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Erythromycin loaded zinc oxide nanoparticles embedded electrospun alginate-based nanofibrous scaffolds for wound dressing applications

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Background: Emergence of multi drug resistant (MDR) bacterial strains is a global healthcare crisis. Therefore, there is an escalating need to improve the efficacy of existing antibiotics against. Nanoparticle incorporated antibiotic delivery system is one alternative to combat with MDR. ZnO nanoparticles (ZNP) reinforced alginate-based nanofibrous scaffolds were successfully fabricated via electrospinning technique to mimic the natural extracellular matrix (ECM) structure which is favorable for tissue regeneration process. These scaffolds provide slow release regimes and make the nanoparticle more biocompatible.

Objective: To synthesize erythromycin grafted ZNP embedded electrospun alginate-based nanofibrours scaffolds for wound dressing applications.

Methods & Materials: Erythromycin was loaded into ZNP using the vacuum evacuation process. ZNP-erythromycin nanoparticles coated with concentric layers of alginate and polyvinyl alcohol (ALG-PVA) were fabricated through electrospining technique. Bare ZNP, loaded ZNP and final matrix were characterized physically, thermally and chemically. Further, loading capacity, antibacterial efficacy and biocompatibility of the prepared systems were assessed.

Results: Nano fibers ranged in diameter from 80 to 120 nm. The loading efficiency of erythromycin was confirmed using thermogravimetry and a UV-vis based drug release study, which revealed the loading to be between 45% and 50 wt%. The ALG-PVA coating was revealed to extend the erythromycin's release (97%) from the ZNP from 24 to 72 hours. The antimicrobial assay exhibited the ALG-PVA electrospun formulation to be effective against both Gram-positive and Gram-negative strains. The cytotoxicity and cell viability studies discovered that the final matrix is non-toxic to cells and human body, with the alginate acting to protect cells from cytotoxic effects up to at least 24 hours post-encounter.

Conclusion: Electrospun ZnO based ALG-PVA scaffolds were able to provide slow-release regimes and make the nanoparticle more biocompatible. Interestingly, these fabricated scaffolds may serve as a sustained and biocompatible antimicrobial protection platform, which can be utilized as synthetic ECM scaffolds for tissue engineering applications.

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