Pharmacogn. Res., 2027; 19(2):703-708.
https://www.phcogres.com

Original Article

Nano Silver Incorporated Carbon Nanoparticles (*Drynaria quercifolia*): Synthesis and Antibacterial Activity Against Wound Pathogens

Hrithikraj M[1], Ponmalai M[2], Aravind Yaswanth Chandran[1], Rajeshkumar Shanmugam[1,*]

[1]Department of Anatomy, Nanobiomedicine Lab, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, INDIA.
[2]Department of Anatomy, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, INDIA.

ABSTRACT

Background: Wound infections continue to be a significant clinical problem because of prolonged wound healing, increased morbidity, and the appearance of Multidrug-Resistant (MDR) pathogens. Nanotechnology offers a viable alternative for the formulation of potent antimicrobial agents. **Objectives:** This study aimed to formulate and evaluate the antibacterial activity of nano silver-loaded carbon nanoparticles using *Drynaria quercifolia*, an herbal plant with therapeutic and antimicrobial activity against wound infectious pathogens. **Materials and Methods:** Evaluation of *in vitro* antimicrobial activity against clinical wound isolates of *Staphylococcus aureus, Pseudomonas* sp., *Enterococcus faecalis*, and *E. coli* was performed using agar well diffusion and time-kill kinetic methods. **Results:** The nanocomposite synthesized showed potential antibacterial activity with the highest inhibition (20 mm at 100 µg/mL of sample) in the well diffusion method against *Pseudomonas* sp., followed by *E. coli* (17 mm at 100 µg/mL). Kinetic studies showed dose-dependent bactericidal activity of *D. quercifolia*-based nano silver incorporated carbon nanoparticles against all four pathogens, with the fastest killing of *S. aureus* and *Pseudomonas* sp. **Conclusion:** Therefore, *D. quercifolia*-mediated nano silver-incorporated carbon nanoparticles have the potential for wound care management.

Keywords: Antimicrobial, Carbon nanoparticles, *Drynaria quercifolia*, Silver nanoparticles, Wound pathogens.

Correspondence:
Dr. Rajeshkumar Shanmugam
Nanobiomedicine Lab, Department of Anatomy, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, INDIA.
Email: rajeshkumars.sdc@saveetha.com

Received: 29-06-2026;
Revised: 18-08-2026;
Accepted: 08-09-2026.

INTRODUCTION

Nanotechnology has become a field of great interest and is being applied in medicine (drug delivery, tissue imaging and diagnosis, etc.), pharmaceuticals, and materials science (Low & Lai, 2018; Ahmed *et al*., 2019). Silver nanoparticles (AgNPs) are among the widely researched metal-based nanoparticles due to its broad-spectrum bactericidal efficacy against both Gram-negative and Gram-positive bacterial strains (Fayaz *et al*., 2010; Khalil *et al*., 2020). Due to toxicity and stability issues, hybrid nano systems, including silver-loaded carbon nanoparticles (Makvandi *et al*., 2021; Negi *et al*., 2024), have been developed. Carbon Nanoparticles (CNPs) are among the most promising nanomaterials due to their biocompatibility and chemical stability (Shaw *et al*., 2021; Zheng *et al*., 2025).

DOI: 10.5530/pres.20270002

Copyright Information :
Copyright Author (s) 2027 Distributed under Creative Commons CC-BY 4.0

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

Wound infections, specifically caused by *Staphylococcus aureus, Pseudomonas* spp., *Enterococcus faecalis*, and *Escherichia coli*, are a great health care problem (Huang *et al*., 2022; Sayed *et al*., 2022). Recent clinical investigations underscore the extreme challenge of eliminating strong and resistant pathogens like *E. faecalis* from infected tissues (Elango *et al*., 2026), and further underscore the demanding need for advanced nanomaterials capable of targeting and controlling the virulence of difficult species such as *Pseudomonas aeruginosa* (Sathishkumar & Khan, 2024).

Plant-mediated green synthesis of Herbo metallic nanoparticles has emerged as a green and non-hazardous substitute to traditional chemical synthesis routes (Banerjee *et al*., 2014; Balamurugan & Sivakumar, 2025). This eco-friendly approach is rapidly expanding across various biological domains, inspiring the biocatalytic synthesis of metallic nanoparticles for targeted, advanced biomedical applications (Baskar *et al*., 2025). *Drynaria quercifolia*, known as the oak-leaf fern, has been employed in traditional folk medicine as an anti-inflammatory, antioxidant, and wound-healing agent (Kumar *et al*., 2017; Mahendran *et al*., 2021).

The incorporation of nano silver into carbon nanoparticles extracted from this plant shows great potential for the design of strong antimicrobial agents for wound treatment (Hosny *et al.*, 2025; Rahuman *et al.*, 2021). Hence, the present research work was carried out to develop nano silver-impregnated carbon nanoparticles using *Drynaria quercifolia* leaf extract and to determine their antimicrobial efficacy against a clinically applicable wound-pathogenic bacterium.

