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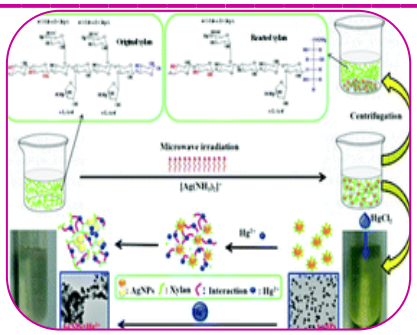
GREEN SYNTHESIS OF SILVER NANOPARTICLES USING *ECLIPTA ALBA* LEAF EXTRACT AND THEIR CHARACTERIZATION



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ABSTRACT

In the present study, biosynthesis of silver nanoparticles by using leaf extract of Eclipta alba and their characterization techniques were investigated. Silver nanoparticles were rapidly synthesized using leaf extract of Eclipta alba and the formation of nanoparticles was observed within 10 min. The results recorded from UV–vis spectrum, scanning electron microscopy (SEM) and Transmission electron microscopy (TEM). Nanoparticles almost spherical in shape having a size of 10–20 nm are found. UV-visible study revealed the surface plasmon resonance at 452 nm.

KEYWORDS: *Silver nano particles, Eclipta alba ,UV-visible, TEM, SEM.*

1. INTRODUCTION:

The development of reliable green process for the synthesis of silver nanoparticles is an important aspect of current nanotechnology research. Nanomaterials such as Ag, Au, Pt and Pd have been synthesized by different methods, including using bacteria [1], fungi [2] and plants [3]. Among these, silver nanoparticles play a significant role in the field of biology and pharmacy due to its attractive physiochemical properties, antimicrobial properties. Silver nanoparticles are playing a major role in the field of nanoscience and nanotechnology. In recent years, the biosynthesis of nanoparticles using plant part extracts has gained more significance. The major advantage of using plant extracts for silver nanoparticle synthesis is that they are easily available, safe, practical, scalable, nontoxic and avoidance of maintaining the microbial culture. It also reduces the cost of micro-organisms isolation and culture media enhancing the cost competitive feasibility over nanoparticles synthesis by microorganisms. A lot of literature is available on green synthesis of silver nanoparticle till date.

As the plants contain different phytochemical products which can breakdown the hazardous silver nitrate complex, into Ag^+ and NO_3^- ions. In the process, the toxic Ag^+ ions are further reduced to the nontoxic Ag^0 metallic nanoparticles through the use of different functional groups on the surface of the extract [4].

Eclipta alba(known as Bhringraj), which belongs to the family Asteraceae, is a common weed growing mostly in shade has proved its potential as medicinallyimportant herb. It is an actively utilized plant as an antidote against scorpion sting, a time tested liver tonic, blood purifier, hair vitalizer, etc. [5]. These plants are rich in flavonoids broadly belonging to the class of phenolic compounds.In present investigation we have reported the synthesis of silver nanoparticles by an ecofriendly method using *Eclipta alba* leaves extract. The synthesized silver nanoparticles were characterised by UV–vis spectrum, scanning electron

microscopy (SEM) and Transmission electron microscopy (TEM). The synthesised nanoparticles were almost spherical in shape having a size of 10–20 nm are found. UV-visible study revealed the surface plasmon resonance at 452 nm.

2. MATERIAL AND METHODS:

2.1. Collection of plant material and extract preparation:

Mature leaves of *E.alba*were collected from College campus. The green leaves were washed and dried in an oven dryer at 40 °C for 48 h. The dried leaves were then ground into powder, stored in dark glass bottles and kept at −20 °C until further analyses. Aqueous extract of E. *alba* was prepared using freshly collected leaves (10 g). They were surface cleaned with running tap water, followed by distilled water and boiled with 100 ml of distilled water at 60^0C for 5 min. This extract was filtered through nylon mesh, followed by Millipore filter (0.45 m) and used for further experiments.

2.2. Synthesis of silver nanoparticles

For synthesis of silver nanoparticles, the Erlenmeyer flask containing 90 ml of $AgNO_3$ (5 mM) was reacted with 10 ml of the aqueous extract of *E.alba.* This setup was incubated in dark (to minimize the photoactivation of silver nitrate), at 37^0C under static condition. A control setup was also maintained without *E.alba* extract.

2.3 . Characterization of silver nanoparticles:

Synthesized silver nanoparticles was confirmed by sampling the reaction mixture at regular intervals and the absorption maxima was scanned by UV–vis spectra, at the wavelength of 200–700 nm in Beckman-DU 20 spectrophotometer. Further, the reaction mixture was subjected to centrifugation at 15,000 rpm for 30 min, resulting pellet was dissolved in deionized water and filtered through Millipore filter (0.45 m). An aliquot of this filtrate containing silver nanoparticles was used for SEM and TEM. For electron microscopic studies, 0.05 ml of sample was sputter coated on copper stub and the images of nanoparticles were studied using SEM (JEOL,Model JFC-1600) and TEM (JEOL-3010).

