

Potential of Agro Products in Green Synthesis of Nano-Metal Pharmaceuticals

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Abstract: *Green synthesis of metal nanoparticles has emerged as a sustainable and eco-friendly alternative to conventional chemical and physical synthesis methods. This study investigates the potential of agro products including fruit peels, leaves, seeds, and agricultural residues as natural reducing, capping, and stabilizing agents in the synthesis of nano-metal pharmaceuticals. Agro-derived extracts rich in phytochemicals such as polyphenols, flavonoids, terpenoids, and tannins were utilized to synthesize silver, gold, zinc oxide, copper oxide, and iron oxide nanoparticles. The formation of nanoparticles was confirmed through a visible color change, UV-Visible spectroscopy showing distinct SPR peaks, FTIR identification of functional biomolecules involved in reduction and stabilization, XRD confirmation of crystallinity, and SEM/TEM analysis indicating predominantly spherical morphologies with good dispersity. Comparative yield analysis demonstrated that phytochemical-rich extracts produce smaller, more uniform nanoparticles with higher stability.*

Pharmaceutical evaluations revealed significant antimicrobial, antioxidant, and cytotoxic properties of the synthesized nanoparticles, highlighting their therapeutic potential. The DPPH assay indicated strong radical scavenging activity, while antimicrobial tests showed effective inhibition zones against selected bacterial strains. Cytotoxicity studies demonstrated dose-dependent anticancer activity, particularly in nanoparticles synthesized using extracts with higher phytochemical content. Although green synthesis offers advantages of biocompatibility, low toxicity, sustainability, and cost-effectiveness, challenges remain in standardization, reproducibility, and large-scale production. This study supports the feasibility of agro product-mediated green synthesis as a promising platform for producing nano-metal pharmaceuticals suited for biomedical applications.

Keywords: Green synthesis, Green synthesis, Metal nanoparticles, Phytochemicals, Phytochemicals, Antimicrobial activity, Cytotoxicity