MATERIALS AND METHODS

Preparation of herbal formulation

A quantity of 1 g of (*Drynaria quercifolia*) was measured, taken and dissolved in 100 mL of distilled water. The solution was heated to 60-80°C for about 5 min, cooled, and filtered through a muslin cloth.

Silver nanoparticle preparation

A 1 mmol aliquot of silver nitrate (0.0169 g) was dissolved fully in 80 mL of distilled water, and subsequently, 20 mL of plant extract was added to it and kept in an orbital shaker at 110 rpm for 48 hr. This was subsequently centrifuged to recover the pellet, which was then air-dried and stored.

Production of carbon nanoparticles

Drynaria quercifolia leaves were cleaned, oven-dried, and ground into a powder. 2.5 g powder was suspended in 100 mL of sterile distilled water and heated. A microwave oven (700 W) was used to produce carbon Nanoparticles in a crucible. The powder obtained was sonicated, dried, and stored.

Synthesis of nano silver-loaded carbon nanoparticles

For the preparation of the nanocomposite, 0.5 µL of the prepared carbon nanoparticles was mixed with 0.5 µL of the silver nanoparticles, maintaining the equal ratio (1:1). The mixture was ultrasonicated to obtain a homogeneous mixture and to avoid the aggregation of the nanomaterials. Sonication was continued until silver and carbon nanoparticles were fully and homogeneously distributed, resulting in a stable composite. The prepared black nanocomposite suspension was finally collected and stored appropriately for subsequent characterization and antimicrobial tests.

Characterization

Synthesized Silver-Loaded Carbon Nanocomposites (Ag/C NCs) were characterized by UV-visible spectroscopy, and absorption spectra were obtained by scanning the sample in the range of 350 nm to 600 nm.

Evaluation of antimicrobial activity

Antimicrobial activity was Quantified using the agar well diffusion assay. Suspensions of bacteria (*S. aureus, Pseudomonas* sp., *E. faecalis*, and *E. coli*) were spread on Mueller Hinton agar plates. 9mm wells were filled with nanocomposite at 25 µg/mL, 50 µg/mL, and 100 µg/mL. The amoxicillin served as a positive control. Incubation of plates was conducted at 37°C for 24 hr, and the Zone of Inhibition (ZOI) was measured by using measuring scale.

Time-kill kinetic curves

A time-kill curve assay was performed by culturing all four bacteria (*S. aureus, Pseudomonas* sp., *E. faecalis*, and *E. coli*) in Mueller-Hinton broth with the nanocomposite at 25, 50, and 100 µg/mL. Optical density was measured at 0, 1, 2, 3, and 5 hr preparation of Silver Nanocomposite.

RESULTS

Visual observation and synthesis confirmation

Preparation of silver Nanoparticles

The step-by-step procedure for the green formulation of silver nanoparticles using *Drynaria quercifolia* extract. Color changes in the reaction mixture confirm the reduction of silver ions (Ag^+) and the rapid formation of silver nanoparticles. During reaction, the starting pale-yellow solution gradually turns dark brown (Figure 1).

Preparation of Carbon Nanoparticles

Preparation of Carbon Nanoparticles obtained from *Drynaria quercifolia* leaves. After the leaf powder solution is prepared and boiled, it undergoes pyrolysis. Visual confirmation of the formation of the carbon nanoparticles is obtained at the end of this process as a fine, black powder (Figure 2).

UV-visible absorption spectroscopy

Formation of Silver-Loaded Carbon Nanoparticles was indicated by a transition from a colorless to a dark brown black coloration. UV-visible spectroscopy revealed the presence of the characteristic surface plasmon resonance of the nano Silver-Loaded Carbon Nanoparticles at around 440 nm (Figure 3).

Antimicrobial efficacy: Agar well diffusion analysis

The antimicrobial efficacy of the nano silver embedded carbon nanoparticles was analyzed on four wound infecting bacteria: *E. faecalis, S. aureus, Pseudomonas* sp., and *E. coli*, by employing agar well diffusion assay. The nanocomposite demonstrated concentration-dependent inhibition in the concentrations of 25 µg/mL, 50 µg/mL, and 100 µg/mL shown in Figure 4.

The extract showed the highest antibacterial activity against *Pseudomonas* sp., with a zone of clearance (inhibition) of 20

mm at 100 µg/mL. *E. coli* exhibited the highest inhibition zone (17 mm at 100 µg/mL of sample), whereas *S. aureus* exhibited a zone of 13 mm. *E. faecalis* was the least susceptible (9 mm) in all concentrations (Figure 5).

