IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 12, May 2026
Impact Factor: 8.2

Green Synthesis and Characterization of Silver Nanoparticles Using *Dracaena marginata* Leaf Extract and Evaluation of Their Antimicrobial Activity

Shubhangi Thakur[1], Deepika Hasija[2], Tehseen Shaikh[3], Riya Dwiwedi[4], Isha Disale[5]
SYBSc, Department of Chemistry[1 2 3 4 5]
Ramsheth Thakur College of Commerce and Science, Kharghar, Maharashtra, India

Abstract: *The development of eco-friendly approaches for nanoparticle synthesis has gained significant attention in recent years. In this study, silver nanoparticles (AgNPs) were synthesized using leaf extract of Dracaena marginata through a green synthesis method. The plant extract served as both a reducing and stabilizing agent, eliminating the need for hazardous chemicals. Formation of AgNPs was confirmed by a visible colour change and further characterized using UV–Visible spectrophotometry, which showed characteristic surface plasmon resonance peaks. The synthesized nanoparticles were purified and evaluated for antimicrobial activity against Staphylococcus aureus and Escherichia coli using the well diffusion method. The results demonstrated significant antibacterial activity against S. aureus, while no inhibition was observed against E. coli. These findings suggest that D. marginata-mediated silver nanoparticles have potential applications as effective antimicrobial agents, particularly against Gram-positive bacteria, and highlight the importance of green synthesis as a sustainable alternative in nanotechnology.[1-3]*

Keywords: Green synthesis ,Silver nanoparticles (AgNPs) ,Dracaena marginata, Antimicrobial activity

I. INTRODUCTION

Nanotechnology has emerged as a rapidly advancing field with wide-ranging applications in medicine, electronics, agriculture, and environmental science. Among various nanomaterials, silver nanoparticles (AgNPs) have attracted considerable interest due to their unique physicochemical properties and strong antimicrobial activity against a broad spectrum of microorganisms. Conventional methods for synthesizing silver nanoparticles often involve toxic chemicals, high energy consumption, and environmentally hazardous byproducts, limiting their biomedical applications.

In recent years, green synthesis methods using biological resources such as plant extracts have gained prominence as eco-friendly, cost-effective, and sustainable alternatives. Plant-mediated synthesis utilizes naturally occurring phytochemicals—including flavonoids, phenolics, alkaloids, and proteins—as reducing and stabilizing agents, thereby simplifying the synthesis process and reducing environmental impact. Dracaena marginata, a commonly available ornamental plant, is known to contain bioactive compounds that can facilitate the reduction of metal ions into nanoparticles.

However, its potential in nanoparticle synthesis and antimicrobial applications remains relatively underexplored.

The present study focuses on the green synthesis of silver nanoparticles using D. marginata leaf extract, followed by their characterization using spectroscopic techniques. Additionally, the antimicrobial activity of the synthesized nanoparticles is evaluated against representative Gram-positive and Gram-negative bacteria, namely Staphylococcus aureus and Escherichia coli. This work aims to contribute to the development of sustainable nanomaterials with potential applications in biomedical and pharmaceutical fields.[4-7]



II. PLANT MATERIAL AND PREPARATION OF THE EXTRACT

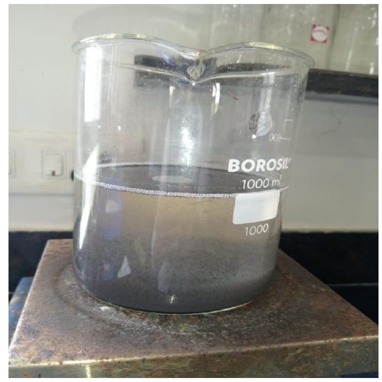
1. Leaves of Dracaena marginata (common name: Colorama) were collected from a local source.
2. The collected leaves were washed thoroughly with distilled water to remove dust and surface impurities.
3. The cleaned leaves were chopped into small pieces for efficient extraction.
4. Approximately 50 g of fresh leaf material was boiled in 500 mL of distilled water at 60–70°C for 15–20 minutes
5. The mixture was then allowed to cool to room temperature and filtered using Whatman filter paper No. 1 (or muslin cloth) to remove solid residues.
6. The clear filtrate obtained was used as the plant extract for the synthesis of silver nanoparticles.

