Research Article

Plant Extracts Derived Silver Nanoparticles

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ABSTRACT

Nanotechnology is a most promising field for generating new applications in medicine. The present investigation is highly warranted to through more light upon the Ag nanoparticles from medicinal plants will helpful to investigate the active principle action for biochemical and molecular fields. In this study, nanoparticles of 80 ± 90 nm were synthesized by using medicinal plants such as *Mukia maderaspatana*, *Kedrostis foetidissima* and *Cayratia pedata*, and are confirmed by SEM. These nanoparticles showed a characteristic absorption peak at 420 nm in UV spectra. The possibility of protein as a stabilizing material in silver nanoparticles is revealed by FTIR analysis.

Keywords: Green synthesis, silver nanoparticles, *mukia maderaspatana*, *kedrostis foetidissima*, *Cayratia pedata*

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INTRODUCTION

Nanotechnology can be delineated as a researcher for the design, synthesis, and manipulation of structure of particles with dimension smaller than 100nm. A young offshoot of nanotechnology is Nanobiotechnology. It combines biological principles with physical and chemical processes to generate nano-sized particles with specific functions [1-3]. Nanotechnology represents an economic alternative for chemical and physical methods of nanoparticles formation. These methods of deduction can be divided on intracellular and extracellular [4]. Recently, metal nanoparticles have gained a great deal of attention due to their unique chemical, optical, magnetic, mechanical and electric magnetic properties. Thus, metallic nanoparticles are used in different applications such as electronics, catalysis and photons [5]. Nanotechnology is dynamically developing as an important area of innovative research with potential effects in electronics and medicine [6].

MATERIALS AND METHODS

Study area and sampling

The *Mukia maderaspatana, Kedrostis foetidissima* and *Cayratia pedata* plant materials were collected from Kolli hills, Namakkal district of Tamil Nadu in India during monsoon 2013. The fine powder of the plant material was sterilized at 121°C for 15 min and weighed. Sterilized fine powder, 20 g each was taken each plant, mixed with 200 ml of Milli Q water and held in boiling water bath at 60°C for 10 minute. The extracts were filtered with Whatman 1 filter paper and the filtered extracts were stored in a refrigerator at 4°C and it's used as test samples.

Biosynthesis of nanoparticles

For the biosynthesis of silver nanoparticles, silver nitrate prepared at the concentration of 10^{-3} M with pre-sterilized Milli Q water. A quantity of 1.5 cc of each extract was mixed with 30 ml of 10-3 M of silver nitrate for the synthesis of silver nano particles. Silver nitrate has taken in similar quantities of 1.5 ml each without adding plant extracts to main respective controls. The saline bottles were tightly covered with aluminum foil in

order to avoid photo reduction of silver ions, incubated at room temperature under dark condition and notices were recorded in 15, 30, 60 and 120 minutes.

Characterization of Nanoparticles

UV-VIS Spectroscopy

The Ag nanoparticles were characterized in a Perkin-Elmer UV-VIS spectrophotometer, Lambda-19 to know the kinetic behaviour of Ag nanoparticles. The scanning range of the samples was 200-800 nm at a scan speed of 480 mm/minute. Baseline correction of the spectrophotometer was carried out by using a white character.

Fourier Transform-Infra Red (FT-IR) Spectroscopy

The analysis of bio-reducing agent present in each of the extracts was measured by FT-IR. After the reaction, a small aliquot of the concentrated reaction mixture was measured in the transmittance mode at 400 to 4000 cm^{-1}. The spectra of the extracts taken after the biosynthesis of nanoparticles were analyzed.

Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS)

In this research study, Joel JSM-6480 LV SEM machine was employed to characterize the average particle size and sound structure of nanoparticles. Compositional analysis on the sample was carried away by the energy dispersive X-ray spectrometry (EDS) attached with the SEM. The EDS analysis of Ag sample was served by the SEM (JEOLJSM 5800) machine. The EDS normally reveals the presence of phases.

RESULT AND DISCUSSION

Green synthesis of Ag nanoparticles

The plant aqueous solution and silver nitrate solutions were developed individually. A quantity of 1.5 ml of plant extract was mixed with 30 ml of 10^{-3} M of silver nitrate for the synthesis of silver nano particles. During silver nanoparticles synthesis, the change of color from pale greenish to brownish color suggested the establishment of silver nanoparticles.

