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Non-Cytotoxic Natural Sourced Inorganic Hydroxyapatite (HAp) Scaffold Facilitate Bone-like Mechanical Support and Cell Proliferation

Authors : Sudip Mondal, Biswanath Mondal, Sudit S. Mukhopadhyay, Apurba Dey

Abstract : Bioactive materials improve devices for a long lifespan but have mechanical limitations. Mechanical characterization is one of the very important characteristics to evaluate the life span and functionality of the scaffold material. After implantation of scaffold material the primary stage rejection of scaffold occurs due to non biocompatible effect of host body system. The second major problems occur due to the effect of mechanical failure. The mechanical and biocompatibility failure of the scaffold materials can be overcome by the prior evaluation of the scaffold materials. In this study chemically treated Labeo rohita scale is used for synthesizing hydroxyapatite (HAp) biomaterial. Thermo-gravimetric and differential thermal analysis (TG-DTA) is carried out to ensure thermal stability. The chemical composition and bond structures of wet ball-milled calcined HAp powder is characterized by Fourier Transform Infrared spectroscopy (FTIR), X-ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FE-SEM), Transmission Electron Microscopy (TEM), Energy Dispersive X-ray (EDX) analysis. Fish scale derived apatite materials consists of nano-sized particles with Ca/P ratio of 1.71. The biocompatibility through cytotoxicity evaluation and MTT assay are carried out in MG63 osteoblast cell lines. In the cell attachment study, the cells are tightly attached with HAp scaffolds developed in the laboratory. The result clearly suggests that HAp material synthesized in this study do not have any cytotoxic effect, as well as it has a natural binding affinity for mammalian cell lines. The synthesized HAp powder further successfully used to develop porous scaffold material with suitable mechanical property of ~0.8GPa compressive stress, ~1.10 GPa a hardness and ~ 30-35% porosity which is acceptable for implantation in trauma region for animal model. The histological analysis also supports the bio-affinity of processed HAp biomaterials in Wistar rat model for investigating the contact reaction and stability at the artificial or natural prosthesis interface for biomedical function. This study suggests the natural sourced fish scale-derived HAp material could be used as a suitable alternative biomaterial for tissue engineering application in near future.

Keywords : biomaterials, hydroxyapatite, scaffold, mechanical property, tissue engineering
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