III. SYNTHESIS OF SILVER NANOPARTICLES USING PLANT EXTRACT

1. For the synthesis of silver nanoparticles (AgNPs), a silver nitrate ($AgNO_3$) solution was prepared by dissolving 0.084 g of $AgNO_3$ in 500 mL of distilled water.
2. The plant extract (50 mL) was added to 450 mL of $AgNO_3$ solution in a 1:9 ratio under continuous stirring.
3. The reaction mixture was maintained at room temperature and observed visually for any color change.
4. The reduction of silver ions (Ag^+) to silver nanoparticles (AgNPs) was indicated by a gradual color change from light yellow to brownish and finally to dark brown, confirming nanoparticle formation.
5. The synthesis process was monitored visually and further confirmed using UV–Visible spectrophotometric analysis in the wavelength range of 250–800 nm.[8-10]


DOI: 10.48175/IJARSCT-35927

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 12, May 2026
Impact Factor: 8.2

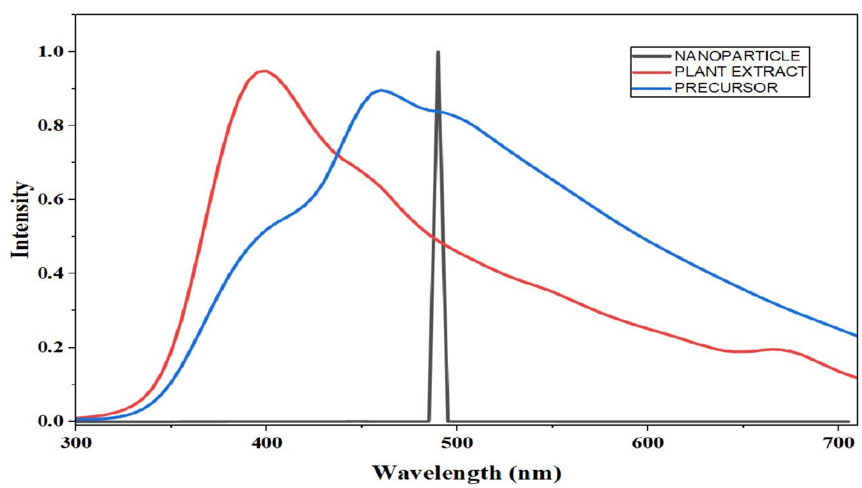


IV. CHARACTERIZATION

4.1 UV–Visible Spectral Analysis

UV–Visible spectroscopy was carried out using a UV–Visible spectrophotometer to confirm the formation of silver nanoparticles. The absorbance of precursor solution, plant extract, and synthesized nanoparticles was recorded in the wavelength range of 250–800 nm.

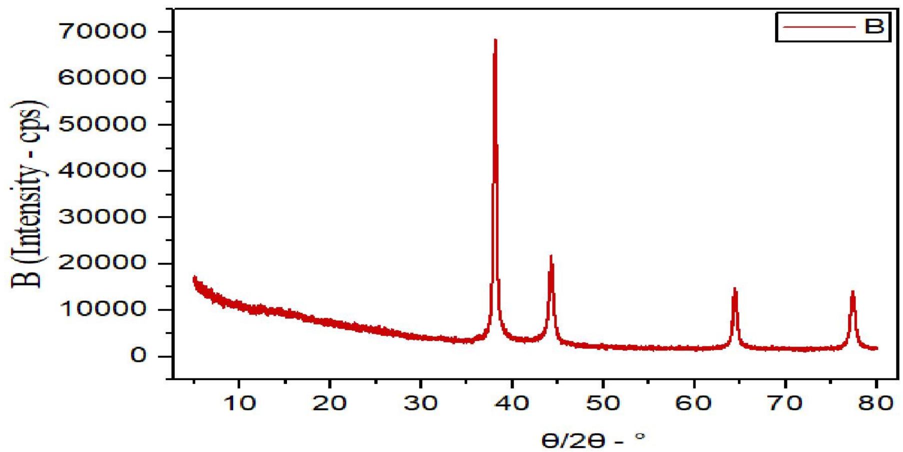
The synthesized AgNPs exhibited characteristic Surface Plasmon Resonance (SPR) peaks in the visible region, confirming nanoparticle formation. A gradual increase in absorbance intensity was observed with increasing wavelength, indicating the reduction of silver ions and stabilization of nanoparticles by phytochemicals present in the plant extract .[11-15] The absorption data demonstrated distinct differences between precursor, plant extract, and nanoparticle solution, with the nanoparticle solution showing higher absorbance in the visible region, confirming successful synthesis.



4.2 X-ray Diffraction (XRD) Analysis

X-ray diffraction (XRD) analysis was performed to investigate the crystalline structure and phase purity of the synthesized silver nanoparticles (AgNPs). The dried nanoparticle sample obtained after centrifugation and oven drying was subjected to XRD analysis using a standard X-ray diffractometer operated under appropriate conditions.

