INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com ISSN : 0976-4550

Volume-7, Issue-2, April-June-2016 Coden IJABFP-CAS-USA Copyrights@2016

Received: 1st Mar 2016 *Revised: 15th Mar 2016* *Accepted: 18th Mar 2016*

Research article

SCREENING AND CHARACTERIZATION OF SILVER NANOPARTICLES FROM BIRD EXCRETA

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ABSTRACT: Nanomaterials are at the leading edge of the rapidly developing field of nanotechnology. Ecofriendly methods of green mediated synthesis of nanoparticles are the present research in the limb of nanotechnology. Silver nanoparticles have important applications in the field of biology. An effective and versatile technique was implemented for the synthesis of silver nanoparticles using extract of bird excreta. The aqueous silver ions exposed to the extract of country fowl *Gallus domesticus* excreta, which were reduced and the nanoparticles were synthesized. The presence of nanoparticles was confirmed by the formation of brown colour of the reaction mixture. The brown colour was observed after 3 hours. The silver nanoparticules qualitatively characterized by UV-Visible spectrophotometer. A sharp peak was observed in 443 nm indicates formation of silver nanoparticles. The particle size was found to be 14 nm, possessing spherical shape as confirmed from XRD, EDAX and SEM analysis. Functional groups of these silver nanoparticles were confirmed by using FTIR.

Key words: Bird excreta, Silver nanoparticles, UV-Visible Spectrophotometer, SEM, XRD EDAX and FTIR.

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INTRODUCTION

Nanotechnology is an important field of modern research dealing with design, synthesis, and manipulation of particles structure ranging from approximately 1-100 nm. The term "Nanotechnology" was first defined by Norio Taniguchi, Tokyo Science University in 1974, as follows: ‘Nanotechnology' mainly consists of the processing, separation, consolidation, and deformation of materials by one atom or one molecule (Taniguchi, 1974). Nanoparticles are viewed as the fundamental building blocks of nanotechnology (Mansoori, 2007). Nanoparticle synthesis is the widely growing area of nanotechnology. Silver nanoparticles are emerging as one of the fastest growing materials due to their unique physical, chemical and biological properties; small size with high specific surface area (Sarah *et al.*, 2012). Silver nanoparticles have extremely large surface area-to-mass ratios and have a high percentage of their component atoms on the surface, which gives them unique biological activity or toxicity (Colvin, 2003; Warheit, 2008 and Griffitt *et al.,* 2009). Biological methods for nanoparticle synthesis using microorganisms, enzymes and plants or plant extracts have been suggested as possible as ecofriendly alternatives to chemical and physical methods (Mohanpuria *et al.*, 2008). Biosynthesis of silver nanoparticles using plants, bacteria, fungi and yeast (Shivshankar *et al.*, 2004 and Ahmad *et al.*, 2003) is known to reduce silver ions into silver nanoparticles by both extra and intra cellular levels. Hence the present study was aimed to synthesize silver nanoparticles using country fowl, *Gallus domesticus* excreta.

MATERIALS AND METHODS

Synthesis of silver nanoparticles

10 ml of bird *Gallus domesticus* excreta extract was added to the aqueous solution of 1mM silver nitrate. Then the sample was incubated in dark for 24 hours at room temperature. The colour change of the sample yellow to dark brown was checked periodically. This reaction mixture was repeatedly centrifuged at 7000 rpm for 20 minutes. The pellets were kept in a lyophilizer for 24 hours to get powder form of nanoparticle. Then this powder was obtained for characterization.

Characterization of silver nanoparticles

Characterization of nanoparticles is important to understand and control nanoparticles synthesis and applications. The techniques are used for determination of different parameters such as particle size, shape, crystallinity, fractal dimensions, pore size and surface area. Moreover, orientation, intercalation and dispersion of nanoparticles and nanotubes in nanocomposite materials could be determined by these techniques. X-ray diffraction is used for the determination of crystallinity and UV-Visible spectroscopy is used to confirm sample formation by showing the Plasmon resonance. The synthesized nanoparticles were characterized by SEM and EDAX for focusing on morphology and clusters of particles and functional groups were analyzed by Fourier Transform Infra Red Spectroscopy.

RESULTS AND DISCUSSION

In recent years, the development of efficient green chemistry methods employing natural reducing, capping, and stabilizing agents to prepare silver nanoparticles with desired morphology and size have become a major focus of researchers. Biological methods can be used to synthesize silver nanoparticles without the use of any harsh, toxic and expensive chemical substances (Ahmad *et al*., 2003; Shankar *et al*., 2004; Huang *et al*., 2007). The present study provides the evident that the excreta of *Gallus domesticus* have the potential to convert silver nitrate to silver nanoparticles by the reduction of silver ions (Ag^+ into Ag^0).

