TOXICOLOGICAL EVALUATION OF BIOCOMPATIBLE POLY(VINYL ALCOHOL) (PVA) NANOFIBERS INCORPORATING NISIN

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INTRODUCTION: Nisin is a lantibiotic bacteriocin commonly produced by *Lactococcus lactis* and is widely used as a biopreservative. Nanofibers are structures formed by extremely thin polymeric fibers and can be produced through the electrospinning method. Electrospun nanofibers incorporating nisin can be fabricated using biodegradable and biocompatible polyvinyl alcohol (PVA), a material gaining attention due to its safety and environmental appeal. Such nanostructures can encapsulate bioactive compounds, including antimicrobials, antioxidants, and enzymes, serving as efficient carriers in various applications. OBJECTIVE: This study aimed to incorporate nisin into PVA nanofibers via electrospinning and evaluate their antimicrobial, antioxidant, and toxicological properties to explore their potential in biomedical and packaging applications. MATERIALS AND METHODS: Nanofibers were produced using polymeric solutions of 10% (100 mg/mL) and 15% (150 mg/mL) PVA, with 0.125 mg/mL of nisin. Control nanofibers without nisin were also prepared. Surface morphology was analyzed by scanning electron microscopy (SEM). Antimicrobial activity was assessed via agar diffusion assay, and antioxidant capacity using ABTS radical scavenging. Toxicity was evaluated by hemoglobin release, MTT assay (ISO 10993-5), and agar diffusion cytotoxicity test using L929 cells. RESULTS AND CONCLUSION: All formulations successfully formed nanofiber mats with diameters ranging from 295.5 to 402.0 nm. Nisin-loaded nanofibers inhibited *Staphylococcus aureus*, maintaining activity even after 1.5 years, and were effective against *S. aureus* and *Listeria monocytogenes* in a milk-based model. Antioxidant activity ranged from 757 to 777.83 µM TEAC. Hemolysis rates were low (0.01–1.24%), indicating non-hemolytic properties. PVA10 and PVA10+nisin showed no significant cytotoxicity or reduction in

cell viability. Minimal cell damage was observed with PVA10 exposure, indicating slight reactivity. PVA10+nisin showed slightly increased NR uptake, suggesting higher metabolic activity. This indicates the fibers' ability to leach bioactive compounds without significant toxicity. PVA-Nisin nanofibers demonstrated antimicrobial and antioxidant activity with excellent biocompatibility, supporting their potential as safe and effective carriers for bioactive compounds in pharmaceutical, biomedical, and food applications. These results suggest that the nanofibers exhibit good biocompatibility, making them a promising biomaterial. It is essential to develop more infrastructure and resources for the safety assessment of nanotechnologies, which will help refine methods, expand knowledge, and accelerate commercial adoption.

KEYWORDS: electrospun nanofiber; nisin; biocompatible polymers; toxicological evaluation

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