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Green Synthesis of Silver Nanoparticles from Ocimum Sanctumleaf Extract and Its Phytochemical Screening by Fourier Transform Infrared Spectroscopy

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ABSTRACT: Silver nanoparticles were produced using leaf extract from Ocimum sanctum. The objective of this study is to create an aqueous extract of silver nanoparticles (AgNPs) derived from Ocimum sanctum using a green approach. Thus, the current study uses FTIR to assess the phytochemical components of the plant extract of Ocimum sanctum that contains silver nanoparticles. Ocimum sanctum leaf extracts were ground, allowed to boil in water, and then the contents were filtered using Whatman no.1 filter paper to create the plant extract or filtrate needed to create silver nanoparticles.After that, this filtrate was added to a solution of silver nitrate to create silver nanoparticles.Color change and UV spectrometric measurements were used to characterize biosynthesized silver nanoparticles.After that, the extract of silver nanoparticles was examined using a variety of phytochemical tests, and Fourier transform infrared spectroscopy was used to determine which functional groups were present.The silver nanoparticles extract were found to contain secondary metabolites like alkaloids, flavonoids, phenolic compounds, tannins.The spectra, which ranged from 450 cm-1 to 4000 cm-1, revealed the existence of several phytochemical functional groups. When compared to chemical approaches, plant extract was shown to be less hazardous and require less purification when used to create silver nanoparticles.One of the medical industry's turning points is the application of silver nanoparticles in medication delivery systems.

Keywords: Silver nanoparticles, Phytochemicals, Ocimum sanctum, UV –vis spectroscopy, FTIR study

I INTRODUCTION

Green chemistry, often known as sustainable chemistry, is a branch of chemistry that focuses on developing products and methods that reduce the use and production of harmful compounds. Nanotechnology synthesizes particles ranging from 1 to 100 nm. They have a high surface area to volume ratio due to this. They exhibit optical characteristics [(1)]. Over the last several years, the synthesis of metal nanoparticles has become an important focus of research in modern material science because to its particular prospective applications in the fields of electrical, magnetic, optoelectronic, information storage, and medication administration[(2)] .silver nanoparticles are the most noble of all metal nanoparticles, with excellent conductivity, catalytic activity, and chemical durability[(3)].Silver nanoparticles have antibacterial qualities, thus they are widely employed in the health business, food storage, textile coatings, and a variety of environmental applications. There are three techniques for synthesizing silver nanoparticles: physical, chemical, and biological[(4)].

Green synthesis is a nontoxic alternative to typical physiochemical processes.Green nano silver has numerous benefits, including the use of phytochemicals and antioxidants, which operate as natural reducing agents. Large-scale production is cost-effective and reduces the use of harmful chemicals, high pressure, and energy [(5)]. The present study deals with Ocimum sanctum is a herbaceous, multi-branched, annual, upright, softly hairy plant that grows up to 1800 m. Holy Basil, also known as Ocimum sanctum (L.), is a widely used medicinal plant. This plant has been used for traditional medicine and has been shown to have therapeutic properties such as anticancer,

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antibacterial, cardioprotective, analgesic, actions[6]. Phytochemicals, often known as green chemicals, are naturally occurring substances produced by plants through primary or secondary metabolic processes.The goal of current study is to green synthesis silver nanoparticles from ocimum sanctum leaf extract and screening ofphytochemicals by Fourier Transform Infrared Spectroscopy.

II MATERIALS AND METHODS

Plant collection and identification:
Fresh samples of ocimumsantum leaves were collected and authentified in Siddha medicinal plants garden, mettur dam Tamil Nadu.

Plant Samplesand chemical reagent required:
Silver Nitrate (AgNO3),Distilledwater.

Instrument required:
UV Spectroscopy, FTIR, Hot plate.

Glassware's required:
Conical flask, beaker, measuring cylinder, funnel,Whatman no.1 filter paper

Preparation of leaf extract:

Collect fresh Tulsi leaves. Wash the leaves thoroughly with distilled water to remove dirt and impurities.10g washed leaves were cut into fine pieces and crushed with the help of mortar and pestle in 100 ml distilled water. Chop the leaves into small pieces to increase the surface area. Place the chopped leaves in a beaker and add distilled water (1: 10 ratio of leaves to water). Boil the mixture for 10 – 15 minutes. After boiling, let the extract cool. Filter the mixture, usingWhatman filter paper to obtain a clear extract.

Fig 1: ocimum sanctum aqueous leaf extract

Preparation of 1mM silver nitrate:

The concentration of 1 mM silver nitrate was obtained by dissolving 0.169g AgNO3 in one liter of distilled water.To prevent self-oxidation of the silver nitrate solution, it is stored in an amber-colored bottle.

Green synthesis of silver nanoparticles:

Silver nanoparticles (AgNPs) are synthesized in a single step using 10 ml of Tulsi leaf extract, as described in section. Add this to 90 ml of silver nitrate solution and heat for 15 minutes at 80 °C. When silver nanoparticles (AgNPs) formed, the solution's hue changed from pale yellow to brown.

