

# Green Synthesis of Zinc Oxide Nanoparticles: A Comprehensive Review

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**Abstract:** *The synthesis of zinc oxide nanoparticles (ZnO NPs) using green chemistry approaches has gained significant attention due to its eco-friendly nature, cost-effectiveness, and biocompatibility. Conventional physical and chemical synthesis methods often involve toxic chemicals and high energy consumption, raising concerns about environmental sustainability. Green synthesis offers an alternative by utilizing plant extracts, microorganisms, and natural polymers as reducing and stabilizing agents. This review provides an in-depth discussion on various biological methods employed for ZnO NP synthesis, their mechanisms, characterization techniques, and applications in biomedical, environmental, and industrial fields. Additionally, challenges and future perspectives of green synthesis are explored.*

**Keywords:** zinc oxide nanoparticles

