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BIO-SYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES

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ABSTRACT

During present investigation silver nanoparticles were synthesized with the help of Neem (*Azadirachta indica*) and Tulsi (*Ocimum tenuiflorum*) extracts, which were mixed with 2 mM $AgNO_3$. The synthesized nanoparticles were characterized by UV- Vis Spectroscopy, SEM, FTIR. Silver nanoparticles showed antimicrobial activity against *Pseudomonas* spp.

Key words: *Pseudomonas*, silver nanoparticles, SEM, FTIR, antimicrobial activity.

Introduction

Various methods have been suggested for the synthesis of nanoparticles, among which its synthesis with the help of plant material is advantageous as far as environmental protection is concerned.

Neem (*Azadirachta indica*) and Tulsi (*Ocimum tenuiflorum*) are medicinal plants having various medicinally active compounds. Silver is traditionally known for its antimicrobial properties. Its nanoparticle, being small in size with large surface area, make it more suitable antimicrobial agent (Palanivel *et al*, 2022). Silver nanoparticle is less damaging to the cells of living organisms and hence considered as biocompatible. Silver nanoparticles are also being shown to inhibit the biofilm formation makes it prominent option in treatment of microbial infections (Muhammad *et al*, 2017). During present study silver nanoparticles were synthesized using Neem and Tulsi extract, and its antimicrobial activity against *Pseudomonas* Spp was evaluated.

Material and Methods

Twenty g of Tulsi (*Ocimum tenuiflorum*) and neem (*Azadirachta indica*) leaves were collected from the Botanical garden of Tuljaram Chaturchand College of Arts, Commerce and Science, Baramati, Tal.: Baramati, Dist.: Pune-413102, Maharashtra, India. Those were thoroughly washed with water two times, dried in shade, then ground to a fine powder by using mortar and pestle. The plant powder was added to 100 ml distilled water and the mixture was kept in water bath at 60^{O}C. Yellow and greenish coloured liquors were obtained from Neem and Tulsi leaves respectively, were passed through Whatman filter paper No.1. The filtered plant extracts were stored at 4^{O}C for further use (Banerjee *et al*,2014).

Silver nanoparticles were synthesized by adding 100 ml of extract recovered from plant into 50ml of 2mM $AgNO_3$ solution. After adding plant extract there was change in the colour, due to the reduction of silver metal ions. The solution was heated in water bath at 60^{O}C for 10 minutes and thereafter placed in dark condition on rotary shaker for 24 hours. This solution was used to detect and confirm the presence of silver nanoparticles by employing UV-visible spectroscopy.

After incubation of 24 hours, the solution was centrifuged at 10000 rpm for 10 min at 4^{O}C. The pellet was extracted with alcohol and kept for drying in petri plate. Pellet was burnt in muffle furnace at 300^{O}C to remove impurities from the pellet. This powdered form of pellet is then used for the Scanning Electron Microscopy (Rout *et al*,2012).

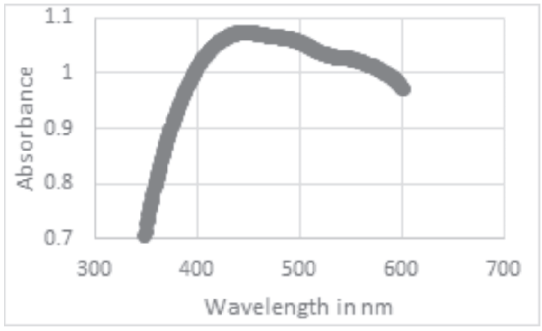
Formation of Silver nanoparticles was

confirmed by using UV-Visible spectrophotometer, within the range of 200-600nm wavelength. The characterization of functional groups on the surface of AgNPs were investigated by Fourier transform infrared (FTIR) Spectroscopy. The morphological characters of the samples were studied using Nova Nano-SEM NPEP303 for SEM (Scanning Electron Microscopy) analysis. The powdered form of pellet ignited in the Muffle Furnace was used for SEM (Rout *et al*,2012) Antimicrobial Activity of AgNPs against *Pseudomonas* spp was assessed by disc diffusion method. (Gupta *et al*, 2023).

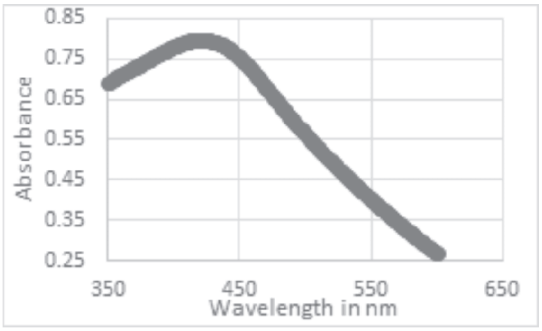
Results and Discussion

The yellow and green colours of Neem and Tulsi extracts turned into brown and dark brown respectively, indicating synthesis of silver nanoparticle. Devaraj et al, (2013) also experienced similar colour change while working with Cannonball Leave's extract. Rout *et al*, (2012) and Gupta *et al*, (2003) also experienced similarly.

