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Green Synthesis and Characterization of Zinc Oxide Nanoparticles Using Neem (Azadiractha Indica) Leaf Extract and Investigate Its Antibacterial Activities

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Abstract : Zinc oxide nanoparticles (ZnO NPs) have attracted huge attention due to catalytic, optical, photonic, and antibacterial activity. Zinc oxide nanoparticles were successfully synthesized via a fast, non-toxic, cost-effective, and eco-friendly method by biologically reducing Zn(NO3)2.6H2O solution with Neem (Azadirachta indica) leaf extract under optimum conditions (pH = 9). The presence of active flavonoids, phenolic groups, alkaloids, terpenoids, and tannins, which were in the biomass of the Neem leaf extract before and after reduction, was identified using qualitative screening methods (observing the color changes) and FT-IR Spectroscopy. The formation of ZnO NPs was visually indicated by the color changes from colorless to light yellow color. Biosynthesized nanoparticles were also characterized by UV-visible, FT-IR, and XRD spectroscopies. The reduction process was simple and convenient to handle and was monitored by UV-visible spectroscopy that showed surface plasmon resonance (SPR) of the ZnO NPs at 321 nm. This result clearly revealed the formation of ZnO NPs. X-ray diffraction was used to investigate the crystal structure. The average particle size of ZnO powder and around 20 nm using the line width of the plane, and the refraction peak using Scherrer's equation. The synthesized zinc oxide nanoparticles were evaluated for antimicrobial activities against Gram-positive and Gram-negative bacteria. Zinc nanoparticles exhibited the maximum zone of inhibition against Escherichia coli (15 mm), while the least activity was seen against Staphylococcus aureus.

Keywords : antimicrobial activity, azadirachta indica, green synthesis, ZnO NPs
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