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Evaluation of *in vitro* Antioxidant Potential of Multifaceted Phytogenic ZnO Nanoparticles Synthesized from Peel Waste Extracts of *Ananas comosus* Varieties

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Green synthesized nanoparticles (NPs) reveal many advantages over conventional physiochemically synthesized NPs and exhibit numerous applications in various fields. The present study focused on the synthesis of zinc oxide (ZnO) NPs from *Ananas comosus* peel waste extracts that are obtained from two varieties: Murusi and Kew. The effect of various parameters on green NPs synthesis was studied, including Zn $(CH_3COO)_2$. $2H_2O$ ion precursor concentration, peel extract to ion precursor ratio, irradiation methods (solar, microwave, UV), pH of the medium, and incubation time. The structural properties of NPs were investigated by UV-Vis spectrophotometer, FTIR spectroscopy, XRD, SEM, and TEM. The antioxidant potentials were determined using 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) assays. The optimal conditions for the synthesis of ZnO NPs were 0.1 M Zn $(CH_3COO)_2$. $2H_2O$ concentration, 4:1 metal ion solution to peel extract ratio, microwave irradiation, medium pH of 12, and a 24-hour incubation time for both peel extracts. The absorption of surface plasmon resonance (SPR) peaks appeared in the range of 340 to 350 nm. The presence of O-H and N-H bioactive functional groups involved as capping agents in the synthesis of ZnO NPs was confirmed by FTIR. According to the XRD pattern, the average crystallite size of the Murusi and Kew peel mediated ZnO NPs under optimal conditions was 14.74 nm and 14.47 nm, respectively. SEM analysis revealed that Murusi and Kew mediated NPs were spherical in shape. The presence of rod-shaped ZnO NPs synthesized from Murusi and Kew peel was confirmed by TEM images with sizes of 15.44 nm and 10.23 nm, respectively. The biosynthesized ZnO NPs were found to have a high antioxidant potential. At 100 ppm, Kew peel-mediated ZnO NPs had a higher DPPH radical scavenging capacity (84%) than Murusi peel-mediated ZnO NPs (79%). Similarly, Murusi and Kew peel mediated ZnO NPs showed high FRAP scavenging power when compared to metal ion precursor and peel extracts.

Keywords: *antioxidant activity, agro waste, Kew and Murusi, peel extract, Zinc oxide nanoparticles*