TS55
Designing novel starch/cellulose acetate structures for biomedical applications

M Martins[1,2], SS Silva[1,2], AR Duarte[1,2] and RL Reis[1,2]
[1]3B's Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, AvePark, 4806-909 Taipas, Guimarães, Portugal; [2]ICVS/3B's - PT Government Associate Laboratory, Braga/Guimarães, Portugal

Starch-based blends present an enormous potential to be widely used in the biomedical area, because they are totally biodegradable, inexpensive, available in large quantities. However, natural-based polymers have great limitations in processability particularly due to their usually high crystallinity which limits their solubility. This can be overcome by the use of ionic liquids which are recognized as 'green' replacements for conventional organic solvents. Earlier reports emphasized the use of certain ionic liquids to solubilize some natural macromolecules such as cellulose, starch, chitin, chitosan and silk fibroin. Furthermore, they present unique physicochemical properties, namely lower vapour pressure, excellent chemical and thermal stabilities, high ionic conductivity and easy recyclability. Starch based materials have been proceed in a variety of different morphologies and shapes by a number of different processes. In this work, starch/cellulose acetate (SCA) was dissolved in 1-butyl-3-imidazolium acetate, followed by regeneration of the polymer in different non-solvents (water, ethanol and isopropanol) in order to obtain membranes. Different concentrations of SCA (5 and 10%) in ionic liquid and drying techniques (vacuum oven and freeze drying) were studied. The starch/cellulose acetate structures were evaluated by their swelling capability, degradation behaviour and morphological features. Moreover, the influence of thickness on physical chemical properties of the membranes was assessed. The results revealed that membranes with lower thickness showed high water absorption, which by its turn accelerated their degradation rate. Furthermore, the membranes dried by vacuum oven present a more compact structure as compared those prepared by freeze drying. Some previous works reported SCA as a suitable material for tissue engineering purposes, supporting the cell adhesion. Then, in vitro cell culturing assays will be performed using osteoblast like cells (SaOs-2) and mouse fibroblast-like cell line (L929).The cell viability and proliferation on membranes will be evaluated through the MTS test and the DNA quantification. The development of innovative technology such as novel natural polymers materials is of grater interest in medical field. All findings suggested that the obtained structures (membranes) present adequate properties for several biomedical applications for instance drug delivery, skin substitutes, guided bone regeneration or as coatings for medical devices.

TS56
Sustained release of prednisone and mesalamine from diatom exoskeletons: bioinspiration for the development of safe oral drug delivery devices to tackle gastrointestinal diseases

H Zhang[1], M-A Shahbazi[1], E Mäkilä[1,2], TH Silva[3,4], RL Reis[3,4], J Salonen[2], J Hirvonen[1] and HA Santos[1]
[1]Division of Pharmaceutical Technology, Faculty of Pharmacy, University of Helsinki, FI-00014 Helsinki, Finland; [2]Laboratory of Industrial Physics, Department of Physics and Astronomy, University of Turku, FI-20014 Turku, Finland; [3]3B's Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, AvePark, 4806-909 Taipas, Guimarães, Portugal; [4]ICVS/3B's – PT Government Associate Laboratory, Braga/Guimarães, Portugal

Mesoporous silicon and silica-based particles have recently been synthesized and proposed for the controlled delivery of several drugs [1,2]. On the other hand, nature and in particular marine organisms have been the source and inspiration for the development of different biomedical applications, including drug delivery devices [3]. On the border of both rests diatoms exoskeletons, nature-made porous silica-based microparticles with amazing morphological features, promising a high potential in drug delivery. Nevertheless, its safety and drug permeability on oral formulations have not yet been studied. In this study, we have demonstrated that diatoms silica microparticles (DSM) have almost no toxicity in colon cancer cells Caco-2, HT-29, HCT-116 and Caco-2/HT-29, even at concentrations as high as 1000 μg/mL. Moreover, the delivery profile of two common drugs to address gastrointestinal diseases, mesalamine (anti-inflammatory) and prednisone (glucocorticosteroid). DSMs are able to release prednisone in a controlled manner and change its absorption pattern, which may improve the safety of its administration. In addition, DSMs can enhance the permeation of mesalamine. These results confirm the potential of DSMs for the development of oral formulations for the therapy of gastrointestinal diseases.

References:

1. Santos HA, Bimbo LM, Lehto VP, Airaksinen AJ, Salonen J, Hirvonen J, "Multifunctional porous silicon for therapeutic drug delivery and imaging", Current Drug Discovery Technologies 8 (2011), 228-249.
2. Limnell L, Santos HA, Mäkilä E, Heikkilä T, Salonen J, Murzin DY, Kumar N, Laaksonen T, Peltonen L, Hirvonen J, "Drug delivery formulations of ordered and non-ordered mesoporous silica: comparison of three drug loading methods", Journal of Pharmaceutical Science 100 (2011), 3294-3306.
3. Silva TH, Alves A, Ferreira BM, Oliveira JM, Reys LL, Ferreira RF, Sousa RA, Silva SS, Mano JF, Reis RL, "Materials of marine origin: a review on polymers and ceramics of biomedical interest", International Materials Reviews, 57 (2012), 276-306.

DOI: 10.1002/term.1822