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Soy protein meets bioactive glass: electrospun composite fibers for tissue engineering applications

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Abstract

Soy protein isolate (SPI) was used to produce electrospun nanofibers, intended for tissue engineering (TE) applications. For the first time electrospun composite fibers have been successfully fabricated by the addition of nano and micron-sized 45S5 bioactive glass (BG) powders to SPI solution. The influence of BG particles on electrospun fiber morphology and mechanical properties was investigated. Optimization of electrospun parameters with focus on environmental factors indicated the need to control humidity for SPI fibers fabrication.

Keywords

Soy protein isolate, electrospinning, bioactive glass, nanofibers, tissue engineering

1. Introduction

The main goal of scaffolds in TE is to create a temporary environment that can mimic the natural extracellular matrix (ECM) until new tissue is generated [1]. In order to mimic the ECM morphology, polymeric nanofibrous scaffolds have been fabricated and widely investigated for TE applications [1]. Electrospinning (ES) is a method for fabrication of nanofibrous scaffolds, obtained on a grounded target from a liquid polymeric solution by applying a high electric field [2]. The use of natural biomaterials like proteins can be considered advantageous for TE applications due to their biochemical and structural similarity to the components of the native ECM [3]. Furthermore, the residues from the degradation of synthetic polymers can decrease the local pH and can potentially cause cells and tissues necrosis, inflammatory and immune response in the body [4].

Soy protein is a plant derived biomolecule isolated from soy beans, which includes almost all amino acids [5]. The isoelectric point of soy protein is at pH 4.8 and at this pH the solubility of soy protein is low [6]. Increasing the solubility by processing at higher pH values has been considered to fabricate SPI fibers by ES [7]. Incorporation of BG particles into biopolymers has been investigated for more than 10 years to develop composite scaffolds with bioactive properties and improved mechanical behavior [8]. ES of SPI has been already investigated. Some research works dealt with the ES of SPI by using harmful toxic solvents [9], while the focus of other studies has been on the optimization of the ES by using benign solvents [7]. In this framework, the aim of this investigation is the fabrication and characterization of electrospun composite scaffolds, obtained by electrospun SPI fibers with the

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