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Green Synthesis of Silver Nanoparticles From *Geranium hortorum* leaf

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ABSTRACT
Silver nanoparticles are important in the domains of Nanomedicine and nanotechnology. Silver nanoparticles range in size from 1 to 100 nanometers. Nanoparticles can be made in a variety of forms, depending on the purpose. The silver nanoparticles come in a variety of shapes and sizes, including spherical, diamond, octagonal and thin sheets. In the present study, Silver nanoparticles (AgNPs) were synthesised from silver nitrate solution using a plant extract of Geranium hortorum. The presence of silver nanoparticles was confirmed using a UV-visible spectrophotometer (AgNPs). The disc diffusion technique was used to investigate the antibacterial activity of silver bio nanoparticles against Bacillus subtilis, Pseudomonas spp., Staphylococcus spp., and Propionibacterium spp. The silver nanoparticles synthesised by Geranium hortorum extract had the best antibacterial efficacy against Pseudomonas spp.,. The silver nanoparticles inhibition zone was 6 mm in diameter, whereas the antibiotic disc zone was 10 mm. AgNPs with excellent antibacterial activity against dangerous pathogens are produced using this approach.
Keywords: Silver nanoparticles (AgNPs), Geranium, Nanomedicine, Nanotechnology

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INTRODUCTION

The production of NPs utilizing various forms or elemental properties shapes has attracted the curiosity of many people[1].As a consequence of its physical and chemical properties and wide range of applications, (AgNPs) is one of the most widely utilized Nps of metallic nanoparticles. It's employed in a variety of industries, including medicine, antimicrobial agents, pigmented inks and many more[2].Silver nanoparticles are routinely produced via physicochemical operations, biochemical degradation, ultrasonic procedures, pulsed laser deposition, electrolytic and other ways[3].Biosynthetic procedures based on microbes, biology-based processes, fungi, and bioactive substances from plants, and more advanced chemical synthetic operations, have lately become simple and clearly possible for the production of nanoparticle's[4],[5].They are important in the disciplines of metallic nanoparticles, nanotechnology and biomedicine [6].Colloidal silver is of great interest because of its unusual properties, such as superior pharmacological and bactericidal activity, as well as resistivity and high stability[7, 8].Plant-mediated synthesis is referred to as green synthesis since it takes place without the use of any hazardous chemicals[9].Natural extracts such as yeasts, algae, fungi, plants, and microbes are used in the biological synthesis process[10].

Metal NPs have been prepared using a variety of methods such as physical (attenuation using a lasers, arc therapy discharge,Barrel grinding, component product, and so on) and chemical (chemical etching, Sol-gel, hydrothermal method, co-precipitation, decomposition, chemically electrochemical reactions, as well as other terms) and biologically derived approaches (Plants, fungus, microbes, viruses, protozoa, and other organisms) [11]. The toxic chemicals and solvents are frequently used in physical and chemical procedures, which may have negative environmental consequences. In fact, remaining harmful species of chemical compounds on the surface of synthesised NPs are difficult to eliminate, and their biological and medicine applications may be hampered. Furthermore, their manufacturing frequently necessitates more energy and is difficult to scale [12].As a result, biological approaches for synthesizing NPs have received a lot of attention as a viable alternative because they employ natural resources and are thought to be more biocompatible [13].Pelargoniums are native to South Africa (NB: and from now on, we'll refer to them as geraniums to follow one of most prevalent nomenclature). The clippings were most likely sent to Europe but by end of the 17th century, and geranium was eventually re-exported to the French colonies from there.

The facile production of silver nanoparticles using an environmentally *Geranium hortorum* extract as well as evolution of its antibacterial properties efficacy opposing diverse germs that cause disease in humans are described in this study.

MATERIAL AND METHODS

Selection and collection of plant material

The sample was collected from shree ambika farm and nursery, vadu.The natural plant of*Geranium hortorum* was chosen for the source of silver nanoparticles. *Geranium hortorum* leaves were gathered and washed twice with de-ionized water.

Preparation of $AgNO_3$ solution

Silver nitrate($AgNO_3$), used in this study was purchased from Aaturinstru Chem, Vadodara, Gujarat. To prepare 0.1 mM $AgNO_3$ solution, 0.17 g of $AgNO_3$ was diluted in 100 mL triple distilled water.

