alkanes band is CH_3C-H bend,1546.8 compounds of amides band is N-H bend, 1639.38 compounds of amides bond is C=O stretch, 2920.03 compounds of alkanes bond is C=H stretch,3361.69 compounds of alcohols bond is O-H stretch. To obtain good ratio of silver nanoparticles were taken in the range 400-4000cm^{1}. Murugan *et al*. (2014) reported that FTIR absorption spectra with the presence of the N–H stretching hydrogen-bonded primary amine (3,420 cm^{-1}), C–H stretching hydrogen (2,922 cm^{-1}), N–H bonding (1,622 cm^{-1}), and (1,260 and 1,196cm^{-1}) are the C=O peaks, indicating aldehyde/ketone and aromatic compounds.

EDAX provides the supporting confirmation for the formation of silver nanoparticle. EDAX Spectrum showed the signal for silver which confirmed the presence of silver nanoparticles. The signal was observed at 3Kev, which is typically for silver nanoparticles due to the surface Plasmon resonance. The other spectral signals such as O, K, Ca, Ag, Si, Cl, and Al were the noticed in the EDAX spectrum (Figure 6). Vaishnavi *et al*. (2015) reported that EDAX spectrum of silver nanoparticles synthesized from the leaves *Jasminum sambac* (Mogra). Showed signal for Ca, K, Cl, O, Mg, and Si both these observation were confirmed the presence of common spectral signals found in both *Amorphophallus campanulatus* and *Jasminum sambac*.

(a) (b)

Figure 1. Aqueous *Amorphophallus campanulatus* peel extract (a) and the color change was showed in the *Amorphophallus campanulatus* peel extract (b) when $AgNO_3$ synthesized.

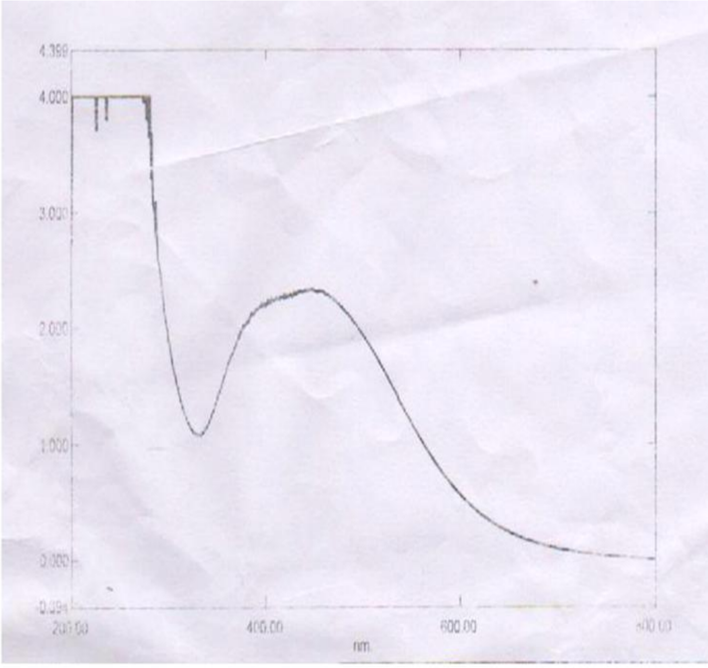

Figure 2. UV-Visible spectrophotometer patterns of synthesized silver nanoparticles using *Amorphophallus campanulatus* peel extract.

