

## Assessing the Efficacy of Pumpkin Waste-mediated Zinc Oxide Nanoparticles in Enhancing Agro-waste Valorization through Antioxidant Activity Evaluation

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### Abstract

The utilization of agro-waste to synthesize nanoparticles (NPs) has drawn significant fascination owing to its crucial role in promoting environmental sustainability. This study focused on utilizing agro-wastes of Suprema F1 variety, pumpkin leaf (PL), pumpkin peel (PP), and pumpkin seeds (PS) and synthesizing ZnO NPs to examine the antioxidant potential. By utilizing aqueous extracts of the agro-waste under various conditions, (ion precursor concentration, the ratio of plant extract to ion solution, pH, irradiation methods [solar, microwave, UV], incubation time) the best conditions for synthesizing ZnO NPs with higher yields were identified. NPs were characterized using UV-vis spectroscopy, FTIR, SEM, TEM, and XRD analysis. Antioxidant potential was assessed using DPPH, ABTS, and FRAP assays. The formation of ZnO NPs was preliminarily characterized through surface plasmon resonance peaks within the range of 340 - 350 nm. FTIR analysis indicated the presence of the hexagonal phase of ZnO, while SEM analysis revealed the hexagonal morphology of NPs, with sizes below 320 nm observed through TEM analysis. XRD analysis confirmed the formation of desired hexagonal wurtzite crystalline structure of ZnO. The results revealed that plant extracts have lower antioxidant activity than phyto-genic ZnO NPs, and PL-mediated ZnO NPs exhibited the highest DPPH (IC<sub>50</sub>; 42.81 ppm) and ABTS•<sup>+</sup> (IC<sub>50</sub>; 170.99 ppm) radical scavenging activities. The antioxidant potential of PL-ZnO NPs compared with ascorbic acid (AA) was 1.42 mg AAE/g as measured by FRAP assay. *In vitro*, antioxidant potentials revealed that PL-ZnO NPs had higher antioxidant potential than PP and PS-mediated ZnO NPs. Suprema F1 agro-waste converted into eco-friendly ZnO NPs with effective antioxidant activities.

**Keywords:** *Antioxidant potential, Suprema F1, ZnO NPs*