22294 - Poster

Evaluation of the Compatibility of Electrospun Collagen/PVA Scaffolds Crosslinked with Citric Acid

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Abstract

Abstract: In this study, the effect of citric acid crosslinking below the denaturation temperature on electrospun mats composed of PVA and collagen was investigated. PVA, due to its inherent solubility, exhibits limited stability, while collagen is a key biopolymer in the extracellular matrix. Collagen was solubilized in 0.5 M mild acid, and 10% w/v PVA was blended with varying concentrations of citric acid relative to PVA. Electrospinning parameters were kept constant for all solutions. The resulting mats were first heat-treated in an oven at 40 °C and subsequently exposed to citric acid vapor for 24 hours. Characterization was performed using FTIR, SEM, contact angle measurements, and HDF cell viability assays. FTIR spectra of all mats exhibited a peak at 1730 cm^{-1}, confirming ester bond formation and crosslinking of citric acid with PVA functional groups. In samples treated with intermediate citric acid concentrations, additional amide peaks were observed below 1500 and at ~3200. Contact angle analysis showed a slight increase after heat treatment, with higher hydrophobicity observed in samples exposed to citric acid vapor. SEM images revealed uniform fibers across all groups. Moreover, HDF cell viability was enhanced in mats treated with citric acid compared to the control, and the presence of collagen further promoted cell adhesion and proliferation. Overall, the findings demonstrate that intermediate concentrations of citric acid provide the most favorable balance for HDF fibroblast survival and growth in electrospun PVA/collagen scaffolds, highlighting the importance of optimizing citric acid content to enhance biocompatibility and support tissue regeneration.

keywords: Electroporation, polyvinyl alcohol, collagen, citric acid, HDF.