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Characterization of Octacalcium Phosphate Powder and Octacalcium Phosphate - Chitosan Scaffolds

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Abstract – Octacalcium phosphate and chitosan-octacalcium phosphate scaffolds were prepared in this work. The scaffolds were obtained by the freeze-drying method. Both materials were characterized by SEM-EDS, XRD and FTIR-ATR. The scaffolds showed interconnected porous and the properties of each one of them materials together can promote the bone regeneration. In addition, there are not enough studies in the literature about the combination of both materials.

The limitations of transplant such as donor organs and tissue rejection have inspired the development of new materials for several biomedical applications. In this context, new materials have been studied as for their capability of regenerating the bone tissue [1].

Polymer-ceramic composites have been proposed for bone tissue engineering in order to achieve controlled bioactivity and biodegradability. Octacalcium phosphate $C_8H_2(PO_4)_6 \cdot 5H_2O$, is considered as one of the calcium phosphate which participates in the early mineralization of the bone tissues [2]. Chitosan is a polymer with its composition much similar to glycosaminoglycans. Besides, the biocompatibility shown by this material is very attractive. The purpose of this work was to obtain octacalcium phosphate and a scaffold formed by octacalcium phosphate (OCP) and chitosan (Ch).

Octacalcium phosphate powder was prepared at 70 ^{o}C, pH 5.0 using calcium acetate and sodium phosphate monobasic as precursor reagents. A chitosan solution 2% wv was mixtured with OCP in order to obtain a OCP-Ch (50/50 wt%) composite. The scaffolds were obtained by the freeze-drying method and a porous composite was produced. Both OCP powder and OCP-Ch scaffolds were characterized by scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS), Fourier-transform infrared - attenuated total reflectance (FTIR-ATR) and X-ray diffraction (XRD). Calcium and phosphorous contents in OCP were determined using inductively coupled plasma analysis (ICP). The porous size of scaffolds was determined by image analysis of 37 SEM micrographies.

OCP showed plate-like morphology, Figure 1(a), and this is in accordance with the literature. XRD analysis, Figure 2 (a), confirmed the main peak of OCP at 4.7^{o}. Ca/P molar ratio of OCP quantified by ICP and its confidence limit are 1.3±0.019. The FTIR-ATR spectra of OCP and OCP-Ch scaffolds showed characteristic bands of OCP in both cases, which confirm the good interaction between OCP and Ch. These results are according to SEM and XRD. In Figure 1 (b) plate-like morphology of OCP on the polymeric matrix can be observed. Furthermore, the peaks regarding OCP are noticed in scaffold, Figure 2 (b). According to the SEM images the pore diameter was in the range of 20-100 μm and the porosity around 62%. Previous research demonstrated that human osteoblasts can penetrate pores larger than 20 μm [3]. This suggests that the OCP-Ch scaffold can promote a good environment to the cells grow and proliferate.

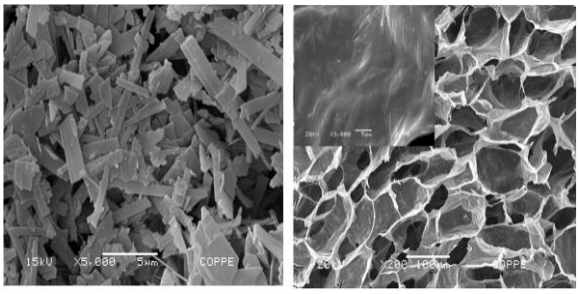

Figure 1: SEM micrographs **a**) OCP and **b)** Chitosan-OCP scaffold.

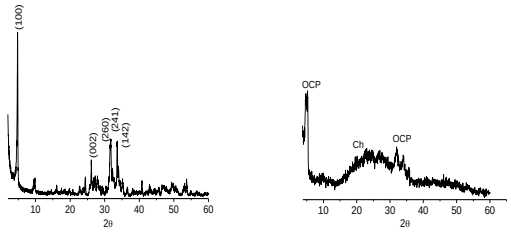

Figure 2: DRX **a**) OCP and **b)** Chitosan-OCP scaffold.

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