Biosynthesis of Silver Nanoparticles Using Triumfetta Rhomboidea Leaf Extract and the anti-bacterial efficacy

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Abstract -Development of reliable and eco-friendly process for synthesis of metallic nanoparticles is an important step in the field of application of nano-technology. This research paper deals with a rapid and eco-friendly method for green synthesis of nanoparticles. In the present investigation, stable silver nanoparticles were prepared using Triumfetta rhomboidea leaf extract. The leaf extract was added to 1mM of silver sulphate solution and the colour change was observed in the solution. The colour change indicates the formation of Ag nanoparticles. The synthesized nanoparticles were confirmed with the help of UV-Vis spectrum, Fourier transform infrared spectrum (FTIR) and X-ray diffraction (XRD). The synthesized silver nanoparticles from the Triumfetta rhomboidea leaf extract, which do not contain any harmful chemicals, were well-dispersed and stabilized through this green method.

Keywords: Silver nanoparticles, Triumfetta rhomboidea, UV-vis, FTIR, FESEM and biosynthesis.

I. INTRODUCTION

Nanoparticles can be synthesized using various approaches including chemical, physical, and biological methods. Although chemical method of synthesis requires short period of time for synthesis of large quantity of nanoparticles, this method requires capping agents for size stabilization of the nanoparticles. Currently, nanometal particles have gained significant attention (particularly silver), due to their broad uses in the areas of electronics, material science and medicine [1]. Unfortunately, most of the synthetic methods are expensive, toxic and not ecofriendly [2], and thus there is an ever growing need for green chemistry to use biosystems for production of nanoparticles [3]. Metal nanoparticles have a high specific surface area and a high fraction of surface atoms. Because of the unique physicochemical characteristics of nanoparticles, including catalytic activity, optical properties, electronic properties, antibacterial properties, and magnetic properties [4-7] they are gaining the interest of scientists for their novel methods of synthesis. Over the past few years, the synthesis of metal nanoparticles is an important topic of research in modern material science. However, there is still need for economically viable as well as environmentally clean synthesis route to synthesize the silver nanoparticles. In recent years, silver nanoparticles have attracted much attention of researchers due to their application in wound dressings and biocides properties, potential industrial use such as gas sensors, catalytic process, high temperature superconductors and solar cells[8-10].So far many reports have been published in literature on the biogenesis of silver NPs using several plant extracts [11-15].

II. MATERIALS AND METHODS

Preparation of leaf extract

Leaves of Triumfetta rhomboidea medicinal plant leaves were collected from the Western Ghats in Tirunelveli district near Courtallam falls. 5 g of the fresh green leaves was mixed with 100 ml of double distilled water and boiled to 60° to 70° C for about 5 min. Then the crude extract was filtered using Whatman No.1 to get clear solution. The filtrate was stored at 4° C and used for further work.

Synthesis of Nanoparticles

5 ml of stock solution of leaf extract was slowly added into 20 ml of 1mM solution of silver solution under room temperature. After the complete addition of leaf extract, the colourless solution changed from pale yellow colour to brown colour. The colourchange indicates the formation of silver nanoparticles. Then the solution was centrifuged for 10 min.
The reduction of Silver ions was confirmed by qualitative testing of supernatant by UV-Visible spectrophotometer. The UV–Visible spectroscopy measurements were performed using Shimadzu UV-1800 spectrophotometer at a resolution of 1nm from 200 to 900 nm. Ag nanoparticles gave sharp peak in the range of visible region of the electromagnetic spectrum. The functional groups in the synthesized silver nanoparticles were analyzed by FT-IR at the wave number region of 4000–400. Sample was used for X-ray diffraction. The Coherently diffracting Crystallography domain size of the Silver nanoparticles was calculated from the width of the XRD peaks. The morphology and size of the silver nanoparticles was studied by FESEM (FEI Quanta 200 FEG). Elemental composition of the sample was analyzed with energy dispersive spectroscopy (EDS) coupled to the Scanning Electron Microscope.

III. RESULTS AND DISCUSSION

UV-Vis spectra Analysis:

UV–visible spectroscopy is an important technique to determine the formation and stability of metal Nanoparticles in aqueous solution. The color changes arise because of the excitation of surface plasmon vibrations in the silver Nanoparticles[16]. It shows a change from yellow to brown in color. The brown color of silver colloid is accepted to be the surface plasmon resonance arising when a group of free conduction electrons is induced by an interacting electromagnetic field [17]. The band appears at the range of 440 nm and the broadening of peak indicated that the particles are monodispersed. The reduction of pure silver to nanoparticles was studied by the UV-Vis spectrum.

X-ray diffraction

X-ray diffraction was recorded for the silver nanoparticles shown in Fig. 3. XRD shows that the crystalline structure of silver is face centered cubic. In XRD, silver has three distinct diffraction peaks at 2θ of 38.13°, 44.1° and 64.35° corresponding to the planes (111), (200), and (220) respectively. This clearly showed that the synthesized silver nanoparticles by the reduction of Ag⁺ ions using plant extract of Triumfetta rhomboidea had a crystalline nature. The low intense peak at 77.88° belongs to (311) crystal plane.
The morphology of the silver nanoparticles was determined by SEM. FESEM images were obtained by using FEI Quanta 200 FEG. The SEM image shows the morphological characters of Ag nanoparticles synthesized by using extract of Triumfetta rhomboidea. This image shows that the particle size is around 37 to 70 nm with poly crystals in the form of rods and of spherical shape.

**SEM analysis**

The antibacterial activity of synthesized silver nanoparticles was analyzed [21]. Biosynthesised silver nanoparticles were studied for their antibacterial activity against two Gram-positive bacteria, Staphylococcus aureus, Bacillus cereus and One Gram negative bacteria Escherichia coli. Inoculum size was adjusted to 1 to 2 × 10^7 CFU (Colony Forming Units)/ml by serial dilution with sterilized nutrient broth media. Nutrient agar (pH 7.2-7.4) was used for routine susceptibility testing of nonfastidious bacteria. Ciprofloxacin was used as a standard. 20 % WFI in DMSO was used as a control. Antibacterial assay was carried out by agar Well Diffusion Method. After 16 to 18 hours of incubation, each plate is biosynthesis examined. The silver nanoparticles synthesized showed inhibition zone in the Escherichia coli, Staphylococcus aureus and Bacillus cereus Bacteria. Among these bacteria, Bacillus cereus was found to be more active and Escherichia coli and Staphylococcus aureus was found to be less active in inhibition zone.

**IV. CONCLUSION**

In this study, silver nanoparticles using Triumfetta rhomboidea leaf extract were green synthesised. The simplest and efficient method to synthesise silver nanoparticles without involving any harmful chemical as reducing agent. Appearance of a peak at 440 nm confirmed the presence of extract decorated silver nanoparticles. SEM also confirmed the distorted morphology of silver nanoparticles. The above silver nanoparticles revealed to possess an effective antibacterial property against Staphylococcus aureus and Escherichia Coli. The present study emphasizes the use of medicinal plants for the synthesis of silver nanoparticles with potent antibacterial effect. These results concluded that even though the reduction process is slow, the green chemistry approach has many advantages such as eco-friendly, cost effective and easily scaled up to large scale synthesis.

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**VI. REFERENCES:**


