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Antioxidant and Antimicrobial Activity of Pure and Ag-Doped $CuFe_2O_4$ Nanoparticles Prepared by Microwave-Assisted Green Synthesis

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Abstract: *This investigation demonstrates the successful fabrication of silver-substituted copper ferrite nanoparticles (AgxCu1-xFe2O4, where x = 0.05, 0.1, 0.2) through microwave-assisted biosynthesis utilizing Asteracantha longifolia leaf extract as both reducing and stabilizing agent. X-ray diffraction analysis confirmed single-phase cubic spinel structures with lattice parameters ranging from 8.294 to 8.165 Å. Electron microscopy revealed morphological transitions from spherical to irregular geometries with crystallite sizes between 15.43 and 18.85 nm. Enhanced optical absorption in the UV-visible region (300-800 nm) resulted from surface plasmon resonance effects of silver nanodomains. Magnetic characterization showed decreased saturation magnetization correlating with silver content, attributed to diamagnetic Ag^+ ions disrupting magnetic exchange interactions. Thermal analysis indicated structural stability up to 600°C with minimal mass loss. Antioxidant evaluation through DPPH radical scavenging demonstrated concentration-dependent activity enhancement, with AgxCu1-xFe2O4 exhibiting 55.35% radical neutralization efficiency compared to 41.87% for undoped copper ferrite.*

Keywords*:* Microwave, sol-gel, Ferrite, X-ray diffraction, HRTEM, Antimicrobial activity