Synthesis and Evaluation of Histidine-Capped Silver Nanoparticles Loaded with Ciprofloxacin as a Potent Antibacterial Formulation

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ABSTRACT

Introduction: The scientific discipline of nanotechnology is becoming more and more significant every day. Researchers are employing nanotechnology to combat bacterial strains that have developed resistance to broad-spectrum antibiotics. In this research, the activity of the drug Ciprofloxacin has been enhanced by synergizing it with histidine-capped silver nanoparticles.

Objectives: The presented research therefore loaded the antibiotic ciprofloxacin (CIP) onto histidine - capped AgNPs (silver nanoparticles), resulting in improved antibacterial activity of CIP against resistant strains of Gram-negative bacteria; *Pseudomonas aeruginosa* and *Escherichia coli*; Gram-positive bacteria, *Staphylococcus aureus* and *Listeria monocytogenes*. Histidine stabilizes the AgNPs conjugate against aggregation and controls the size of AgNPs

Methodology: All AgNPs were characterized through color transition, UV-visible spectrometry, Fourier-Transform infrared spectroscopy, and scanning electron Microscopy. The antibacterial, antioxidant, and anti-biofilm activities of AgNPs, HisAgNPs, and Cip-HisAgNPs were tested against the resistant strains, through the well-diffusion method, DPPH scavenging assay, and anti-biofilm assay.

Key Findings: Results have shown that Cip-HisAgNPs exhibited enhanced antimicrobial activity in contrast to ciprofloxacin and bare AgNPs. The Nano-conjugate of Cip-HisAgNPs inhibited the growth of bacteria remarkably, and the highest zone of inhibition in diameters was 35 mm for *E. coli*, 28 mm for *P. aeruginosa*, 25 mm in *S. aureus* and 28 mm in *L. monocytogenes*. The anti-biofilm activity is manifested among several bacterial strains where Cip-HisAgNPs completely inhibited the biofilm of resistant bacteria at several concentrations. Similarly, Cip-HisAgNPs exhibited the highest antioxidant activity at the concentration of 100 µg/ml. To our knowledge, this is the first time Nano-conjugate of Cip-HisAgNPs has been synthesized and the results of UV-visible spectroscopy, FTIR, and SEM further support the formation of Cip-HisAgNPs.

Conclusion: The histidine-capped silver nanoparticles conjugated with ciprofloxacin has shown enhanced antimicrobial activity against resistant bacterial strains.

Keywords: Histidine Capped Silver Nanoparticles, Ciprofloxacin, *Staphylococcus aureus, Pseudomonas aeruginosa, Listeria monocytogenes, Escherichia coli,* Antibacterial activity.

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