The X-ray diffraction (XRD) pattern did not show any significant impurity peaks, suggesting the successful formation of silver nanoparticles. However, the presence of minor undetected impurities cannot be completely ruled out.[16-18]

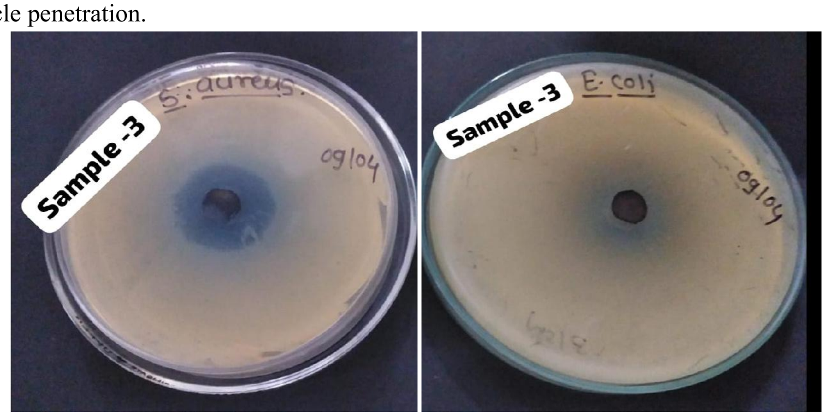


4.3 Antimicrobial Activity Analysis

The antimicrobial activity of the biosynthesized silver nanoparticles was evaluated against the Gram-positive bacterium Staphylococcus aureus and the Gram-negative bacterium Escherichia coli using the agar well diffusion method (zone of inhibition assay).

The results demonstrated that the synthesized nanoparticles exhibited significant antibacterial activity against Staphylococcus aureus, as evidenced by clear zones of inhibition around the wells. In contrast, no zone of inhibition was observed against Escherichia coli, indicating a lack of antibacterial activity against this organism.[19-20]

The difference in antimicrobial efficacy may be attributed to variations in cell wall structure between Gram-positive and Gram-negative bacteria. Gram-negative bacteria such as E. coli possess an outer membrane that can act as a barrier, limiting nanoparticle penetration.



Test Organism	AgNP Concentration	Zone of Inhibition (mm)	Activity
S. aureus	50 µg/mL	21.10	Active
E. coli	50 µg/mL	NZ (No Zone)	Inactive
S. aureus	50 µg/mL	24.28	Highly Active
E. coli	50 µg/mL	NZ (No Zone)	Inactive

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 12, May 2026
Impact Factor: 8.2

V. RECOVERY OF SILVER NANOPARTICLES

The synthesized nanoparticles were recovered by centrifugation at 8000–10,000 rpm for 15–20 minutes. After centrifugation, the supernatant was discarded and the pellet containing silver nanoparticles was collected.

The pellet was washed 2–3 times with distilled water to remove unreacted substances and impurities. The purified nanoparticles were then dried in a hot air oven at 60–80°C.

VI. STORAGE OF NANOPARTICLES

The dried nanoparticles were stored in sterile, airtight containers and kept away from light and moisture to prevent oxidation and maintain stability.

VIII. APPLICATIONS OF SILVER NANOPARTICLES SYNTHESIZED USING *DRACAENA MARGINATA*

The green synthesized silver nanoparticles (AgNPs) using *Dracaena marginata* leaf extract possess unique physicochemical and biological properties that make them suitable for a wide range of applications in various fields.

1. Antimicrobial Applications

- Silver nanoparticles are well known for their strong antimicrobial activity against a broad spectrum of microorganisms. The synthesized AgNPs can be effectively used against pathogenic bacteria such as *Staphylococcus aureus* and *Escherichia coli*. These nanoparticles disrupt bacterial cell membranes, generate reactive oxygen species, and interfere with cellular processes, leading to cell death. Hence, they can be applied in:
- Antibacterial coatings for medical devices
- Wound dressings and bandages
- Disinfectants and sanitizing agents

2. Biomedical Applications

Due to their biocompatibility and eco-friendly synthesis, plant-mediated AgNPs are highly suitable for biomedical uses. They can be utilized in:

- Drug delivery systems
- Antimicrobial therapies
- Tissue engineering
- Development of nano-based medicines

3. Pharmaceutical Applications

- Green synthesized AgNPs can be incorporated into pharmaceutical formulations due to their enhanced stability and reduced toxicity. They are useful in:
- Development of antibacterial drugs
- Anti-inflammatory formulations
- Topical ointments and creams

4. Environmental Applications

Silver nanoparticles synthesized via green methods are environmentally safe and can be used in:

- Water purification systems (removal of microbial contaminants)
- Wastewater treatment
- Antimicrobial coatings for surfaces

5. Food Packaging Industry

AgNPs can be incorporated into food packaging materials to enhance shelf life by preventing microbial contamination. Their antimicrobial nature helps in maintaining food quality and safety.

