BIODEGRADABLE POLYMERIC MICROFIBRES REINFORCED WITH NANOFIBRES FOR BIOMEDICAL APPLICATIONS

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In the biomaterials field, nanofibre based structures and its composites are promising materials to produce scaffolds. The enhanced physicochemical properties and its structure being similar to the architecture of the extracellular matrix (ECM) may solve the major challenge of tissue engineering, which is obtaining the appropriate scaffold [1].

The main purpose of this work was to develop a novel composite structure which combines polymeric microfibres reinforced by nanofibres. This combination was obtained by melting extrusion of a synthetic biodegradable polymer, poly(butylene succinate) (PBS) (99,95% wt), reinforced with chitosan nanofibre meshes (0.05% wt). The chitosan meshes, composed by randomly aligned nanofibres, were produced by electrospinning technique (Figure 1a)). Longitudinal and cross sections of reinforced microfibres were observed by scanning electron microscopy (Figure 1b)).

The tensile mechanical properties revealed that the introduction of the reinforcement into the microfibres increased the tensile modulus to 553.2 ± 48.4 MPa. This improvement is around 70%, considering that the tensile modulus of microfibres without nanofibre reinforcement was 327.8 ± 35.3 MPa (Figure 2 and Table1).

The various structures were subjected to swelling and degradation tests upon immersion in an isotonic saline solution at 37ºC. The presence of chitosan nanofibres in the microfibres also enhanced the water uptake in up to 10% (Figure 3), caused by the higher hydrophilicity of the chitosan nanofibre meshes.

The combination of good mechanical properties and enhanced degradability of the developed structures is believed to have great potential for the production of 3D fiber mesh scaffolds, to be applied in the field of Tissue Engineering and Regenerative Medicine.

References:

[1] Lutolf, M.P., Hubbell, J.A., "Synthetic biomaterials as instructive extracellular microenvironments for morphogenesis in tissue engineering", Nature Biotechnology, **23**, 2005, 47-55.

Figures:

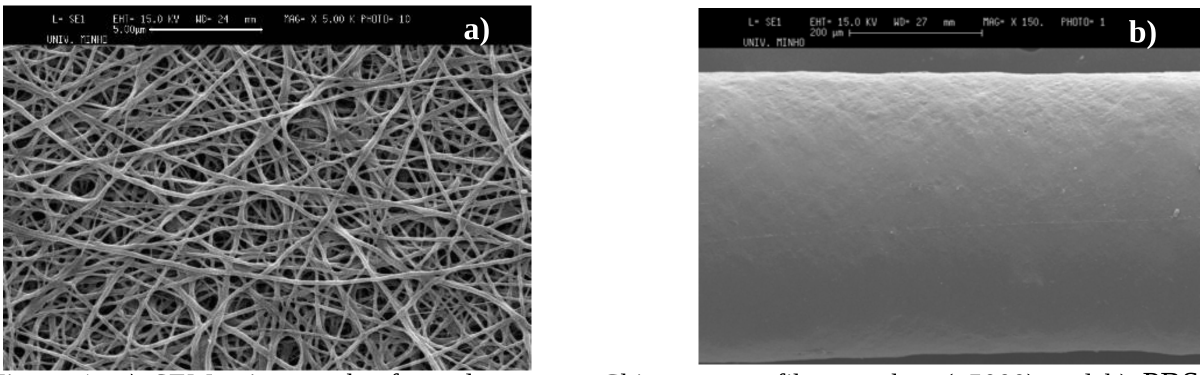

Figure 1- a) SEM micrograph of an electrospun Chitosan nanofibre meshes (x5000) and b) PBS microfibre (x150)

