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ELEUSINE CORACANA: ECOFRIENDLY APPROACH FOR THE SYNTHESIS OF SILVER NANOPARTICLES

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ABSTRACT

Green nanotechnology is a step towards eco-friendly approach for the synthesis of nanoparticles. In this work, we have synthesized silver nanoparticles using extract of *Eleusine coracana* seeds as a reducing agent. The formation of silver nanoparticles was initially confirmed using UV-Visible spectroscopy and further characterized by Transmission Electron Microscopy (TEM). TEM analysis revealed spherical shape of silver nanoparticles with an average size of 4-25 nm. *Eleusine coracana* seed extract demonstrated strong potential for the synthesis of silver nanoparticles by simple and rapid reduction of silver ions.

KEYWORDS: *Eleusine coracana,* silver nanoparticles, UV-Visible spectroscopy, TEM, green synthesis.

INTRODUCTION

Nanotechnology is a rapidly rising scientific field of research with broad range of sphere of influence. It provides opportunities for the development in diverse fields including those for medical applications. Nanoparticles have unique size-dependent properties which make them advanced and fundamental in many fields (Kawadkar et al., 2011). Today, nanoparticles are being progressively used in numerous fields and there is growing importance in the biological and environment safety of their production (Makarov et al., 2014). Therefore, development of simple, rapid and ecofriendly processes is still fascinating area.

Nanoparticles are synthesized by various physical and chemical methods (Panigrahi et al., 2004; Iravani, 2011) but most of the techniques involved are labor intensive and requires use of hazardous chemicals, stabilizing and capping agents (Paul and Yadav, 2015).

Currently, scientists are focusing on the development of biological methods for the synthesis of nanoparticles. In biological methods, nanoparticles can be synthesized through plants or microorganisms (Paul et al., 2015). Synthesis of nanoparticles using microorganisms like bacteria and fungi is very tedious process because these microbes require highly aseptic conditions, maintenance and needs to sub culture (Baker et al., 2013).

As there is rich biodiversity and easy accessibility of plant entities, plants have been highly examined for the synthesis of nanoparticles (Monda et al., 2011). Biomolecules present in plant extracts can be used to reduce metal ions to nanoparticles and nanoparticles can be synthesized more rapidly using plants than microbes (Roy and Das, 2015).

Thus, the synthesis of nanoparticles using various plant materials and their extracts can be favorable and beneficial over microorganisms (Prabhu and Poulose, 2012; Prasad, 2014). Due to the potent and positive properties which do not exist in its magnitude form metal nanoparticles have grasped more attention among researchers (Paul and Yadav, 2014). Currently, efficient silver nanoparticles are instantaneously used in various fields of biotechnology and medicine; having major interest of researchers over their biological applications.

In the present investigation, we are focusing on synthesis of silver nanoparticles in an easy, cost effective and ecofriendly way. Keeping in view the importance of ecofreindly approach, present study highlights on *Eleusine coracana* seeds as the new source of plant material for the generation of silver nanoparticles.

MATERIALS AND METHODS

Materials

Eleusine coracana seeds were collected from local market of Aurangabad, Maharashtra, India. Silver nitrate ($AgNO_3$) was purchased from Merck Ltd Mumbai. Freshly prepared double distilled water was used during the experimental work.

Preparation of extract

20 gm of *Eleusine coracana* seeds were homogenized with 120 ml of double-distilled water. The mixture was filtered by Whatman filter paper No.-1. It was stored in refrigerator at 4^0C for further experimental use.

Synthesis of silver nanoparticles

10 ml of *Eleusine coracana* seed extract was mixed with 90 ml of 3mM silver nitrate solution. The reaction mixture was kept in boiling water bath for 25 min. Reduction of silver ions to silver nanoparticles was examined by noticeable colour change of reaction mixture.

Characterization of silver nanoparticles

UV-visible spectroscopy analysis

The biosynthesis of silver nanoparticles was monitored by measuring UV-vis spectra of the solution. UV-vis spectrum of reaction mixture was monitored on Thermo scientific UV-vis spectrophotometer. The periodic scan of the optical absorbance between 200 to 500 nm was performed.

TEM analysis

TEM analysis was used for the identification of size and shape of the synthesized nanoparticles. The TEM analysis was performed on a PHILIPS- Model No- CM200 instrument at IIT-SAIF, Bombay. Prior to the sample preparation for TEM analysis, sonication of sample was done for 10 min. The thin film of the sample was prepared on a small copper grid and allowed to dry.

