

Green Synthesis of Copper Nanoparticles for Antimicrobial and Water Purification Applications

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Abstract: The green synthesis of nanoparticles (NPs) has gained significant attention in nanotechnology due to its eco-friendly and cost-effective approach. Copper nanoparticles (Cu NPs) exhibit notable properties, including antimicrobial activity and disinfecting capabilities. Green-synthesized NPs are highly effective in heavy metal removal and wastewater treatment, addressing global water quality concerns. The plant-mediated synthesis of nanomaterials is advantageous as it utilizes naturally occurring biomolecules for metal ion reduction and stabilization. Silver nanoparticles were successfully synthesized within 10 minutes and demonstrated antibacterial effects. Similarly, green-synthesized Cu NPs have been employed as nano-adsorbents for the removal of pharmaceutical contaminants such as ibuprofen (Ibu), naproxen (Nab), and diclofenac (Dic) from wastewater. Optimal removal was achieved under conditions of 298 K, pH 4.5, and 60 minutes, with the adsorption process being endothermic. Additionally, copper-enriched paper sheets exhibited a bacterial reduction of log 8.8 against *E. coli*. The CuNP-infused paper filter presents a promising, cost-effective solution for water purification..

Keywords: Wastewater Treatment, Nanoparticles, Copper, Green Synthesis, Applications, Characterization, Disinfection