Amoxicillin, a commonly used antibiotic, produced a 30mm of inhibition against *Staphylococcus aureus* and 28 mm against *Escherichia coli*, whereas it was only 9mm against *Pseudomonas* sp. and *Enterococcus faecalis*.

Time-kill kinetic analysis

Time-kill curve assays were performed for 5 hr at 25 µg/mL, 50 µg/mL, and 100 µg/mL to assess the antibacterial activity of the nanocomposite against the four bacteria *S. aureus, Pseudomonas* sp., *E. faecalis*, and *E. coli*. The data exhibited dose and time dependent bactericidal activity against all the tested strains (Figure 6).

Against *Pseudomonas* sp

At the highest tested concentration (100 µg/mL), a quick and nearly 100% kill from the viable count occurred in 5 hr, which was similar to Amoxicillin. Subsequently, to lower concentrations (25 and 50 µg/mL, respectively), reduction was progressive, albeit slower.

Against *S. aureus*

Fastest primary bactericidal activity was observed between the first 1 hr at 100 µg/mL; thereafter, continued bactericidal activity was observed.

Against *E. coli*

The nanocomposite showed a significant concentration-dependent bactericidal activity. A 100 µg/mL concentration resulted in a nearing the efficacy in the number of living cells after 3 hr, nearing the efficacy of the conventional antibiotic. At the more dilute concentrations of 25 and 50 µg/mL, a continued, small decrease was observed over the 5-hr duration.

Compared to *E. faecalis*, the nanocomposite was moderately bactericidal, with the maximum reduction observed at the highest concentration after 5 hr.

Continuous proliferation was observed in all four untreated controls during the 5-hr incubation. Among the four wound-associated bacterial species tested, the nanocomposite

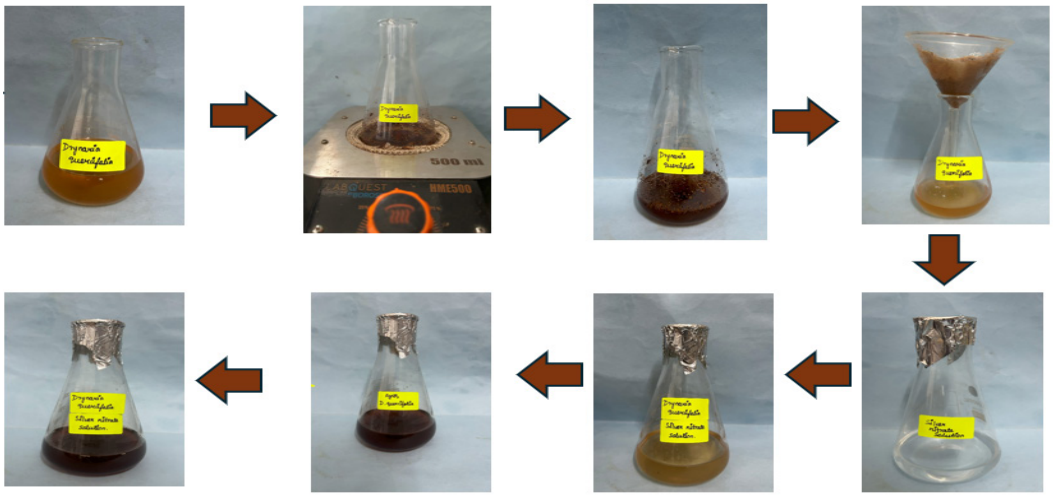


Figure 1: Preparation of Silver nanoparticle.

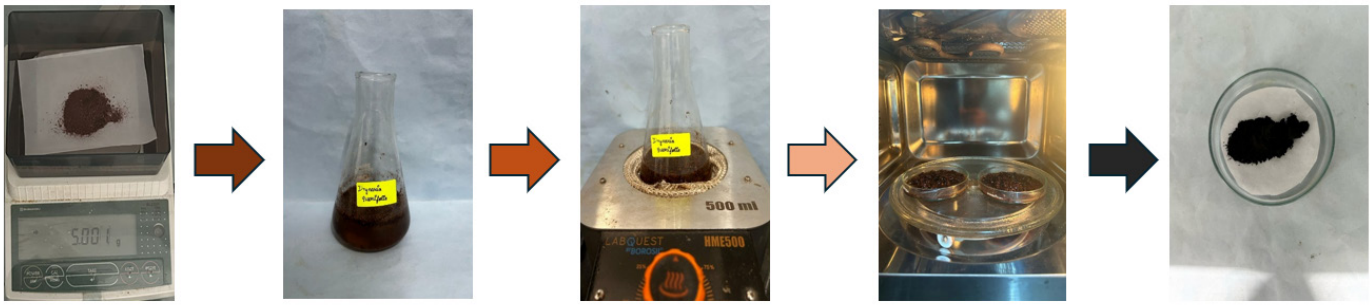


Figure 2: Preparation of carbon nanoparticle.

