



Synthesis of Silver Nanoparticles by Plant-Mediated Green Method: Optical and Biological Properties

Anuoluwa Abimbola Akinsiku¹, Enock Olugbenga Dare², Kolawole Oluseyi Ajanaku¹, Joseph Adeyemi Adekoya¹, Samson Oluwagbemiga Alayande^{3, 4}, and Alaba Oladipupo Adeyemi¹

¹Department of Chemistry, Covenant University, Canaan Land, Nigeria

²Department of Chemistry, Federal University of Agriculture Abeokuta, Nigeria

³Centre for Energy Research and Development, Obafemi Awolowo University, Nigeria

⁴Nanotechnology for Water Sustainability, University of South Africa, South Africa

In this study, silver nanoparticles (Ag NPs) were successfully synthesized by plant-mediated green route. The leaf extracts of locally sourced *Canna indica* and *Senna occidentalis* acted as the reducing agents/capping agents instead of toxic chemicals leading to unprecedented bioreduction which promoted nucleation and particle growth within 2 minutes of reaction. Optical measurements were characterized by high intensities of absorption revealed by narrow absorption peaks indicating confinement of excitons, with surface Plasmon resonance (SPR) bands of silver nanoparticles at 340–380 nm (*S. occidentalis*-stabilized Ag NPs) and 400–430 nm (*C. indica*-stabilized Ag NPs). Morphological characterization with scanning electron microscope coupled with energy dispersed spectrometer (SEM-EDS) and transmission electron microscope (TEM) revealed quasi-spherical, cubic and truncated edge Ag NPs with mean sizes of 9.10 ± 1.12 nm and 9.4 ± 1.95 nm. Formation of crystalline Ag NPs was also supported by X-ray diffraction (XRD) pattern and selected area electron diffraction (SAED) showing peak broadening. FTIR analysis revealed some characteristic vibrational bands of O–H, C–O, C–N functional groups at 3306, 1647 and 1246 cm^{-1} respectively in the organically capped silver nanoparticles. The mechanism of reaction in both syntheses was considered to be diffusion controlled Ostwald ripening process. The antimicrobial activity of the synthesized nanoparticles was tested against clinically isolated Gram positive bacteria: *Staphylococcus aureus*, *Streptococcus pyogenes* and clinically isolated fungus-*Candida albicans*. Significant growth inhibitions were found using analysis of variance (ANOVA), SPSS statistical tool at $P < 0.05$. The highest activity of *C. indica*-synthesized Ag NPs was against *C. albicans*, while *S. occidentalis* derived Ag nanoparticles were most active against *S. aureus* and *S. pyogenes*. Hence, the findings of this research suggest potential applications of the bionanoparticles as optical materials, electronically conductive adhesives (ECA), and as a candidate for therapeutic drugs because of their biogenic nature.

Keywords: Silver Nanoparticles, *Canna Indica*, *Senna occidentalis*, Antimicrobial Activity, Optical Property.