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Phytochemical Analysis of Blumea eriantha and its Application for the Synthesis of AgNO3 Nanoparticles

Smita T. Morbale[1] and Srushti T. Telange[2]
Anandibai Pradhan Science College, Nagothane, Raigad
smituku10@gmail.com

Abstract: *In the present work, silver nanoparticles (AgNPS) were prepared from aqueous leaves extracts of Blumea eriantha. The study presents the biological method by using the extract from the plant leaves rich in phytochemicals. The synthesized nanoparticles were separated from aqueous solution by centrifugation process followed by decantation. The time required to complete the synthesis of nanoparticles was 4-5 hrs.*

The phytochemical analysis of leaves extracts of Blumea eriantha is carried out before applying it to synthesis of nanoparticles. The synthesized AgNPS were characterized by different techniques as X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, ultraviolet (UV) spectroscopy, scanning electron microscopy (SEM), and thermogravimetric analysis (TGA). The crystallites exhibited a mean size of 21 nm measured via XRD and were highly pure, while SEM analysis of synthesized NPs confirmed their spherical or elliptical shape. The functional groups responsible for stabilizing and capping of NiCl-NPs were confirmed using FTIR analysis. Green synthesis of AgNPs has eco-friendly aspects and various biomedical applications. The metabolites found in the aqueous extract of Blumea eriantha act as an oxidizing, reducing, and capping agent for the synthesis of biogenic AgNPs. Due to their distinctive characteristics and broad range of uses, AgNPs have been the subject of a great deal of scientific investigation in recent years, particularly in the pharmaceutical, medicinal, cosmetic, food, agricultural and biomedical sectors.

Key Words: AgNps, Green Synthesis, FTIR, IR, XRD

I. INTRODUCTION

Today, developments in the nanotechnology field draw great attention due to the use in many fields of science of various nanomaterials, including nanoparticles. Nanomaterials have deserved this interest because of their unique size, physico-chemical properties, and activity in biological systems. The unique properties of metal nanoparticles find application in biological labeling, drug delivery, diagnostics, imaging, probing, gene insertion, artificial implant production, and tissue engineering [1-3]. Recent advances in nanotechnology show that nanomaterials, in particular silver-based ones, can play a crucial role in biological, pharmaceutical and biomedical fields. The size of nanoparticles significantly affects their properties (electrical, magnetic, toxic, etc.), which determines the importance of the synthesis process for obtaining nanoparticles of a given shape and size. Among the variety of metal nanoparticles, silver nanoparticles (AgNPs) have found wide application in various fields due to their superior physical, chemical and biological characteristics. Three main components are involved in the production of nanoparticles using biological methods: a solvent medium, an environmentally friendly reducing agent, and a non-toxic stabilizing agent [4-9]. The synthesis of nanoparticles using parts of plants, algae, fungi, and microorganisms has an advantage over chemical synthesis because the latter can produce toxic compounds adsorbed on a nanostructured surface, hindering the use of chemically synthesized particles for medical purposes [8-10].

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Blumea eriantha is a medicinal plant rich in bioactive compounds such as flavonoids, phenolics, alkaloids, tannins, terpenoids, and saponins. These phytochemicals possess antioxidant, antimicrobial, anti-inflammatory, and other therapeutic properties. The study helps identify these phytochemicals and evaluate their potential in the biosynthesis of silver nanoparticles.

Green synthesis of silver nanoparticles using plant extracts offers several advantages over conventional chemical and physical methods [11-14]. It is simple, cost-effective, environmentally friendly, and avoids the use of toxic reducing and stabilizing agents. The phytochemicals present in Blumea eriantha act as natural reducing and capping agents, making the synthesis process safe and sustainable.The silver nanoparticles synthesized from Blumea eriantha are expected to exhibit enhanced biological activities such as antibacterial, antifungal, antioxidant, and anticancer properties. These nanoparticles have potential applications in medicine, pharmaceuticals, wound dressings, drug delivery, food packaging, water purification, and biomedical research.

