Title : Design and Fabrication of Poly(***ε***-caprolactone) Nanofibers for Use as Biodegradable Wound Dressing Applications.

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ABSTRACT

Chronic wounds, particularly pressure ulcers in bedridden patients, remain a major clinical challenge due to persistent inflammation, elevated risk of infection, and impaired tissue regeneration. The development of wound dressing materials that provide both structural support for cellular infiltration and intrinsic biological functionality is therefore of significant importance. This study aimed to fabricate electrospun nanofibrous wound dressings based on poly(***ε***-caprolactone) (PCL) incorporated with an extract of Andrographis paniculata to enhance anti-inflammatory and antioxidant performance. PCL was synthesized via ring-opening polymerization (ROP) of ***ε***-caprolactone monomers. The resulting polymer was characterized in terms of solution viscosity and thermal properties to ensure suitability for electrospinning. Electrospinning parameters were systematically investigated, including polymer solution concentrations 8, 10, 12, 14,16, 18 and 20% w/v, flow rates 0.05, 0.10 and 0.20 ml/min, a fixed collector distance of 15 cm, and an applied voltage of 15 kV. The polymer solutions were supplemented with A. paniculata extract at concentrations ranging from 1, 3 and 5% v/v prior to fiber fabrication. The morphology of the electrospun fibers was evaluated using Scanning Electron Microscopy (SEM), and fiber diameters were measured using ImageJ software. The results demonstrated that increasing extract content significantly affected fiber diameter and mechanical properties, indicating that extract incorporation alters both solution characteristics and fiber formation behavior. Mechanical performance was likewise influenced in a concentration dependent manner. Overall, the incorporation of Andrographis paniculata extract into electrospun PCL nanofibers represents a promising strategy for developing multifunctional wound dressings that integrate structural integrity, mechanical robustness, and bioactive functionality within a single material platform. This work highlights a materials driven design approach toward clinically relevant wound dressings suitable for long term therapeutic applications.

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