GREEN SYNTHESIS OF SILVER NANOPARTICLES USING LIPOPHILICITY-MODIFIED LINDEN EXTRACTS

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Green synthesis of silver nanoparticles has emerged as a sustainable alternative to conventional chemical methods, particularly for antimicrobial and biomedical applications, yet achieving controlled stability and surface functionality using plant extracts remains challenging. This study aimed to evaluate whether modification of the lipophilic properties of Tilia cordata (linden) flower and leaf extracts can improve the reduction, stabilization, and surface energy control of silver nanoparticles synthesized via a green approach. Crude linden extract, Medusomyces gisevii–fermented extract, and enzymatically modified extract were employed as reducing and stabilizing agents, and the resulting nanoparticles were characterized using UV–Vis spectroscopy, SEM, TEM, SAED, XRD, FTIR, and colorimetric analysis. Antimicrobial activity was assessed against Gram-positive and Gram-negative bacteria and Candida albicans, while antioxidant capacity was evaluated using CUPRAC, ABTS, and DPPH assays; in addition, in vitro antifungal activity was tested on post-harvest table grapes. All extract variants successfully produced stable, predominantly spherical silver nanoparticles with nanometer-scale dimensions and defined crystallinity, while extract modification influenced particle size, aggregation behavior, and surface chemistry. Silver nanoparticle formulations exhibited markedly enhanced antimicrobial activity compared to crude extracts, with enzymatically modified nanoparticles showing the strongest broad-spectrum effects, whereas antioxidant activity displayed matrix-dependent changes following nanoparticle formation. Overall, the results demonstrate that tuning the lipophilicity of linden extracts is an effective strategy for controlling the physicochemical and biological properties of green-synthesized silver nanoparticles, highlighting their potential for sustainable antimicrobial and antioxidant applications.

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