II. EXPERIMENTAL SECTION

Material and Method: -

Plant material and preparation of the extract

Fresh Blumea eriantha plants were collected from the road aside of Nagothane region of Roha Taluka of Raigad district in the month of February-March 2026. The leaves were washed twice with sterile distilled water to remove medium components before grinding. The leaves were grinded into powder after drying in ambient temperature, 5.0 g of the powder sample was added into 40 ml of water solvent and stirred for 24 h without heat using magnetic stirrer. The solution was filtered through filter paper (Whatmann No.1). The extract was stored and kept away from ray of the sun.

Sample preparation: -

10 ml of extract of Blumea eriantha was added to 90 ml aqueous solution of AgNO3 (2mM) solution separately for reduction in to Ag++ ions and stirred at room temperature (35°C) for about 4-5 hours. The primary detection of synthesized silver nanoparticles was carried out in the reaction mixture by observing the colour change of the medium from greenish to dark brown. After 5 hours of incubation the silver nanoparticles were isolated and concentrated by repeated (4-5 times) centrifugation of the reaction mixture at for 10 min. Procedure followed and schematic presentation of silver nanoparticles is as shown in fig 1 and fig. 2.



Fig 1. Synthesis of Nickel chloride (NiCl) Nanoparticles



Fig. 2. Separation and collection of synthesized AgNP

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Phytochemical Analysis: -

Phytochemical analysis of leaves extract Table 1. showed presence of alkaloids, Flavonoids, Glycosides, Terpenoids, Tannin which might be responsible for synthesis of nickel nanoparticles15. The phytochemicals found in the aqueous extract of Cinnamomum verum act as an oxidizing, reducing, and capping agent for the synthesis of biogenic NiCl-NPs.

Table 1. Phytochemical Analysis of plant extract

DETECTION OF FLAVONOIDS 0.5 ml of aqueous solution of extract is added to 2ml of furfuraldehyde in a test tube- Red color indicate the presence of flavonoid.		
Test	Procedure	Observation
Alkaline reagent test	Extract is treated with 10 % NaOH solution.	Intense yellow colour
Ammonium hydroxide test	3ml of extract is 10% NH4OH solution.	Yellow fluorescent
DETECTION OF TANNINS		
Ferric chloride test	About 50 ml of extract is dissolved in distilled water and to these few drops of neutral 5% ferric chloride solution is added.	Blue, green and violet colour
Lead acetate test	A small quantity of extract is dissolved in distilled water and to this; 3 ml of 10% lead acetate solution is added.	Bulky white precipitate
Detection of Glycosides 50 mg of extract is hydrolysed with concentrated hydrochloric acid for 2 hrs on a water bath and filtered.		
Borntrager's Test	To 2 ml of filtrate, 3 ml of ethyl acetate is added and shaken, ethyl acetate layer is separated and 10% ammonia solution is added to it.	Pink colour
DETECTION OF TERPENOIDS		
Liebermann-Buchard's test	The extract is dissolved in acetic anhydride, heated and then 1 ml of conc. sulphuric acid is added along the side of the test tube.	Red, pink or violet
DETECTION OF ALKALOIDS 50 mg of solvent free leaves extract is stirred with little quantity of dilute hydrochloric acid and filtered. The filtrate is tested with various alkaloidal reagents as follows:		
Mayer's Test	To a few ml of filtrate, two drops of mayer's reagent is added along with the sides of the test tube.	White or creamy precipitate.
Wagner's Test	To a few ml of the filtrate few drops of wagner's reagent were added along with the sides of the test tube.	Reddish brown precipitate

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III .RESULTS AND DISCUSSION

Table 2. Measurement of optical density of resulting AgNO3 solution:

Optical density of reaction mixture at time interval	Optical density
Just after addition of tuber peel extract	0.29
30 min	0.38
60 min	0.43
90 min	0.48
120 min	0.52
120 min	0.58