6. Textile Industry

Silver nanoparticles can be used to produce antimicrobial fabrics. These fabrics are useful in:

- Medical textiles
- Sportswear
- Protective clothing

7. Catalytic Applications

AgNPs act as efficient catalysts in various chemical reactions due to their high surface area. They can be used in:

- Degradation of organic pollutants
- Industrial chemical processes

IX. CONCLUSION

The silver nanoparticles synthesized using *Dracaena marginata* leaf extract offer a sustainable, cost-effective, and eco-friendly alternative to chemically synthesized nanoparticles. Their wide range of applications, especially in antimicrobial and biomedical fields, highlights their potential for future research and industrial use.

REFERENCES

1. Iravani S (2011). Green synthesis of metal nanoparticles using plants. Green Chemistry, 13(10), 2638–2650.
2. Ahmed S, Ahmad M, Swami B L, & Ikram S (2016). A review on plant extract mediated synthesis of silver nanoparticles for antimicrobial applications. Journal of Advanced Research, 7(1), 17–28.
3. MittalA K, Chisti Y, & Banerjee U C (2013). Synthesis of metallic nanoparticles using plant extracts. Biotechnology Advances, 31(2), 346–356.
4. Rai, M., Yadav, A., & Gade, A. (2009). Silver nanoparticles as a new generation of antimicrobials. Biotechnology Advances, 27(1), 76–83.
5. Song, J. Y., & Kim, B. S. (2009). Rapid biological synthesis of silver nanoparticles using plant leaf extracts. Bioprocess and Biosystems Engineering, 32(1), 79–84.
6. .Kumar, V., & Yadav, S. K. (2009). Plant-mediated synthesis of silver and gold nanoparticles and their applications. Journal of Chemical Technology and Biotechnology, 84(2), 151–157.
7. 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), 2346–2353.4
8. Shankar, S. S., Ahmad, A., & Sastry, M. (2003). Rapid synthesis of Au, Ag, and bimetallic nanoparticles using plant extracts. Journal of Colloid and Interface Science, 275(2), 496–502.
9. Kumar V & Yadav S K (2009). Plant-mediated synthesis of silver and gold nanoparticles and their applications. *Journal of Chemical Technology and Biotechnology*, 84(2), 151–157.
10. Ahmed, S., Ahmad, M., Swami, B. L., & Ikram, S. (2016). A review on plant extract mediated synthesis of silver nanoparticles. Journal of Advanced Research, 7(1), 17–28.
11. Prabhu, S., & Poulose, E. K. (2012). Silver nanoparticles: mechanism of antimicrobial action. International Nano Letters, 2(1), 32.
12. Link, S., & El-Sayed, M. A. (1999). Size and temperature dependence of the plasmon absorption of colloidal gold and silver nanoparticles. Journal of Physical Chemistry B, 103(21), 4212–4217. 13. Song, J. Y., & Kim, B. S. (2009). Rapid biological synthesis of silver nanoparticles using plant leaf extracts. Bioprocess and Biosystems Engineering, 32(1), 79–84.

13. Song, J. Y., & Kim, B. S. (2009). Rapid biological synthesis of silver nanoparticles using plant leaf extracts. *Bioprocess and Biosystems Engineering*, 32(1), 79–84.
14. Shankar, S. S., Ahmad, A., & Sastry, M. (2003). Biosynthesis of silver nanoparticles using plant extracts. Journal of Colloid and Interface Science, 275(2), 496–502.
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), 2346–2353.
16. Kelly, K. L., Coronado, E., Zhao, L. L., & Schatz, G. C. (2003). The optical properties of metal nanoparticles: The influence of size, shape, and dielectric environment. Journal of Physical Chemistry B, 107(3), 668–677.
17. Link, S., & El-Sayed, M. A. (1999). Size and temperature dependence of the plasmon absorption of colloidal gold and silver nanoparticles. Journal of Physical Chemistry B, 103(21), 4212–4217.
18. Morones J R et al. (2005). The bactericidal effect of silver nanoparticles. *Nanotechnology*, 16(10), 2346–2353.19.Sathishkumar M, Sneha K, & Won S W (2009). Biogenic synthesis of silver nanoparticles and their stability studies. Colloids and Surfaces B: Biointerfaces, 73(2), 332–338.
19. Sathishkumar M, Sneha K, & Won S W (2009). Biogenic synthesis of silver nanoparticles and their recovery and stability studies. *Colloids and Surfaces B: Biointerfaces*, 73(2), 332–338.
20. Venkatesham M, Ayodhya D, & Sivarama Krishna R (2012). Green synthesis, characterization and antimicrobial activity of silver nanoparticles. *Journal of Nanomaterials*, 2012