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Soybean Seeds Extract Based Green Synthesis of Silver Nanoparticles

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ABSTRACT
Synthesis of silver nanoparticles using seeds extract of soy bean has been investigated. The manipulates of different concentration of soy bean seed extract, same metal ion concentration and different reaction time on the above cases on the synthesis of nanoparticles were evaluated. Nanoparticles were characterized using UV-vis transmission electron microscopy (TEM), X-ray diffraction (XRD) and FTIR analysis. XRD studies reveal a high degree of crystalline and monophasic silver nanoparticles of face-centered cubic structure. FTIR analysis proved that particles are reduced and stabilized in solution by the capping agent that is likely to be proteins veiled by the biomass. The present process is an excellent candidate for the synthesis of silver nanoparticles is simple, easy to perform, pollutant free and inexpensive.

Keywords: *Green synthesis, Silver nanoparticle, X-ray diffraction, FT-IR, and transmission electron microscopy (TEM).*

1. INTRODUCTION

Optoelectronic and physicochemical properties of nano scale matter are size and shape dependent. Shape dependent optical properties of Ag nanoparticles hold considerable promise for biomedical and photonic applications [1-4]. Recently, several Shapes and structures of Ag nanoparticles have been studied. They include nano rings, nano plates, dendrimer-like shapes, nano cubes and nano prisms [5-8]. In the last decade, biosynthesis of metal nanoparticles is a growing need to develop clean, nontoxic chemicals, environmentally benign solvents and renewable materials [9] and hence the focus turnedicles towards synthesis of biocompatible metal and semiconductor nanoparticles [10,11] The biological methods of nanoparticles synthesis using biological entities; including bacteria, yeast, fungi [12-16] and plants [17-28] is already reported as clean, nontoxic, and cost effective environmentally acceptable routes. The use of plant extracts for synthesis of nanoparticles is potentially advantageous over microorganisms due to the ease of scale up, the less biohazard, and elaborate process of maintaining cell culture .Malvaparviflora, a prostrate perennial herb, with a deep strong tap root system, found in Europe, has become a cosmopolitan weed species in gardens throughout Egypt [29]. The whole herb show healing properties and externally used in resolving boils, abscesses and removing splinter tissue. Anti-inflammatory, antimicrobial, antioxidant and wound healing abilities have been reported [30].In this work, we report the biosynthesis of silver nanoparticles via a single-step reduction of silver ions using renewable and biodegradable soybean seeds extract at room temperature without the use of any reducing or capping agents in order to have high advantages and properties of both components to use in bio medical applications. To the best of our knowledge, it is the first time here to use soybean seeds extract for synthesis of silver nanoparticles.

2. Experimental

2.1. Characterization

UV-vis absorption spectra were recorded using Shimedzu 2400 UV-vis at a resolution of 1 nm. The X-ray diffraction measurements were done on a Seifert 3003 TT X-ray diffractometer with Cu Kα radiation with a wave length of 1.52A and the quantitative elemental analysis of the nanoparticles were carried out an Oxford instruments Inca Penta FET x 3 Energy dispersive spectrum (EDS). The FT-IR spectra of silver nanoparticles and soybean seeds extract was carried out with a Thermo Nicolet FTIR-200 thermo electron corporation.

2.2 Preparation of leaf extract from soybean

Soybean seeds were gathered from trees budding in the fields of madanapalli, Chittoor (Dt), Andhra Pradesh, India. The seeds were shade dried for 10 days at room temperature. The fresh soybean seeds extract used for the reduction of Ag^+ ions to Ago was prepared by placing 10g of thoroughly washed finely cut seeds in 500ml flask along with 100ml of distilled water and then boiling the mixture for 30min before decanting it. The extract was filtered and stored at room temperature in order to be used further experiments.

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2.3. Synthesis of silver nanoparticles

5mL extract is added to a eagerly stirred 25mL aqueous solution of $AgNO_3$ ($1×10^{−3}$ M) and stirring continued for 10min.Reduction takes place rapidly at 300K and is complete in 10 min as shown by stable light greenish-yellow colour of the solution which gives colloid s_1. Similarly by adding 10ml of extract two more set of samples hereafter called s_2 respectively were prepared.

3. Results and discussion

3.1. UV–Vis spectra of silver nanoparticles

The formation and stability of silver nanoparticles were followed by UV–Vis spectro photometry. Fig;1 shows the UV–Vis spectra of silver nanoparticles formation using a constant $AgNO_3$ concentration (($1×10^{−3}$ M)) with different concentrations of the extract. Fig.1a represents the UV–Vis spectra of aqueous component as a function of concentration variation of leaf broth with 1 Mm aqueous $AgNO_3$ solution. Here, the sharp bands centered at 434nm clearly notify the formation of silver nanoparticles, it is observed that the absorption peak becomes sharp as the amount of extract increases. The broad spectra indicate the presence of particles with a broad size distribution. At lower concentrations of the extract the SPR band is broad and it is due to the formation of particles with broad size distribution .Thus from the results it can be inferred that at room temperature the amount of extract is an important factor in determining the size distribution of silver nanoparticles. From fig. 1b it is seen that the SPR absorption band appears to be broad as the amount of extract increases In fig1a and b represent the peaks of 5 ml and 10ml of extract, added to the aqueous 1 Mm $AgNO_3$ solution of 25 Ml respectively.