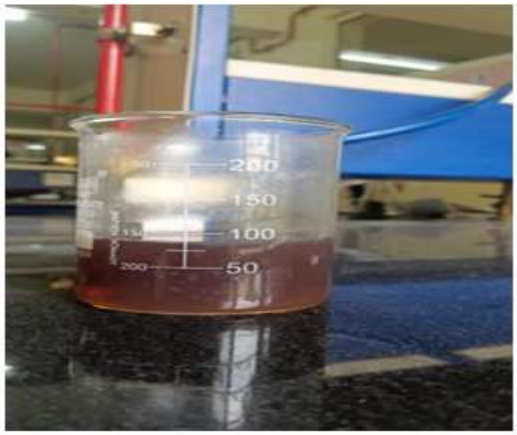

Fig 2: silver nanoparticles synthesized solution

Phytochemical screening:

A Portion of aqueous leaf extract of ocimum sanctum was used for the screening tests of qualitative analyses , using standard procedure by panchal et .al ., (2019).

Phytochemical	Aqueous extract
Flavonoids	+
Saponins	–
Phenols	+
Alkaloids	+
Tannins	+
Proteins	–

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III INSTRUMENTATION

The formation of silver nanoparticles is characterized by UV spectrophotometer.

The functional group of active components present in silver nanoparticles extract is conformed by PerkinElmer Spectrum IR ES 10.7.2 FTIR Spectrometer.

IV RESULT

A. UV Spectrum:

Silver ions were reduced, and nanoparticles produced. Because of the phytochemical components found in the leaf extracts, which aid in the reduction of silver ions. Silver nanoparticles synthesized from Ocimum sanctum leaf extracts were identified using a UV-Vis spectrophotometer. The UV-Vis spectrum of a colloidal solution of silver nanoparticles derived from Ocimum sanctum leaf extract shows a surface plasmon resonance broad peak at 403 nm, demonstrating the creation of silver nanoparticles in the colloidal solution.

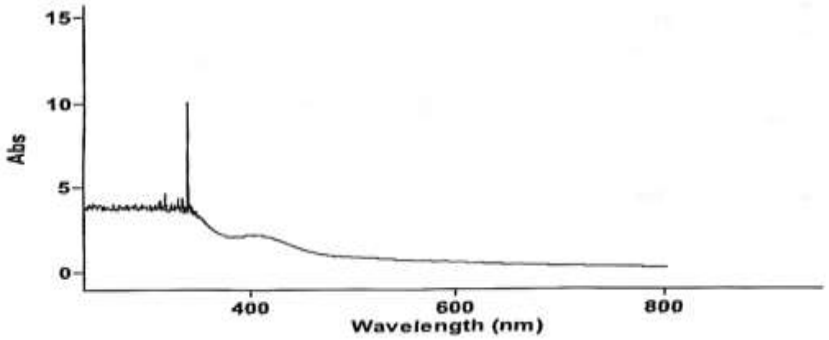

Fig 3: UV Spectrum of silver nanoparticles solution

B. FTIR

Fourier transform Infrared Spectroscopy converts infrared spectra generated by the absorption of electromagnetic energy in the frequency range of 400 to 4000 cm-1. Various functional groups in the solution were absorbed at their specific frequencies. The frequency and strength of absorption revealed the band structures and structural geometry of the molecule. The peak values of FTIR were recorded, with the readings being repeated twice for spectrum confirmation.

The FTIR spectrum showed peak at:

3326.20 cm-1 indicates presence of N-H stretching of alkaloids.

1635 .00 cm-1 (C =C) alkenes were present.

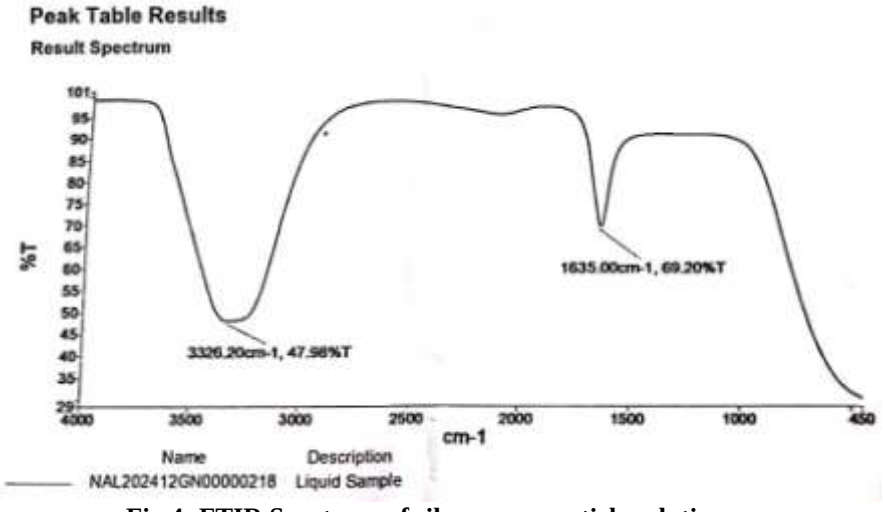

Fig 4: FTIR Spectrum of silver nanoparticle solution

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V CONCLUSION

This study effectively demonstrated the green synthesis of silver nanoparticles (AgNPs) utilizing an extract from the Ocimum sanctum leaf. The phytochemicals present in the leaf extract acted as both reducing and stabilizing agents, leading to the formation of stable AgNPs. The synthesized AgNPs were characterized by UV-Vis spectroscopy.Ocimum sanctum leaf extract can serve as an eco-friendly and sustainable alternative to chemical methods for the synthesis of AgNPs. FTIR analysis revealed the involvement of various functional groups present in the leaf extract, such as alkaloids, flavonoids, and tannins, in the reduction and stabilization of AgNPs. This green silver nanoparticle can serve as a novel therapeutic agent in a variety of medicinal applications.

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