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Surface functionalization of polyesters nanofibers via aminolysis and gelatin immobilization

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INTRODUCTION: The main limitation of polymer nanofiber scaffolds is associated with their hydrophobicity and the lack of biological cues on the surface, which hinder their effective interactions with cells [1]. Aminolysis combined with protein immobilization is one of the ways to enhance cellular response to polymer scaffold [2]. In this study, effectiveness of surface functionalization was compared for three types (polycaprolactone (PCL), polylactide (PLA) and poly(lactide-co-caprolactone) (PLCL)) of electrospun nanofibers.

METHODS: Three types of electrospun nanofibers were subjected to surface functionalization at the same conditions to compare effectiveness of process in the case of different polyesters. Firstly, samples were immersed in 6% w/v ethylenediamine /isopropanol solution at 30°C for 5 and 15 minutes to introduce free amino groups on the surface. Then, samples were activated with glutaraldehyde (1% w/v, RT, 2.5h). The last step was immobilization of gelatin on the surface using 0.2% w/v gelatin/water solution at 37°C for 20h. Samples were characterized by SEM observation, water contact angle measurements, quantification of amino groups and immobilized gelatin on the surface and mechanical testing. Also, L929 cells were cultured on the samples to evaluate biological response to modified scaffolds.

RESULTS & DISCUSSION: The applied process conditions did not change morphology of nanofibers. However, a decrease of Young modulus was observed for all samples, being the most significant for PLA samples. Prolongation of aminolysis time caused drop of stress at break in the case of PLCL and PLA samples. For all samples after gelatin immobilization surface became completely hydrophilic. After 5 days of culturing we observed well spreaded cells on the surface of modified samples in contrast to reference samples. The positive effect was visible even after first step of functionalization - aminolysis reaction, and increased with the time of aminolysis for PCL and PLCL nanofibers.

CONCLUSIONS: This study confirms that aminolysis combined with gelatin immobilization is effective method to enhance cellular response to polymer nanofiber scaffolds. Our study shows that effectiveness of process is different in the case of each type of polyester (the highest for PLA, and the lowest for PCL nanofibers), which has impact on amount of amino groups and gelatin on the surface as well as mechanical properties, but for all samples positive effect on cellular response was achieved.

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