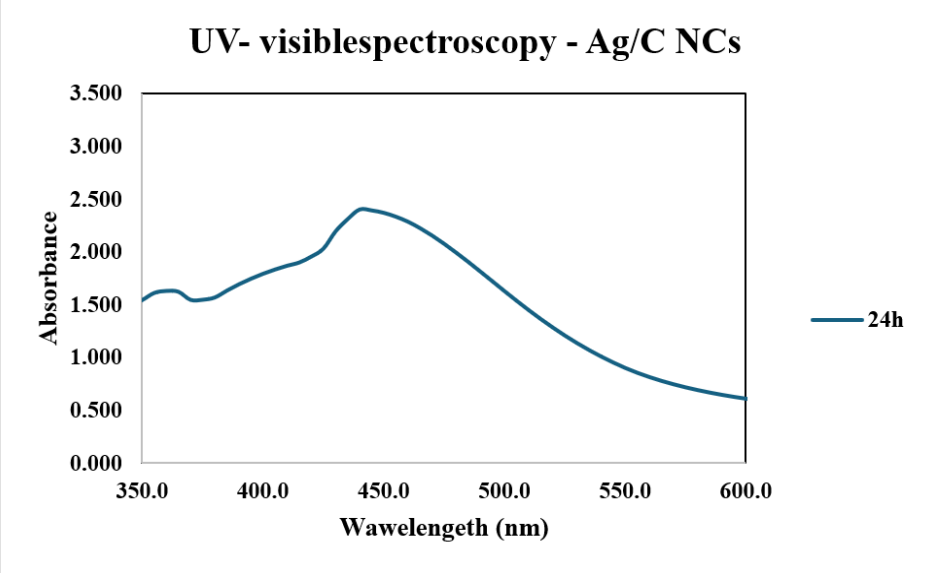


Figure 3: UV-visible absorption spectrum of the synthesized silver-loaded carbon nanocomposites, showing the characteristic surface plasmon resonance peak at approximately 440 nm. Shown at column width.

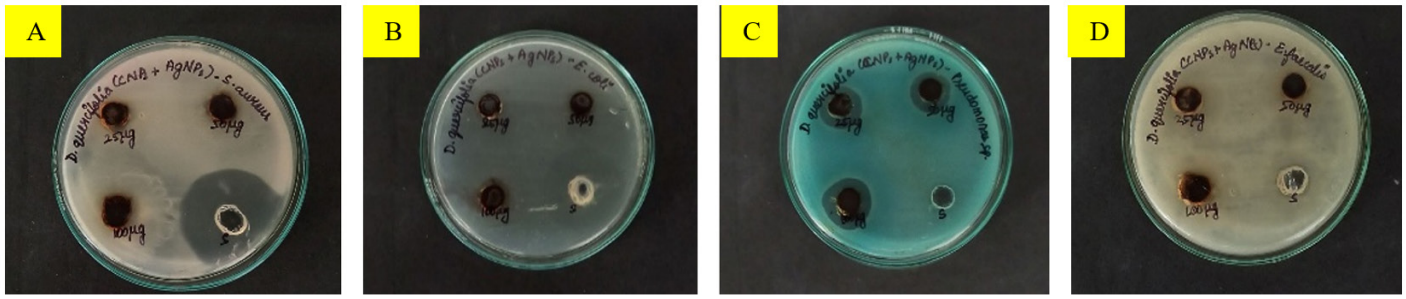


Figure 4: Agar well diffusion assay demonstrating the antibacterial activity of the nanocomposite against. (A) *S. aureus*, (B) *E. coli,* (C) *Pseudomonas* sp., and (D) *E. faecalis*. Shown at full page width.

