

A New Method for Tailoring the Degradation Rate of Chitosan Fibre-mesh Scaffolds

C. Cunha-Reis^{1*}, K. TuzlaKoglu², Y. Yang¹, A. El Haj¹ and R. L. Reis²

¹ Institute for Science and Technology in Medicine, School of Medicine, Keele University, Thornburrow Drive, Hartshill, Stoke-on-Trent ST4 7QB UK E-mail: c.m.reis@pmed.keele.ac.uk

² 3B's Research Group – Biomaterials, Biodegradables and Biomimetics, Department of Polymer Engineering, University of Minho, Campus de Gualtar 4710-057, Braga, Portugal

* Visiting researcher in 3B's Research Group

INTRODUCTION: The degradation of scaffolds depends on several parameters, namely the biomaterials intrinsic properties and the scaffolds morphology. It is possible to tailor the degradation rate by changing the polymers chemical structure. Nevertheless, that may be time consuming and difficult to control. In addition, that approach may lead to undesired changes in other properties of the polymer [1]. The aim of this study was to investigate the influence of porosity and fibre diameter on the degradation rate of chitosan fibre-mesh scaffolds, as a possible way to tailor the degradation rate of such type of scaffolds.

METHODS: Scaffolds production: The scaffolds with different porosities were produced by wet spinning 4.2 and 3.2 mL of a 3% chitosan solution in 2% acetic acid, placing the correspondent fibres in equal moulds and drying at 60 °C. For each porosity, fibers with 200 µm and 90 µm of diameter were produced.

Scaffolds degradation: The scaffolds were weighted and immersed for 4 weeks in a 1mg/mL lysozyme solution – in Phosphate Buffer Saline (PBS), pH 7.4 - at 37 °C. The degradation solution was changed weekly. The scaffolds were weighted before and after drying and the water uptake and the weight loss, respectively, were determined.

Morphological analysis: The morphological analysis of the scaffolds before and after degradation was performed by Scanning Electronic Microscopy (SEM) and micro CT.

RESULTS: Figure 1 evidences the differences in the scaffolds porosity that can be achieved by this method.

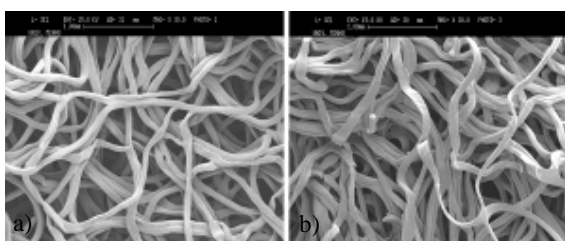


Fig.1. SEM picture of chitosan fibre-mesh scaffolds produced from different volumes of chitosan solution (a – from 3.2 mL; b – from 4.2 mL).

Scaffolds composed of fibres with different diameters were also achieved consistently.

The fibres with smaller diameter have shown higher values for the water uptake and the weight loss, independently of the scaffolds porosity (Figure 2).

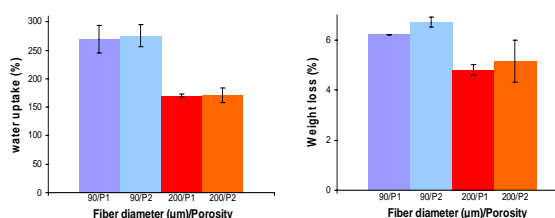


Fig.2. Water uptake (left) and weight loss (right) of the chitosan fibre-mesh scaffolds after 4 weeks of degradation in a 1 mg/mL lysozyme solution. P1 – low porosity; P2 – high porosity

DISCUSSION & CONCLUSIONS: It is of general acceptance that the higher the water uptake, the higher the degradation rate. The results obtained with this work are in accordance to that. The scaffolds produced with the thinner fibres have a higher surface area and consequently a higher water uptake comparing to the thicker ones. That leads to more contact points between chitosan and the lysozyme solution, giving rise to higher weight loss. Regarding the scaffolds porosity, no differences in the degradation rate were observed between the two obtained structures. It is possible that the difference in the porosity is not big enough to produce a structural difference capable of influencing the degradation rate.

In summary, it is confirmed that the fibre diameter influences the degradation rate of chitosan fibre-mesh scaffolds. Tailoring the fibre diameter will be a very useful tool to adjust the scaffolds degradation to a specific application without the need to change the polymers chemistry.

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REFERENCES: ¹ T.Freier, et al *Biomaterials* (2005) 26:5872–5878.