3. RESULT AND DISCUSSION:

3.1. UV–Vis spectroscopy:

UV–Vis spectroscopy is one of the most frequently used techniques for structural characterization of silver nanoparticles. The UV-vis spectra results are an indirect but most competent method to detect the formation of nanoparticle. A colour change from light green to dark brown upon incubation due to surface plasma resonance (SPR) vibration was observed indicating the formation of nanoparticles (figure 1). The progress of the reaction leading to the change of Ag^+ from $AgNO_3$ to reduced nanosilver was examined by observing the color change and absorbance maxima peak. The colour change from light green to dark brown was observed within 10 minutes of addition. The aqueous leaf extract helped in reduction of silver ions to silver metal and change in color indicated the formation of nanoparticles [6]. In the present work, the UV–vis spectra of synthesized silver nanoparticles displayed a strong broad peak around 452 nm (figure 1). The control $AgNO_3$ solution (without leaf extract) showed no change of color. The characteristic absorption peak at 452 nm in UV–vis spectrum (Fig.2) confirmed the formation of silver nanoparticles. SPR patterns, characteristics of metal nanoparticles strongly depend on particle size, stabilizing molecules or the surface adsorbed particles and the dielectric constant of the medium.

3.2. Scanning Electron Microscope (SEM)

SEM technique is employed to find out the surface morphology and the topography of synthesized silver nanoparticles. SEM photomicrograph shows sample is highly concentrate and particle shows spherical surface morphology (Figure 3). The nanoparticles obtained are highly crystalline.

3.3.TEM Analysis

The shape and size of the biosynthesized AgNPs is further analyzed by TEM. TEM image shows particles with average size of nearly 10–20 nm. TEM micrograph clearly shows that particles were spherical (Figure 4). Nearly similar results were reported by Perugu with Saraca indica leaf extract [7].

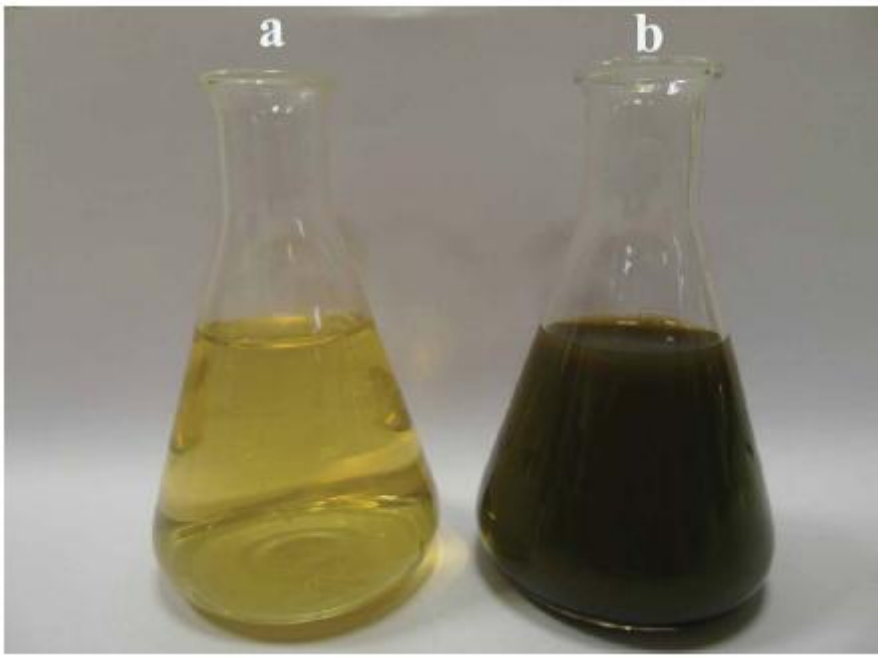

Fig.1. Aqueous solution of 5mM $AgNO_3$ with*E. alba* leaf extracts (a) before adding the leaf extract and (b) After addition of leaf extract at 30 min.

