DIFFUSIONAL AND SURFACE PROPERTIES OF ELECTROSPUN POLY (ε-CAPROLACTONE) NANOFIBERS WITH TRYPSIN ENCAPSULATION

Artur J. Martins[1*], Ana I. Bourbon[1], António A. Vicente[1], Susana Pinto[2], J. A. Lopes da Silva[2], C. Rocha[3]

1. Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, *University of Minho,* Braga, Portugal
2. QOPNA, Department of Chemistry, *University of Aveiro*, Portugal
3. REQUIMTE, Department of Chemical Engineering, Faculty of Engineering, *University of Porto*, Porto, Portugal

**amartins@ceb.uminho.pt*

Electrospun Nanofibers (ENf) find applications in several areas, such as biomedical, tissue engineering, pharmacology and also food engineering. One of the most important features is the ability of the ENf to serve as a filtration membrane as well as a catalytic surface. The pore size and the ability to encapsulate enzymes within the nanofibrous membrane will render them able to have a double function when in the presence of suitable molecules. To optimize the fabrication methods as well as the development of ENf in food engineering, some material properties and functions must be studied. This work focused in the diffusion properties of simple Poly ε-caprolactone nanofibers (PCL membrane), and Poly ε-caprolactone nanofibers with trypsin encapsulated, (E_PCL membrane), as well as ENfs' surface properties. Bovine serum albumin (66.5 kDa), lactoferrin (80 kDa), lysozyme (14.7 kDa), were the solutes chosen for effective diffusivity (*D*) evaluation. An acrylic diffusion cell with flow recirculation was used to determine *D* for the various solutes and systems. Subsequent analyses of the ENf were made by Contact Angle measurements (CA), Differential Scanning Calorimetry (DSC), Termogravimetric Analysis (TGA), Water Solubility and Swelling Degree (SD) and Mechanical properties assessment.

High hydrophobicity values of PCL were observed and the E_PCL membrane revealed stronger mechanical properties and an increase of mass due to water incorporation; SD (PCL)

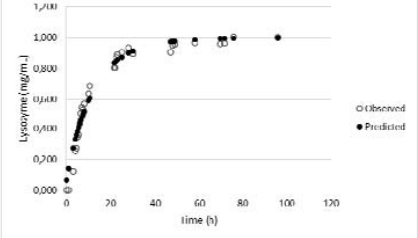

Figure 1. Model fitting for Lysozyme diffusion in E_PCL

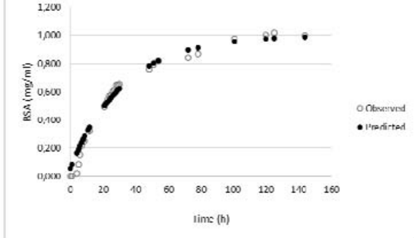

Figure 2. Model fitting for BSA diffusion in E_PCL

was 2.71 ± 0.11 g H_2O/g membrane; however after water evaporation the ENf revealed a reversible behaviour with a shrunken conformation. The E_PCL revealed a decrease of average pore size in the range of 30% to 40%, and an average pore diameter of 1/3 of the size when compared to the PCL membrane; this difference is significant enough to influence the transport of larger molecules (e.g. lactoferrin), thru the ENf membrane. The values of *D* acquired by fitting the model, which accounts for both Fickian diffusion and relaxation of polymer [1], of E_PCL were 5.19×10^{-14} m^2/s regarding the BSA migration and 11.25×10^{-14} m^2/s for lysozyme.

Acknowledgements

The present study was developed under the scope of the NanoBioCats project (PTDC/CTM-POL/112289/2009), funded by the Portuguese Science and Technology Foundation (FCT) and by the COMPETE program, subsidized by the European Community fund FEDER.

References

1. Flores, S. , et al. Mass transport properties of tapioca-based active edible films. *Journal of Food Engineering 81 (2007) 580–586.* 2007, 81 , pp. 580–586.