Preparation of *Geranium* leaf extract

The dried leaves from *Geranium hortorum* plant was crushed and mixed in 100 ml of distilled water. The mixture was homogenised using the magnetic stirrer at 20℃ for 45–60 minutes.The mixture was further filtered using Whatman filter paper number 1 (Figures 1(a), 1(b), and 1(c)).

Biosynthesis of silver nanoparticles (AgNPs)

To produce nanoparticles from *Geranium hortorum* plant leave, the plant extract mixture was mixed with the 100 mL of silver nitrate solution in a flask covered by aluminum foil. The flask was kept on magnetic stirrer at 35℃temperature.

Characterization of silver nanoparticles

A UV-visible spectrophotometer was used to examine the samples' absorption spectra, which ranged from 300 to 600 nm. The test helped to determine the highest number of silver nanoparticles produced from the plant extract.

Antimicrobial activity by using disc diffusion method

The silver nanoparticles synthesised from *Geranium hortorum* were subjected to test the antimicrobial activity using the disc diffusion technique. The pathogenic microbes against which the antibacterial assay was performed includes *Bacillus subtilis*, *Pseudomonas spp.*, *Staphylococcus spp.,* and *Propionibacterium spp*. The antibiotic discs such as Gentamicin, Streptomycin, Penicillin, and Chloramphenicol were used to combat these bacteria. The plates having swabbing of microbes, antibiotic discs at one side and silver nanoparticles on other side were incubated at 36℃for 18–24 hours.

RESULT AND DISCUSSION

Biosynthesis of AgNPs from leaves extract

The production of silver nanoparticles from natural plant extract of *Geranium hortorum* was observed. The silver ions in water were transformed to silver nanoparticles when they were combined with a natural *Geranium hortorum* plant extract. The colour of the solution changed from yellow to bright yellow and then dark brown after the titration, suggesting the formation of silver nanoparticles.The appearance of a brown colour in the leaves extract treatment flask indicates the formation of silver nanoparticles. (Figure 2 depicts the outcome).

UV- visible spectrophotometer analysis

The production and stability of reduced silver nanoparticles in colloidal solution were studied using UV-visible spectra spectroscopy. The capacity to use UV-Vis spectroscopy to explore the structure or shape-controlled nanoparticles in aqueous solutions is well established. In the UV-visible spectrum of the reaction medium of silver nitrate solution with *Geranium hortorum* leaf extract, which exhibited a peak at 385nm, the presence of silver nanoparticles, which are generated by *Geranium hortorum* leaf extract, was found. The peak was increased due to the impact of electron plasmon resonance in the reaction medium, and the broadening of the peak indicated that the molecules were polydisperse. This peak's existence, which is linked to plasmonic surfaces, has been thoroughly documented. When the peak was visible, the absorbance was 0.383. (Figure 3).

Antimicrobial activity

The antibacterial efficacy of silver nanoparticles derived from natural plant*Geranium hortorum* extract was investigated using the disc diffusion method against a range of pathogenic bacteria, including *Bacillus subtilis, Pseudomonas spp., Staphylococcus spp.,* and *Propionibacterium spp*. The presence of silver nanoparticle solution and antibiotic disc, the diameter of the inhibition zone (mm) surrounding each well is shown in Table 1. The silver nanoparticles synthesised by *Geranium hortorum* extract were found to have highest antibacterial activity against *Pseudomonas spp* which reveals that the silver nanoparticles isolated from *Geranium hortorum* leavesmay be used to treat the diseases caused by *Pseudomonas*. The silver nanoparticle zone was 6 mm in diameter, whereas the antibiotic disc zone was 10 mm (Figure.4-C).The antimicrobial activity was observed against *Staphylococcus spp*. And *Bacillus subtilis* which expressed that the silver nanoparticles of *Geranium hortorum* plant can kill these pathogen till some extent (Figure.4-A, B).There was no zone of inhibition observed in *Propionibacterium* which signifies that the silver nanoparticles isolated from *Geranium hortorum* leaves have no antibiotic activity against the Propionibacterium. (Figure.4-D). Silver nanoparticles beat other salts in terms of antibacterial activity due to their extremely high surface area, which allows for greater interaction with germs. The nanoparticles are able to penetrate the bacteria by adhering to the cell membrane. The bacterial membrane contains sulfur-containing proteins, and silver nanoparticles interact with these proteins as well as phosphorus-containing molecules such as DNA. When silver nanoparticles enter a bacterial cell, they create a reduced molecular weight zone in the bacteria's center that protects the DNA from silver ions. The nanoparticles choose to attack the chain, which results in cell division and death. The nanoparticles create silver ions in bacterial cells, which improve their antibacterial action [14, 15].