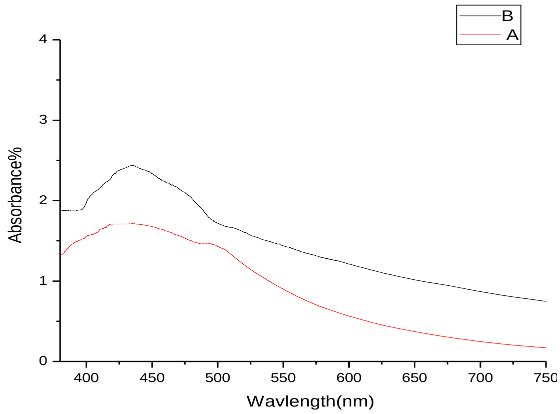

Figure 1. UV-Vis absorption spectra of synthesized AgNPs. (1A 5ml Extract, 1B 10 ml Extract)

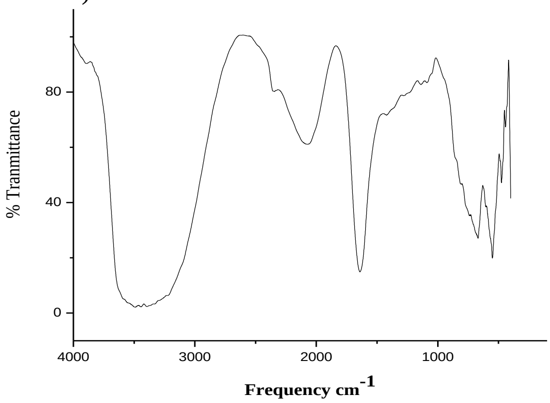

Figure 2. FT-IR Spectrum of the synthesized AgNPs.

3.2. FT-IR spectra

FT-IR analysis was used to understand the existence of surface functional groups in metallic interactions. Fig. 2 shows the FT-IR spectrum of soybean seeds extract. The bands in the region 3448 cm-1 were assigned to hydroxyl stretching of poly phenols, whereas N-H vibrational band peak appears at 1645 cm-1. The FT-IR results indicate the presence of poly phenols and proteins molecules in the soybean seeds extract which have reduced Ag + to Ag as well as stabilizing Ag NPs.

3.3. XRD

The XRD pattern of the silver nanoparticles is as shown in Fig. 3 shows five main characteristic diffraction peaks for Ag were observed at 2θ values of 38.22°, 46.46°, 65.05°and 77.12° are indexed to the (111), (200), (220)and (311) reflections of the fcc structure of metallic silver The average particle size of silver nanoparticles can be calculated using Debye-Scherrer equation: D = kk/bcosh, where D is the thickness of the nano crystal, k is a constant, k is the wave length of X-rays and b is the full width at half maxima of (111) reflection at Bragg's angle 2h. The average particle size calculated from the XRD patterns is 50 nm and it is in good agreement with the particle size assigned from the TEM studies.

3.4. TEM and EDX analysis

Fig. 4 revealed that the transmission electron microscope image with scale 50 nm. This TEM image shows that the green synthesized silver NPs were nearly monodisperse spherical shape and its size range 25nm to 50nm .The result of energy dispersive spectroscopy (EDX) analysis was shown in Fig. 5. This confirmed the significant presence of elemental silver. The above results indicate the spherical shape and elemental silver formed by a facile manner.

4. CONCLUSION

In conclusion, we have recognized that Ag NPs was synthesized form seeds extract of soybean in a quick method by using eco-friendly green synthesis. These nanoparticles are found to be highly crystalline as evidenced by the peaks in the XRD pattern corresponding to Bragg reflections from the (111), (200), (220), and (311) planes of

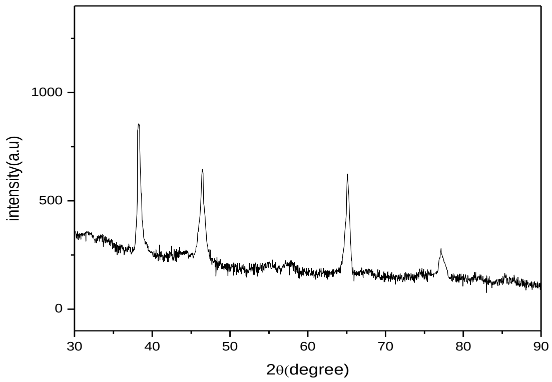

Figure 3. XRD Pattern of AgNPs synthesized using soybean seeds extract.

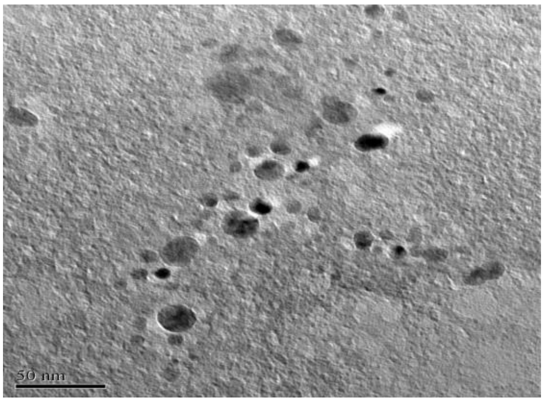

Figure 4. Transmission electron microscope (TEM) image of synthesized silver nanoparticles.

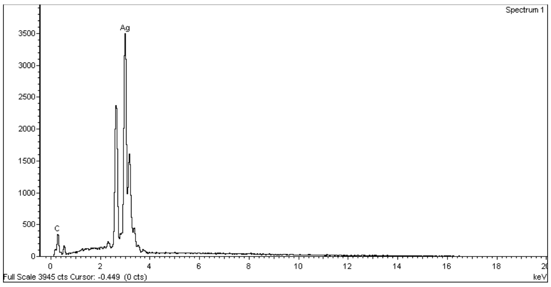

Figure 5. Energy dispersive X-ray spectroscopy (EDS) image of synthesized AgNPs.

fcc structure. The size of the particles is found to be 50 nm from TEM image analysis

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***Biographical sketch**

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