Development of marine-based nanocomposite scaffolds for biomedical applications

Lara L. Reys[1, 2*], Simone S. Silva[1,2], M. Boutinguiza[3], R. Comesaña[3], F. Lusquiños[3], J. Pou[3], João F. Mano[1,2], Tiago H. Silva[1,2], Rui L. 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

[3] Applied Physics Dpt., Universidade de Vigo, E.E.I., Lagoas-Marcosende, E-36310, Vigo, Spain

Despite the increasing attention that marine organisms are receiving, many of those are not efficiently exploited and subproducts with valuable compounds are being discarded. Two examples of those subproducts are the endoskeleton of squid, from which β-chitin and consecutively chitosan can be obtained; and fish-bones, as a source for the production of nano-hydroxyapatite. In this work, inspired in the nanocomposite structure of human bone, marine-based nanocomposite scaffolds composed by chitosan and nano-hydroxyapatite (nHA) were developed using particle aggregation methodology. Chitosan was obtained from endoskeleton of giant squid Dosidicus Gigas while fish hydroxyapatite nanoparticles were synthesized from fish-bones by pulsed laser in deionized water. An innovative methodology was used based on the agglomeration of prefabricated microspheres of chitosan/nHA, generally based on the random packing of microspheres with further aggregation by physical or thermal means to create a marine nanocomposite (CHA) .The morphological analysis of the developed nanocomposites revealed a low porosity structure, but with high interconnectivity, for all produced scaffolds. Furthermore, the nanocomposite scaffolds were characterized in terms of their mechanical properties, bioactivity, crystallinity and biological behavior. The obtained results highlight that the chitosan/nHA-based marine nanocomposite can be a good candidate for biomedical applications, namely on bone regeneration.