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Research Article

SILVER NANOPARTICLES FROM MEDICINALLY IMPORTANT *EUPHORBIA CYATHOPHORA* EXTRACT: BIOSYNTHESIS, CHARACTERIZATION, AND ANTICANCER ACTIVITY

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ABSTRACT

Objective: The present study was aimed at the biosynthesis of silver nanoparticles (AgNPs) using aqueous extract of *Euphorbia cyathophora* leaves and testing their anticancer potential using HT-29 cell line model.

Methods: Green synthesis of silver nanoparticles was obtained with the aqueous extract of *E. cyathophora*. The synthesized nanoparticles were confirmed initially by ultraviolet-visible spectroscopy. Further, scanning electron microscopy, transmission electron microscopy, and X-Ray diffraction studies also ensured the presence of silver nanoparticles. Zeta potential studies revealed the stability of the silver nanoparticles.

Results: Antioxidant and anticancer studies of the nanoparticles against HT-29 cell line exhibited remarkable results.

Conclusion: This ensures that the synthesized nanoparticles play an important role in medicinal biology.

Keywords: Green synthesis, Nanoparticles, *Euphorbia cyathophora,* Scanning electron microscopy, Antioxidant, Anticancer.

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INTRODUCTION

Researches pertaining to silver nanoparticles are very much extensive due to their wide range of direct and effective applications. Silver nanoparticles are mostly used for diagnostic, antibacterial, conductive, and optical applications [1]. Recent advancements prove their excellence using nanoparticles as the targets for drug delivery [2] and the studies over nanotoxicology. Synthesis of nanoparticles requires capping agents and/or reducing agents. However, in green synthesis, plant proteins or enzymes present in the cell wall act as the reducing and capping agents [3,4]. Green synthesis of nanoparticles gains its importance because it is eco-friendly and cost-effective when compared to other harmful chemical methods.

Euphorbia cyathophora is a perennial and unarmed herb. It has a lot of medicinal uses. This has emetic and cathartic effects. A decoction of roots and barks are used to treat ague. Latex is applied to cure erysipelas and corns. Previous works pertaining to *E. cyathophora* showed the antimicrobial and wound healing activities [5]. Herein, we report the antioxidant and cytotoxic potential of silver nanoparticles produced from the green synthesis of *E. cyathophora* extract.

METHODS

Plant material

The leaves of *E. cyathophora* were collected from Dimapur, Nagaland, India. The plant was authenticated by Dr. Jayendran, Department of Botany, Government Arts College, Ootacamund, India. The leaves were shade dried and powdered. The dried powder of 10 g was mixed with 100 mL of distilled water. After 24 h, the aqueous extract was filtered using Whatman 42 filter paper. The extract was lyophilized and the samples were used for further silver nanoparticles synthesis.

Synthesis and characterization of silver nanoparticles

10 ml of aqueous extract was added with 5 ml of 1 mM silver nitrate and allowed to react for 15 min under sunlight. The color change was noted from light brown to dark reddish brown indicated the formation of silver nanoparticles. The formation of silver nanoparticles was confirmed by measuring the absorbance by ultraviolet (UV)-visible spectroscopy (UV-2450, Shimadzu). The characterization was done by transmission electron microscopy (TEM) (HR-TEM, JEOL JEM-2100-F), scanning electron microscopy (SEM) (JEOL JSM-6701-F, Japan), and X-ray diffraction (XRD) (D8 Focus, Bruker, Germany). The size and zeta potential of the reduced silver metal ions were determined by zeta potential analyzer (Malvern, UK).

Anticancer and antioxidant activity

The *in vitro* antioxidant potential of the aqueous extract and its silver nanoparticles were assessed by 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) assay [6]. The cytotoxicity of the green synthesized silver nanoparticles was determined by MTT assay [7] measuring the total cell viability on HT-29 colon cancer cells.

