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Metal nanoparticle production assisted by α-amylase

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Background and Aims: Metal nanoparticles have different applications in chemistry, physics, biomedical and material sciences. Gold nanoparticles (AuNPs) are used in several purposes such as leukemia therapy, biomolecular immobilization and biosensor design. Silver nanoparticles (AgNPs) are applied as selective coating agent for solar energy absorption, catalysts in chemical reactions and antimicrobial agents. This study describes biosynthesis of Au, Ag and Au-Ag alloy nanoparticles assisted by α-amylase and characterizations of produced nanoparticles.
Methods: Formation of gold, silver and Au/Ag alloy nanoparticles was investigated by dissolving 2 mg of the pure enzyme (130 U/mg) in 2 ml deionized water followed by adding aqueous concentrations of HAuCl4 (0.05, 0.1, 0.5 and 1 mM), AgNO3 (0.05 to 10 mM) and different Au/Ag mole ratios (0.1:0.1, 0.1:0.5, 0.1:1, 0.5:0.1, 0.5:0.5, 0.5:1, 1:0.1, 1:0.5 and 1:1). UV-Vis spectra of the mixtures of nanoparticles were recorded in the range of 300–700 nm. Other characteristics of produced nanoparticles such as average particle size (Malvern master sizer instrument), SEM and EDX analysis (Philips, XL30, 30 KV), as well as FTIR were also determined.
Results: UV-Vis spectrum for Au, Ag and Au/Ag solution after incubation showed peaks at 530, 430 and 458-470 nm, respectively. Biosynthesis of AgNPs occurred only at 70°C in 0.1 to 4 mM concentrations of AgNO3. Optimum condition for production of Au/Ag alloy nanoparticles was found to be at 70°C with Au/Ag mole ratios of 0.1:0.1 and 0.1:1. In the mole ratio of 1:1 Au/Ag rapid formation of large and aggregated nanoparticles was observed. The average particle sizes of Au, Ag and Au/Ag alloy nanoparticle analyzed by laser light scattering method were found to be 86 nm, 37 nm and 63 nm, respectively.
Conclusions: The ability of α-amylase and probably its reducing group as a green biocatalyst for production of metal nanoparticles were described here.

Keywords: α-Amylase; Green synthesis; Au/Ag alloy; Bimetallic nanoparticles