

Antibacterial properties of Cuprous Oxide nanoparticles against *Staphylococcus aureus*

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Antimicrobial properties of copper ions and salts are well known. Antibacterial activities of cuprous oxide nanoparticles (Cu₂O-NPs) against *Staphylococcus aureus*, especially strains like vancomycin intermediate *S. aureus* (VISA) and heterogeneous vancomycin intermediate *S. aureus* (hVISA) with thickened cell wall, have not been studied. Hence we evaluated the antibacterial and antibiofilm activities of Cu₂O-NPs against hVISA and VISA strains since such strains are emerging global health care problems and they show poor clinical response to vancomycin therapy.

Nanoscaled octahedral Cu₂O-NPs were generated by solution phase technology. Field emission electron microscopy demonstrated particles size ranged from 100-150 nm. Five bacterial strains, *S. aureus* (ATCC 29213), Mu3 (hVISA), Mu50 (VISA), and two clinical hVISA isolates (St1745, B10760) were used in this study. Minimum inhibitory concentration (MIC) and minimum biofilm inhibitory concentration (MBIC) of Cu₂O-NPs to these strains were determined by broth dilution technique. Bacterial membrane damaging properties of Cu₂O-NPs were studied by leakage of cellular constituents, uptake of ethidium bromide (ETBr) and propidium iodide (PI), and binding of vancomycin-bodipy (dipyromethene boron difluoride [4,4-difluoro-4-bora-3a,4a-diazas-indacene] fluorescent dye) to bacterial cell wall.

Cu₂O-NPs inhibited the growth of hVISA and VISA strains and showed antibiofilm activity. MIC and MBIC of Cu₂O-NPs ranged from 625 µg/ml to 5000 µg/ml and 2500 µg/ml to 10,000 µg/ml, respectively. Bacterial exposure to Cu₂O-NPs caused leakage of cellular constituents and increased uptake of ETBr and PI by bacteria. Significant reduction in vancomycin-bodipy binding to bacterial cell wall and reduction in viable bacterial counts in presence of 7.5% sodium chloride were also observed. Assessment of Cu₂O-NPs toxicity by haemolysis assay showed no cytotoxic effect at concentrations between 625 and 10000 µg/ml.

In conclusion, Cu₂O-NP_s are capable of disrupting cell membrane of *S. aureus* including VISA and hVISA strains and reducing their biofilm formation with no apparent in vitro cytotoxicity. The above observations suggest use of Cu₂O-NPs as effective anti-staphylococcal and antibiofilm agents on medical devices. Further studies of these nanoparticles on other microbial species including yeasts and assessment of their in-vivo toxicity are required for future clinical applications.

Biography:

Dr Kashi Nath Prasad completed his MD from Institute of Medical Sciences, Banaras Hindu University, Varanasi, India. He is Professor of Microbiology at Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, a tertiary care referral hospital in North India. He has guided 16 PhD and 10 MD students. He has published more than 200 scientific papers, mostly in reputed International Journals. He has received several awards by different Academic Bodies and Scientific Societies. He is a Fellow of Royal Society of Tropical Medicine and Hygiene, International Congress of Environmental Research, National Academy of Medical Sciences (India) and Indian Academy of Tropical Parasitology. He has been invited speaker in more than 50 National and International events.