

## Study of synergistic bioactivities of *Coffea arabica* leaf extract with copper oxide nanoparticles

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This study explores the concept of synergistic bioactivities, where combined substance action exceeds individual effects, producing enhanced biological reactions. *Coffea arabica* leaves are subjected to maceration using hexane and methanol, producing extracts for detailed analysis. The methanol extract, rich in Phenols and Flavonoids, underwent thorough investigation. Simultaneously, copper oxide nanoparticles (CuO NPs) were synthesized via chemical synthesis using Copper(II)acetate as the starting material, NaOH; the reducing agent and Glacial Acetic Acid. Characterization of the nanoparticles was done by UV-visible spectroscopy and FTIR analysis. Anti-inflammatory effects were evaluated using the Albumin denaturation inhibitory assay, while the anti-bacterial properties were assessed through the Agar Well-diffusion method against *E. coli* and *S. aureus* bacteria, representing gram-negative and gram-positive strains, respectively. Combining the *Coffea arabica* methanol extract with CuO NPs exhibited significant bioactivity across each category. The combination produced the lowest IC<sub>50</sub> value ( $75.19 \pm 0.05 \mu\text{g/mL}$ ), surpassing individual activities of coffee leaves ( $138.854 \pm 0.12 \mu\text{g/mL}$ ) and CuO NPs ( $1508.38 \pm 0.09 \mu\text{g/mL}$ ), indicating remarkable anti-inflammatory activity of the combination. Meanwhile, maintaining the plant extraction at 5 mg/mL while varying nanoparticle concentration from 0.5 mg/mL to 8 mg/mL against bacteria revealed enhanced anti-bacterial properties with increasing nanoparticle concentration in the combined form. Individual activities were inferior to the combination confirming nanoparticles boost Coffee leaves' antibacterial properties. These findings propose pharmaceutical and nutraceutical applications for inflammation and bacterial infection treatment by combining CuO NPs with *Coffea arabica* leaf extract. Further research is essential for understanding mechanisms and thoroughly evaluating the safety and toxicity profiles of this synergistic blend.

**Keywords:** *Coffea arabica*, Copper oxide nanoparticles, Synergistic, Anti-inflammatory, Anti-bacterial

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