Nanofibres prepared using electrospinning

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INTRODUCTION: There are a variety of manufacturing techniques used to produce fibers in nanoscale such as phase separation, drawing, template synthesis and electrospinning. Electrospinning has been shown to be more advantageous recently due to its simplicity, high porosity of the obtained structure, nanometer scale of fibers and versatility in that it can be applied to a variety of polymers. One of the most important application areas of nanofibers fabricated by electrospinning is tissue engineering[1], which deals with producing scaffolds that mimic both biological functions and structure of naturally existing extracellular matrix (ECM). However, this process has many parameters that have to be controlled in order to obtain a good structure that can enhance adhesion, proliferation and differentiation of cells. The aim of this study is to construct a nanofibrous scaffold that will play a significant role in new bone tissue regeneration.

METHODS: Biodegradable poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV8) polymer, containing 8% of hydroxyvalerate, was dissolved in different amounts of chloroform or a mixture of chloroform/ N,N-dimethyl formamide (DMF) (96:4) in order to observe the effect of solvent on fiber morphology. Moreover, the effect of presence of salt in the polymer solution was studied. Nano/micro fibers were collected onto a metal substrate in the form of an interconnected, non-woven mat. The morphology of electrospun fibers was observed by scanning electron microscopy (SEM) and their diameter was measured via an Image J analyzer program.

RESULTS: SEM analysis demonstrated that increase in polymer concentration results in an increase of fiber diameter and a change in bead formation. However, bead presence is not desirable in tissue engineering scaffolds, therefore, their formation should be prevented. It was observed that addition of salt led to the disappearence of the beads but in this case some fiber fusion occurred due to slow solvent evaporation. On the other hand, addition of a solvent with a higher dielectric constant (DMF) improved electrospinning conditions and more straight fibers without beads were obtained. This was chosen to be the best condition for the future tissue engineering studies.

DISCUSSION & CONCLUSIONS: It is possible to produce nano/micro fibers from PHBV8 polymer that can be used as a scaffold in tissue engineering applications. Conductivity of polymer solution was an important parameter in this case. The best condition for proper fiber formation was found to be 15% polymer concentration in a 96:4 (v/v) mixture of chloroform and DMF.

REFERENCES: [1] F. Yang, C. Y. Xu, M. Kotaki, S. Ramakrishna (2004) *J Biomater. Sci. Polymer Ed.* **15**:1483

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