Table 1. The Zone of inhibition of silver nanoparticles synthesized by natural plant extract against various pathogenic bacteria and their antibiotics

AgNPs sample from	Pathogenic bacteria	Antibiotic disc	AgNPs zone (mm)	Antibiotic zone (mm)
Extract	*Bacillus subtilis*	Chloramphenicol	4	14
Plant	*Staphylococcus spp.*	Streptomycin	1.8	12
(Pelargoniums)	*Pseudomonas spp.*	Gentamicin	6	10
Geranium	*Propionibacterium*	Penicillin	No zone	No zone

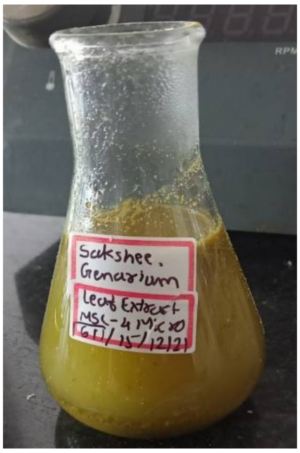

Figure. 1(a) Plant extract ready for filtration **Figure. 1(b)** Filtration process

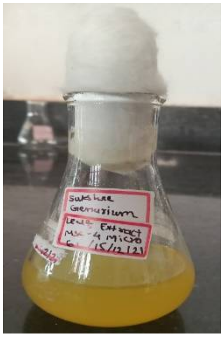

Figure. 1(c) Plant extract **Figure.2** Result of biosynthesis of AgNPs from leaves extract

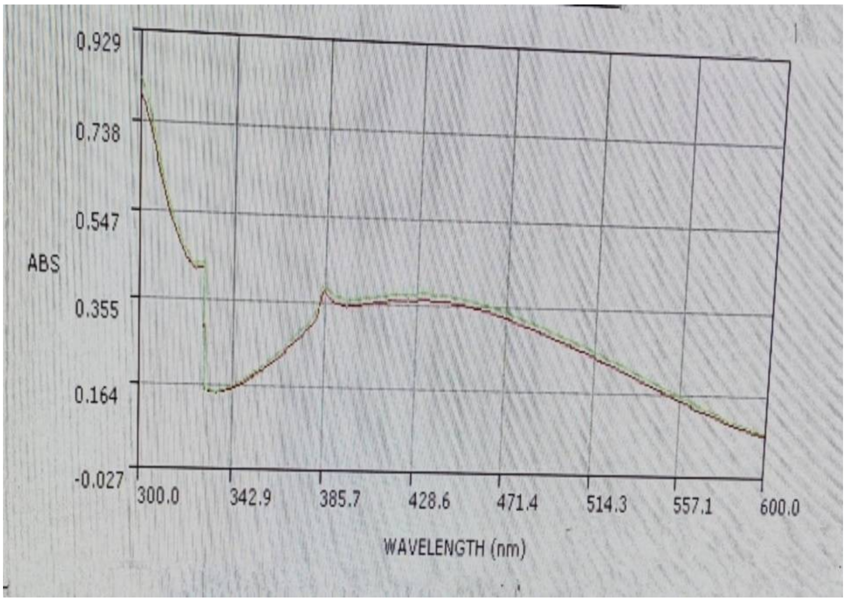

Figure. 3 Result of UV-visible spectra [Graph: Absorbance (ABS) vs. wavelength]