UV-VIS spectral analysis

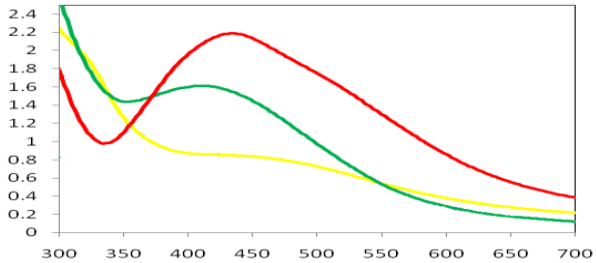
The UV-VIS spectroscopy studies revealed the presence of beard peaks at 420 nm Figure 1a. The absorption spectra of Ag nanoparticles formed in the reaction media have absorbance maxima at 421 nm. A remarkable broadening of peak at around 350 nm to 480 nm indicates that the particles are polydispersed. During each time interval, the park became distinct and moving up. This peak rising clearly denoted the increasing nanoparticles synthesis as the time increments. The shaping of silver nanoparticles when constant aqueous AgNo3 at 50 ml, 1 mm with 0.1 g bio-mass produced silver nanoparticles as indicated by sharp observance at around 440 NM in Cinnamomum camphora [7].

Fourier transform infrared (FTIR) spectrometry

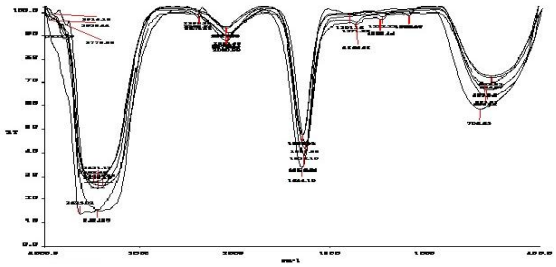
The FTIR spectrum of the Mukia maderaspatana extract, wherein some pronounced absorbance was recorded in the area between 4000 and 400 cm^{-1}. They include a 3435 (secondary amine, free, N-H asymmetric stretching), 2076 (Diazo, RCH=N=N Stretching), 1638 (Nitrate, O-NO2 Stretching asymm), 1371 (Alkanes, CH3 symmetric bending, R-CH3), and 695 (C-S, R-C-CH3 stretching for sulfur compounds), cm^{-1} The FTIR spectrum of the *Mukia maderaspatana* extract with the silver nitrate solution was given Figure 1b. Wherein some pronounced observances were recorded in the area between 4000 and 400 cm^{-1}. They include a 400 (Polymeric hydroxyl compounds, O-H /-NH is stretching Bonded), 2081 (Isothio-cyanates, Aromatic N=C=S stretching), 1637 (Nitrate, O-NO2 Stretching asymm), and 691 (sulfur compounds, C-S stretching). FTIR spectra of the plant *Kedrostis foetidissima* extract revealed absorptions at 3468 (Dimeric associated (intermolecular), O-H / NH is stretching bonded), 2081 (Isothio-cyanates, Aromatic N=C=S stretching), 1638 (Nitrate , O-NO_2 stretching asymm), and 648 (sulfur compounds, C-S stretching) *Kedrostis foetidissima* extract with the silver nitrate solution, such as 3431 (secondary amine (free), N-H asymmetric stretching) 2078 (Diazo, RCH=N=N Stretching), 1638 (Nitrate , O-NO2 Stretching asymm), and 644 (sulfur compounds, C-S stretching).

FTIR spectra of the plant *Cayratia pedata* extract had absorbed as a 3435 (secondary amine, free, N-H asymmetric stretching), 2368 (Tertiary amine salt, -NH+ stretching), 2076 (Diazo, RCH=N=N Stretching), 1636 (Nitrate, O-NO2 Stretching asylum) and 687 (C-S, R-C-CH3 stretching for sulfur

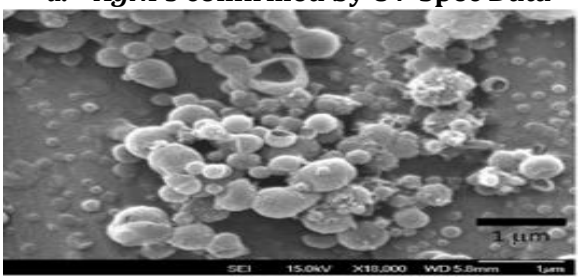
compounds), cm^{-1}. Heliotropium indicum extract with the Silver nitrate solution, They include a 3434 (secondary amine, free, N-H asymmetric stretching), 2371 (Tertiary amine salt, -NH+ stretching), 2076 (Diazo, RCH=N=N Stretching), 1636 (Nitrate, O-NO2 Stretching asymm), 1365 (Monametric, O-H plane bending), 1229 (Formats, Acetates, proportionate and higher ester, C-O-C stretching) and 687 (C-S, R-C-CH3 stretching for sulfur compounds), cm^{-1}. The mechanisms involved in the uptake of metal ions may be intracellular accumulation and surface adsorption. The former one is an active process because the plant must be active to carry out. In the case of surface adsorption, it is a passive process because the chemical groups attached to the cell walls of the plant can bind with metal ions even though when the plant is dead. It is considered as an advantage in phyto-remediation technologies by which metal contaminants are removed. If the chemical groups attached to the cell walls are the binding sites then these groups can be adsorbed as metal ions. Therefore, there may be a possibility to use the plant tissues to filter such ions out of the aqueous solutions. This technology is called phytofiltration.



