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The production of lignin-capped silver nanoparticles with high antimicrobial activity against multidrug resistant bacteria

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Background: One of the most important issues in healthcare today is the development of bacterial resistance to antibiotics which has created a generation of bacteria known as multidrug resistant (MDR) bacteria. Due to antibiotics' inability to treat these MDR bacteria metal and metal oxide nanoparticles have been gaining interest as antimicrobial agents. Among those, silver nanoparticles have been used extensively as broad spectrum antimicrobial agents. Here we describe the production and characterization of silver nanoparticles made from the wood biopolymer lignin as a reducing and capping agent with excellent antimicrobial activity against MDR bacteria. We describe and compare the productions of these particles both through a standard heating procedure and through a microwave irradiation procedure.

Methods: The lignin-capped silver nanoparticles were produced using a simple, one-pot synthesis method and characterized by ultraviolet-visual spectroscopy, dynamic light scattering, x-ray diffraction, and transmission electron microscopy. These particles were then tested for antimicrobial activity against clinical isolates of *S. aureus 700, P. aeruginosa, K. pneumoniae, A. baumannii, and E. casseliflavus*. The bacteria were exposed to the particles overnight in 96-well plates at increasing concentrations (1–20 μg/mL), and their minimum inhibitory concentration (MIC) was recorded for each bacterial strain.

Results: Characterization of the lignin-capped silver nano particles shows uniform spherical nanoparticles with a silver core and a lignin coating with a diameter of 62±1.9 nm for the standard heating and 42.03±0.39 nm for the microwave synthesis, but the microwave method was much faster (10 min vs. 3 days). The MIC of the silver nanoparticles was ≤2.5 μg/mL for S. aureus 700 and *P. aeruginosa*, and ≤1 μg/mL for all other tested strains.

Conclusion: Lignin-capped silver nanoparticles can be successfully produced using both standard heating and microwave irradiation, and show very high antimicrobial activity against a wide range of MDR bacterial strains.

Speaker Biography

Jason Asnis received his BEng in Chemical Engineering (2015) from McGill University, Canada. He is currently an MSc student in the Häfeli Lab in the Faculty of Pharmaceutical Sciences, at The University of British Columbia, Canada. In addition to his research position, he is also the Social Director for the Pharmaceutical Sciences Graduate Society.

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