Abstract No: MO-05

In vitro evaluation of antibacterial activity mediated by palmyra pulp and sprout silver-zinc oxide nanocomposites

A. M. S. Aththanayake[1,2], G. Thiripuranathar[2*] and S. Ekanayake[2]

[1]Department of Biochemistry, Faculty of Medical Sciences, Sri Jayewardenepura University, Nugegoda, Sri Lanka.
[2]College of Chemical Sciences, Institute of Chemistry Ceylon, Welikada, Rajagiriya, 10107, Sri Lanka.
tgobika@ichemc.edu.lk*

Pathogenic bacterial resistance to antibiotics has become a significant barrier to the accurate identification and treatment of infectious diseases. To address this challenge, there is a high demand for new chemical substances acting as antibiotics or potential antibacterial targets. Biogenic metal nanoparticles (NPs)/ nanocomposites (NCs) show promise as sustainable solutions, exhibiting remarkable antimicrobial activities against various bacteria, viruses, and fungi. This study uses palmyra pulp and sprout extracts, rich in phytochemicals, to sustainably synthesize AgNPs, ZnO NPs, and Ag-ZnO NCs. Additionally, it aims to explore the effectiveness of overcoming bacterial resistance by suppressing resistance mechanisms through biogenic NPs and NCs. The study explored the impact of different factors (ion precursor concentration, extract-to-metal ion ratio, pH, irradiation methods, and incubation time) on nanomaterials (NMs) synthesis. The biogenic NMs were characterized by UV-Vis spectroscopy, FTIR, SEM, TEM, and XRD analysis. Antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* was also investigated. The positive controls used for comparison were Azithromycin and Tetracycline (2000 ppm: 100 µL). NMs synthesis was verified by surface plasmon resonance peaks: 436-438 nm for AgNPs, 350-354 nm for ZnO NPs, and 350-450 nm for Ag-ZnO NCs. FTIR analysis revealed the involvement of bioactive compounds as reducing and capping/stabilizing agents in phytoextracts. SEM analysis confirmed successful Ag-ZnO NCs synthesis, with spherical AgNPs aggregating on nanoflower-shaped ZnO NPs. TEM images showed the coexistence of Ag on ZnO for NCs, with an average particle size ranging from 11-120 nm for NMs. XRD analysis indicated a hexagonal wurtzite structure for ZnO and a face-centered structure for Ag during Ag-ZnO NCs formation. Biogenic AgNPs and Ag-ZnO NCs displayed the highest growth inhibition, while ZnO NPs had the least inhibitory activity. Pulp and sprout-mediated AgNPs (2000 ppm: 100 µL) showed greater inhibition zones against *E. coli* (16.0 ± 0.6 mm, 15.0 ± 1.0 mm respectively) and *S. aureus* (18.0 ± 0.3 mm, 19.0 ± 0.3 mm respectively). Pulp and sprout-mediated Ag-ZnO NCs (2000 ppm: 100 µL) exhibited average inhibition zones of 15.0 ± 0.3 mm and 14.0 ± 0.3 mm against *E. coli*, and 17.0 ± 1.0 mm and 16.0 ± 0.5 mm against *S. aureus*, respectively. The inhibition zones for Azithromycin against *E. coli* were 3.5 cm and Tetracycline against *S. aureus.* was 4.5 cm. There were no significant differences ($p \geq 0.05$) in growth inhibition between pulp-mediated AgNPs and Ag-ZnO NCs against *S aureus* and between sprout-mediated AgNPs and Ag-ZnO NCs against *E. coli*. However, there were highly significant differences in growth inhibition between extracts mediated AgNPs and ZnO NPs, and between ZnO NPs and Ag-ZnO NCs against both bacterial strains. These findings highlight the sustainable synthesis of Ag-ZnO NCs using palmyra pulp and sprout extracts, which effectively inhibit bacterial growth.

Keywords: Antibacterial activity, Ag-ZnO NCs, Biosynthesis, Palmyra pulp and sprout, Sustainable

Acknowledgment
This work was supported by the Institute of Chemistry Ceylon, Rajagiriya under the research grant umber 19/02.