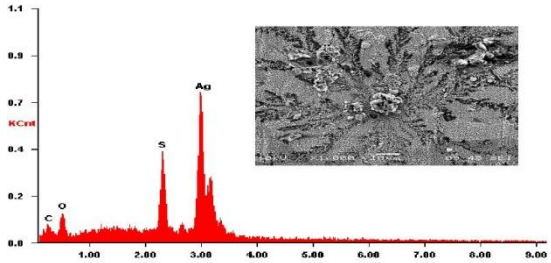
***a. AgNPs* confirmed by UV-Spec Data**



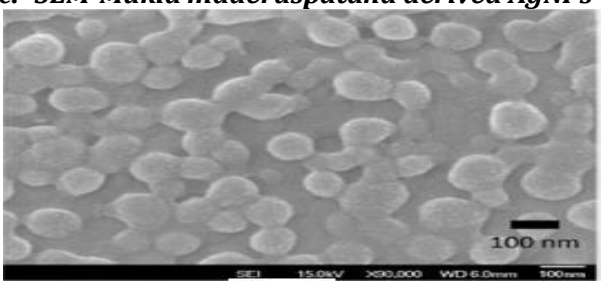
b. FTIR analysis of *AgNPs*



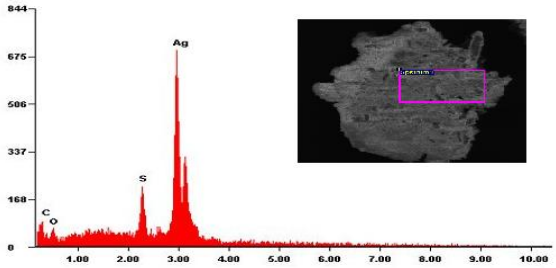
c. SEM-Mukia maderaspatana derived AgNPs



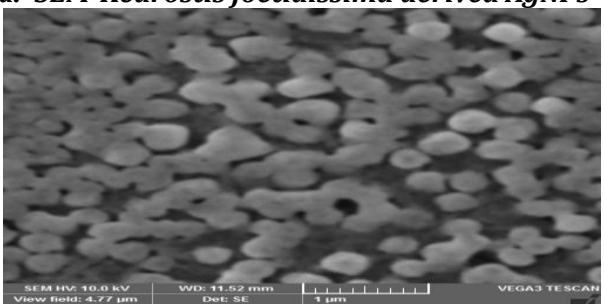
f. EDS- Mukia maderaspatana derived AgNPs



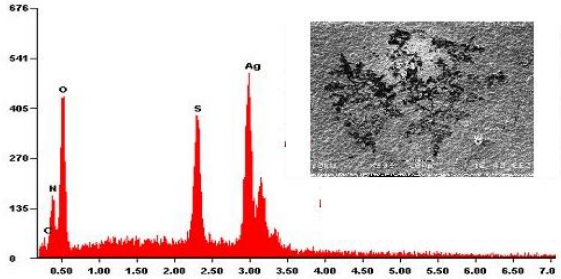
d. SEM-Kedrostis foetidissima derived AgNPs



g. EDS-Kedrostis foetidissima derived AgNPs



e. SEM-Cayratia pedata derived AgNPs



h. EDS-Cayratia pedata derived AgNPs

Figure 1 Characterization of Silver Nanoparticles (AgNps)

Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS)

The SEM image of Silver nanoparticles synthesized by green synthesis process by using 5 % leaves extract and 1mM $AgNO_3$ concentration it gave a clear image of highly dense silver nanoparticles. The SEM image showing silver nanoparticles synthesized using *Mukia maderaspatana*, *Kedrostis foetidissima* and *Cayratia pedata* extracts confirmed the growth of silver nanostructures (Figure 1c, d, e). The EDS reading proved that the compulsory phase of silver (Ag) and oxygen (O) is present in the sample. The graph also shows the presence of carbon (C), sulfur (S) and Nitrogen (N) are present in the EDS picture of silver nanoparticles. It's revealed the presence of pure silver nanoparticles in higher percentages than other factors. This is likely due to the presence of substrate over which the NP sample was held during SEM microscopy (Figure 1f, g, h). Alfalfa biomass using SEM micrographs and a corresponding elemental composition of Ag L as well as traces of C K, Si K analysis by EDS. They reported the highest being Ag, Si, C with 71.59%, 1.34%, 27.06% respectively and the absence of Fe. As EDS equipment works at low vacuum (1-270 pa) it allows to observe non-conducting samples without the need to cover them with a thin conductive film, and consequently no evidence of noise by the coating material [8].

CONCLUSION

A green chemistry synthetic route has been used for silver nanoparticles synthesis. The reaction occurred at ambient temperature. Several plant biomass or plant extracts have been successfully used for extracellular biosynthesis of silver nanoparticles. Analytical techniques, such as ultraviolet-visible spectroscopy (UV-vis), and scanning electron microscopy (SEM) were applied to characterize the nanoparticles morphology.

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