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Bioactive ceramics for tissue engineering and regenerative medicine derived from marine sponges

A Barros[1], IM Aroso[1], TH Silva[1], JF Mano[1], ARC Duarte[1] and RL Reis[1]
3B's Research Group – Biomaterials, Biodegradables and Biomimetics,, University of Minho, Braga, Portugal

Introduction: The use of biostructures and bioceramics derived from the marine environment for several application has been proposed in the last years by different authors. Examples are the use of different marine species like coral skeletons, sea urchins and sponges as three dimensional biomatrices[1-3].We have focused on the potential of bioceramics obtained from three marine sponges, *Petrosia ficidormis* (PET), *Agelas oroides* (AG) and *Chondrosia reniformis* (CR) for biomedical applications. In vitro bioactivity studies promote the precipitation of crystals of calcium phosphate (e.g. hydroxyapatite) on the surface of marine sponge derived bioceramics suggesting these as a new source of bioactive ceramics for tissue engineering and regenerative medicine (TERM) applications.
Materials and methods: In these work, Sponge samples were collected in Mediterranean Sea, namely in Spanish north east coast (*Petrosia ficiformis*. and *Agelas oroides*) and Israeli coast (*Chondrosia reniformis*). Bioceramics were obtained, after sponge calcination in a furnace at 750°C for 6 hours. In vitro bioactivity of the bioceramics was evaluated by immersion in simulated body fluid (SBF), for 14 and 21 days. The structures were observed by SEM and the chemical composition was evaluated by energy dispersive x-ray spectroscopy (EDS) and Fourier transform infrared spectroscopy (FTIR). Cytotoxicity studies were also performed, using the commercial Bioglass 45S5® as reference.
Results: The bioceramics structures obtained after calcination present different morphological and chemical compositions, as observed by SEM-EDS (FIG. 1). PET skeleton is a 3D architecture, composed of SiO2 groups. On the other hand the inorganic part of AG and CR is a powder mainly composed of silicates. However, they also contain Ca and Mg. The microscopic observation of the ceramics crystals after immersion in SBF solution for 14 and 21 days disclosed surface crystals, with the typical cauliflower-like shape characteristic of hydroxyapatite, in case of AG and CR. These crystals are composed of Ca, P and Mg as demonstrated by EDS analysis. PET on the other hand, did not reveal any crystal precipitation, suggesting no inherent bioactivity. FTIR confirmed the presence of characteristics peaks of carbonates and phosphates of hydroxyapatite, nxCO3 and nxPO4, after immersion of the marine origin ceramics in SBF solution. XRD analysis confirms the crystallographic planes of hydroxyapatite and some intermediate crystals. Finally, in vitro test results demonstrate that bioceramics from these sponges are non-cytotoxic to L929 Cells.