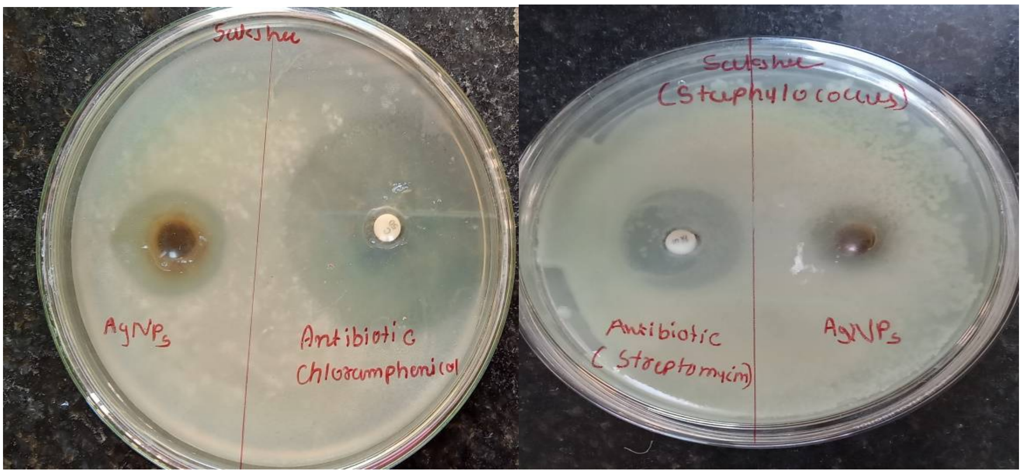

Figure. A Bacterium: *Bacillus subtilis***Figure. B** Bacteria: *Staphylococcus spp.*
Antibiotic: Chloramphenicol Antibiotic: Streptomycin

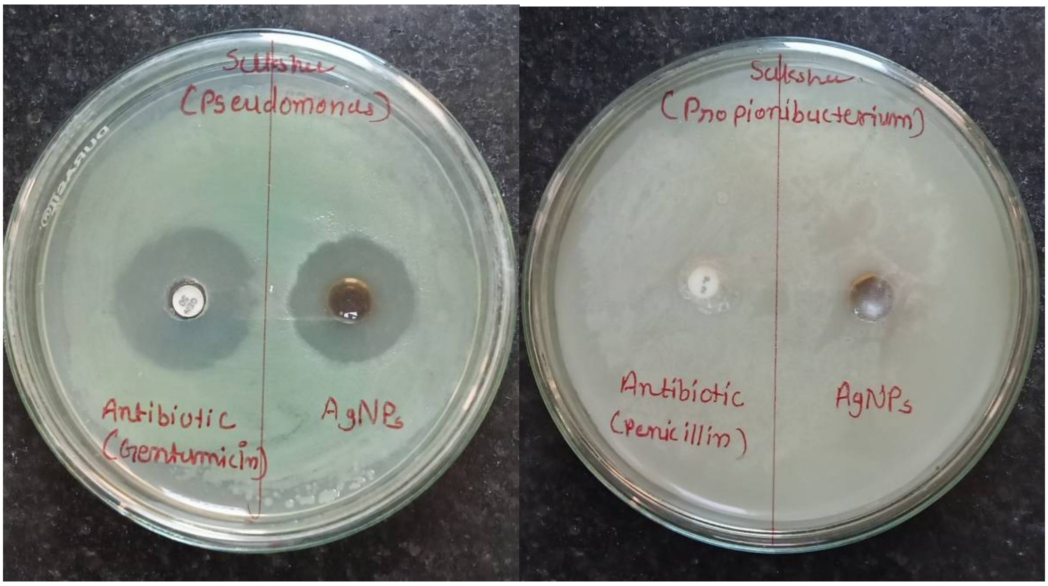

Figure. C Bacteria: *Pseudomonas spp.* **Figure. D** Bacteria: *Propionibacterium*
Antibiotic: Gentamicin Antibiotic: Penicillin

Figure 4. Antimicrobial activity of Silver nanoparticles isolated from *Geranium hortorum* leaf extract

Conclusion

The silver nanoparticles are synthesized from*Geranium hortorum* extract. This was a low-cost, high-efficiency, and ecologically beneficial strategy. The conversion of silver nitrate to silver nanoparticles has been confirmed using UV-visible spectrophotometer methods. The zone of inhibition established in the antimicrobial screening test demonstrated that the silver nanoparticles synthesised in this method have effective antibacterial action against *Pseudomonas spp., Staphylococcus spp.,Bacillus subtilis* pathogens. Biologically generated silver nanoparticles can be used in the medical area because of their potent antibacterial function.

