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# Green Synthesis Of Silver Nanoparticles Using Neem (Azadirachta Indica) Leaf Extract And Its Characterization

**D. R. Bijwe[1], A. V. Rajgure[2], Vaishnavi Bhadke[3], Dipti Dharmale[4],**
[1,2,3,4] Department of Physics, G. S. Tompe Arts, Commerce & Science College, Chandur Bazar, Dist.- Amravati (Maharashtra), India
drbijwe28@gmail.com
Corresponding Author:- drbijwe28@gmail.com

**Abstract:-**

The development of eco-friendly and reliable processes for manufacturing silver nanoparticles (AgNPs) represents a significant milestone in the field of nanotechnology. Silver nanoparticles (AgNPs) have been widely used as antimicrobial agent in many bacterial strains and microorganisms. Green synthesis is preferable because it is cheap, pollution free and improves environmental and human health safety. The synthesis of silver nanoparticles was achieved by heating aqueous silver nitrate solution with neem ( A. Indica) leaf extract. The reduction of silver ion to silver nanoparticles was confirmed by observing a change in color from reddish to dark brown indicating the formation of AgNPs. The synthesized nanoparticles was characterized using scanning electron microscopy (SEM). SEM images provided evidence of their mild agglomerated spherical shape.

**Keyword:-** Green Synthesis, Neem leaf extract, Silver nanoparticles, SEM

## Introduction:-

Indian greeneries are the chief and cheap source of medicinal plants and plant product. Recently many such plants have been gaining importance due to their unique constituents and their versatile applicability in various developing fields of research and development. Silver is well known material for its ability to kill bacteria and thus widely utilized in medical fields as a topical bactericide [1]. Dental procedure, catheters and burn injuries are among the applications that utilized the function of Ag in order to control the bacterial growth [2]. Nanoparticles enhanced the physical as well as chemical characteristics due to its larger surface area as compare to microparticles. Many researchers studied and developed the potential of nanoparticles in the nanotechnology field has been recognized since ages and proven [3]. Nanotechnology is presently one of the most dynamic disciplines of research in contemporary material science whereby plants and different plant products are finding an imperative use in the synthesis of nanoparticles (NPs). Nanotechnology is the study of minute Particles. Particles having dimension in the range of 1–100 nm. Which involves alternating materials within size range. Nanotechnology is based on the fact that nanoscale particles hold properties of their own which are different from that of the bulk materials altogether [4]. The green synthesis plays a convenient role as it is non-toxic, requires less time and is economically cheap [5]. A lot of work has been done on green synthesis of nanoparticles using living organisms including bacteria,

fungi and plants because of their antioxidant properties capable of reducing metal compounds in their respective nanoparticle. Plant extracts produce best capping material for the stabilization of nanoparticles [6]. Extracts of leaves, fruits, stems are being utilized for the production of nanoparticles as they contain phytochemicals like polyphenols, alkaloids, flavonoids, that act as reducing as well as stabilizing agents [7].

**2. Materials and Methods:**

**2.1. Preparation of Plant Extract:**

A. indica (neem) leaf extract was used to prepare silver nanoparticles based on the cost effectiveness, ease of availability, and medicinal properties. Fresh leaves were collected from a greenhouse facility in college campus (G. S. Tompe Mahavidyalaya, Chandur Bazar, Dist. Amravati, Maharashtra, India). The surfaces of the leaves were cleaned with running tap water to remove debris and other contaminated organic contents, followed by washing with deionized water and air drying at room temperature. About 15 gm of finely cut leaves was kept in a 250 mL flask containing 50 mL deionized water and boiled for 25 min at 60 ◦C in a water bath. The extract was cooled down to room temperature, filtered with Whatman filter paper no. 42 under vacuum, and stored at 4 ◦C for further use.

**2.2. Green Synthesis of Silver Nanoparticles :**

A volume of 100 mL of 1 mM solution of silver nitrate (AgNO3) was prepared in an flask. The Ag-NPs were synthesized by adding 10 mL of A. indica (neem) leaf extract to 50 mL of 1 mM aqueous AgNO3 solution at room temperature, stirring continuously for 20 min. The mixture obtained was incubated in a dark chamber at room temperature to prevent the auto-oxidation of the silver nitrate. The reduction of silver ions to silver nanoparticles was confirmed by the colour change of the solution from reddish to dark brown , indicating the synthesis of Ag-NPs.