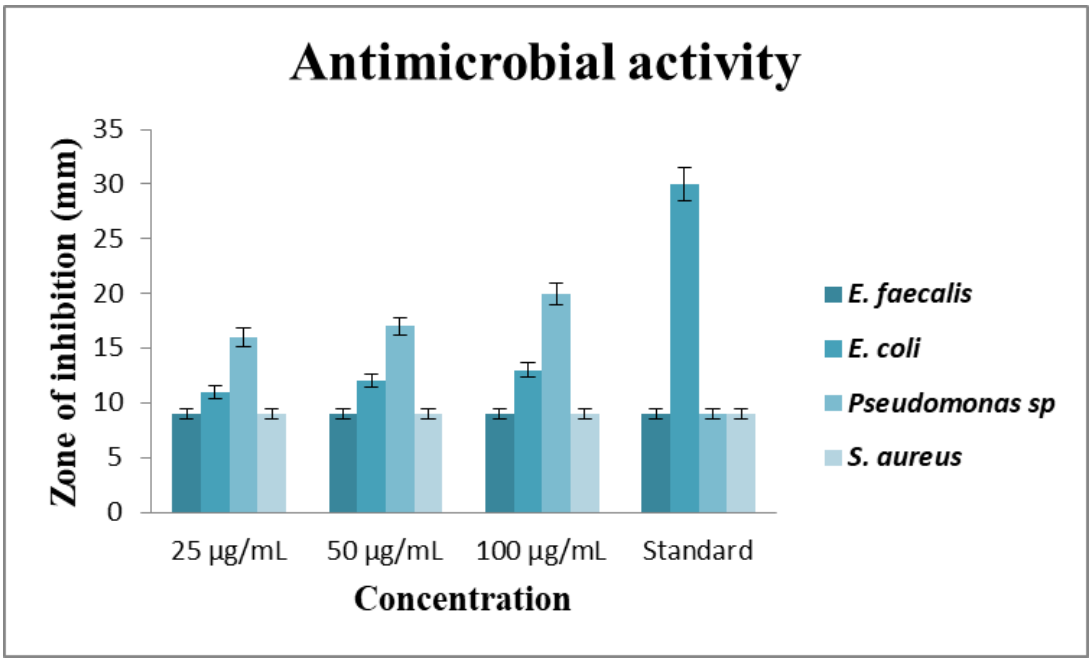


Figure 5: Zone of inhibition (mm) of silver-loaded carbon nanocomposites against wound pathogens at varying concentrations (25, 50, 100 µg/mL) compared to the positive control (Amoxicillin). Shown at full page width.

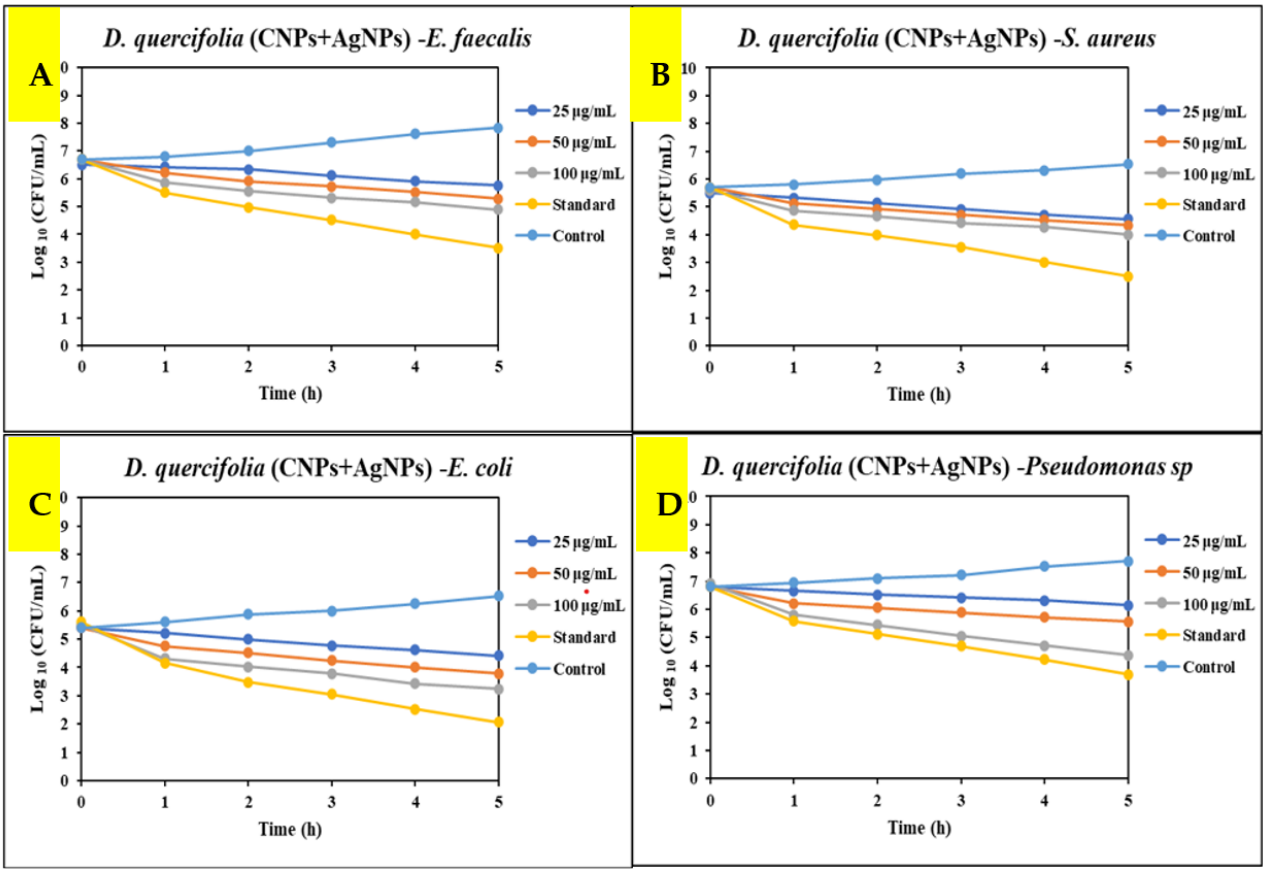


Figure 6: Time-kill kinetic analysis of the nanocomposite against the four tested bacterial strains over a 5-hour duration, illustrating concentration-dependent bactericidal activity. Shown at full page width.