The colour of the reaction mixture changed from transparent to brown within 3 hours (Plate 1). It is reported that the colour change in the solution may be due to the excitation of surface plasmon vibrations in the nanoparticles (Jha and Prasad, 2010). Similar result was also observed by Vaishnavi *et al*., 2015 in the leaf extract of *Jasminum sambac*. UV-visible spectroscopy is very useful to identify the formation of metal nanoparticles in reaction mixture (Gnanajobitha *et al*., 2012). In the present study Surface Plasmon Resonance peak in the UV-vis absorption spectra of the silver nanoparticles synthesized by biological reduction showed an absorption peak at 443 nm (Figure 1). UV- Spectra recorded at 422 to 447 nm when green synthesized silver nanoparticles from aqueous leaf extract of *Cardiospermum halicacabum* (Shekhawat *et al*., 2013).
Figure 2 shows the SEM image of the synthesized silver nanoparticles by excreta of *Gallus domesticus*. Bird excreta extract synthesized nanoparticles were spherical and particle size was identified as 14 nm. Sahayaraj *et al*., 2012 reported that the SEM image showed that the synthesized silver nanoparticles were spherical and their size ranged from 45-64 nm. The XRD analysis showed that three distinct diffraction peaks at 32.47^0, 46.45^0 and $28.04^0$and can be indexed 2ɵ values of (838), (512) and (337) crystalline planes of cubic silver (Figure 3; Table 1). Vaishnavi *et al*., 2015 reported that the XRD pattern with the diffraction peaks at 29.73°, 38.27° and 43.61°. EDAX further confirmed the presence of the signal characteristic of elemental silver (Figure 4). Peaks for Cl and O correspond to the protein capping over the silver nanoparticles. Silver nanocrystallites display an optical absorption band peak at approximately 3 keV, which is typical of the absorption of metallic silver nanocrystallites due to surface. The peaks of Ag, Cu, C, S, P and N correspond to the protein capping over the silver nanoparticles (Ahmad and Sharma, 2012).
Figure 5 ; Table 2 show the absorption bands from silver nanoparticles synthesized from bird excreta extract at 669.25 cm^{-1}, 1037.63 cm^{-1}, 1382.87 cm^{-1}, 1542.95cm^{-1}, 1622.02 $cm^{-1,}$ 2916.17 cm^{-1} and 3272.98 cm^{-1} and were assigned to the C-Br stretching of alkyl halides, C-N stretching of aliphatic amines, -C-H bend of alkane, N-O asymmetric stretching of nitro compounds, N-H bend of 10 amines, C-H stretching of alkanes and -C≡C-H:C-H stretching of alkynes (terminal). Similar results were reported by Brindha *et al*., 2014 the band at 1635.64 cm^{-1}, 1381.64 cm^{-1}corresponding to primary amide groups (strong peak), nitro compounds including primary (CN) and secondary amines (NH) stretch vibration of proteins. Strong bands of phenyl ring compounds indicate the occurrence of proteins with silver nanoparticles synthesized by *Pongamia notatum.*

Thus the present study suggests that the bird excreta extract is the good source for the synthesis of potential silver nanoparticles by ecofriendly manner at low cost. Results concluded that bird excreta extract is a prominent producer of silver nanoparticles.