RESULTS AND DISCUSSION

Visual observation

Eleusine coracana seed extract was used to produce silver nanoparticles. In this experiment Ag+ ions were reduced to Ag nanoparticles when the extract was exposed to 3mM $AgNO_3$ solution, the reduction rate is found to increase with the reaction time & temperature. The reduction is followed by change in pale yellowish to reddish brown color in the reactiion mixture due to excitation of surface plasmon vibration in silver nanoparticle (Fig 1). The appearance of a reddish brown color in the reaction vessel indicated formation of silver nanoparticles. Therefore, reaction mixture was further analyzed by UV-vis spectrophotometer.

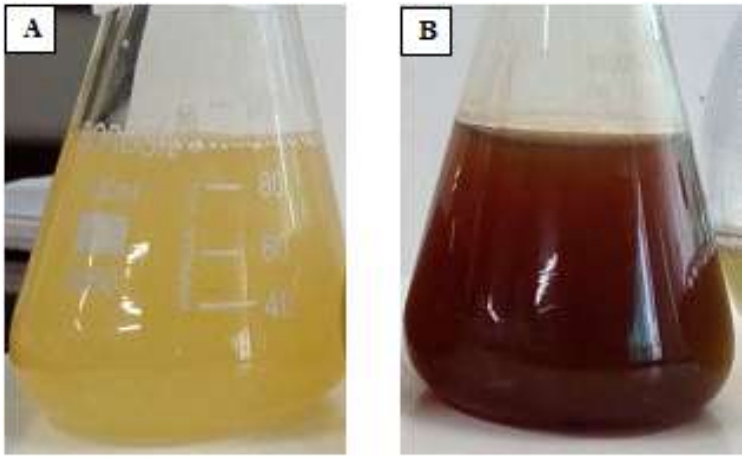

Figure 1: Visual observation of silver nanoparticles synthesized using *Eleusine coracana* seed extract. A) Seed extract of *Eleusine coracana* B) Reaction mixture of silver nitrate and seed extract indicates the color change due to nanoparticle synthesis (reddish brown color).

UV- VIS spectrophotometer

UV-Vis spectroscopy is primary confirmatory analytical technique for the characterization of nanoparticles. The silver nanoparticles synthesized using *Eleusine coracana* seed extract was analyzed by UV-vis spectrophotometer (Thermo Scientific). UV-visible absorption spectra showed the peak at 412.35 nm (Fig 2). This peak was due to the surface-plasmon resonance (SPR) phenomenon (Shameli et al., 2012); it illustrates the formation of silver nanoparticles.

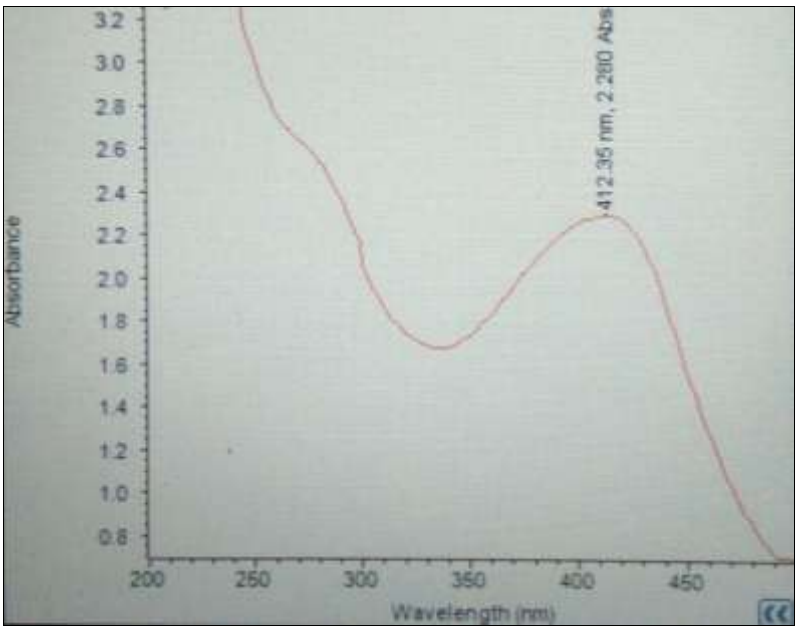

Figure 2: UV-Vis absorption spectra of silver nanoparticle synthesized using *Eleusine coracana* seed extract.

TEM analysis

Transmission Electron Microscopy is a powerful method to determine the morphology and size of nanoparticles. TEM micrographs of the generated silver nanoparticles revealed the formation of spherical nanoparticles with a size range 4-25 nm (Fig 3).

