Reactivity of Crystalline ZnO Superstructures against Fungi and Bacterial Pathogens: Synthesized Using Nerium oleander Leaf Extract

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ABSTRACT:

For the first time, different morphologies of zinc oxide (ZnO) superstructures are synthesized by a simple and environmental friendly route using *Nerium oleander* leaf extract as fuel. Powder X-ray diffraction, scanning electron microscopy, UV–visible spectroscopy, and photoluminescence studies are performed to ascertain the formation and characterization of ZnO. X-ray diffraction confirmed the crystalline nature of the compound with hexagonal Wurtzite structure. When the concentration of the leaf extract is varied, different morphologies are formed. ZnO are tested for antifungal using soybean seed-borne fungi by food-poison method and antibacterial activity against bacterial human pathogens by a broth microplate dilution method using 96-well plates. Among the screened soybean seed-borne fungi, *Fusarium equisiti* was found to be more susceptible, which was followed by *Macrophomina phaseolina* for ZnO nanoparticles (NPs) prepared using 0.2188 mol/dm^3 *N. oleander* leaf extract. It was observed that NPs exhibited pronounced antifungal activity in a dose-dependent manner with a relatively high percentage of mycelial inhibition. ZnO obtained with the concentration of 0.2188 mol/dm^3 leaf extract showed both minimum inhibitory concentration and minimum bactericidal concentration effectiveness compared to other synthesized compounds. It is observed that the

samples with small crystallite size show greater antibacterial activity than those of larger crystallite size. Further, we found that crystallite size and morphology significantly affects the antibacterial activity of ZnO. Prepared compounds showed significant inhibition against *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, and *Pseudomonas aeurginosa*. Among the tested bacteria, *P. aeurginosa* is more susceptible and *E. coli* is the least effective against bacterial pathogens. The antibacterial activities of the as-formed ZnO are preliminarily studied against Gram-positive (*B. subtilis* and *S. aureus*) and Gram-negative (*E. coli* and *P. aeruginosa*) bacteria and are found to be dependent on the shape of the nanostructures.