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Effect of chitosan addition in polyhydroxybutyrate scaffolds properties.

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Abstract – PHB/chitosan scaffolds were obtained by salting leaching technique. The scaffolds properties were investigated by scanning electron microscopy, energy dispersive spectrometry, X-ray diffraction and Fourier transformed infrared. Chitosan seems to increase the scaffold crystallinity and modify the scaffold morphology.

The microbial polyester polyhydroxybutyrate (PHB) are of particular interest for bone tissue engineering since it has been shown that medical devices made of PHB are compatible to some cultured mammalian cells, including osteoblasts[1-2]. However, PHB has several inherent deficiencies in use, including brittleness and thermal instability in molten. An approach to improve PHB properties is combining this one with other polymers. PHB-based materials can be blended with chitosan (CTS), a cationic polysaccharide derived from the deacetylation of chitin. Chitosan seems to improve cell growth and the secretion of a mineral rich matrix by cultured osteoblasts[3]. The aim of this work was to develop a PHB/CTS scaffold ($S_{PHB/CTS}$) using salting leaching technique. Chitosan (degree of acetylation = 22%) and sodium chloride were added to 10% (w/w) PHB solution in chloroform at ratio (w/w/w) PHB:Salt:CTS equal to 2.25:0.35:5.6. The mixture was homogenized at 8000 rpm for 3min using a dispersion device. Then, it was distributed in glass molds and allowed to dry at room temperature for 48h. The dried films were immersed in distillated water for 48h to remove the salt. The scaffolds were analyzed by scanning electron microscopy (SEM), energy dispersive spectrometry (EDS), Fourier transformed infrared (FTIR) and X-ray diffraction (XDR)

A decrease in the degree of crystallinity of PHB was observed by FTIR experiments. The bands attributed to crystalline PHB phase[3] at 980, 1230, 1282 and 1728 cm^{-1} became weaker after CTS addition. Other authors have already reported that chitosan is able to impair PHB crystallization[3-4]. Nevertheless, XDR analysis (Fig. 1) showed that the crystallinity degree of $S_{PHB/CTS}$ was higher than that for pure PHB samples. The presence of a new peak at 2θ = 16° in SPHB/CTS diffractogram can be observed. The formation of a new crystalline structure may explain the increase in crystallinity of the chitosan-containing scaffolds. Nevertheless, no significant changes in the overall morphology of scaffolds after chitosan addition were observed since a dense top layer and a pore structure with mean pore size similar to SPHB was obtained. (Fig. 2). However, some features were visualized in $S_{PHB/CTS}$ dense top layer, which were identified by EDS analysis as chitosan agglomerates. By images with higher magnitude, it was observed that the outer surface of $S_{PHB/CTS}$ in contact with air seemed to be rougher than that of PHB scaffolds. Further studies will be conducted to investigate the interaction between PHB and CTS, the mechanical properties and the biocompatibility of this material.

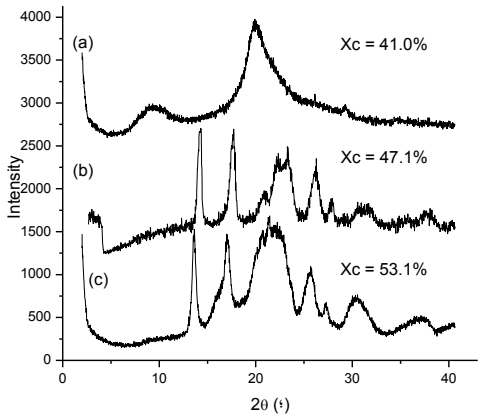

Figure 1: X-ray diffactograms: (a) CTS; (b) PHB and (C) PHB/CTS.

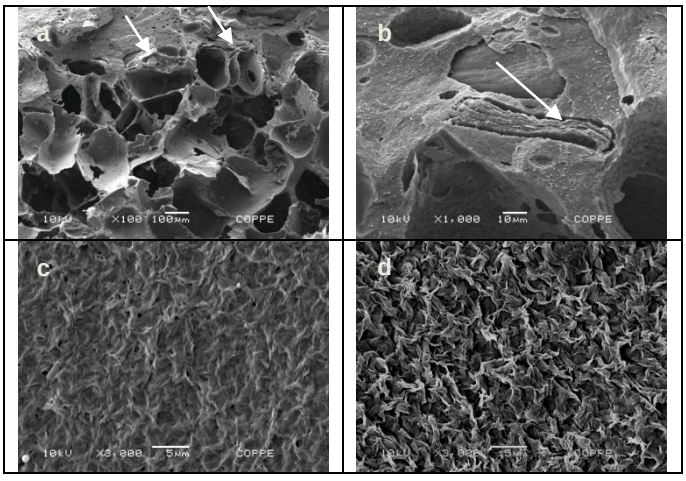

Figure 2: SEM images of: $S_{PHB/CTS}$ cross section (a) and (b); S_{PHB} and $S_{PHB/CTS}$ outer surface formed in contact with the air, respectively (c) and (d).

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