demonstrated the most potent bactericidal activity against *Pseudomonas* sp., inhibiting it at 100 µg/mL. Comparatively, the bacterium. *E. faecalis* exhibited minimal inhibition, with only moderate susceptibility observed at the highest concentration.

DISCUSSION

Combining nanotechnology with classic medicine is a potential approach to develop new antimicrobial methods, especially for controlling wound infections in the context of increasing antibiotic resistance (Gao *et al.*, 2018; Tharani *et al.*, 2023). Dose-dependent antimicrobial activity of the silver nanocomposite was observed in the agar well diffusion analysis, with most potent activity recorded against *Pseudomonas* sp (He *et al.*, 2016; Pammi *et al.*, 2025). *E. coli* was also significantly inhibited in accordance with the literature on the susceptibility of gramnegative bacteria to AgNPs (Xu *et al.*, 2023; Hernández-Díaz *et al.*, 2021). The time kill assay also demonstrated rapid bactericidal activity against the four pathogens, with *S. aureus* and *Pseudomonas* sp. exhibiting the fastest killing kinetics. These findings align with prior research on silver containing nanocomposites (Wetteland *et al.*, 2016; Nguyen *et al.*, 2018). By integrating nanotechnology with the classic attributes of *Drynaria quercifolia*, the present research addresses the critical need for potential antimicrobial therapeutics to combat antibiotic-resistant bacteria that cause chronic wound infections (Rajeshkumar *et al.*, 2019; Rifaath *et al.*, 2023).

CONCLUSION

Therefore, this study confirms the effective production of nano silver-loaded carbon nanoparticles from *Drynaria quercifolia*. The synthesized nanocomposite demonstrated a notable, quantifiable antibacterial effect on clinically isolated bacteria, including *S. aureus, Pseudomonas* sp., *E. faecalis*, and *E. coli*, with the most potent effect on *Pseudomonas* sp. and *E. coli*. Therefore, biosynthesized nanocomposites are a potential material for the fabrication of new wound dressings and topical antimicrobial preparations. Additional studies may establish these silver incorporated nanomaterials as a new effective approach for difficult wound care management.

ABBREVIATIONS

MDR: Multidrug-resistant; **AgNPs:** Silver nanoparticles; **CNPs:** Carbon nanoparticles; **Ag/C NCs:** Silver-Loaded Carbon Nanocomposites; **ZOI:** Zone of inhibition.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization, Methodology, Writing, Hrithikrajc. M, M. Ponmalai, Aravind Yaswanth. C; Supervision, Review, Editing, S Rajeshkumar.

SUMMARY

This research investigates the synthesis and antibacterial application of nano silver incorporated carbon nanoparticles utilizing *Drynaria quercifolia* extracts. As multidrug-resistant wound infections pose significant clinical challenges, developing potent antimicrobial agents via green nanotechnology serves as a crucial alternative. Testing the formulated nanocomposites against wound isolates (*S. aureus, Pseudomonas* sp., *E. faecalis*, and *E. coli*) demonstrated significant, dose-dependent bactericidal kinetics. The highest efficacy was recorded against *Pseudomonas* sp. and *E. coli*, highlighting the nanocomposite's robust potential for future integration into topical antimicrobial preparations and wound care management dressings.

REFERENCES

Ahmed, B., Solanki, B., Zaidi, A., Khan, M. S., & Musarrat, J. (2019). Bacterial toxicity of biomimetic green zinc oxide nanoantibiotic: Insights into ZnNOP uptake and nanocolloid-bacteria interface. *Toxicology Research, 8*(2), 246-261. https://doi.org/10.1039/c8tx00267h

Balamurugan, R., & Sivakumar, P. (2025). Green synthesis of CuO nanoparticles using *Gloriosa superba* L. extract by phytochemical analysis and antimicrobial applications. *Research Square*. https://doi.org/10.21203/rs.3.rs-6764786/v1

Banerjee, P., Satapathy, M. K., Mukhopahayay, A., & Das, P. (2014). Leaf extract mediated green synthesis of silver nanoparticles from widely available Indian plants: synthesis, characterization, antimicrobial property and toxicity analysis. *Bioresources and Bioprocessing, 1*(1), 3. https://doi.org/10.1186/s13568-014-0003-8

