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Fabrication of Calcium Phosphates/Poly(caprolactone) Composite Using 3D Printing Technique for Bone Tissue Engineering

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With the increase of the average life expectancy, tissue engineering became an area of great interest. Every year, there are millions of people who need some kind of prosthesis and the need for all kind of implants became very well known in our society. In last years, particular attention was paid to the development of new materials for bone replacement/regeneration, with bone tissue engineering scaffolds playing an important role: they are physical substrates for cell attachment, proliferation, and differentiation, thus providing a template for new tissue regeneration. To enable such pivotal role, certain features are required in terms of mechanical properties, surface characteristics, porosity, degradability, and biocompatibility, which all strongly depend on both materials and manufacturing processes. Although polycaprolactone (PCL)- based scaffolds have been extensively proposed for bone regeneration, long degradation times, high hydrophobicity and poor bioactivity (osteointegration, osteoconduction and osteoinduction) are hindering their further use. To overcome these limitations, PCL has been combined with different inorganic materials such as hydroxyapatite (HAp), tricalcium phosphate (TCP) and bioglass. In this study, a PCL/calcium phosphate (CaP) composite was developed by melt-compounding PCL in a twin-screw extruder with calcium phosphate produced from Atlantic cod fish bones. These fish bones are an abundant fish by-product that provides hydroxyapatite (HAp) with fluorine contributions, and whitlockite. Powder size and morphology were proven determinant in their uniform distribution along the produced filament, which was used for the 3D printing of porous structures as potential scaffolds for bone tissue engineering. In this regard, the physical and chemical properties, as well as cytocompatibility of developed scaffolds were investigated in order to provide theoretical and experimental support on the effect of CaP contents, porosity, mechanical properties, degradation profile and others on the performance of the PCL/CaP scaffolds regarding tissue engineering application.