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Research Article

Green synthesis of metronidazole or clindamycin-loaded hexagonal zinc oxide nanoparticles from *Ziziphus* extracts and its antibacterial activity

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Abstract

Green chemistry has become a fruitful approach for the synthesis of semiconductors and nanoparticles with various applications. Herein, we synthesized ZnO hexagonal nanoparticles (HNPs) by green precipitation method using fresh local *Ziziphus* leaf extract (Rhamnaceae) with a heating range of 60–80 in an alkaline medium. It was calcinated on a furnace at 500 °C for 2 h. to get a very fine and homogeneous pale-yellow powder which is then loaded with either metronidazole or clindamycin. The physical characterizations of the particles' morphology, size, and purity were measured using the Scanning electron microscope, UV-spectroscopy, and the Fourier transform infrared spectroscope. The size of ZnO nanoparticles (44.63 nm) was measured using scanning electron microscopy (SEM), and the mean crystal size of the precursor (17.37 nm) was measured using X-ray diffraction methods (XRD). The antibacterial activity of these particles was measured against Staphylococcus aureus bacterial strains and analyzed using a "well-diffusion technique" which revealed that metronidazole or clindamycin-containing ZnO nanoparticles showed good bactericidal activity.

Keywords

ZnO (HNPs), GS, *Ziziphus* leaf extract, drug delivery, Antibacterial activity

1. Introduction

Nanotechnology is an emergent new research field that deals with the synthesis of nanostructures and nanoparticles (NPs) and their use in numerous fields including pharmaceutics, electrical chemistry, biomedical technologies, catalysis, makeups, sensors, nutrition technology, health care, fabric industry, mechanics, physical optics, microelectronics, space engineering, and energy discipline, etc. (Ahmed et al. 2017). Nanotechnology comprises the production of molecules at a nano-measure under a controlled milieu. The NPs have various physical and chemical alterations in their characteristics such as biomechanical features, electrical conductivity, optical absorptive activity, melting degree, and catalysis activity compared with large substances with a similar chemical structure (Perveen et al. 2020). The novel features of NPs are extensively arranged for several applications in biomedicine, makeups, medical devices, as well as environmental remediation (Jamdagni et al. 2016). NPs are also known as the "wonder of modern medicine" owing to its characteristic properties. Several physical and biochemical approaches