Polydioxanone (PDO) microfibers obtained by centrifugal spinning as skin/tendon tissue substitutes

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Polydioxanone (PDO) is a bioabsorbable polyester derived from p-dioxanone monomers which recently gained particularly interest in biomedical field thanks to its optimum biocompatibility, modular degradation rate, and excellent mechanical properties. The aim of this study was to achieve PDO fibers by centrifugal spinning avoiding the use of toxic solvents, typical of other spinning techniques as electrospinning [1][2]. Deep eutectic solvents (DESs) were employed to improve PDO spinning in melt form. In particular, choline chloride/citric acid (ChCl/CA) and betaine/citric acid (Bet/CA) DESs were respectively assessed. Physical mixtures were prepared by blending different polymer/DES weight ratios and maintaining the DES (ChCl/CA or Bet/CA) molar ratio equal to 1:1. The physical mixtures were then poured into the spinneret and melted at 140°C for 5 min. Then, the blends were spun for 1-2 min at 700 rpm. Except for PDO alone, all PDO/DES mixtures spun using the handmade centrifugal spinning apparatus gained fibers and the suitability of DES as plasticizer agent was demonstrated. Scanning electron microscopy analysis (SEM) showed smooth and continuous fibers with dimension ranging from 10 to 20 µM and the hydration did not affect the fiber structure. Microfibers were assembled in aligned and random macro structures and the mechanical behaviors were assessed. Both macro conformations exhibited excellent elastic nature and high tensile strengths (≈8-10 MPa). PDO/DES microfibers resulted biocompatible on human fibroblasts ensuring cellular adhesion and proliferation. The resultant microfibers can be envisioned as optimal biomedical devices to treat skin (random, cotton-like structure) or tendon (aligned, high tough woven band) lesions.