CHAPTER 6

SUMMARY

In the present investigation, silver and gold metal nanoparticles were biologically synthesized using plants such as Coriandrum sativum and Coleus amboinicus, fungi such as Cylindrocladium floridanum and Sclerotium rolfsii, and bacterium, Xanthomonas oryzae pv. oryzae. All these biogenic nanoparticles were characterized using UV–Vis spectrophotometer (UV–Vis), powder X-ray diffractometer (XRD), Fourier transform Infrared spectrometer (FTIR), scanning electron microscope (SEM), high-resolution transmission electron microscope (HR-TEM), fluorescence microscope, inductive coupled plasma-optical emission spectrometer (ICP-OES), energy dispersive X-ray spectrometer (EDAX) and thermogravimeter (TGA). Fungal mycelia based silver- and gold-bionanocomposites were prepared and efficiently used for the degradation of organic nitropollutant such as 4-nitrophenol.

Silver nanoparticles (spherical, decahedral, (111)-oriented fcc, 23.6 nm) were extracellularly synthesized using Coriandrum sativum leaf extract. Aromatic amine, amide II, alcohols and phenols were involved in stabilization of nanoparticles. Silver nanoparticles (spherical, triangle, truncated-triangle, decahedral, (111)-orientated fcc, 30.6 nm) were synthesized by leaf extract of Coleus amboinicus. Aromatic amine, amide I and II, and alcohols were involved in stabilization of nanoparticles.
Silver nanoparticles (monodispersed spherical, (111)-oriented fcc, 25 nm) were extracellularly synthesized by fungus *Cylindrocladium floridanum*. Molecules with functional groups amide I and II, carboxylate ion and amines were involved in stabilization of nanoparticles.

Silver nanoparticles (spherical, triangle, rod, (200)-oriented fcc, 14.86 nm) were extracellularly synthesized by bacterium, *Xanthomonas oryzae* pv. *oryzae*. Molecules with amide I linkage, alcohols and carboxylate ions were involved in capping and stabilization of nanoparticles.

Gold nanoparticles synthesized extracellularly using the leaf extracts of *C. sativum* and *C. amboinicus* showed the formation of (111)-oriented fcc structure with more anisotrophic structures like spherical, triangle, truncated triangle and decahedral with an average size of 20.65 nm and 20.5 nm respectively. Monodispersed nearly spherical nanoparticles were extracellularly synthesized by *Cy. floridanum* with an average size of 19 nm. Amide I linkage and amines and alcohols were involved in stabilizing the particles.

Using a facile method, within 15 minutes gold nanoparticles (spherical, triangle, hexagonal, decahedral, rod, (111)–oriented fcc, 23.57 nm) were extracellularly synthesized by *Sclerotium rolfsii*. Amide I linkage, amines, and COO\(^{-}\) group from amino acids were involved in stabilization of nanoparticles.
Intracellular synthesis of gold and silver nanoparticles was achieved using *Cy. floridanum*. The gold crystals accumulated on the outer surface of cell wall of mycelia showed (111)-oriented fcc structured spherical crystals in the size range of 5–35 nm. Similarly, intracellular silver crystals were accumulated on the cell wall and inner surface of cytoplasmic membrane of fungal mycelia showed (111)-oriented fcc structured spherical nanoparticles in the size range of 5–55 nm.

Both silver and gold nanoparticles have the heterogeneous catalytic potential to reduce the toxic pollutant, 4-nitrophenol to 4-aminophenol. Silver- and gold-bionanocomposites were synthesized using the fungus, *Cy. floridanum*. The rate of reduction of 4-nitrophenol by silver- and gold-bionanocomposites follows pseudo-first-order kinetic model. The rate of reduction increases with reduced size of silver nanoparticles in the silver-bionanocomposite. In contrast, the rate of reduction decreases with the increased size of gold nanoparticles in the gold-bionanocomposite.