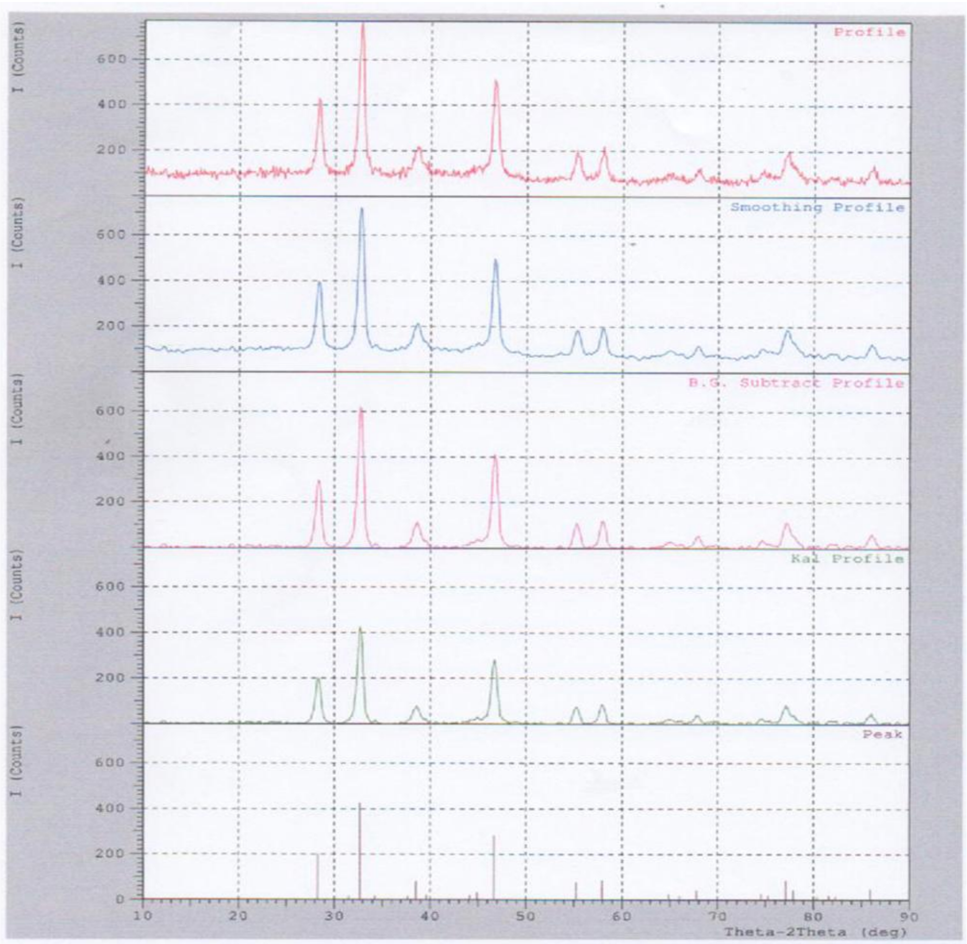

Figure 3. XRD patterns of synthesized silver nanoparticles using *Amorphophallus campanulatus* peel extract.

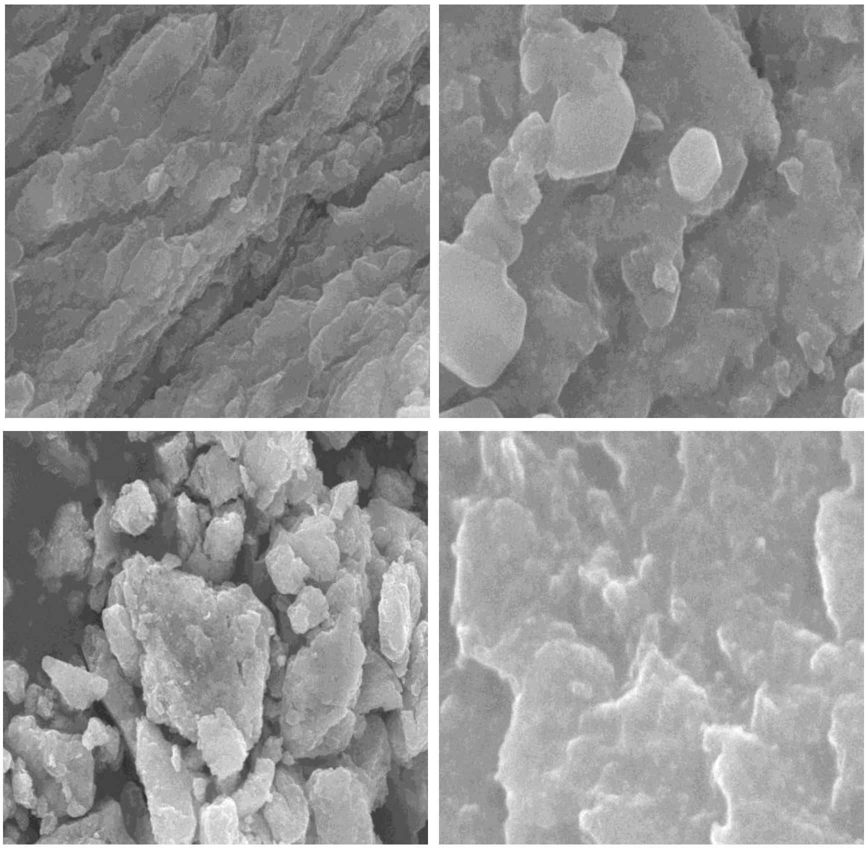

Figure 4. SEM image of synthesized silver nanoparticles using *Amorphophallus campanulatus* peel extract.

