Molasses-silver nanoparticles: synthesis, optimization, characterization, and antibiofilm activity

ABSTRACT

Biofilms are matrix-enclosed communities of bacteria that are highly resistant to antibiotics. Adding nanomaterials with antibacterial activity to the implant surfaces may be a great solution against biofilm formation. Due to its potent and widespread antibacterial effect, silver nanoparticles were considered the most potent agent with different biological activities. In the present investigation, silver nanoparticles (AgNPs) were newly synthesized as antibiofilm agents using sugarcane process byproduct (molasses) and named Mo-capped AgNPs. The synthesized nanoparticles showed promising antimicrobial activity against *S. aureus* ATCC 6538 and *C. albicans* DAY185. Statistically designed optimization through response surface methodology was evaluated for maximum activity and better physical characteristics, namely the nanoparticles' size and polydispersity index (PDI), and it was revealed that molasses concentration was the main effective factor. Minimal biofilm eradication concentration (MBEC) of Mo-capped AgNPs against *S. aureus* ATCC 6538 and *C. albicans* DAY185 was 16 and 32 µg/mL, respectively. Scanning electron microscope study of Mo-capped AgNP-treated biofilm revealed that AgNPs penetrated the preformed biofilm and eradicated the microbial cells. The optimally synthesized Mo-capped AgNPs were spherically shaped, and the average size diameter ranged between 29 and 88 nm with high proportions of Ag^{+} element (78.0%) recorded. Fourier-transform infrared spectroscopy (FTIR) analysis indicated the importance of molasses ingredients in capping and stabilizing the produced silver nanoparticles.