RESULTS

When the extract was mixed with $AgNO_3$ solution, the colorless $AgNO_3$ solution changed into brown color due to the excitation of surface plasmon resonance vibrations in the particles, which indicates the formation of AgNPs. The maximum absorbance was obtained at 420 nm (Fig. 1). The morphological characteristics of AgNPs were analyzed using SEM and TEM (Figs. 2 and 3) that suggest the formation of spherical AgNPs and size ranges from 30 to 50 nm. The size of the AgNPs plays an important role in the process of cell membrane diffusion. It is reported that the smaller the particle size larger the penetration ability [8]. Zeta potential analysis was performed to ascertain the stability of AgNPs with biomolecules. The high negative zeta potential indicates the good stability of AgNPs (Fig. 4). Both the extract and AgNPs were evaluated for antioxidant activity using DPPH assay. Fig. 5 shows the DPPH scavenging activity of AgNPs and extract. The AgNPs exhibited the higher inhibition when compared to the aqueous extract.

In vitro cytotoxicity of silver nanoparticles was investigated against human colon rectal cancer HT-29 cells at different concentrations. In this study, the percentage of cell viability was gradually decreased when the concentration of AgNPs was increased. This finding confirms that the AgNPs treated shows higher activity with lower concentration compared to extract alone (Fig. 6). In earlier reports, several mechanisms have been suggested that nanoparticles induce cytotoxicity through