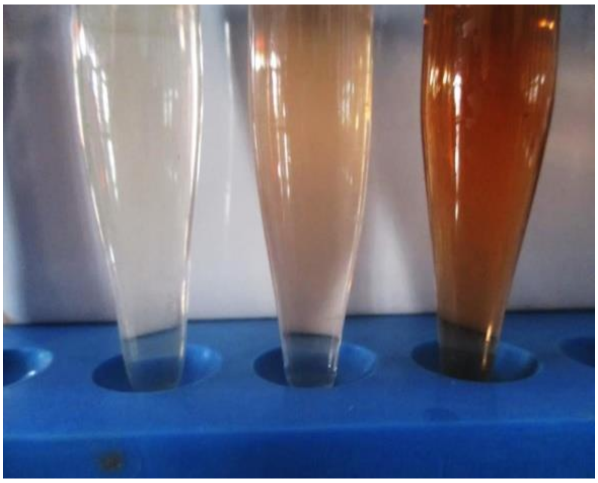

Plate 1: Occurrence of colour change in reaction mixture

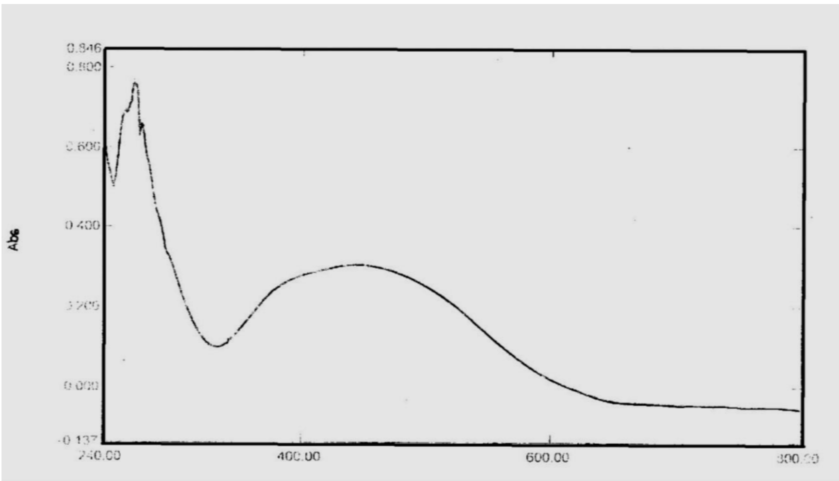

Figure 1: UV- visible absorption spectrum of silver nanoparticles synthesized using bird excreta extract.

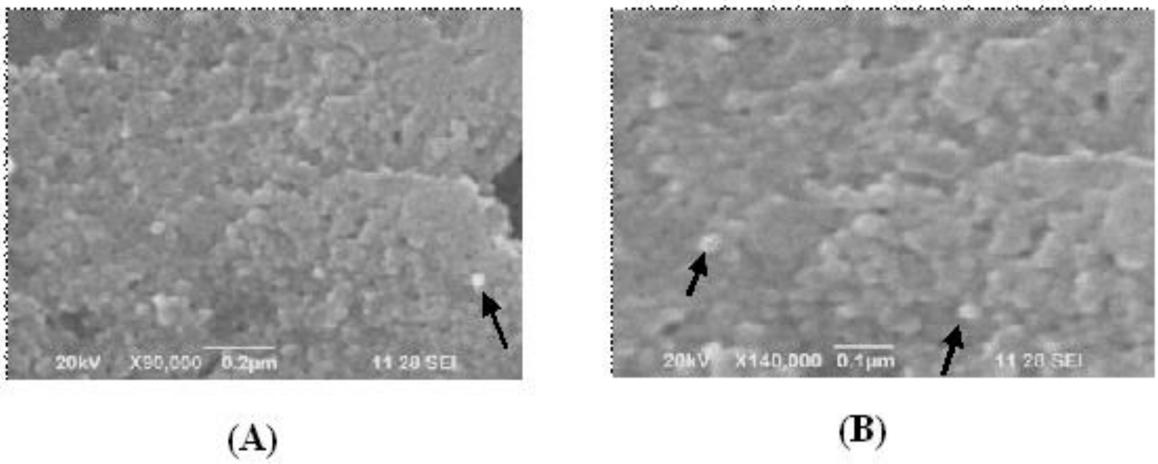

Figure 2: SEM images of synthesized silver nanoparticles at different magnification: (A) 20 kv × 90,000; (B) 20 kv ×140,000.

