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Phyto-synthesis of Silver Nanoparticles Using Extracts of *Ipomoea indica* Flowers

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Abstract The use of silver nanoparticles in the field of nanomedicine is keeping pace and innovating with the ever expanding horizon of Nanobiotechnology. Ipomea species is widely cultivated and use for different purposes, such as, nutritional, medicinal, ritual and agricultural. The present study deals with the synthesis and characterization of silver nanoparticles using methonolic extract of *Ipomoea indica* flowers. UV-visible spectroscopy studies were carried out to assess the formation silver nanoparticles. The formation of Ag-NPs was confirmed by Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD) studies. SEM image revealed that silver nanoparticles are quite polydispersed, the size ranging from 10nm to 50nm. The formation of crystalline silver nanoparticles was confirmed using X-ray diffraction analysis. Extracellular synthesis of Ag nanoparticles using dried biomass appears to be cost effective, eco-friendly to that of conventional methods of nanoparticles synthesis.

Keywords: *silver nanoparticles, Ipomoea indica, X-ray diffraction, scanning electron microscope*

1. Introduction

Nanotechnology is significantly influencing Science and Economy in the 21st century.In the last decade, both science and industry focussed on the production of nanoparticles. Nanoparticles have characteristic physical, chemical, electronic, electrical, mechanical, magnetic, thermal, dielectric, optical and biological properties [1,2]. Therefore, nanoparticles are considered as building blocks of the next generation of optoelectronics, electronics, and various chemical biochemical sensors, in diagnostics, and therapeutics [3,4,5,6]. The chemical and physical procedures,numerous organisms and plants have also been found to synthesize nanoparticles endogenously and exogenously [7]. Nanoparticles are mostly prepared from nobel metals such as Gold, Silver, Platinum and Lead. Among the nobel metals, silver (Ag) is the metal of choice in the field of biological systems, living organisms and medicine [8]. The size dependent use of silver nano particles as carrier molecules in applications, such as drug delivery, diagnostics, nanobiosensors, etc are increasing with the advancement in technology [9,10]. To meet the commercial demand of nano particles, three main objectives are low cost, environmental compatibility and non toxicity.

Studies have already been conducted to synthesize nano particles from different parts of plants [11]. *Ipomoea* species are reported to have antimicrobial, spasmolytic, anti-inflammatory, antipyretic and anticancer activities [12]. Silver nanoparticles and Impomea species which are effective at inhibiting inflammations may be used to treat inflammatory diseases [13,14]. The current study investigates the role of *Ipomoea indica* in invitro synthesis of silver nanoparticles.

2. Materials & Methods

Fresh flowers of widely growing *Ipomoea indica* were picked randomly from the plants at the roadside areas near Presidency College, Hebbal, Bangalore, Karnataka, India. The flowers were washed thoroughly in running 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.

2.1. Preparation of Crude Extracts

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

2.2. UV-VIS Spectral Analysis

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

2.3. Sample Preparation for SEM

The reacted mix(extract with silver nanoparticles) thus obtained was decanted into 15ml centrifuge tubes and centrifuged at 5000rpm for 20minutes followed by redispersion of the pellet of silver nanoparticles into 10ml of double distilled water. The sample (1.5ml) was taken in an eppendorf tube for characterization. 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.

2.4. 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 was 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 [15]

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

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

2.5. Sample Preparation for SEM

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3. Results and Discussion

The instantaneous change in colour of the solutions from a clear liquid to a darker colour in the glass test tubes suggested the formation of silver nanoparticles [16]. The reduction of silver nanoparticles by flower extract was monitered using UV visible Spectrophotometry at an interval of 30 minutes for a period of two hours at wavelength ranging 400nm–480nm (Figure 1). Absorption spectra of silver nanoparticles (Ag-Nps) formed in the reaction media has an absorption maxima at 440nm, broadening of peak indicated that the particles are polydispersed. It has already been reported that the absorption spectrum of aqueous $AgNO_3$ only solution exhibited λ max at about 220nm where as silver nanoparticles λ max at about 430nm [17]. Silver nanoparticles was synthesized within 5mins but maximum synthesis occurred at 120mins. When 1ml flower extract was added to 10ml of 1mM AgNO3 salt, the ionization of $AgNO_3$ (aq) -- Ag^+ (aq) + NO_3^- (aq) took place.

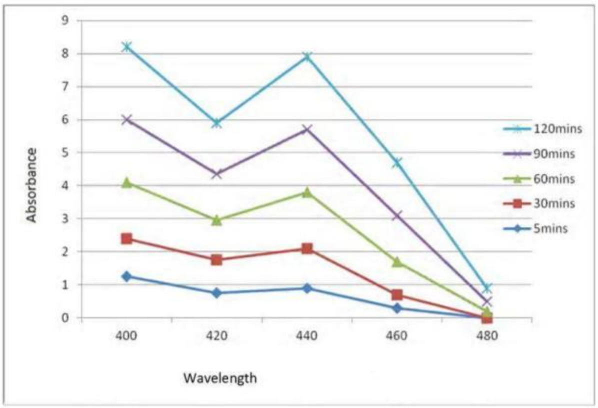

Figure 1. UV-Vis absorption spectra during the formation of silver nanoparticles

Phenolic acid type molecules in flower extract might be responsible for the reduction of silver ions [18]. The hydroxyl groups of of phenolic acids have a stronger ability to bind silver ions and may be involved in the biosynthesis of silver nanoparticles. It may act as reducing agent for the reduction silver ions (Ag+) to silver nanoparticles (Ag0) [19,20].