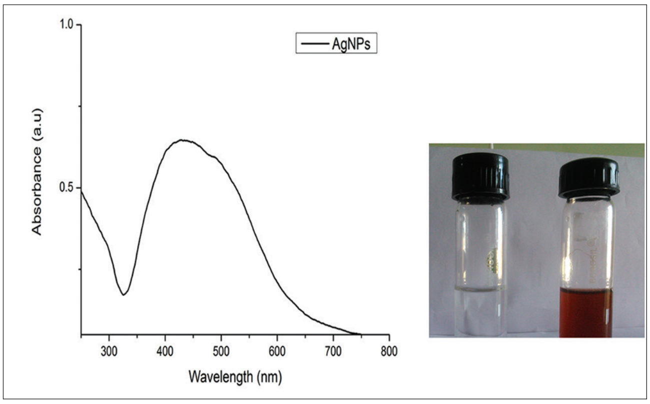

Fig. 1: Ultraviolet-visible spectroscopy of synthesized AgNPs

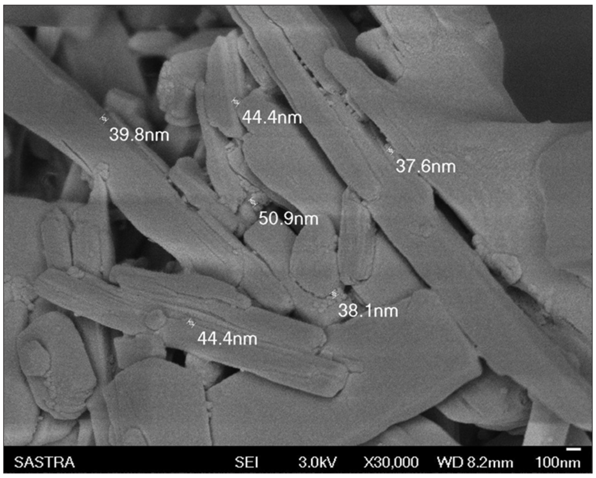

Fig. 2: Scanning electron microscopy image of synthesized AgNPs

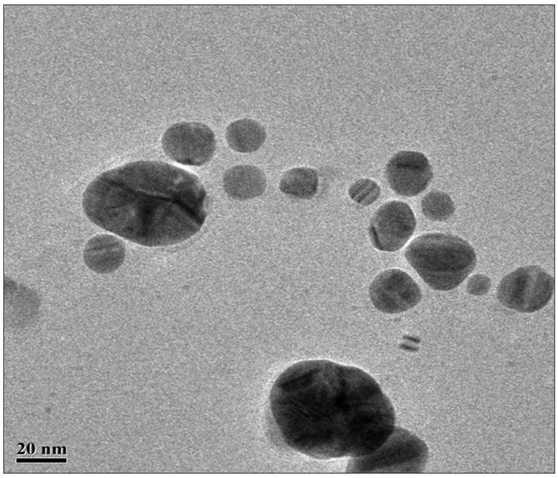

Fig. 3: Transmission electron microscopy image of synthesized AgNPs

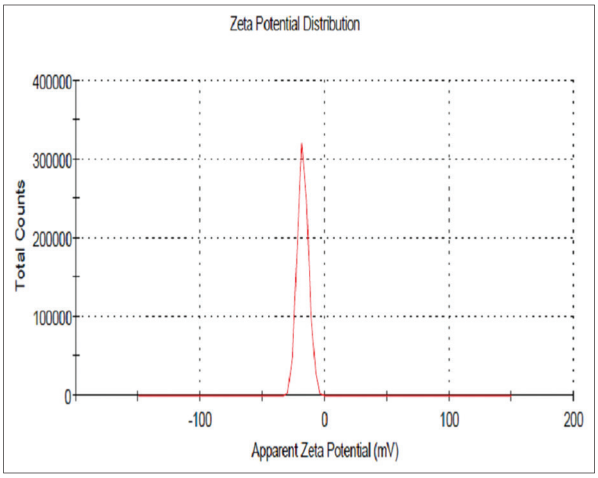

Fig. 4: Zeta potential analysis of synthesized AgNPs

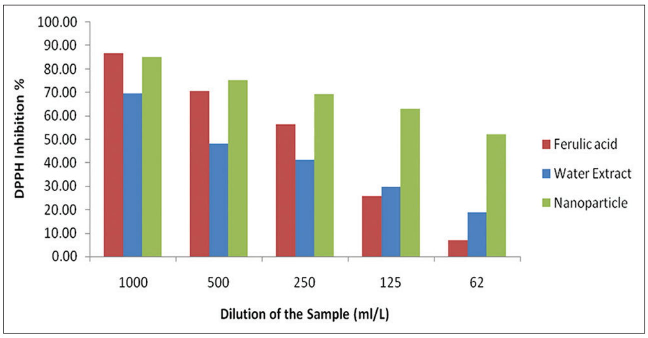

Fig. 5: 2,2-diphenyl-1-picryl-hydrazyl-hydrate radical scavenging activity of aqueous extract and nanoparticle of *Euphorbia cyathophora*

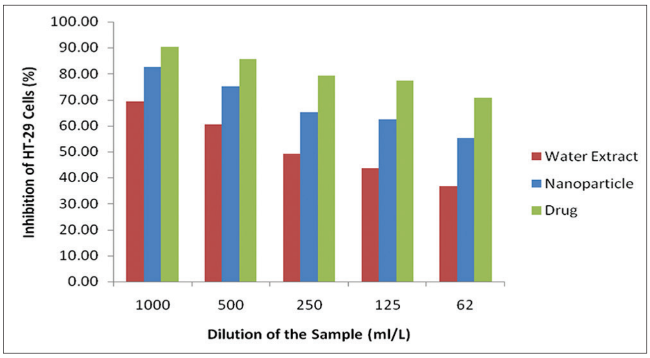

Fig. 6: Cytotoxic effect of aqueous extract and nanoparticle of *Euphorbia cyathophora* against HT-29 cell line

reactive oxygen species cause damages to cellular components and eventually lead to death [9] or increase in the intracellular oxidative stress resulting in cell death [10,11].

CONCLUSION

We report a simple and efficient biosynthesis of AgNPs using the *E. cyathophora* aqueous extract. The synthesized AgNPs were characterized by UV– visible spectroscopy, SEM, TEM, and Zetasizer analysis. The biosynthesized AgNPs shows significant antioxidant and anticancer effect, and thus, it can be used as a potential source for various biomedical applications.

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AUTHORS CONTRIBUTIONS

The authors contributed equally to this work

CONFLICT OF INTERESTS

All authors have none to declare

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