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Synthesis, characterization and application of biopolymer (Pullulan)-mediated silver nanoparticles

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Metal-based nanoparticles serve very good applications in biomedical, nutritional, environment and electronic sectors. In the recent times, a novel concept, called as 'green synthesis of silver nanoparticles by combining biopolymer with silver nitrate for their stabilization. In this study, a rapid method for Pullulan-stabilized silver nanoparticles (PuAgNPs) synthesis has been developed. Different concentrations of Pullulan biopolymer (0.1-5.0% w/v) and Silver nitrate (1-12 mM) and effects of reaction time (0-30 min.), pH (@ 7.0, 9.2) were examined to investigate the formation of silver nanoparticles. The synthesized Pu-AgNPs were first screened and identified using surface Plasmon peaks of UV–VIS spectroscopy. The research results indicated that the surface Plasmon resonance peaks were observed between 410–460 nm wavelengths in UV-VIS spectroscopy studies. The morphology of the synthesized AgNPs proved a variation in spherical shape and polydispersed with an average size of 10-55 nm, using TEM. Further, five characteristic peaks (111, 200, 210, 211, 220) confirmed the presence of elemental silver and the crystalline structure of silver nanoparticles from XRD analysis. The sizes of the formed Pu-AgNPs estimated from the Debye–Scherrer's formula and the calculated nanoparticle size (in nm) also confirm the results obtained in average particle diameters from TEM studies. From FTIR spectra, stretching vibrations of hydroxyl (OH), Carbonyl (C=O) and C=C stretches exhibits the reduction and stabilization of AgNPs. Further, these pullulan-reduced AgNPs' potent antibacterial activities were analyzed using the agar well diffusion for the pathogens such as Escherichia coli, Staphylococcus aureus, Bacillus subtilis and Serratia marcescens. The synthesized PuAgNPs have shown clear zones of inhibition (about 10-25 mm) against these four bacterial pathogens in the antibacterial studies. Thus, the experimental results demonstrated that pullulan biopolymer could be used as reducing and stabilizing agent for formation of AgNPs and can be used as redoubtable bactericidal agents.

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