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Synthesis and characterization of bacteria-mediated silver nanoparticles

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Various organisms including plants and microorganisms can produce metal nanoparticles (NPs) intra- or extracellularly. Silver nanoparticles (AgNPs) were synthesized from *Pseudomonas aeruginosa* (ATCC 27853), *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922) and *Acinetobacter baumannii* (confirmed clinical isolate) in an eco-friendly and less toxic approach. Bacteria were cultured in nutrient broth medium. After 72 h of incubation, 1M $AgNO_3$ solution was added into cell free filtrates. The culture conditions ($AgNO_3$ concentration, pH, temperature, incubation time) were optimized to produce a maximum yield. Biosynthesized AgNPs were purified using ultracentrifugation followed by freeze drying. The characterization of synthesized NPs was performed using UV-Visible Spectroscopy, Fourier Transform-Infra Red Spectroscopy (FT-IR), X-ray Diffraction spectroscopy (XRD) and Transmission Electron Microscopy (TEM). In UV-Visible spectra, characteristic peaks around 425-433 nm were observed in all four biosynthesized AgNPs. This is found to be the first report on AgNP synthesis by *A. baumannii*. All biosynthesized AgNPs were spherical. The average sizes of the NPs were 11.14 ± 6.59 nm (*S. aureus* NPs), 11.71 ± 2.73 nm (*P. aeruginosa* NPs), 12.87 ± 2.95 nm (*E. coli* NPs) and 12.22 ± 2.45 nm (*A. baumannii* NPs). In FT-IR spectra, interaction between AgNPs and media components such as proteins and polymeric compounds was evident (bands at 2924 cm^{-1}, 2916 cm^{-1} and 1643 cm^{-1}, etc). According to XRD patterns of the Ag-NPs, characteristic diffraction peaks were obtained confirming crystalline structure of AgNPs. These results show that the bacteria mediated AgNP synthesis was successful, producing smaller AgNPs (< 20 nm) with a narrow size distribution.

Keywords: Silver nanoparticles, TEM, UV-Visible spectroscopy

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