MITIGATION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL HAZARD MITIGATION

Green Synthesis Of TiO2 Nanoparticles Using Maerua Oblongifolia Root Extract For Hazard Mitigation: A Preliminary Investigation

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The green synthesis of TiO2 nanoparticles (NPs) using plant extracts offers a promising, effective, sustainable, eco-friendly, and cost-effective nanotechnology over conventional chemical and physical methods. Over the last few years, NPs synthesizing methods have been developed; however, NPs using plant extracts are limited. This study focuses on synthesizing TiO2 NPs utilizing an aqueous extract from Maerua oblongifolia roots, aiming to investigate their efficacy as reducing, capping, and stabilizing agents. The research addresses the pressing need for sustainable and efficient hazard mitigation systems, particularly in the face of chemical and biological threats. The synthesized TiO2 NPs were characterized by UV–visible spectroscopy, FTIR, X-ray, diffraction thermogravimetric analysis, and scanning electron microscopy studies. Preliminary results revealed distinct peaks in the UV-Vis spectra at 323 nm, confirming successful TiO2 NPs synthesis. XRD analysis indicated a crystalline nature with a specific particle size range yet to be determined. The presence of bioactive molecules essential for TiO2 NPs synthesis predicted by FTIR. SEM imaging showcased spherical morphology within a size range of 200 nm to 500 nm. The TiO2 NPs were subjected to photocatalytic degradation experiments targeting toxic pollutants under various conditions, including sunlight, dark, and short UV irradiation. The analysis of degradation efficiency considered parameters such as irradiation time, catalyst dose, pH, and initial dye concentration, demonstrating significant correlations through empirical regression quadratic models. Additionally, the antibacterial activity of TiO2 NPs was assessed using the agar-well diffusion method against E. coli and S. aureus, with initial findings indicating stronger efficacy against E. coli. Our research findings indicate promising catalytic properties of the synthesized TiO2 NPs for degrading toxic pollutants and exhibiting antibacterial activity. These results signify a potential breakthrough in hazard mitigation systems, offering sustainable and effective solutions for decontamination.

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