FTIR Analysis: - To record the molecular functional vibration of chemical groups, present in the sample, Perkin-Elmer FT-IR spectrum spectrophotometer (Shimadzu 8400) was used and operated at a resolution of 2 cm−1ranging from 4000 to 500 cm−1.O–H stretching vibrations, associated with the inter and intramolecular hydrogen bonding of polymeric compounds (macromolecular associations), such as alcohols, phenols, and carboxylic acids, as in pectin, cellulose groups on the adsorbent surface is shown by the broad absorption peak at 3421 cm−1. The symmetric and asymmetric C–H stretching vibrations of aliphatic acids are represented by peaks at 2920 cm−1 and 2867 cm−1.The stretching vibration band due to non-ionic carboxyl groups (–COOH, –COOCH3) is shown by the peak observed at 1471.70 cm−1, 1390 cm−1 may be attributed to carboxylic acids or their esters. The stretching vibration of C–OH of alcoholic groups and carboxylic acids may give rise to the broad peak at 880–1126cm−1. Fig 3.

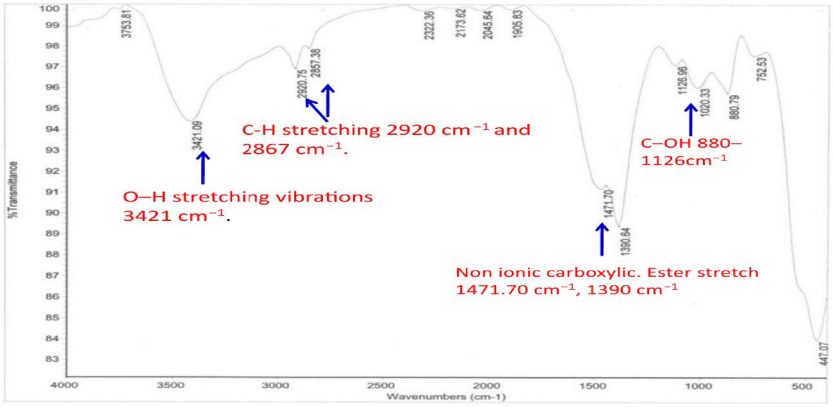


Fig. 3: FTIR Spectra of AgNPs nanoparticles

XRD Analysis: - XRD characterization was conducted to determine the crystallinity of AgNPs NPs. X-ray diffraction data (XRD) was recorded in the 2Θ range of 10-80 using XRD 6000, (Shimadzu) of Cu-Ka radiation, the energy of which was 8.04 keV and wavelength was 1.54 The applied voltage was 40 kV and current was 30 mA. The crystallite size was estimated using the Scherer equation and was found 21 nm. From the results, there are Prominent peaks of 2Θ: 24.26°, 27.74°, 34.57°, 38.29° (highest intensity), 64.60°.

The strong peak at 38.29° corresponds to the (111) crystal plane of face-centered cubic (FCC) silver, which is the characteristic peak of metallic Ag nanoparticles. Other peaks around 64.60° correspond to the (220) plane of FCC silver. Weak peaks at lower angles (24–35°) may arise from phytochemicals of Blumea eriantha or minor crystalline

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impurities such as silver oxide. The sharp diffraction peaks indicate that the synthesized nanoparticles are highly crystalline.The intense peak at 38.29° confirms the successful formation of metallic silver nanoparticles (AgNPs). Additional low-intensity peaks suggest the presence of plant-derived biomolecules acting as reducing and capping agents on the nanoparticle surface. The broad background indicates a small amount of amorphous organic material from the plant extract Fig 4.

