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Bicomponent nanofibers in tissue engineering.

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Abstract

Bicomponent poly(caprolactone)/ chitosan (PCL/Chit) nanofibers are a promising alternative for cartilage tissue regeneration. Chitosan is characterized by high structural similarity to the glycosaminoglycans (GAG) which naturally occur in the extracellular matrix (ECM). Its hydrophilicity is beneficial for cells adhesion and proliferation [1]. The amino groups in chitosan are responsible for the formation of polycations, which subsequently form compounds with natural and synthetic anions (proteins, lipids, synthetic polymers which are negatively charged) [2, 3]. Electrospinning of polycations with positive charge on the needle, is difficult due to the instability of the stream resulting from large repulsion force in the polymer jet [3]. Introduction of synthetic polymer molecules to the solution decreases interactions between the chains of chitosan and reduces the viscosity of the solution, so they are easier to form by electrospinning, as well as with negative charge on the needle [4]. A synthetic polymer, which is poly(caprolactone), improves mechanical properties of the fibers and the time of the hydrolytic degradation of the scaffold [4]. Nanofibers are excellent material for cell scaffolds used in tissue engineering because of high similarity of their morphology to native extracellular matrix (ECM) [1, 2]. From the viewpoint of cartilage tissue regeneration scaffold in the form of nanofibers is particularly justified due to naturally occurring network of polymer fibers (proteins and glycosaminoglycans) called aggrecans, in ECM of cartilage. Chondrocytes are connected with aggrecans [4]. Both, the structure and composition of formed nanofibers may affect the time in which cells will reach their proper morphology and undertake its functions [4].

In order to study cell behavior on electrospun PCL/chitosan nonwoven, fibroblasts L929 were cultured. Actin Green staining was conducted in order to imagine actin cytoskeleton of fibroblasts. To characterize, both fibers structure and cell morphology, SEM imagining was done. AFM imaging was carried to describe fibers topography and phase distribution. Also conductivity and viscosity of the PCL/chitosan solution with various polymer ratio was measured.

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