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Abstract

Poly(vinyl alcohol)/polycaprolactone Co-Axial Wet-Spun Fibrous Scaffolds Loaded with Ceftazidime and Vancomycin for the Eradication of *P. aeruginosa* and *S. aureus* Bacteria in Diabetic Foot Wounds †

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Abstract: Annually, the incidence of diabetic foot ulcers (DFUs) varies between 9.1 to 26.1 million worldwide, with numbers increasing each year. About 25% of diabetic patients develop DFUs, with near 70% of those requiring lower limb amputation. DFUs often fail to progress past the inflammatory phase due to increased bacterial colonization and recurrent infection. Over the last decades, technology breakthroughs have demonstrated the impact of bioactive 3D, fiber-based scaffolding systems in the treatment of DFUs (DOI: 10.1016/j.ijpharm.2021.120423). In the present project, co-axial wet-spun microfibrous scaffolds are proposed as drug delivery platforms for infection control in DFUs-prevalent bacteria infested environments. Microfibers with a shell made of poly(vinyl alcohol) (PVA) at 10 wt.% in water and a core of polycaprolactone (PCL) at 10 wt.% in dimethylformamide were engineered via wet-spinning in a 8 wt.% Na2SO4 and 4 wt.% NaOH coagulation bath. Ceftazidime and vancomycin minimum bactericidal concentrations (MBC) against *S. aureus* and *P. aeruginosa* were determined at 32.0 μg/mL and 7.8 μg/mL, respectively. Antibiotics were loaded at 2 × MBC at the shell of the microfibers. PCL was used to sustain the scaffolding structure and convey mechanical resilience, while PVA was used primarily as a drug carrier, maintaining a local moist environment and absorbing exudates. The microfibers co-axial structure was confirmed via bright-field microscopy. Both polymers and antibiotics presence were verified via Fourier-transform infrared spectroscopy (FTIR) and UV-visible spectroscopy, following antibiotic release up to 24 h in phosphate buffer (PBS, pH 7.4). Artificial exudates were used to attest the scaffold swelling capacity and map its degradation profile. Scaffolds could maintain >80% of their mass up to 28 days of incubation in dynamic conditions. Antimicrobial testing revealed the drug diffusion abilities of the scaffolding system, forming zones of inhibition in single and co-culture settings. Time-kill kinetics studies established this drug delivery platform as effective for infection control in non-sterile DFUs-mimicking environments within a 24 h period.

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