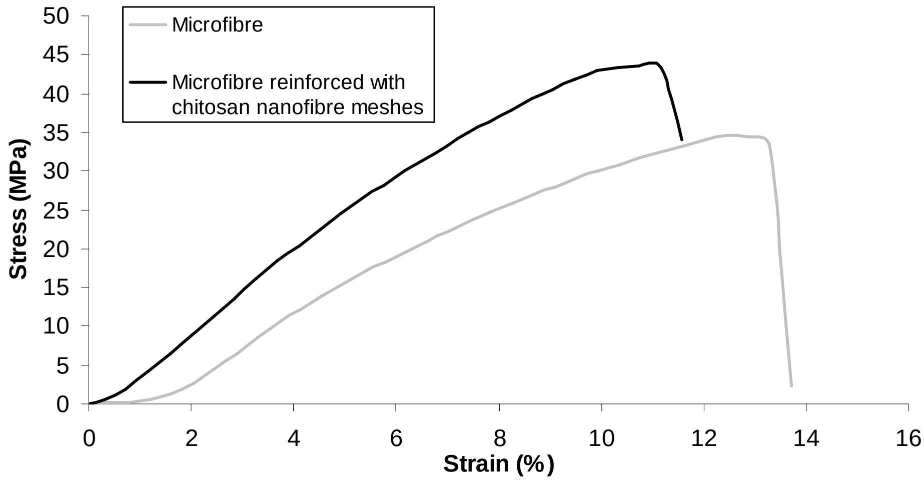

Figure 2 - Tensile stress-strain of chitosan microfibres with and without chitosan nanofibre meshes reinforcements.

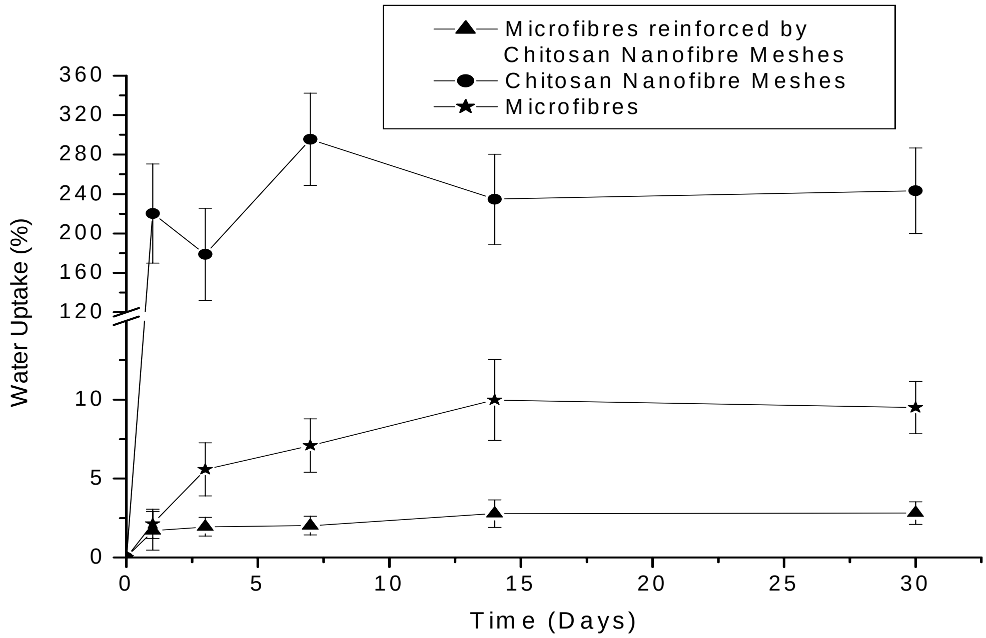

Figure 3 - Water uptake of the microfibres reinforced by chitosan nanofibre meshes, chitosan nanofibre meshes and microfibres, during the periods of immersion in isotonic saline solution.

Table 1 - Tensile properties of microfibres with and without chitosan nanofibres reinforcement.

Materials	Tensile Stress (MPa)	Tensile Modulus (MPa)	Tensile Strain (%)
Microfibres	30.6 ± 7.2	327.8 ± 35.3	11.6 ± 2.3
Microfibres reinforced with chitosan nanofibre meshes	35.4 ± 6.4	553.2 ± 48.4	10.7 ± 0.9