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Green synthesis and characterization of silver nanoparticles using *Vitex leucoxylon* extracts: Analysis of anti-inflammatory activity

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In this investigation, silver nanoparticles (AgNPs) were synthesised through an eco-friendly approach using aqueous leaf extracts of *Vitex leucoxylon*, and their anti-inflammatory activity was examined *in vitro*. The resulting nanoparticles underwent thorough physicochemical characterization employing UV–Vis spectrometry, FTIR, scanning electron microscopy, X-ray diffraction, and dynamic light scattering. A sharp absorbance near 400 nm in the UV–Vis spectrum verified successful nanoparticle formation. FTIR analysis suggested that bioactive plant compounds played a crucial role in reducing and stabilizing the silver ions. Microscopy revealed that the particles were predominantly spherical with moderate uniformity, while crystallinity was affirmed by XRD. The particles ranged in size from approximately 10 to 80 nm, and DLS analysis revealed a dual-modal distribution with peaks around 75.9 nm and 274.5 nm, along with a zeta potential of –1.3 mV. The anti-inflammatory efficacy was validated using LPS-stimulated RAW 264.7 macrophages in MTT and nitric oxide assays, showing that AgNPs enhanced cell survival and reduced nitric oxide production more effectively than the crude extract. Molecular docking studies further revealed a strong interaction between AgNPs and the COX-2 enzyme, with a binding score of –8.2 kcal/mol. These results suggest that *Vitex leucoxylon*-based AgNPs hold promise as bioactive agents in anti-inflammatory therapy.

Keywords: Phytochemical capping agents, Cyclooxygenase-2 inhibition, Nitric oxide suppression, Molecular docking proxy model, RAW 264.7 macrophages