ABSTRACT

Nanotechnology has endorsed enormous development in material science to formulate innovative products by manipulating matter at nano-scale. Due to certain limitations associated with conventional physico-chemical synthesis protocols, novel techniques are still being pursued for fabrication of nanomaterials. Among these protocols, biological synthesis of nanoparticles using plant extract has been considered comparatively, eco-friendly, efficient and cost-effective. This thesis presents study on the investigation of different parts of *Eucalyptus camaldulensis* and *Eucalyptus citriodora* for their ability to synthesize silver nanoparticles. Further, work on the nature and scope of nanoparticles in different applications has been reported.

A green synthesis route for the production of silver nanoparticles using aqueous extracts of leaves stems and fruit of *E. camaldulensis* and *E. citriodora* was explored. Five solutions with varying concentration of plant material were prepared for each of three parts i.e. leaves, stems and fruit of both plant. Among these thirty (30) collected samples, six were selected for further analysis and applications depending upon the information collected from their UV-Vis spectra. Three samples from each plant including one sample for each part were collected. 1 Mm silver nitrate solution was mixed with plant extract at 45 °C under basic medium with stirring time 30 min and formation of silver nanoparticles was observed through color change from light yellow to dark brown Thus synthesized silver nanoparticles were characterized by UV-Vis spectrophotometer, having a surface Plasmon resonance (SPR) band centered at 406 nm, Dispersity and morphology was characterized by scanning electron microscope (SEM). Crystalline nature and purity of synthesized silver nanoparticles were revealed by X-ray diffraction (XRD) and energy dispersive X-ray spectroscopy (EDX). FTIR spectrum was examined to identify the effective functional molecules responsible for the reduction and stabilization of silver nanoparticles synthesized by extracts of parts of plants. For the selected six samples, the effect of time and temperature variation was also observed. The results showed that time of reaction, temperature and concentration of extract could accelerate the reduction rate of Ag^{+} and also affect the size and shape of Ag NPs. The

nanoparticles were found to be about 50 nm to 100 nm in size, mono-dispersed in nature and spherical in shape.

The investigated applications of Ag NPs include catalytic degradation of different dyes and antimicrobial activity. The work emphasizes the effect of the size of silver nanoparticles on the degradation rate of hazardous dyes like methyl orange, methylene blue and eosin Y by $NaBH_4$. The efficiency of silver nanoparticles as a promising candidate for the catalysis of degradation of organic dyes by $NaBH_4$ through the electron transfer process is established in the present study. Catalytic degradation of methyl orange, methylene blue and Eosin Y was measured spectrophotometrically under visible light illumination. These processes were studied by monitoring the simultaneous decrease in the height of absorbance peak of dye solution and increase in the height or shifting of plasmon peak corresponding to silver nanoparticles. The results showed that silver nanoparticles are an efficient catalyst for degradation of dyes and their efficiency depends on morphology of nanoparticles. Biosynthesized samples of silver nanoparticles were found to be impressive in degrading methyl orange. The finalized six samples were also used to evaluate their antimicrobial activity against two bacterial strains, one from gram-positive and one from gram-negative. The zone inhibition results were found to be in comparison of reference standard of Streptomycin.

Among the prepared samples of both plants, six were forwarded for further evaluation and their sizes and shapes were related to time, pH, temperature and concentration of plant extract. After complete characterization, these were evaluated for degradation of dyes and antimicrobial behavior. Both of the applications were assisted through notably prominent results.