ABSTRACT

Swertia chirata, a critically endangered medicinal plant was explored for its reducing ability to synthesize silver and gold nanoparticles (Ag/AuNP). The appearance of surface plasmon resonance (SPR) band at 440 and 540 nm confirmed the biosynthesis of Ag/AuNP respectively. The optimum condition for maximum AgNP synthesis was 2.92 mM concentration of silver nitrate (SN), 23.83 % leaf extract (LE), pH 8.31 and temperature of 44.60 ºC. Maximum biosynthesis of AuNP was achieved under the optimized condition of 4 mM concentration of gold chloride (GC), 17.24 % LE, pH 4.6 and temperature of 53.61 ºC. The synthesized Ag/AuNP were characterized by transmission electron microscopy (TEM) along with selected area electron diffraction (SAED) pattern and energy dispersive X-ray (EDX), atomic force microscopy (AFM), X-ray diffraction (XRD) and fourier transform infrared (FTIR) analysis. TEM analysis revealed that the average size of AgNP synthesized was 20 nm and mainly spherical in shape. AuNP was also spherical shaped along with that a few nanotriangles and hexagonal particles were observed. The diameter of AuNP ranged from 0.5 to 60 nm where average size of AuNP was 50 nm. XRD analysis of the particles confirmed the crystalline nature. Results of AFM and XRD were in accordance with the results obtained from TEM. The plausible mechanisms for the reduction of SN/GC to Ag/AuNP, respectively were proposed following the identification of functional groups by FTIR. The biological activities of AgNP mainly focused on the studies pertaining to in vitro shoot regeneration of *S. chirata* and genotoxicity assessment both at mitotic and meiotic levels using *Allium cepa* chromosomal model. Incorporation of AgNP in the culture medium improved the shoot regeneration of *S. chirata*. Possible role of AgNP by incorporation of ethylene inhibitor and precursor with or without AgNP along with ROS regulation has been illustrated. In contrast to the stimulatory effect on *S. chirata*, AgNP induced severe chromosomal aberrations (CA) in both mitotic and meiotic cells of *A. cepa*. Apart from biological activities, catalytic activity of Ag/AuNP was tested against three textile organic dyes like methylene blue (MB), methyl orange (MO) and rhodamine B (RB) under fluorescent (FL) and LED light conditions. The study revealed that combination of proper nanocatalyst and efficient light source was necessary for proficient degradation of dyes.

Keywords: Nanoparticles, silver, gold, optimization, shoot regeneration, mitosis, meiosis, catalytic activity, dye.