Biosynthesis of Ag-Doped CuO Nanoparticles Using *Heracleum persicum* Extract for Enhanced Antibacterial and Photocatalytic Dye Degradation Properties

RESEARCH | Published: 12 April 2024
(2024) Cite this article

Plasmonics
Aims and scope →
Submit manuscript →

Rusul A. Ghazi, Ahmed Salman Jasim, Kamran Heydaryan, Hossein Khojasteh, Mohsen Mohammadalizadeh, Shaymaa Awad Kadhim & Vahid Eskandari

Abstract

The utilization of natural resources in the synthesis of nanoparticles has emerged as a cost-effective and environmentally sustainable strategy, fostering significant advancements in various fields. This study presents the synthesis of copper oxide nanoparticles doped with silver nanoparticles utilizing *Heracleum persicum* (*H. persicum*) extract (CuO-Ag@*H. persicum*). Characterization techniques including XRD, FT-IR, SEM, and TEM confirmed the successful synthesis of homogeneous CuO-Ag@*H. persicum* nanoparticles without impurities, exhibiting a spherical morphology with sizes ranging from 35 to 65 nm. The incorporation of silver nanoparticles on the surface of the copper oxide introduces unique optical properties, notably the surface plasmon resonance (SPR) phenomenon, enhancing photocatalytic activity. Under UV and sunlight irradiation, CuO-Ag@*H. persicum* nanoparticles displayed superior photocatalytic degradation of organic pollutants (rhodamine B and erythrosine) compared to pure copper oxide nanoparticles. Remarkably, under UV light, CuO-Ag@*H. persicum* nanoparticles achieved degradation percentages of 97.6% and 94.3% for rhodamine B and erythrosine, respectively, surpassing pure copper oxide nanoparticles. Additionally, the antibacterial efficacy of CuO-Ag@*H. persicum* nanoparticles was evaluated against Gram-positive and Gram-negative bacteria, demonstrating promising minimum inhibitory concentrations (MIC). According to the antibacterial activity results, the MIC value against *Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli*, and *Klebsiella pneumoniae* was 5, 5, 2.5, and 1.25 mg/ml, respectively. This study underscores the significant potential of synthesized CuO-Ag@*H. persicum* nanoparticles in environmental and biomedical applications, particularly in enhanced photocatalytic degradation and antibacterial activities, thereby contributing to novel advancements in material science with practical implications.

Sections Figures References
Abstract
Availability of Data and Materials
References
Acknowledgements
Funding
Author Information
Ethics declarations
Additional information
Rights and permissions
About this article