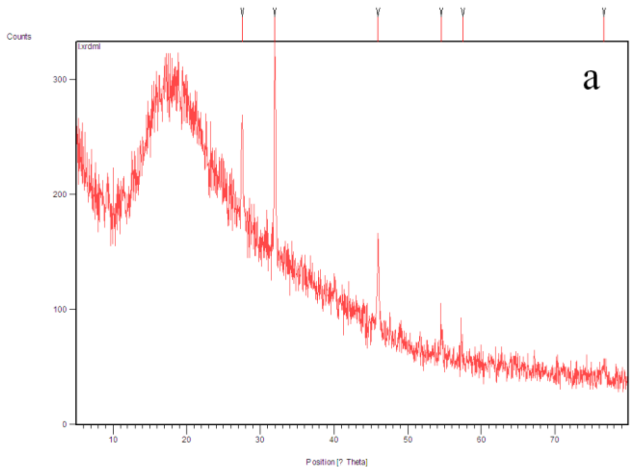

Figure 2. XRD patterns of silver nanoparticles synthesized from flower extract of *Ipomoea indica* treating with 1mM silver nitrate

To study the crystalline nature of the silver nanoparticles, the XRD analysis was performed. XRD pattern of derived AgNPs (Figure 2) shows five intense peaks in the whole spectrum of 2θ values ranging from [27.45°, 31.99°, 45.96°, 67.24°, 76.46°] for *Ipomoea indica* extract. The Full Width at Half Maximum (FWHM) values were used to calculate the size of the nanoparticles. A few intense additional and yet unassigned peaks were also noticed in vicinity of the characteristic peaks of silver. These sharp Bragg peaks might have resulted from some bioorganic compounds/protein(s) present in the *Ipomoea* flower extract [18]. The XRD pattern revealed five peaks corresponding to 5 diffraction facets of silver. The presence of minor peaks suggests that the prepared silver nanoparticles are biphasic in nature. The slight shift in the peak positions indicated strain in the crystal structure which is a characteristic of nanocrystals [21]. The intensity of the Bragg reflections suggests strong X-ray scattering centres in the crystalline phase and could possibly arise from metalloproteins in the broth XRD spectra of pure crystalline silver structures have been obtained with average particle size of 13nm to 16nm, and the shape was cubic in nature. It was reported that Ocimum sanctum leaf extract could bioreduce silver ions into crystalline silver nanoparticles (4-30nm) [22].

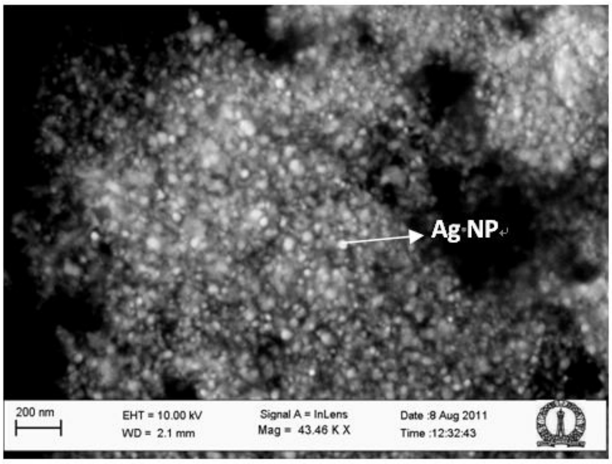

Figure 3. Scanning Electron Microscope image of silver nanoparticles (AgNP) synthesized from flower extract of *Ipomoea indica* treating with 1mM silver nitrate

A scanning electron microscopy employed to analyse the structure of the nanoparticles that were formed. From (Figure 3) it is evident that AgNPs were spherical and cuboid in shape, with a size range of about 5-50nm. Polydispersed silver nanoparticles were also observed to be synthesized by *Cassia Auriculata* flower [23]. Most of the nanoparticles formed showed tendency to congregate. Similar results were reported by Huang et al. [24].

4. Conclusion

The rapid biological synthesis of silver nanoparticles using flower extract of *Ipomea Indica* provides an economic and efficient route for the synthesis of nanoparticles. UV–Vis spectroscopic, SEM and XRD techniques confirmed the formation of silver nanoparticles by flower extract. This work indicates that *Ipomea Indica* petals have a good valuable potential in the future for production of silver nanoparticles. This ornamental plant can be used as potential phyto- factories for producing silver nanoparticles that are generally used in the field of nanomedicine and nano-diagnostics, and these synthesized particles are eco-friendly and non toxic in nature.

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