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SYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES USING AQUEOUS EXTRACT GOAT FAECAL PELLETS

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Abstract

The present study deals with synthesis and characterization of silver nanoparticles using aqueous extract of goat faecal pellets. The production of silver nanoparticles was analyzed by preliminary changes of colour from pale yellow to dark brown and it indicates the formation of silver nanoparticles. Further, the nanoparticle was characterized by Surface Plasmon Resonance through UV-Visible spectroscopic analysis. The observation of strong peak at 535.00 nm and it was achieved at 24 hrs. Functional groups of these silver nanoparticles were confirmed by using FTIR. The XRD spectrum also confirmed the formation of silver nanoparticles and the nanoparticle size is 7 nm and shape proved to be spherical nature by SEM analysis. Elemental silver was confirmed by using EDAX analysis.

Keywords: Silver nanoparticles, Goat faecal pelltes, UV-Vis Spectrophotometer, FTIR, XRD, SEM and EDAX

Introduction

The word "nano" is derived from a Greek word meaning "dwarf". In technical terms, the word "nano" means 10^{-9}, or one billionth of a meter. Targeted nanoparticles exhibit many novel characteristic features, such as, extraordinary strength, more chemical reactivity, magnetic properties and or high electrical conductivity. "Nanotechnology" deals with application in biological, physical, chemical, environmental, agricultural, industrial or pharmaceutical science (Adhikari *et al* 2013). Nanoparticles are particulate dispersion or solid particles with a size in the range of 10-1000 nm (Mohanraj & Chen 2006).

Silver nanoparticles are emerging as one of the fastest growing materials due to their unique physical, chemical and biological properties; small size and high specific surface area.

Biological synthesis of nanoparticles has received increased attention due to a growing need to develop environmentally benign technologies in material synthesis. Several plant species have been utilized in this regard (Sarah *et al* 2012).

Green synthesis provides advancement over chemical and physical method as it is cost-effective, eco-friendly; easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals. Nature has devised various processes for the synthesis of nano and micro- length scaled inorganic materials which have contributed to the development of relatively new and largely unexplored area of research based on the biosynthesis of nanomaterials. Synthesis using bio-organisms is compatible with the green chemistry principles. "Green synthesis" of nanoparticles makes use of environmental friendly, non-toxic and safe reagents (Li *et al* 2007).

The silver nanoparticles mostly synthesized from leaf extract of various medicinal plants. Hence, the present study was undertaken to synthesis and characterization of silver nanoparticles using goat dung extract.

Materials and Methods

Synthesis of silver nanoparticles: Freshly collected goat faecal pellets (10g) were mixed with 90 ml of 1 mM silver nitrate solution, and the resulting mixture was incubated for 24 hrs in dark place at room temperature. Reduction of silver ions in the reaction mixture was monitored by change in colour of the reaction from yellow to dark brown. The silver nanoparticles solution thus obtained was purified by repeated centrifugation at 7000 rpm for 20 minutes. The pellets were kept in a lyophilizer for 24 hour for powder form of nanoparticle. This powder was taken out for characterization studies.

Characterization of biologically synthesized silver nanoparticles: The bio-reduction of silver ions was monitored by UV-Visible spectroscopy. To determine the nature and size of the synthesized Ag NPs, X-ray diffraction (XRD) was performed. Functional groups were analyzed by Fourier Transform Infra Red Spectroscopy. SEM and EDAX spectrum were recorded by focusing on morphology and clusters of particles.

Results and Discussion

The present study is an attempt to synthesize AgNPs using goat faecal pellets. The colour of reaction mixture turned from pale yellow to dark brown after 24 h of reaction, indicating reduction of $AgNO_3$. Similar result was also observed by Lee *et al* 2013 using cow milk. The synthesis of silver nanoparticles in the reaction mixture was further confirmed by UV-Vis Spectroscopy. The UV-Visible spectra showed an absorption band at 535.00 nm (Figure 1) which corresponds to the absorbance of silver nanoparticles. UV- Visible spectroscopy is an important technique to determine the formation and stability of metal nanoparticle in aqueous solution (Gnana Jobitha *et al* 2012). Rajakumar and Rahuman 2011 reported that *Eclipta prostrata* leaf extract showed absorption band at 420 nm. UV- Spectra recorded at 425 nm when green synthesized silver nanoparticles from aqueous bark extract of *Ficus racemosa* (Velayutham *et al* 2013).