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Conflict of Interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Schmid, G., & Corain, B. (2003). Nanoparticulated gold: syntheses, structures, electronics, and reactivities. *European Journal of Inorganic Chemistry*, *2003*(17), 3081-3098.

2. Abou El-Nour, K. M., Eftaiha, A. A., Al-Warthan, A., & Ammar, R. A. (2010). Synthesis and applications of silver nanoparticles. *Arabian journal of chemistry*, *3*(3), 135-140.
3. Schröfel, A., Kratošová, G., Šafařík, I., Šafaříková, M., Raška, I., & Shor, L. M. (2014). Applications of biosynthesized metallic nanoparticles–a review. *Acta biomaterialia*, *10*(10), 4023-4042.
4. Logeswari, P., Silambarasan, S., & Abraham, J. (2015). Synthesis of silver nanoparticles using plants extract and analysis of their antimicrobial property. *Journal of Saudi Chemical Society*, *19*(3), 311-317.
5. Schabes-Retchkiman, P. S., Canizal, G., Herrera-Becerra, R., Zorrilla, C., Liu, H. B., & Ascencio, J. A. (2006). Biosynthesis and characterization of Ti/Ni bimetallic nanoparticles. *Optical materials*, *29*(1), 95-99.
6. Gu, H., Ho, P. L., Tong, E., Wang, L., & Xu, B. (2003). Presenting Vancomycin on nanoparticles to enhance antimicrobial activities. *Nano letters*, *3*(9), 1261-1263.
7. Ahmad, Z., Pandey, R., Sharma, S., & Khuller, G. K. (2006). Alginate nanoparticles as antituberculosis drug carriers: formulation development, pharmacokinetics and therapeutic potential. *Indian journal of chest diseases and allied sciences*, *48*(3), 171.
8. Gong, P., Li, H., He, X., Wang, K., Hu, J., Tan, W., ... & Yang, X. (2007). Preparation and antibacterial activity of Fe3O4@ Ag nanoparticles. *Nanotechnology*, *18*(28), 285604.
9. Philip, D. (2011). Mangifera indica leaf-assisted biosynthesis of well-dispersed silver nanoparticles. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, *78*(1), 327-331.
10. Chaudhuri, S. K., & Malodia, L. (2017). Biosynthesis of zinc oxide nanoparticles using leaf extract of Calotropis gigantea: characterization and its evaluation on tree seedling growth in nursery stage. *Applied Nanoscience*, *7*(8), 501-512.
11. Ahmad, S., Munir, S., Zeb, N., Ullah, A., Khan, B., Ali, J., ... & Ali, S. (2019). Green nanotechnology: A review on green synthesis of silver nanoparticles—An ecofriendly approach. *International journal of Nanomedicine*, *14*, 5087.
12. Nayak, S., Bhat, M. P., Udayashankar, A. C., Lakshmeesha, T. R., Geetha, N., & Jogaiah, S. (2020). Biosynthesis and characterization of Dillenia indica-mediated silver nanoparticles and their biological activity. *Applied Organometallic Chemistry*, *34*(4), e5567.
13. Gharehyakheh, S., Ahmeda, A., Haddadi, A., Jamshidi, M., Nowrozi, M., Zangeneh, M. M., & Zangeneh, A. (2020). Effect of gold nanoparticles synthesized using the aqueous extract of Satureja hortensis leaf on enhancing the shelf life and removing Escherichia coli O157: H7 and Listeria monocytogenes in minced camel's meat: The role of nanotechnology in the food industry. *Applied Organometallic Chemistry*, *34*(4), e5492.
14. Sondi, I., & Salopek-Sondi, B. (2004). Silver nanoparticles as antimicrobial agent: a case study on E. coli as a model for Gram-negative bacteria. *Journal of colloid and interface science*, *275*(1), 177-182.
15. Morones, J. R., Elechiguerra, J. L., Camacho, A., Holt, K., Kouri, J. B., Ramírez, J. T., & Yacaman, M. J. (2005). The bactericidal effect of silver nanoparticles. *Nanotechnology*, *16*(10), 2346.

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