

## Paper 17

### SYNTHESIS AND CHARACTERISATION OF NANOSILVER/CIPROFLOXACIN HYBRID AND SILVER-CIPROFLOXACIN COMPLEX AND THEIR ANTIMICROBIAL ACTIVITIES AGAINST *Staphylococcus aureus*

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#### ABSTRACT

Metals have been found to enhance the efficacy of fluoroquinolones against increasing antibacterial resistance. In this work, nanosilver/ciprofloxacin composite (Ag<sup>0</sup>/CIP) was synthesized, characterized, and its antimicrobial sensitivity evaluated against *Staphylococcus aureus*. Zerovalent silver nanoparticles (AgNPs) were synthesized using *Aloe vera* extract. Consequently, different compositions of Ag<sup>0</sup>/CIP hybrid were prepared. The synthesis of the silver-ciprofloxacin complex (Ag<sup>I</sup>-CIP) was done by reaction of solutions of silver nitrate and the ciprofloxacin hydrochloride. The products were characterized by Uv-Vis spectroscopy, Infra-red spectroscopy (IR) and Scanning Electron Microscopy (SEM) coupled with Energy Dispersive X-ray analysis (EDX). The products and constituents were tested against *Staphylococcus aureus* using the plate agar diffusion method. The result of the Uv-Vis analysis revealed that the AgNPs showed plasmon band at 425 nm. The IR spectra of *Aloe vera* showed prominent bands at 3377, 3288, 2942, 2852, 1618, 1543, 1261, and 1076 cm<sup>-1</sup> depicting -NH<sub>str</sub>, -C-H (aldehydic), amide I, II, and III, -CO<sub>str</sub> which are characteristics of phenolic compounds. These bands were also found in the IR spectra of AgNPs indicating the efficient capping of the nanoparticles by the plant extract. The bands around 1700 and 1600 cm<sup>-1</sup> assigned to 3-carboxylate and 4-keto groups of ciprofloxacin hydrochloride appeared also in the IR spectrum of Ag<sup>I</sup>-CIP meaning the carboxylate and keto oxygens are uncoordinated. This suggests that the silver is coordinated through the terminal piperazinyl nitrogen. SEM analysis depicts the surface morphology of the AgNPs as poly-dispersed and spherical particles. EDX analysis also confirmed the presence of metallic silver. A comparable activity against *Staphylococcus aureus* was observed for ciprofloxacin, nanosilver/ciprofloxacin and silver-ciprofloxacin complex.

Keywords: Fluoroquinolone, Ciprofloxacin, metal complexes, antimicrobial study, nanosilver