

ABSTRACT

Bacterial resistance to antibiotics has driven the development of drug delivery systems using nanoparticles to effectively control antibiotic loading and release. In this study, ZnO:Fe nanoparticles were synthesized with the addition of water hyacinth extract to produce mesoporous materials. Ciprofloxacin was used as a model antibiotic to evaluate drug loading and release characteristics over 6 hours. Structural and morphological characterizations were performed using X-ray diffraction, Field Emission Scanning Electron Microscopy, and Fourier transform infrared spectroscopy, while surface properties were characterized using the Brunauer-Emmett-Teller method. The formation of ZnO:Fe was identified from X-ray diffraction patterns, confirming a hexagonal wurtzite structure. The crystallite size and particle distribution indicated a uniform nanograin structure. ZnO:Fe nanoparticles exhibited an average pore size of 7.81 nm with a specific surface area of 63.607 m²/g. The ciprofloxacin loading capacity of ZnO:Fe increased almost linearly with time, reaching 10.36 mg/g. However, the release profile showed an increase exponential pattern with a release efficiency of 92%. This study provides insights into the role of pore size and specific surface area in the design of ZnO-based antibiotic carriers.

Keywords: zinc oxide, Fe doping, water hyacinth extract, ciprofloxacin, drug loading and release.