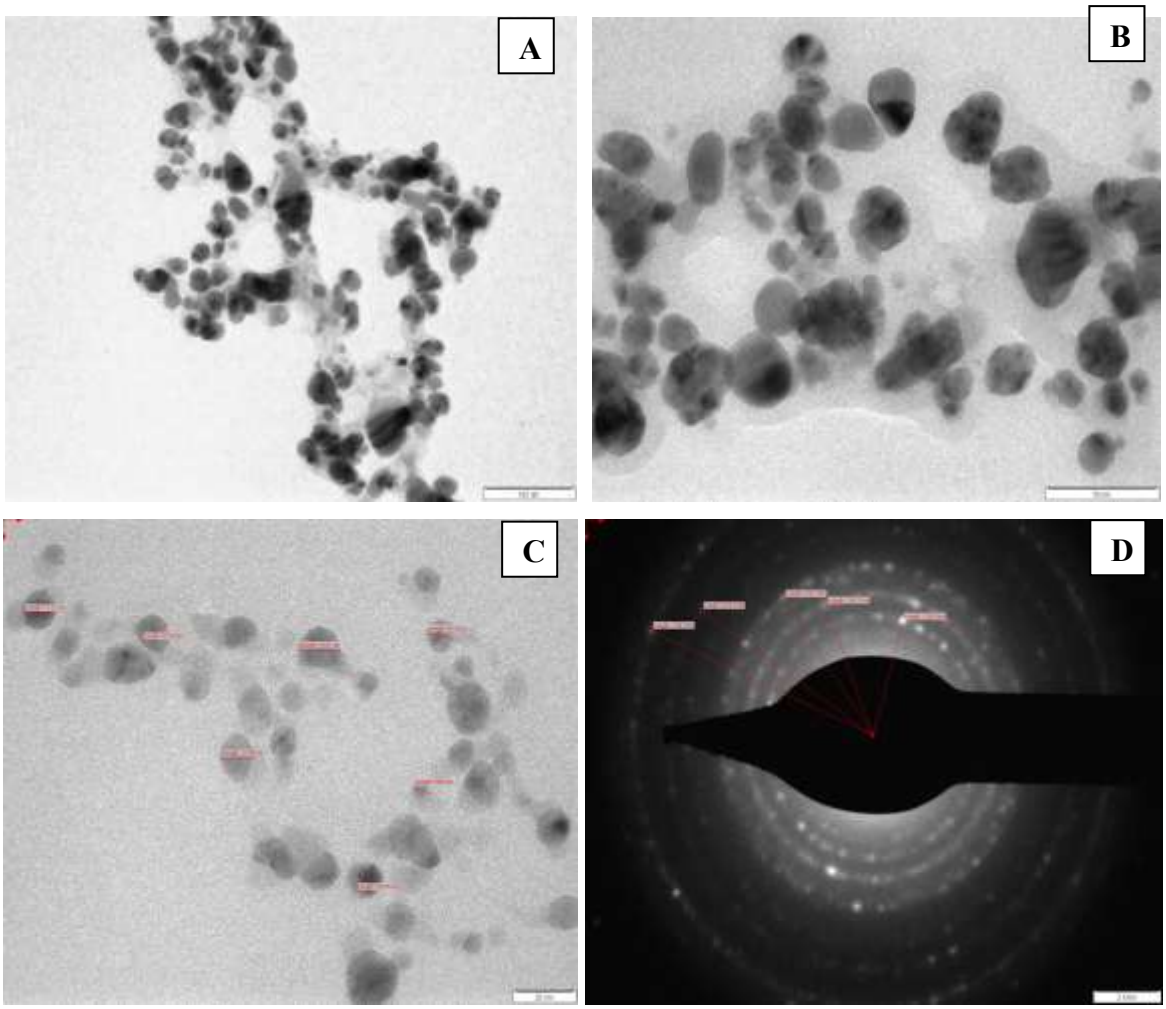

Figure 3: TEM micrographs at A- 100 nm scale, B- 50 nm scale, C- 20 nm scale and D- SAD pattern, illustrating the size of produced silver nanoparticles using extract of *Eleusine coracana* seeds.

CONCLUSION

The present study demonstrated the synthesis of silver nanoparticles using *Eleusine coracana* seed extract. The reduction of silver ions by the seed extract resulted in the formation of stable silver nanoparticles. TEM analysis revealed the biosynthesis of silver nanoparticles. Generated silver nanoparticles were spherical in shape and of the size range 4-25nm. This method is very simple, rapid, cost effective and ecofriendly for synthesis of silver nanoparticles and it can be involved in the many applications.

Conflict of interest statement

The authors declare that they have no conflict of interest.

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