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SYNTHESIS OF SILVER NANOPARTICLES USING EXTRACTS OF *CALOTROPIS GIGANTEAN* FLOWERS

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ABSTRACT

Biological synthesis of silver nanoparticles using *Calotropis gigantea* flower extract was investigated and the effect of flower extract in reduction mechanism and particle size is reported. The reduction of silver (Ag+) was monitored using UV- visible spectrophotometry and showed formation of silver nanoparticles with in 60mins. The formation of Ag-NPs was confirmed by Scanning Electron Microscopy (SEM) and are quite polydispersed, the size ranging from 10 nm to 50 nm. The formation of crystalline silver nanoparticles was confirmed using X-ray diffraction analysis. Extracellular synthesis of Ag nanoparticles using flower extract appears to be cost effective, eco-friendly to that of conventional methods of nanoparticles synthesis.

KEYWORDS

Silver nanoparticles, *Calotropis gigantean*, Flower extract, X-Ray Diffraction and Scanning Electron Microscope.

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INTRODUCTION

Engineered nanomaterials have received greater attention for their positive impact in improving many sectors of economy, including pharmaceutics, cosmetics, transportation, energy, agriculture and environment[1]. Nanoparticles can drastically modify their physico-chemical properties compared to the bulk material[2], the improvement of experimental processes for the synthesis of these nanoparticles of different sizes, shapes, and controlled dispersity is important[3]. Several biological methods using

microorganisms including bacteria, fungi, actinomycetes, and yeast, enzymes, and plants[4,5]. But production of nanoparticles using Plant extracts have been found to be cost effective and environment friendly for the large scale synthesis of nanoparticles. The use of environmentally benign materials like plant leaf and flower extract, bacteria, and fungi for the synthesis of nanoparticles offers numerous benefits of compatibility for pharmaceutical and biomedical applications as they do not use toxic chemicals in the synthesis protocols[6,7]. *Calotropis gigantea*is a widely growing plant and has been reported to possess number of medicinal properties[8] commonly called as Akada (in hindi), or Milk weed. It has bitter, healing, laxative and anthemintic properties that cure ulcers, acts as an expectorant. Its leaves are used to relieve stomach pain. Its flower is a tonic, appetiser, that cures piles, asthma and wounds and also useful in cholera[9].

MATERIALS AND METHOD

Fresh flowers of widely growing *Calotropis gigantea* were picked from the plants at the roadside Areas of Bangalore, Karnataka, India. The flowers were washed thoroughly in tap water for 5 minutes then the petals were separated from the flower (for the study) and kept for drying in a tray at room temperature.

Preparation of Crude Extracts

10 g of dried flowers were cut into fine pieces and were crushed in mortar and pestle using 100 ml methanol and then filtered using Whatman No.1 filter paper (pore size 25 μm). The filtrate obtained is dried in a vacuum drier and the powder was stored at 4^{o}C or for further use. 100ml distilled water was added to the powder and the aqueous extract was used for the studies.

UV-VIS Spectral analysis

The dried powder was added in 100ml distilled water and used for further studies. 1ml of aqueous flower extract was added into the 10ml of 5mM Silver Nitrate. The reduction of Ag+ to Ag0 was monitored by measuring the UV-Vis spectrum at different time intervals (range from 5 - 120 min) within the range of 400 - 480 nm wave length in the UV-Vis spectrophotometer (ELICO-SL159).

Sample preparation for XRD analysis

The reaction mixtures were kept for drying for 3 days (till the formation of a thick gel like extract). The gels were decanted on to clean sterile glass slides and were combusted to powder form and characterized by X-Ray Diffraction (XRD), for the presence of silver nanoparticles by using X'Pert Pro x-ray diffractometer (PAN alytical BV) operated at a voltage of 40 kV and a current of 30 mA with Cu Kα radiation in a θ-2θ configuration. The crystallite domain size was calculated from the width of the XRD peaks, assuming that they are free from non-uniform strains, using the Scherrer formula[10].

$$D = \frac{0.9\lambda}{\beta cos\theta}$$

Where D is the average crystallite domain size perpendicular to the reflecting planes, λ is the X-ray wavelength (1.5418A^{o}), β is the full width at half maximum (FWHM), and θ is the diffraction angle.

