

**Title:** Synthesis of Green Copper Nanoparticles Using Medicinal Plant *Hagenia abyssinica* (Brace) JF. Gmel. Leaf Extract: Antimicrobial Properties

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### **Abstract**

Indigenous medicinal plant of Ethiopia has been applied for the first time to investigate the synergistic influence of phytoconstituents in green copper nanoparticles (g-Cu NPs) towards the enhancement of antimicrobial properties of NPs. We report the green synthesis of Cu NPs using *Hagenia abyssinica* (Brace) JF. Gmel. leaf extract. The synthesized g-Cu NPs were characterized by UV-visible, UV-DRS, FT-IR, XRD, SEM, EDXA, TEM, HRTEM, and SAED techniques. The maximum absorbance,  $\lambda_{max}$ , was found to be 403 nm for g-Cu NPs due to surface plasmon resonance. The energy gap,  $E_g$  of NPs, was found to be 2.19 eV. FTIR spectra confirmed the presence of polyphenols, tannins, and glycosides in the leaf extract of *Hagenia abyssinica*. The spectral band at 740  $cm^{-1}$  is a characteristic of interaction between Cu and biomolecules of the extract. The XRD analysis revealed that the g-Cu NPs appears to be more crystalline in nature. SEM and TEM micrographs showed a mix of spherical, hexagonal, triangular, cylindrical, and irregularly shaped Cu particles. The average particle size of NPs was found to be 34.76 nm by ImageJ analysis. EDX analysis confirmed the presence of copper in the g-Cu NPs. In addition, the SAED pattern of g-Cu NPs presented concentric circular patterns for 4 major planes of crystalline copper and its oxides. The experimental and calculated  $d$ -spacing values of one of the crystal planes (111) were found to be 0.2432 nm and 0.2444 nm, respectively. The  $d$ -spacing values of 0.2444 nm and 0.2040 nm correspond to  $d_{111}Cu_2O$  and  $d_{111}Cu$  lattice fringes, respectively. The antibacterial test conducted on *E. coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis* showed good zone of inhibitions 12.7, 12.7, 14.7, and 14.2 mm, respectively, proving potentiality of g-Cu NPs as a remedy for infectious diseases caused by tested pathogens.

### **Keywords:**

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