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Hemicelluloses as reducing and dispersing agents for fabrication of noble metals nanoparticles

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Statement of the Problem: The hemicelluloses are heteropolymers of reducing sugars having aldehydic group in equilibrium with the cyclic form; thus they can reduce noble metal ions to metallic particles and can disperse particles in their network. The metal NPs thus prepared are suitable for biomedical applications.

Methodology & Theoretical Orientation: Hemicelluloses are of great value for fabrication of metal nanoparticles (NPs) due to their reducing and dispersion power, hydrophilicity, low cost, high thermal stability and biocompatibility. Metal NPs of copper (Cu), silver (Ag) and gold (Au) were rapidly obtained after mixing the aqueous suspensions of hemicelluloses, isolated from various plant species with precursor metal salts. Effect of various parameters such as amount of hemicellulose, pH and temperature was optimized by response surface methodology using Design Expert® 10.0.0 software.

Findings: The reduction of metal ions was observed by change in colour: yellowish to purple/blue/ruby red in case of gold or colourless to yellow/brown in case of silver, depending upon the temperature and pH, as monitored by recording the characteristic surface plasmon resonance (SPR) spectra in the 300-800 nm range. The synthesized NPs were spherical in shape and size of particles was determined by XRD, electron microscopy, dynamic light scattering techniques. The size was purely dependent on pH, amount of the hemicellulose and temperature of the reaction-mixture. The synthesized gold NPs were proved to be nontoxic as in cytotoxic tests.

Conclusion & Significance: The size of gold NPs (>30) obtained by certain hemicelluloses fits in the range which can hardly pass into the nucleus of cell, so they are suitable carriers for drug delivery. On the other hand NPs of silver and copper, showed dose-dependent antimicrobial and cytotoxicity activities, so have potential to be used as anti-cancer and anti-infective agents. Moreover, these types of biopolymers can be modified toward new functionalities with metals or biomolecules.

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