Sample preparation for SEM

The samples were characterized using Cambridge Scanning Electron Microscope with EDAX attachment (CF) for the analysis of size and the presence of silver nanoparticles. The samples were sonicated before drop-casting on Silicon wafer, a very small amount of the sample were dropped on the grid, and excess solution removed using a blotting paper and then the film on the SEM grid were allowed to dry under a mercury lamp for 5 minutes. The SEM study was carried out in the Department of Chemical Engineering, Indian Institute of Science, Bangalore.

RESULTS AND DISCUSSION

UV-Vis spectroscopy is an indirect method to examine the bio reduction of Ag nanoparticles from aqueous $AgNO_3$ solution. Addition of flower extract resulted in the gradual change of the colour of $AgNO_3$ solution from light blue to brown indicating the synthesis of Ag-NP_S. The color intensity also increased with the duration of incubation. After 60 minutes there was no significant colour change,

which is evidence for the completion of reduction reaction and the intensity of the colour started to decrease which indicates that aggregation of silver nanoparticles. The flower extracts without $AgNO_3$ did not show any change in color. The absorbance was monitored at a wave length in the range of 300-600 nm and the resulting absorption spectrum showed the peak at 440 nm that was characteristic of Ag-NPs. Figure No.1 shows the UV-Vis spectra recorded from the reaction mixture at different time intervals. Although, Ag-NPs were synthesized rapidly within 1 min of incubation period in flower extract solutions, silver nanoparticles development was increased with time. It may be due to the excitation of surface Plasmon resonance (SPR) effect and reduction of $AgNO_3$[10,11]. Shankar *et al*.[12] reported that the peak at 440 nm was due to the excitation of longitudinal Plasmon vibrations.

The XRD pattern clearly shows that the silver nanoparticles are crystalline in nature by the reduction of silver ions by using flower broth. The X-ray diffraction analysis further provided evidence for the extracellular formation of silver nanoparticles and the Ag-NPs are crystalline in nature. The XRD pattern showed numbers of Bragg reflections that may be indexed on the basis of the face-centered cubic structure of silver. Unassigned peaks are also observed suggesting that the crystallization of bio-organic phase occurs on the surface of the nanoparticles. SEM analysis was carried out to understand the topology and the size of the Ag-NPs, which showed the synthesis of poly, dispersed spherical, yeast like Ag-NPs of various sizes. The SEM image showing the high density silver nanoparticles synthesized by the flower extract further confirmed the development of silver nanostructures. The SEM analysis showed the particle size between 10-50nm. Yeast like structure was observed from SEM image as reported earlier by sivakumar *et al*., in *Calotropis gigantean* leaf extract also synthesized yeast like Ag-NPs[13].