SEM results provided the information about morphology and size of the silver nanoparticles (Figure 2). The shape of the silver nanoparticles was found to be spherical. The average particle size was identified as 7 nm. Further SEM image showed the high density of silver nanoparticles and confirmed the synthesis of silver nanoparticles by the calculation of XRD analysis. Vaishnavi *et al* 2015 reported that the SEM image showed that the synthesized silver nanoparticles was cluster and their size ranged from 14-17 nm. Similar shape of nanoparticles was synthesized by *Musa balbisiana* (Banerjee *et al* 2014). The XRD data showed 2θ intense values with various degrees such as 37.10°, 47.66°, 63.97° and 70.01 and these results are corresponds to (111), (200), (220) and 311 Bragg's reflection based silver nanoparticles (Gnanadesigan *et al* 2011). Govarthanan *et al* 2014 the XRD pattern with the diffraction peaks at 46.1°, 54.55°, 67.74°, and 76.84° corresponding to the 111, 200, 142, 220, and 311 planes for silver.

The EDAX spectral pattern showed the successful synthesis of silver nanoparticles from goat faecal pellets extract. EDAX results, a peak of silver and confirmed the presence elemental silver in the suspension. This result is with consistent with many reports, leaf extract of *J. sambac* (Vaishnavi *et al* 2015), leaf extract of *Euphorbia hirta* (Durgadevi *et al* 2014).

The FTIR spectrum of produced silver nanoparticles had many absorption bands (Fig 3) and the absorption bands seen at 630.68 cm^{-1}, 702.04 cm^{-1}, 1041.49 cm^{-1}, 1240.14 cm^{-1}, 1529.45 $cm^{-1,}$ 1641.31 cm^{-1} ,2916.17 cm^{-1} and 3290. 33 cm^{-1} were assigned to the C-Br stretching of

alkyl halides, = C-H bend of Alkenes, C-F Stretching of Alkyl halides, C-O Stretching of Alcohols, N-H bend of Amides, C=O Stretching of Amides, C-H Stretching of Alkanes and Alkyls and ≡ C-H Stretching of Alkynes. This indicates that the silver nanoparticles synthesized using extract of goat dung was proved to have all these functional groups in it. Similar result was reported by Lalitha *et al* 2013 the spectrum exhibits the band at 3237 cm^{-1} corresponding to amide group (strong peak) it indicates silver nanoparticles synthesis by leaf extract of *Azhadirachta indica.* Fourier transform infrared spectrometer (FTIR) analysis was carried out to determine the nature of the capping agents in each of *Musa balbisiana* (banana), *Azadirachta indica* (neem) and *Ocimum tenuiflorum* (black tulsi) leaf extracts (Banerjee *et al* 2014).