**3. Characterization of Silver Nanoparticles:**

**3.1. Scanning Electron Microscopy (SEM):**

Scanning Electron Microscopy (SEM) plays a crucial role in providing valuable insights into the sample under investigation. This technique allows for the examination of various aspects, including the external morphology, chemical composition, crystalline structure and material orientation. SEM operates by utilizing a focused electron beam that systematically scans the surface of the sample, detecting secondary or backscattered electron signals. These signals are then processed to generate highly detailed and high resolution images, enabling a comprehensive characterization of the sample's features and properties.

**4. Results and Discussions:**

**4.1. Observation of Colour changes:**

The primary identification of the synthesized AgNPs was being done by merely visual observation specifically its colour changes after the treatment of $AgNO_3$ solution with neem extract. Generally the colourless solution of $AgNO_3$ changed into yellowish brown up to addition of neem extract. Then the solution turned into dark brown in colour after the exposure to microwave irradiation. It is indicated that there is no silver salt left for further reaction when the solution becomes constant in colour.

**4.2 Scanning Electron Microscopy (SEM):**

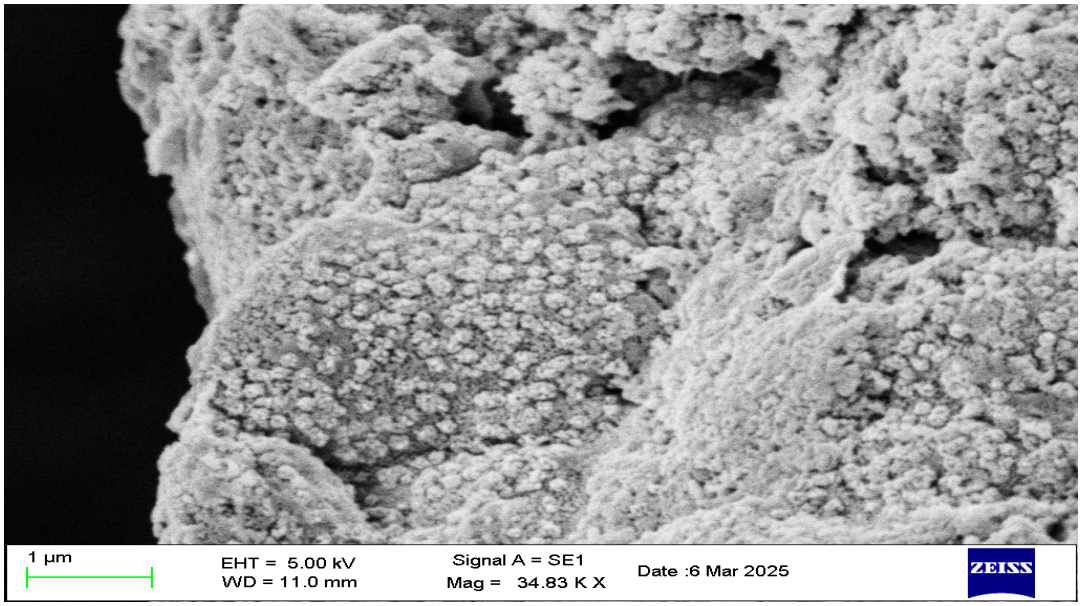


Fig. 1. SEM image of synthesized AgNPs

The SEM images of the AgNPs are shown in figure. The SEM image clearly demonstrates that the silver nanoparticles exhibit spherical structures with mild agglomeration. This observation further corroborates the findings of the analysis, confirming the successful synthesis of the nanoparticles with the desired morphological features. From SEM image, it was clear that the majority of the AgNPs synthesized through green methods exhibited a spherical shape, with some particles showing angular characteristics. Furthermore, it was observed that the nanoparticles tended to agglomerate, forming small aggregates. These findings align with the typical behaviour and characteristics of AgNPs synthesized using green approaches, highlighting the consistency of the results across different studies

**Conclusion:**

Silver nanoparticles were successfully synthesized using a neem leaf extract in the presence of AgNO3. The synthesized nanoparticles was characterized by Scanning Electron Microscope (SEM) analysis unveiled the morphology of the nanoparticles, demonstrating a mild agglomeration and a spherical shape. This green synthesis method is alternative to chemical method, since it is cheap, pollutant free and eco-friendly. The results showed that neem leaves plays an important role in the reduction and stabilization of silver to silver nanoparticles.

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