Baskar, G., Palaniyandi, T., Al-Mutiry, M., Alshammari, N., & Saeed, M. (2025). Biocatalytic Green Synthesis of Iron Oxide Nanoparticles Using Red Seaweed *Portieria hornemannii* for Biomedical Applications. *Biocatalysis and Agricultural Biotechnology*, 103831. https://doi.org/10.1016/j.bcab.2024.103831

Elango, R., Gunasekaran, V., & Sathishkumar, P. (2026). Eradication of ampicillin-resistant *Enterococcus faecalis* in root canal infections using tannic acid: A tooth model investigation. *Archives of Oral Biology, 189*, 106638. https://doi.org/10.1016/j.archoralbio.2026.106638

Fayaz, A. M., Balaji, K., Girilal, M., Yadav, R., Kalaichelvan, P. T., & Venketesan, R. (2010). Biogenic synthesis of silver nanoparticles and their synergistic effect with antibiotics: A study against gram-positive and gram-negative bacteria. *Nanomedicine, 6*(1), 103-109. https://doi.org/10.1016/j.nano.2009.04.006

Gao, W., Chen, Y., Zhang, Y., Zhang, Q., & Zhang, L. (2018). Nanoparticle-based local antimicrobial drug delivery. *Advanced Drug Delivery Reviews, 127*, 46-57. https://doi.org/10.1016/j.addr.2017.09.015

He, Y., Ingudam, S., Reed, S., Gehring, A., Strobaugh, T. P., Jr., & Irwin, P. (2016). Study on the mechanism of antibacterial action of magnesium oxide nanoparticles against foodborne pathogens. *Journal of Nanobiotechnology, 14(1)*, 54. https://doi.org/10.1186/s12951-016-0202-0

Hernández-Díaz, J. A., Garza-García, J. J., Zamudio-Ojeda, A., León-Morales, J. M., López-Velázquez, J. C., & García-Morales, S. (2021). Plant-mediated synthesis of nanoparticles and their antimicrobial activity against phytopathogens. *Journal of the Science of Food and Agriculture, 101*(4), 1270-1287. https://doi.org/10.1002/jsfa.10768

Hosny, S., Gaber, G. A., Ragab, M. S., Ragheb, M. A., Anter, M., & Mohamed, L. Z. (2025). A comprehensive review of silver nanoparticles (AgNPs): Synthesis strategies, toxicity concerns, biomedical applications, AI-driven advancements, challenges, and future perspectives. *Arabian Journal for Science and Engineering*. Advance online publication. https://doi.org/10.1007/s13369-025-09876-5

Huang, R., Cai, X., Du, J., Lian, J., Hui, P., Gu, M., Li, F., Wang, J., & Chen, W. (2022). Bioinspired plasmonic nanosensor for on-site antimicrobial susceptibility testing in urine samples. *ACS Nano, 16*(11), 19229-19239. https://doi.org/10.1021/acsnano.2c06937

Khalil, O. A., Enbaawy, M. I. E., Salah, T., Mahmoud, H., & Ragab, E. (2020). *In vitro* investigation of the antibacterial effect of silver nanoparticles on ESBL-producing *E. coli* and *Klebsiella* spp. isolated from pet animals. *World's Veterinary Journal, 10*(4), 514-524. https://doi.org/10.54203/scil.2020.wvj64

Kumar, A., Rani, A., & Kumar, S. (2017). Pharmacological properties of *Drynaria quercifolia*: A review. *Journal of Ethnopharmacology, 200*, 1-10. https://doi.org/10.1016/j.jep.2017.02.025

Low, F. W., & Lai, C. W. (2018). Recent developments of graphene-TiO2 composite nanomaterials as efficient photoelectrodes in dye-sensitized solar cells: A review. *Renewable and Sustainable Energy Reviews, 82*, 103-125. https://doi.org/10.1016/j.rser.2017.09.024

Mahendran, D., Kishor, P. B. K., Geetha, N., Manish, T., Sahi, S. V., & Venkatachalam, P. (2021). Efficient antibacterial/biofilm, anti-cancer and photocatalytic potential of titanium dioxide nanocatalysts green synthesised using *Gloriosa superba* rhizome extract. *Journal of Experimental Nanoscience, 16*(1), 11-30. https://doi.org/10.1080/17458080.2020.1856372

Makvandi, P., Ashrafizadeh, M., Ghomi, M., Najafi, M., Hossein, H. H. S., *et al.* (2021). Injectable hyaluronic acid-based antibacterial hydrogel adorned with biogenically synthesized AgNPs-decorated multi-walled carbon nanotubes. *Progress in Biomaterials, 10*(1), 77-89. https://doi.org/10.1007/s40204-021-00154-7