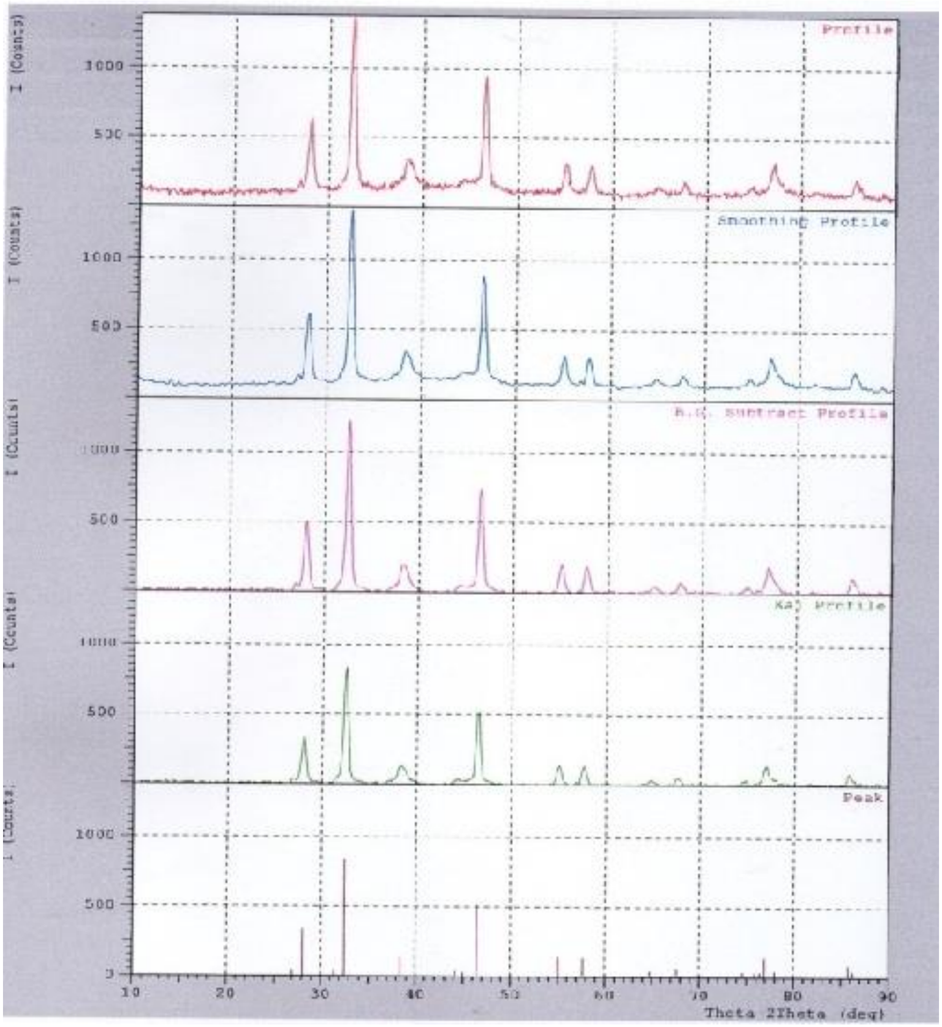

Figure 3: XRD spectrum of AgNPs synthesized from the extract of bird excreta

Table 1: 2θ and FWHM values of strongest 3 peaks observed in XRD spectra.

S. No	Peaks	2θ value (degree)	FWHM (degree)
1	4	32.4771	0.57260
2	8	46.4550	0.57480
3	2	28.0427	0.60960

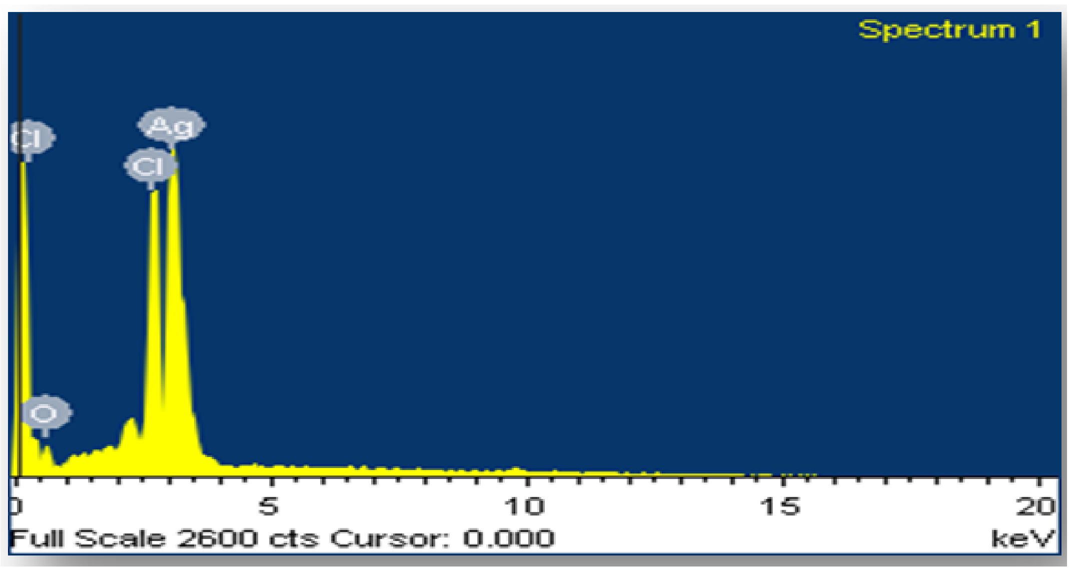

Figure 4: EDAX spectrum of synthesized silver nanoparticles using bird excreta extract