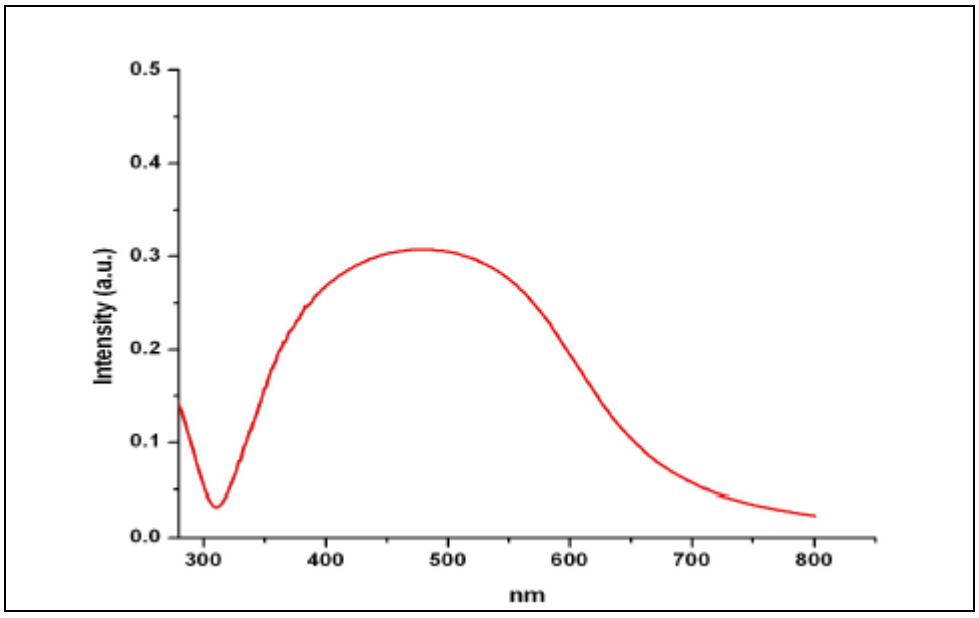

Fig. 2. UV–vis spectra of aqueous silver nitrate with *E. alba* leaf extract

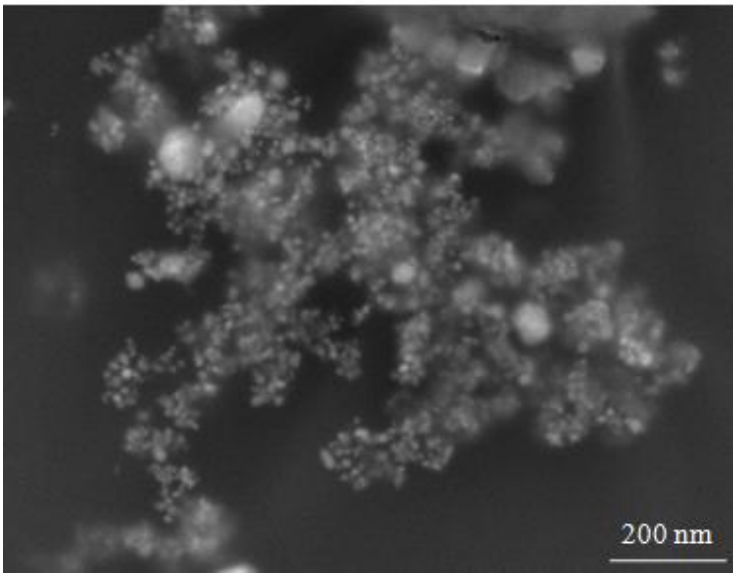

Fig.3. SEM Analysis of synthesized silver nanoparticlesusing *E.alba* leaf extract

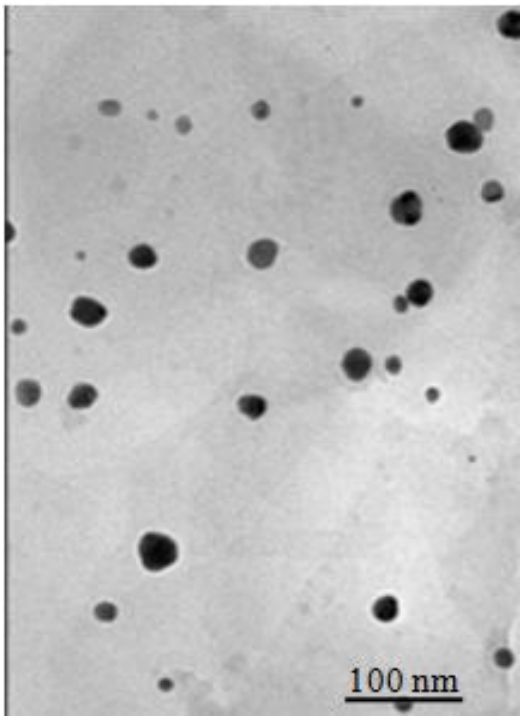

Fig.4. TEM Analysis of synthesized silver nanoparticlesusing *E.alba* leaf extract

4. CONCLUSION:

One pot green synthesis of silver nanoparticle using *E.alba* leaves extract has been reported. Silver nanoparticle has been successfully synthesized by this simple, fast, cost effective, environment friendly, efficient method. The synthesized nanoparticles were characterized by different methods such as UV-Vis spectrophotometer, SEM and TEM. The observations suggest that nanoparticles are crystalline, polydispersed and spherical in shape with nearly 10–20 nm size.

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