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PLANT-EXTRACT-ASSISTED GREEN SYNTHESIS OF SILVER NANOPARTICLES USING *AZADIRACHTA INDICA* (NEEM)

A. R. Somwanshi
Department of Chemistry, Shri. Shivaji Arts, Commerce and Science College, Akot.
E-Mail: anilsomwanshi40@gmail.com

ABSTRACT :

Nanoparticles are gaining interest in biomedical applications due to its importance such as anti-bacterial, anti-fungal and anti-cancer agents. Eco-friendly green methods using plant extracts are gaining popularity due to the abundance of raw materials and the production of non-toxic by-products threatening to the environment. For the synthesis of silver nanoparticles (SNPs) using the leaf extract of Azadirachta indica as a reducing agent from 1 mM silver nitrate ($AgNO_3$) has been investigated. The synthesis silver nanoparticles were characterized by UV/VIS spectroscopy, XRD, EDAX, IR and Scanning Electron Microscopy. Thus from this study it can be concluded that *Azadirachta Indica* can be effectively used for synthesizing silver oxide nanoparticles.

KEYWORDS: Silver oxide Nanoparticles, Green Synthesis, Azadirachta indica

INTRODUCTION

Biological synthesis process provides a wide range of environmentally acceptable methodology, low cost production and minimum time required. At the same time the biologically synthesized silver nanoparticles has many applications includes catalysts in chemical reactions [1]. In this context, the concepts of green chemistry have gained immense popularity; these are mainly concerned with replacing chemical products and improving or developing processes and technologies to reduce or even eliminate substances that are harmful to health and the environment [2]. Generally, metal nanoparticles can be prepared and stabilized by chemical, physical, and biological methods; the chemical approach, such as chemical reduction, electrochemical techniques, photochemical reduction and pyrolysis and physical methods, such as Arcdischarge and physical vapor condensation are used. To synthesis stable metal nanoparticles with controlled size and shape, there has been search for inexpensive, safe, and reliable and "green" approach. The novel methods so called green/biosynthesis have been recently developed by a variety of plant extract such as Ocimum Sanctum, Petroselinum crispum, Murraya koenigii, Coriandrum Sativum for the synthesis of metal nanoparticles[3-5]. Among the various metal nanoparticles synthesized (such as silver, gold, iron, zinc and platinum), silver nanoparticles have gained more importance in the nanotechnology field. As,

silver in the nano size is safe inorganic and non-toxic agents and encompasses a wide range of applications such as antibacterial and antifungal effects. It promotes reactions without hazardous solvents, reducing agents, and stabilizers [6]. Several green methods have been applied so far for the preparation of AgNPs including electrochemical reduction, microwave and sonochemical preparation, or synthesis from supercritical liquids [7].

Here we have developed a rapid, eco-friendly and convenient green method for the synthesis of silver nanoparticles from silver nitrate using leaf extracts of Azadirachta indica.

MATERIAL AND METHODS

Materials: Materials used in this research consist of Silver nitrate, *A. indica* (Neem) used in this work were collected from the garden of Shri. Shivaji science college Akot.

Preparation of Water Leaf Extract of A. indica (Neem): To 10 gram of powered leaf sample 100 ml of water as a solvent was added (10g/100ml). Plugged with cotton wool and then kept on a rotary shaker at 200 for 10 hours. After 10 hours the extract was filtered and the filtrate was concentrated using flash evaporator and stored in air tight containers at 4°C and used for further experiments.

Synthesis of Silver Nanoparticles (AgNPs) from water Leaf Extract of A. indica (Neem): Silver nanoparticles were prepared from water leaf extract of *A. indica (Neem)*. To 10 ml of the water leaf extract 90 ml of 1mM silver nitrate solution was added. The extent of nanoparticles synthesis was monitored by measuring the absorbance at 400-600nm

Characterization of Silver nanoparticles

UV-Vis spectrophotometer:

Formation of silver nanoparticles is easily detected by spectroscopy because the colored nanoparticle solution shows a peak ~400 nm. The band in silver nanoparticles solution was found to be close to 400 nm. In this study, spectrophotometer was used to measure the optical density of solutions.

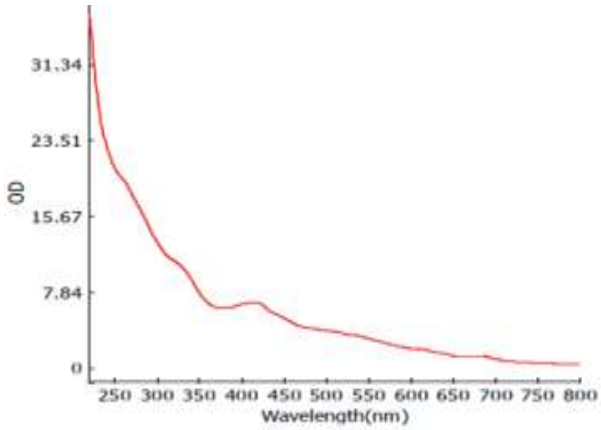
EDAX Spectroscopy:

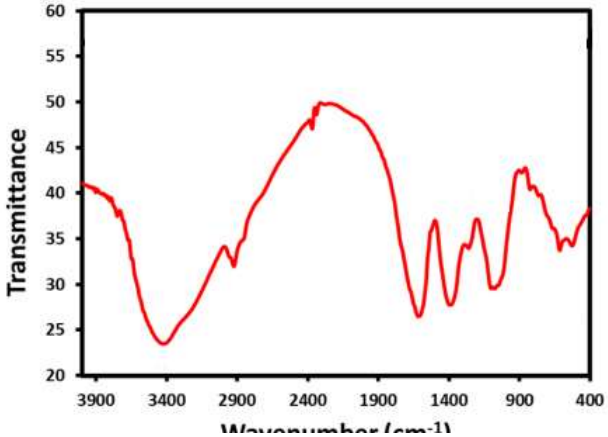
The EDAX is a reliable tool to determine the elemental composition of the synthesized AgNPs from *A. indica (Neem)* extract. The EDX profile of the AgNPs from *A. indica (Neem)* extract showed the presence of typical peaks for silver. Additional peaks also observed which indicated the presence of nitrogen and oxygen, representing the existence of other elemental compounds in the AgNPs.

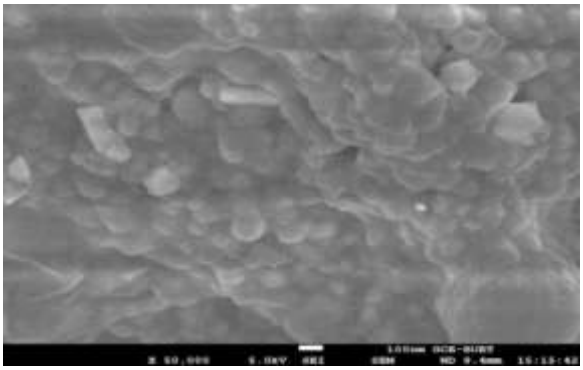
FTIR Spectroscopy:

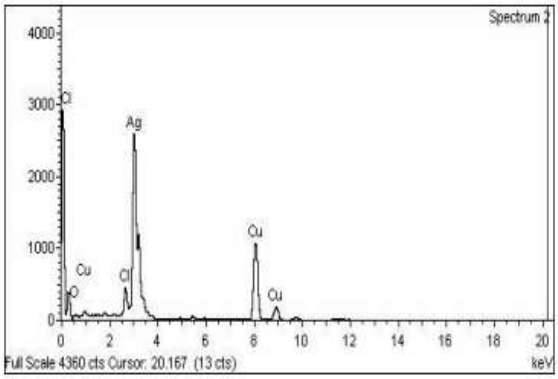
The FTIR spectra of *A. indica (Neem)* extract leaf extract showed the characteristic peaks of OH, alkene, aldehyde groups which may be involved in the reduction and stabilization of silver

nanoparticles. The presence of OH, aldehyde and alkene in the extract acted as the capping and stabilizing agent for the synthesis of silver nanoparticles. The silver nanoparticles synthesized from *A. indica (Neem)* extract leaf extract showed the presence of phytoconstituents namely amides, alkenes, aliphatic amines, alkanes and alkyls, responsible for the reduction of silver nitrate.









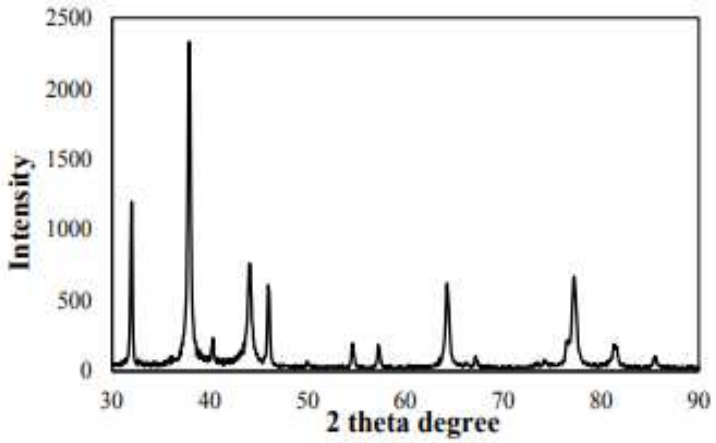


Fig. (A) UV-Vis spectrum (B) FTIR spectrum (C) SEM spectrum (D) EDAX spectrum (E) XRD spectrum of silver nanoparticles.

Scanning electron microscopy:

SEM images showed that most of the silver nanoparticles are predominately spherical in shape having smooth surface and well dispersed with close compact arrangement shown in fig. (C).

X-Ray Diffraction:

The XRD pattern of synthesized AgNPs using *A. indica (Neem)* leaf extract was shown in Fig. (E). The XRD was done to determine the crystalline nature of AgNPs and the resulted peaks were found at 37.90°, 44.05°, 64.25° and 77.20° representing (111), (200), (220) and (311) face centered cubic structure of silver.

CONCLUSIONS :

The green synthesis of AgNPs using *A. indica (Neem)* leaf extract was shown to be rapid, eco-friendly and produced nanoparticles are fairly uniform in size and shape. The functional groups present on their surface confirm the bioactive potential. The AgNPs showed a good stability profile. The ideally suited structure for AgNPs was successfully characterized. This work indicates that neem leaf extract had a good valuable potential in the future for production of silver nanoparticles

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