The samples of silver nanoparticles were observed for their maximum absorbance under a UV-visible spectrophotometer to confirm the reduction of silver nitrate. Reduction of $AgNO_3$ by Neem extract showed peak at 444 nm and while Tulsi extract at 422 nm (Figure 1). Gupta *et al*, (2023) and Devaraj *et al*, (2013) obtained similar type of absorption maxima at 435 and 440 nm respectively



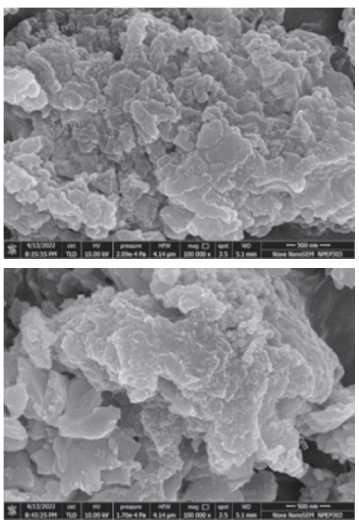
(A)



(B)

Figure 1: UV-visible absorption spectrum of silver nanoparticles synthesized by using (A) Neem extract (B) Tulsi Extract.

The images obtained under Scanning electron microscope showed presence of spherical silver nanoparticles (Figure 2). along with agglomerates of small, dispersed nanoparticles of variable size ranging from 20-50 nm in case of nanoparticles synthesized using neem extract and 50-100nm with Tulsi extract. Gupta *et al.*, 2023 also did SEM analysis of silver nanoparticles and found their size of 25.83 to 46.29 nm. Devaraj *et al*, (2013) shown that silver nanoparticles of relatively spherical and uniform size were 13 to 61 nm



(A)

(B)

Figure 2: SEM micrograph of silver nanoparticles synthesized by using (A) Neem leaf extract (B) Tulsi leaf extract.

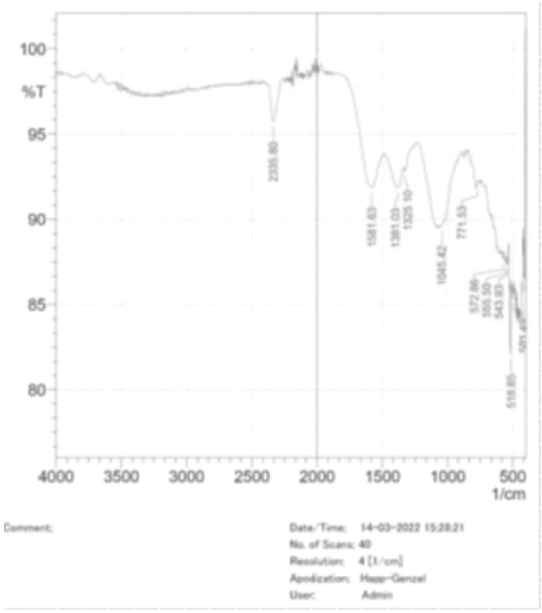


Figure 3: FTIR spectra of AgNPs of mixture of Tulsi leaf extract.

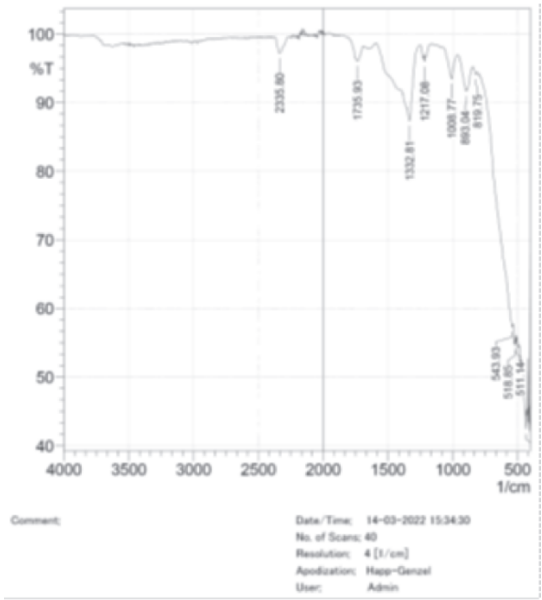


Figure 4: FTIR spectra of AgNPs of mixture of Neem leaf extract.

Characterization of Silver nanoparticles by FTIR has been depicted in figures 3 and 4. The absorbed peak shows, -C-O-, germinal methyls, -C-O-C, ether linkages, -C=C- groups, aromatic rings and alkyne bonds. The bands display extending vibrational bands which are accountable for compounds such as terpenoids and flavonoids.

The antibacterial assay of nanoparticles prepared by each plant extract was evaluated against *Pseudomonas* spp. showed zone of inhibition of 1.7 and 1.8 cm for neem and Tulsi respectively. Similar results were obtained by Gupta *et al*. (2023) and Rout *et al*, (2012).

Acknowledgments

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