BICOMPONENT PCL/BIOPOLYMER NANOFIBERS ELECTROSPUN FROM VARIOUS SOLVENTS – CELLULAR AND BIODEGRADATION STUDIES

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Abstract

Electrospun nonwovens from PCL/gelatin and PCL/collagen structurally mimic native extracellular matrix and provide cells with chemical cues affecting them. Electrospinning of bicomponent nanofibres requires the use of a solvent which dissolves both of the polymers.

We have optimized the process of electrospinning of PCL/gelatin and PCL/collagen nanofibers based on the use of non-toxic, alternative solvents: acetic acid and formic acid (AA/FA) as previously described [1].

Bicomponent PCL/gelatin and PCL/collagen nanofibers were formed by electrospinning using the mixture of acetic acid and formic acid (9:1 w/w ratio), while hexafluoroisopropanol (HFIP) was used as a reference solvent. Nonwoven materials were subjected to cellular in vitro and biodegradation tests and compared.

All in vitro tests were performed using L929 mouse fibroblast cells. Cytotoxicity test was carried out on extracts and showed that all type of materials are not cytotoxic. Materials with 10% biopolymer content as well as made from PCL only underwent experiment in direct contact. Cells were cultured on materials for 3, 5 and 7 days and afterwards taken for SEM as well as fluorescent dying of nuclei and cytoskeleton. Obtained results proved that the addition of Arg-Gly-Asp (RGD) amino acid sequences from biopolymer, in comparison to pure PCL materials, facilitates cell adhesion and spreading on the surface of nonwovens regardless of solvent used in electrospinning.

PCL/gelatin and PCL/collagen nonwovens underwent biodegradation in PBS solution at 37°C. After different times, ranging from 1 to 90 days samples were subjected for comparative analysis via various methods.

Despite the fact that bicomponent nanofibers electrospun from alternative solvents have similar morphology to those electrospun from perfluorinated alcohols, they differ in the internal structure which seriously affects biodegradation process. Biodegradation of investigated materials is manifested mainly by the gelatin leaching, which leads to nanofibers erosion, particularly large for nanofibers spun from AA/FA.

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References

1. P. Denis, J. Dulnik, P. Sajkiewicz, “Electrospinning and Structure of Bicomponent Polycaprolactone/Gelatin Nanofibers Obtained Using Alternative Solvent System”, International Journal Of Polymeric Materials and Polymeric Biomaterials, 64 (2015), 354-364.