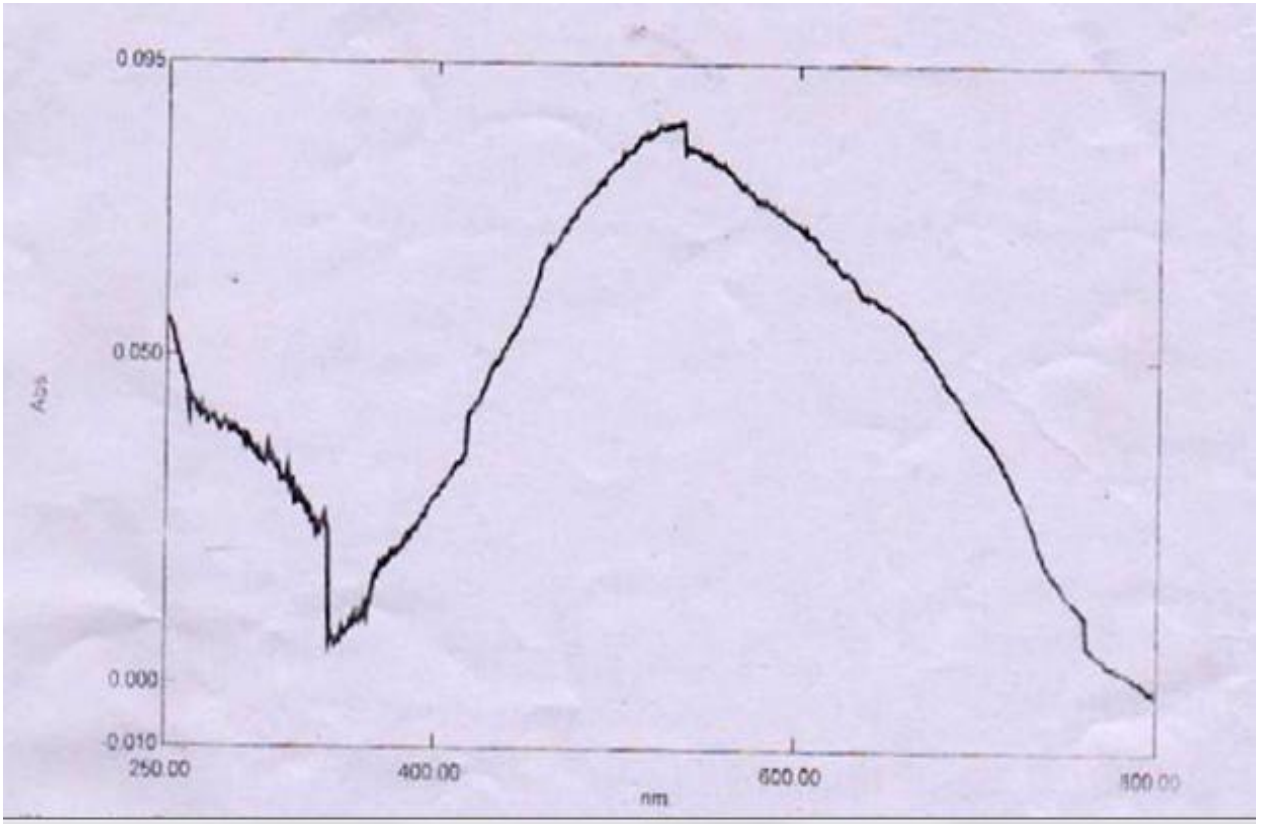

Fig 1: UV- visible absorption spectrum of silver nanoparticles synthesized using goat dung extract.

