PLA/HA Implant Materials Doped with Silver Nanoparticles for Bone Fixation

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Abstract

Bone implant materials were synthesized using the "solvent casting method", based on polylactide/hydroxyapatite and various organic-inorganic modifiers, such as MgF_2, CaF_2, $Mg_3(PO_4)_2$ and citric acid. The physicochemical properties of the materials were studied using modern analytical (FTIR, XRD, TGA, DTA, DSC, hardness and ect.) methods. IR spectroscopy showed that interactions occurred between PLA macromolecules and hydroxyapatite and other modifiers. By the X-ray diffraction method, it was found to have an average crystallinity of 50-90% after the extrusion. When the textural properties were examined using SEM analysis, it was found that the introduction of magnesium phosphate into the samples effected the formation of porous particles with dimensions of 100-250 μm. This in turn, leads to the improvement of metabolic processes when the samples are introduced into bone tissues. Microhardness was determined by the Vickers method and it was found to be close to the hardness of natural bone, i.e. 27-34 HV. *In vitro* resorbtion was also performed in simulated body fluids (SBF). Synthesized materials are shown non-toxicity for L929 cells. Resorbtion process was studied *in vivo* in the upper third of the femur of rabbits, it was found that the ossification process of the samples was about 90-95% after 75 days. Silver nanoparticles were synthesized using Lycium depressum berry extract using green synthesis. The resulting extract and nanoparticles were characterized physicochemically (TEM, SEM, thermal analysis, X-ray, etc.) and biologically (cytotoxicity, anticancer, antibacterial, antifungal, phytochemical composition, antioxidant properties, etc.). Silver nanoparticles were incorporated into the implant material at concentrations of 1%, 3%, and 5%. The resulting materials possessed antibacterial properties, which are highly desirable for implants.

Keywords

Poli-L-lactide, Hydroxyapatite, Femur, Fixation Materials, Physical-chemical and Antibacterial Properties, Ag-nanoparticles