Unlocking the antibacterial potential of zirconium oxide nanoparticles biosynthesized from *Aspergillus niger* against gram negative bacteria

Abdul Rahman Nursyarah Izzati, Ibrahim Nur Aina Athirah, Azizul Syahril Alani Fatini, Majeed Shahnaz, Muthukumarasamy Ravindran

Faculty of Pharmacy and Health Sciences Universiti Kuala Lumpur Royal College of Medicine Perak, No.3, Jalan Greentown, Ipoh, Perak Darul Ridzuan, Malaysia

ABSTRACT

Introduction: Advancements in nanotechnology has been widely accepted in various fields like biomedical, pharmaceutical, biotechnology etc. Green synthesis of nanoparticles is of high interest among the researchers due to their controlled nanoparticle synthesis using natural resources, economical, and ecofriendly to nature. **Objective:** The aim of this study is to explore the synergistic antibacterial activity of *Aspergillus niger (A. niger)* mediated biosynthesis of zirconium oxide nanoparticles (ZrO2NPs) against selected gram negative bacteria. **Materials and Method:** A. niger was isolated from forest soil and species confirmation was done through 18s rRNA sequencing. The ZrO2NPs were biosynthesized from A. niger extracellularly and underwent further analytical characterizations using UV-Visible Spectroscopy, Fourier transform infra-red spectroscopy (FTIR), Scanning electron microscope (SEM), Thermogravimetric analysis (TGA) and Zeta Potential analysis. The synergistic antibacterial activity was evaluated using disc diffusion method, biosynthesised ZrO2NPs was tested against *Escherichia coli* (ATCC 25922), *Proteus vulgaris, Vibrio cholerae* using different antibiotics. **Results:** The characterization results confirm the formation of ZrO2NPs from *A. niger*. The UV-Visible Spectroscopy recorded the maximum absorbance at 266 nm. FTIR analysis showed absorption peak which corresponds to O-H bond, C=O bond, C=C bond, Zr-O-Zr bond and Zr-O bond. SEM analysis revealed that the particles were spherical to irregular in shape. TGA analysis showed that the nanoparticles are highly thermostable at different temperatures. The zeta potential results (-34.1 mV) exhibited good stability of the nanoparticles. The biosynthesised ZrO2NPs showed good commendable synergistic antibacterial activity against *Escherichia coli* compared to the other two tested bacteria. **Conclusion:** To conclude the ZrO2NPs synthesized from *A. niger* shows good characteristics as a nano particle with significant anti-bacterial effects, however further studies is recommended for their comparison with gram positive bacteria and explore their mechanism and toxicity profiles for its biomedical application.