

Plant-mediated synthesis of ZnO nanoparticles from *Dillenia triquetra* leaf extract and investigation of photocatalytic efficiency

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Zinc Oxide (ZnO) nanoparticles (NPs) are widely utilized semiconductor photocatalysts due to its eco-friendly nature and cost effectiveness in degrading environmental pollutants. In this study, plant extract-based synthesis of ZnO NPs was achieved using *Dillenia triquetra* leaf extract, where natural phytochemicals acted as reducing and capping agents. The leaves of *D. triquetra* collected were powdered and subjected to extraction with deionized water. The synthesis parameters including pH, precursor concentration, and extract to precursor ratio were optimized to obtain nanoparticles with desirable properties. The physical properties of the synthesized ZnO nanoparticles (NPs) were analyzed using UV-visible spectroscopy, Fourier transform Infrared spectroscopy (FTIR), X-ray diffraction (XRD) and scanning electron microscope (SEM) analysis. UV-visible analysis showed characteristic absorption peak for ZnO NPs at 356 nm while the FT-IR spectra confirmed the presence of functional groups in the synthesized ZnO nanoparticles. XRD patterns confirmed the crystalline nature of the

synthesized NPs and SEM analysis indicated mostly spherical nanoparticles with an average size of 10.53 ± 0.47 nm. The photocatalytic activity of ZnO NPs was investigated against Methylene Blue (MB) organic dye and it was optimized with respect to MB dye concentration, pH of the solution, and the catalytic load. The optimum conditions were identified as pH 11, 5 ppm MB concentration, and 5 mg catalytic load. Under optimum experimental conditions, the synthesized ZnO nanoparticles achieved up to 95% degradation of MB over 2 hours, demonstrating their strong potential as an effective photocatalyst for reducing water pollution. Further investigations will be conducted to evaluate the performance of ZnO NPs with other organic dyes and polluted samples in addition to MB.

Keywords:

Zinc oxide, green synthesis, *Dillenia triquetra* leaf extract, photocatalytic activity