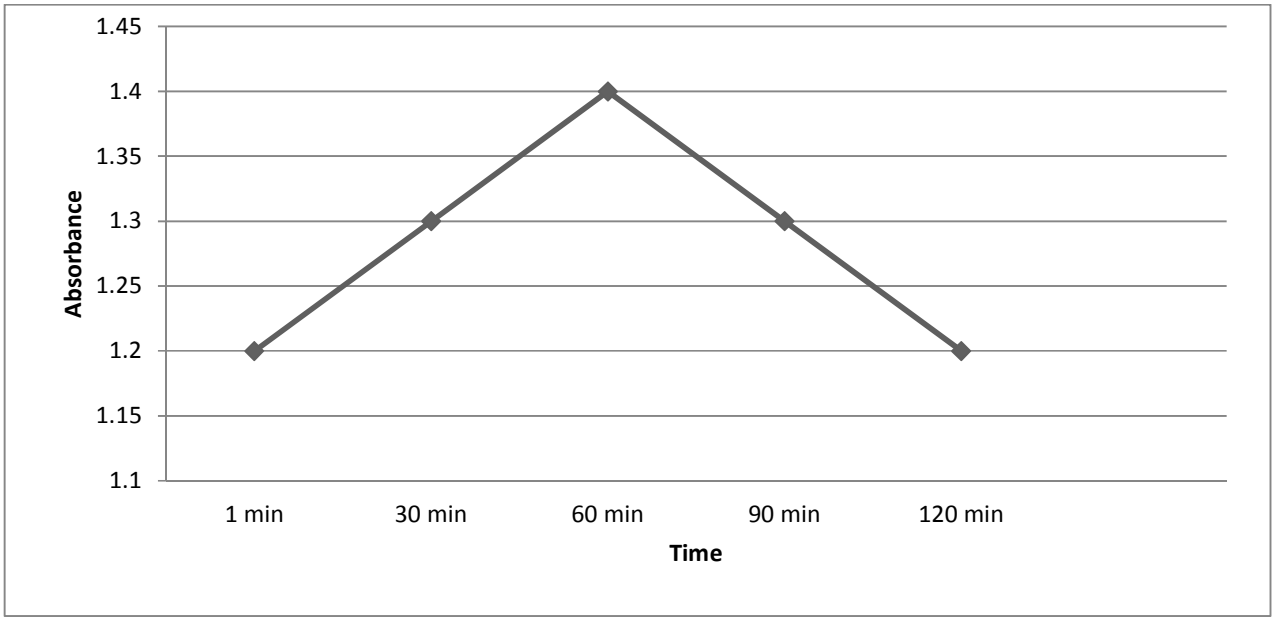

Figure No.1: UV-Vis Spectra of silver nanoparticles synthesized at different intervals