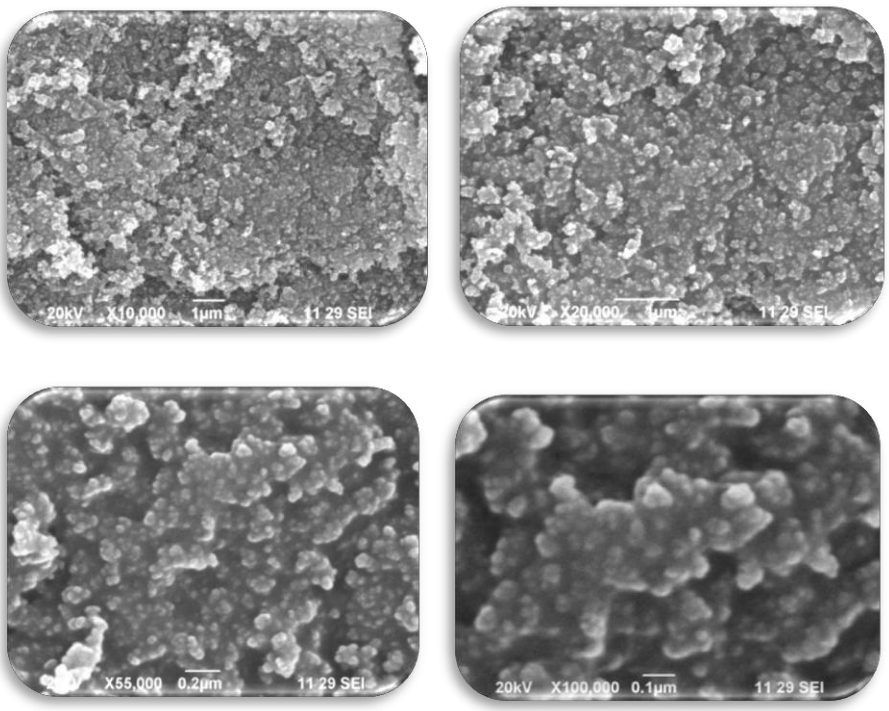

Fig 2 SEM images of synthesized silver nanoparticles at different magnification: (A) 20 kv × 10,000; (B) 20 kv ×20,000; (C) 20 kv ×55,000; (D) 20 kv ×100,000.

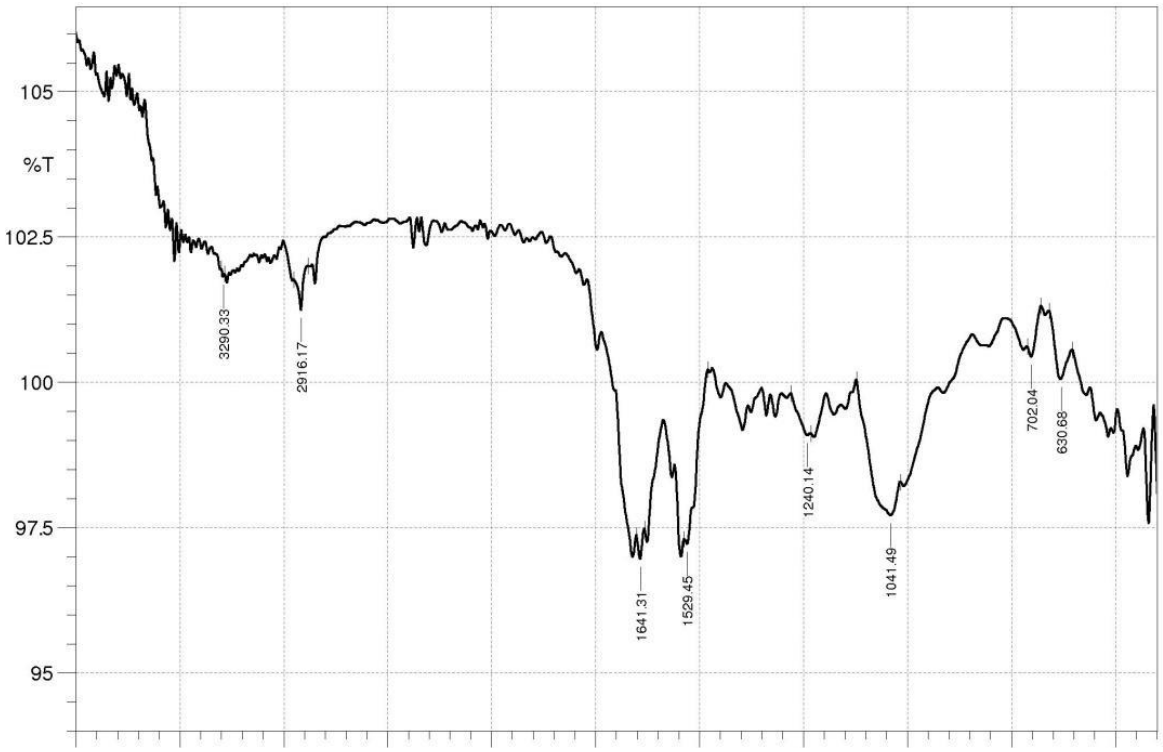

Fig 3: FTIR spectrum of silver nanoparticles synthesized using goat dung extract.

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