Negi, P., Chadha, J., Harjai, K., Gondil, V. S., Kumari, S., & Raj, K. (2024). Antimicrobial and antibiofilm potential of green-synthesized graphene-silver nanocomposite against multidrug-resistant nosocomial pathogens. *Biomedicines, 12*(5), 1104. https://doi.org/10.3390/biomedicines12051104

Nguyen, N. Y., Grelling, N., Wetteland, C. L., Rosario, R., & Liu, H. (2018). Antimicrobial activities and mechanisms of magnesium oxide nanoparticles (nMgO) against pathogenic bacteria, yeasts, and biofilms. *Scientific Reports, 8(1)*, 16260. https://doi.org/10.1038/s41598-018-34567-5

Pammi, S. V. N., Ealla, K. K. R., Veeraraghavan, V. P., Ravikumar, A., Mohan, S. K., & Patil, S. (2025). Unlocking the synergistic potential of green metallic nanoparticles and antibiotics for antibacterial and wound healing activities. *iScience, 28*(6), 112518. https://doi.org/10.1016/j.isci.2025.112518

Rahuman, H. B. H., Dhandapani, R., Velmurugan, P., Thangavelu, S., Paramasivam, R., & Saravanan, M. (2021). Bioengineered phytomolecules-capped silver nanoparticles using *Carissa carandas* leaf extract to embed on to urinary catheter to combat UTI pathogens. *PLoS ONE, 16*(9), e0256748. https://doi.org/10.1371/journal.pone.0256748

Rajeshkumar, S., Tharani, M., Jeevitha, M., & Santhoshkumar, J. (2019). Anticariogenic activity of fresh Aloe vera gel mediated copper oxide nanoparticles. *Indian Journal of Public Health Research & Development, 10*(11), 278-282. https://doi.org/10.5958/0976-5506.2019.03463.3

Rifaath, M., Rajeshkumar, S., Anandan, J., Munuswamy, T., Govindharaj, S., Shanmugam, R., *et al.* (2023). Preparation of herbal nano-formulation-assisted mouth paint using titanium dioxide nanoparticles and its biomedical applications. *Cureus, 15*(11), e48321. https://doi.org/10.7759/cureus.48321

Sathishkumar, P., & Khan, F. (2024). Leveraging bacteria-inspired nanomaterials for targeted controlling biofilm and virulence properties of *Pseudomonas aeruginosa*. *Microbial Pathogenesis, 197*, 107103. https://doi.org/10.1016/j.micpath.2024.107103

Sayed, F. A.-Z., Eissa, N. G., Shen, Y., Hunstad, D. A., Wooley, K. L., & Elsabahy, M. (2022). Morphologic design of nanostructures for enhanced antimicrobial activity. *Journal of Nanobiotechnology, 20*(1), 477. https://doi.org/10.1186/s12951-022-01683-1

Shaw, Z. L., Kuriakose, S., Cheeseman, S., Dickey, M. D., Genzer, J., *et al.* (2021). Antipathogenic properties and applications of low-dimensional materials. *Nature Communications, 12*(1), 3897. https://doi.org/10.1038/s41467-021-24203-6

Tharani, M., Rajeshkumar, S., Al-Ghanim, K. A., Nicoletti, M., Sachivkina, N., & Govindarajan, M. (2023). *Terminalia chebula*-assisted silver nanoparticles: Biological potential, synthesis, characterization, and ecotoxicity. *Biomedicines, 11*(5), 1472. https://doi.org/10.3390/biomedicines11051472

Wetteland, C. L., Nguyen, N. Y., & Liu, H. (2016). Concentration-dependent behaviors of bone marrow derived mesenchymal stem cells and infectious bacteria toward magnesium oxide nanoparticles. *Acta Biomaterialia, 35*, 341-356. https://doi.org/10.1016/j.actbio.2016.02.023

Xu, J., Huang, Y., Zhu, S., Abbes, O., Jing, X., & Zhang, L. (2023). Applications and challenges of ultra-small particle size nanoparticles in tumor therapy. *Journal of Controlled Release, 353*, 699-712. https://doi.org/10.1016/j.jconrel.2022.12.016

Zheng, J. P., Yan, M., Jiang, H., & Yin, T. (2025). Carbon dots derived from corn silk and their antimicrobial properties. *Food & Medicine Homology, 2*(1), 9420094. https://doi.org/10.26599/FMH.2025.9420094

Cite this article: Hrithikraj M, Ponmalai M, Chandran AY, Shanmugam R. Nano Silver Incorporated Carbon Nanoparticles (*Drynaria quercifolia*): Synthesis and Antibacterial Activity Against Wound Pathogens. Pharmacog Res. 2027;19(2):703-8.