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Antibacterial Effect of Carboxymethyl Cellulose Hydrogel Containing Zinc Oxide Nanoparticle Against *Pseudomonas Aeruginosa*

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ABSTRACT

Introduction: The emergence of a wide range of resistant infections caused by bacterial pathogens increases the need for new strategies and drug molecules to combat bacterial infections, particularly those caused by *Pseudomonas aeruginosa*. *P. aeruginosa* is a Gram-negative opportunistic pathogen that is resistant to many antibiotics and can survive in hospital environments. Nanomaterials, particularly metal ones, have shown promising antibacterial effects against various infections. Zinc oxide nanoparticles (NPs) are absorbed due to their antibacterial properties and wide usage in the medical industry. This study used carboxymethyl cellulose (CMC) as a base to disperse zinc oxide NPs.

Methods and Materials: After preparing microbial culture media, glycerol stock, and hydrogel, the bacterial culture was incubated in liquid and solid culture media. The hydrogel was prepared by adding CMC to acetate buffer, and zinc oxide NPs were added to one section. An in vitro antibacterial activity assay was conducted by spreading bacterial culture on agar plates and sampling different substances, including erythromycin gel, hydrogel with zinc oxide NPs, zinc oxide ointment, and control hydrogel without NPs. The plates were then incubated for observation of bacterial growth or non-growth. The next day, the plates were examined in the non-growth zone.

Results: In the growth culture plate, the zinc oxide NP hydrogel sample prevented bacterial growth, resulting in a non-growth zone. This observation demonstrates that the hydrogel containing zinc oxide NPs exhibits a significant antibacterial effect against *P. aeruginosa*. In the first section of the plate, where zinc oxide ointment was applied, there was no zone of inhibition, and the bacteria growth was evident. However, in the second section, where erythromycin gel was used, a clear zone of inhibition was observed. Bacterial growth is present in the fourth and fifth sections, which were treated with CMC hydrogel without zinc oxide NPs.

Conclusion and Discussion: According to our findings, the hydrogel composed of CMC containing zinc oxide NPs demonstrated antibacterial activity, whereas standard zinc oxide particles were ineffective in inhibiting bacterial growth. Therefore, it is worthwhile to conduct further experiences using zinc oxide NPs incorporated into a CMC gel base.

Keywords: Pseudomonas aeruginosa, Nanoparticles, Zinc oxide

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