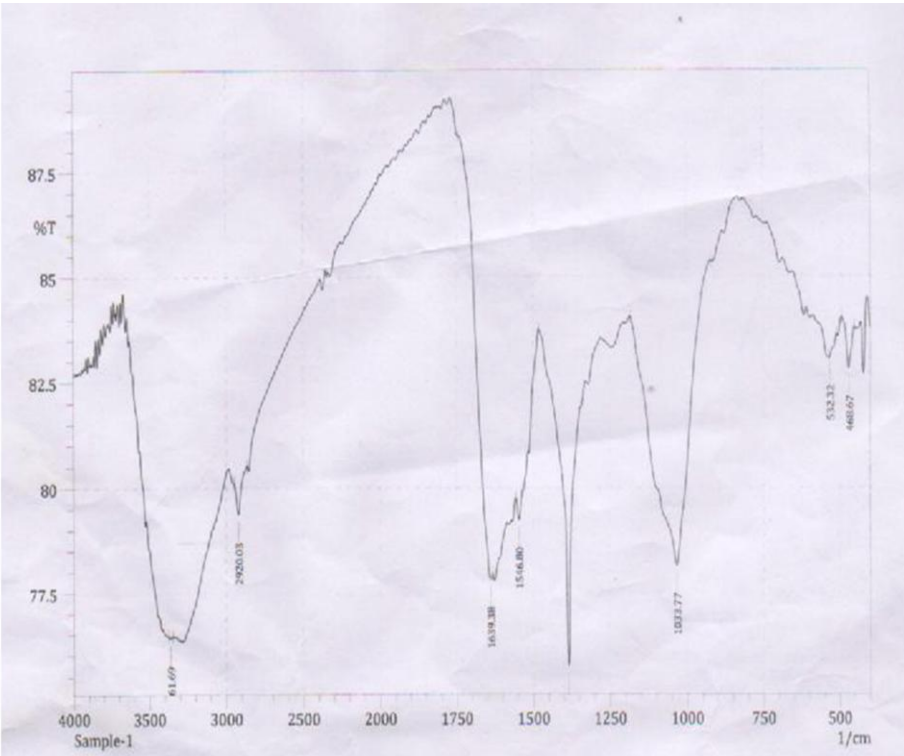

Figure 5. FTIR Spectrum of silver nanoparticles synthesized using *Amorphophallus campanulatus* peel extract.

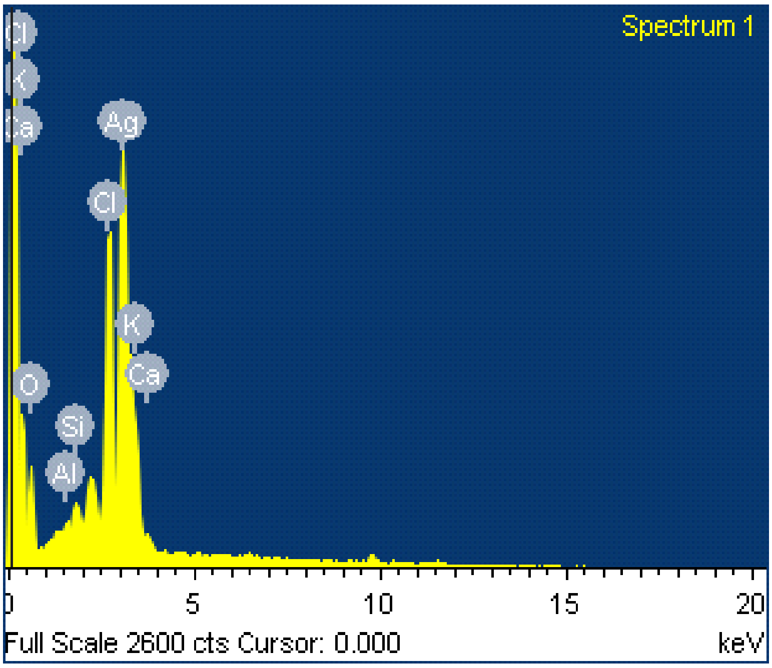

Figure 6. EDAX image of synthesized silver nanoparticles using *Amorphophallus campanulatus* peel xtract.

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