Title: ***Stellera chamaejasme-Driven Green Nanosilver forCatalysis of Bacteria and Toxic Dye***

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Abastact: Metal nanoparticles produced via green chemistry routes offer broad potential for nanotechnology, yet their practical deployment is often constrained by colloidal instability and aggregation. Herein, silver nanoparticles (AgNPs) were biosynthesized using phytonutrients in *Stellera chamaejasme* L. *S. chamaejasme* root extract (SCRE), which served as both reducing and stabilizing agents. The synthesis was optimized through a one-variable-at-a-time (OVAT) approach, enabling precise control of reaction conditions. A characteristic surface plasmon resonance peak at 402 nm confirmed the formation of AgNPs and the appearance of a distinct yellow coloration. Under optimal conditions, the AgNPs were spherical, uniformly dispersed, and highly crystalline, with an average size of 23.3 ± 3.3 nm and a d-spacing of 0.236 nm. Selected-area electron diffraction (SAED) patterns confirmed a face-centered cubic (FCC) structure. The biogenic AgNPs demonstrated strong antibacterial efficacy, achieving >98.5% reductions in *Staphylococcus aureus* (*S. aureus*) and *Escherichia coli* (*E. coli*) with inhibition zones of 14.25 ± 1.43 mm and 12.34 ± 1.2 mm, respectively. Furthermore, they catalyzed the degradation of reactive yellow 179 dye, achieving nearly 100% removal within 30 min, following pseudo-first-order kinetics ($k = 0.11155\ \text{min}^{-1}$, $R^2 = 0.9973$). These results highlight the potential of SCRE-mediated AgNPs for applications in antimicrobial coatings and sustainable wastewater treatment, particularly in textile effluents.

Keywords: antibacterial | azodye catalysis | green synthesis | silver nanoparticles | Stellera chamaejasme

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