

Evaluation of antibacterial activity in green synthesized chitosan–silver nanoparticles for therapeutic applications

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Green synthesis is a safe and eco-friendly way to make silver nanoparticles. Chitosan, a natural and biodegradable polymer was used as both the reducing and stabilizing agent in the silver nanoparticle synthesis. Chitosan-silver nanoparticles (CS-AgNPs) were synthesized by mixing chitosan (500 mg) with 500 ml silver nitrate solution (2 mM) while heating at 90 °C and stirring for 15 minutes followed by a dropwise addition of sodium hydroxide (1% W/V, 2.50 mL). A visual colour change from pale yellow to reddish brown, along with a surface plasmon resonance (SPR) band by UV-Visible spectroscopy, confirmed CS-AgNPs formation. Synthesized CS-AgNPs were characterized by Transmission Electron Microscopy (TEM), Fourier Transform Infrared Spectroscopy (FTIR). Antibacterial activity of CS-AgNPs was tested against *Staphylococcus aureus* and *Escherichia coli* using a liquid broth assay for a two-fold dilution concentration series. UV Visible spectroscopy showed the SPR band at 434 nm, confirming the successful formation of CS-AgNPs. FTIR analysis revealed characteristic bands at 3200–3600 cm⁻¹ (OH and NH stretching), 1300 and 1000

cm⁻¹ (C-O stretching) and 1000 to 1250 cm⁻¹ (CN stretching) indicating the presence of chitosan AgNPs as a capping agent. TEM images showed spherical particles with an average size of 15.68 nm. Optical density (OD600) values of the bacterial cultures were measured after 24h incubation period. Values of CS-AgNPs for the concentration series starting from 250 µg/mL were 0.489, 0.600, 0.773, 1.040, 1.054 respectively for *E. coli* while for *S. aureus* values were 0.464, 0.659, 0.732, 0.780, 0.818 respectively for the same concentration series. It was observed that OD600 values were decreased with increasing nanoparticle concentrations. Ciprofloxacin (30 µg/mL) was used as a positive control and OD600 values of 0.059 for *E. coli* and 0.077 for *S. aureus* were obtained. These findings demonstrate that CS-AgNPs exhibit dose-dependent antibacterial properties.

Keywords:

Green synthesis; chitosan; silver nanoparticles; optical density; antibacterial