

Silver Oxide Nanoparticles: Synthesis, Characterisation and Antimicrobial Properties: A Review

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Structured Abstract

Background: The growing incidence of antimicrobial resistance poses a significant threat to global health, prompting urgent efforts to find alternative therapeutic agents. Silver oxide nanoparticles (AgO NPs) have shown potential in this area due to their favourable physicochemical and antimicrobial properties. Silver has been used for a long time and is a well-studied antimicrobial agent, and the unique physicochemical profile of nanotechnology enables novel uses of silver.

Literature Review: AgO NPs are synthesised chemically, physically, or biologically. Chemical methods provide high yield; they also use toxic chemicals. Green synthesis uses plant extracts from various species, such as *Lawsonia inermis* and *Phragmanthera macrosolen*, as a safer, greener alternative. Characterisation by SEM, XRD, DLS, and FTIR yields insight into the size, shape, and elemental composition of the synthesised nanoparticles. Smaller, well-dispersed particles allow better release of Ag⁺ ions, thereby providing stronger antimicrobial action. The mechanisms of AgO NPs include membrane disruption, ROS production, and interference with DNA/protein synthesis, and microbial pathways are blocked, which reduces the chance of microbial resistance

Objective: This review will examine the various synthesis methods for AgO NPs, how their physical properties correlate with their antimicrobial activity, and the biochemical mechanisms underlying their antimicrobial effect. Our aim is to provide insights into AgO NPs to improve their production and use against resistant pathogens safely and effectively.

Conclusion: Silver oxide nanoparticles can be a flexible and powerful solution to microbial resistance. Green synthesis routes that produce stable, nanosized, and potent AgO nanoparticles have shown potential as a solution. The multifaceted mechanisms of action, from the generation of oxidative stress to interference with gene expression, enable effectiveness against even multidrug-resistant microbes. AgO nanoparticles have significant potential in therapeutic and environmental applications, but these issues must first be resolved.

Keywords: Silver oxide nanoparticles, antimicrobial resistance, green synthesis, reactive oxygen species, nanoparticle characterisation, microbial membrane disruption

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