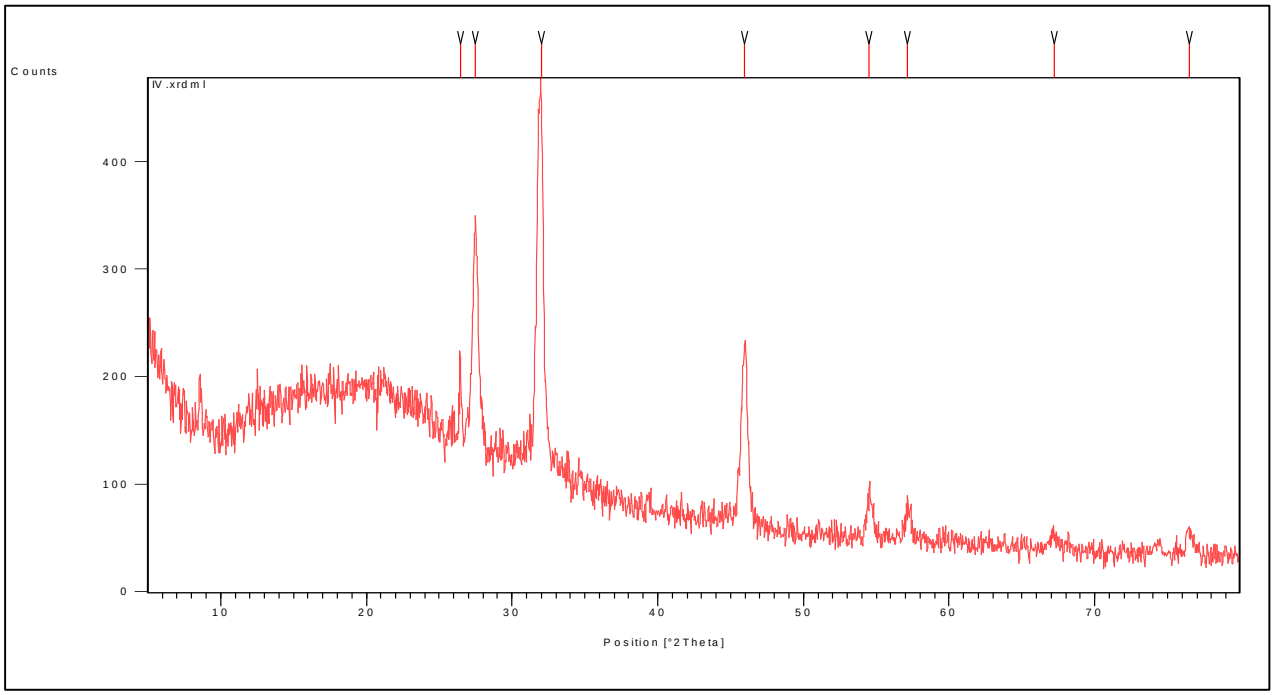

Figure No.2: X-ray diffract gram of silver nanoparticles synthesized from *Calotropis gigantean*

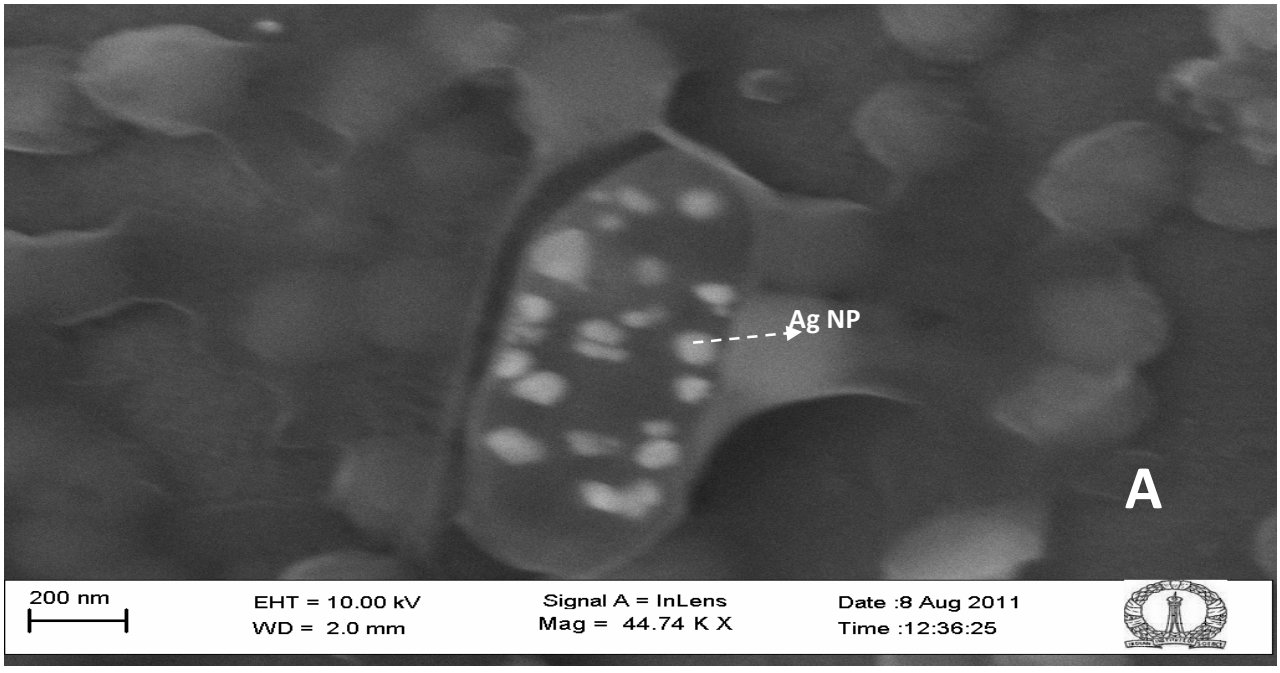

Figure No.3: Scanning Electron Microscope images of silver nanoparticles (AgNP) synthesized from *Calotropis gigantean* flower extract

CONCLUSION

It is clearly indicated that the *Calotropis gigantean* flower extract successfully synthesized yeast like silver nanoparticles. The nanoparticles showed characteristic absorption peak at 440nm in UV spectra. The SEM analysis showed yeast like silver nanoparticles of particle size between 10-50nm.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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