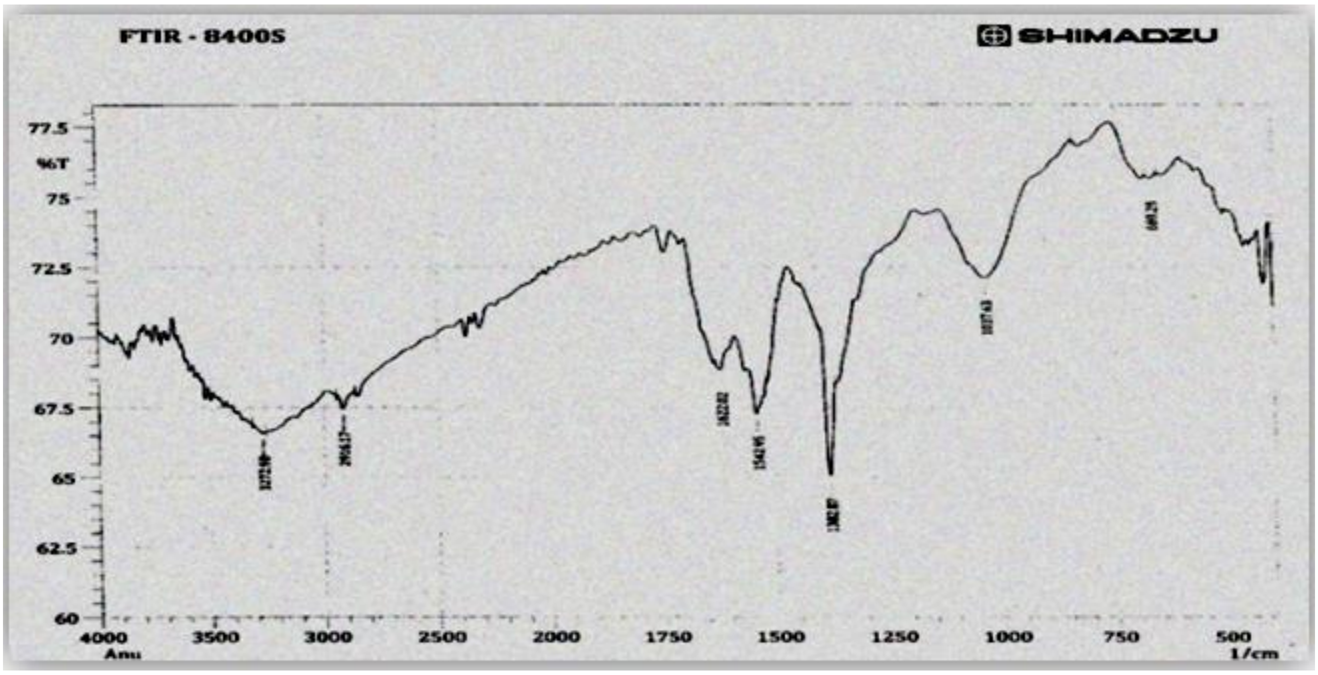

Figure 5: FTIR spectrum of silver nanoparticles synthesized using bird excreta extract.

Table 2: Functional groups in synthesized silver nanoparticles revealed by FTIR.

S. No	Absorption (cm^{-1})	Class of compounds	Bond
1	669.25 cm^{-1}	Alkyl halides	C-Br stretch
2	1037.63 cm^{-1}	Aliphatic amines	C-N stretch
3	1382.87 cm^{-1}	Alkane	-C-H bend
4	1542.95 cm^{-1}	Nitro compounds	N-O asymmetric stretch
5	1622.02 cm^{-1}	Amines	N-H bend
6	2916.17 cm^{-1}	Alkanes	C-H stretch
7	3272.98 cm^{-1}	Alkynes (terminal)	-C≡C-H:C-H stretch

CONCLUSION

We have developed a fast, eco-friendly, and convenient green method for the synthesis of silver nanoparticles from silver nitrate using bird excreta extract at ambient temperature. Color changes occur due to surface plasmon resonance during the reaction with the ingredients present in the bird excreta extract resulting in the formation of silver nanoparticles, which is confirmed by UV–vis spectroscopy, SEM, XRD, EDAX, FT-IR.

ACKNOWLEDGMENT

Authors wish to thank Management and Principal, Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi for providing facilities to carry out this research work.

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ISSN : 0976-4550

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