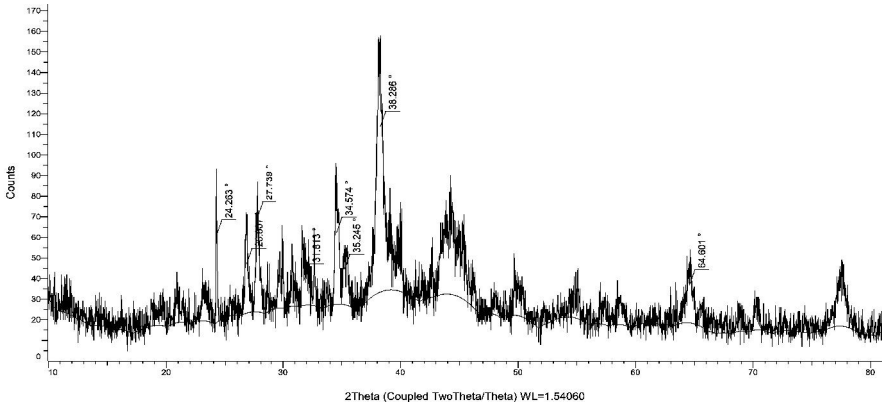


Fig 4: XRD spectra of synthesised AgNPs nanoparticles

SEM Analysis: -

The AgNPs shape and size was determined by scanning electron microscopy. SEM analysis revealed the presence of cluster of aggregated nanoparticles with irregular shapes with some agglomeration due to sampling preparation. The size of the particles was calculated by SEM analysis and was found to be with an average particle diameter of 21 nm as displayed in the size distribution histogram Fig 5.

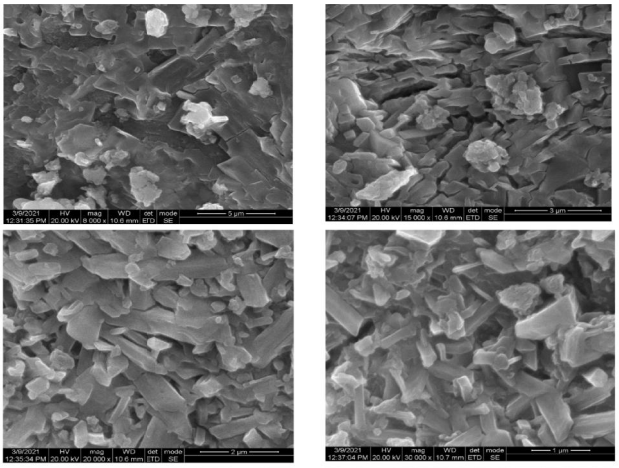


Fig 5. SEM analysis of synthesised nanoparticles

IV. CONCLUSION AND FUTURE PERSPECTIVES:

In present work we have reported plant-based synthesis of silver nanoparticles using the aqueous extracts of Blumea eriantha. The phytochemicals found in the aqueous extract of Blumea eriantha act as an oxidizing, reducing, and capping agent for the synthesis of biogenic AgNPs. Green synthesis of AgNPs has eco-friendly aspects and various biomedical applications. The metabolites found in the aqueous extract of Blumea eriantha act as an oxidizing, reducing, and capping agent for the synthesis of biogenic AgNPs. The green synthesized nanoparticles are characterized using modern techniques such as Fourier transform infrared (FTIR) spectroscopy, ultraviolet (UV) spectroscopy, X-ray

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diffraction (XRD) and scanning electron microscopy (SEM). Due to their distinctive characteristics and broad range of uses, AgNPs have been the subject of a great deal of scientific investigation in recent years, particularly in the pharmaceutical, medicinal, cosmetic, food, agricultural and biomedical sectors.

The carbohydrates, flavanoids and poly phenols constituents present in leaf extract act as the surface active stabilizing molecules for the synthesis of silver nanoparticles. The plant material used is of wide occurrence as a weed and as far as known used for the first time in green synthesis of nanoparticles.

The synthesized silver nanoparticles can be evaluated for enhanced antibacterial, antifungal, antioxidant, anti-inflammatory, anticancer, and wound-healing properties through in vitro and in vivo studies. Large-scale production, toxicity assessment, and clinical evaluation may also be carried out to develop safe nanoparticle-based drugs, medical coatings, drug delivery systems, and other healthcare products. This research can contribute to the advancement of green nanotechnology and sustainable medicinal plant utilization.

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