Synthesis and characterization of a Composite Biomaterial Containing Cow Bone Derived Hydroxyapatite, and Polylactic Acid

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Hydroxyapatite is a ceramic biomaterial that mimics the mineral composition of bones and teeth of vertebrates. Hydroxyapatite can be synthesized from various chemical methods. However, most are non-economical and does not have sufficient biological properties as natural Hydroxyapatite in human bones. Cow bone waste is rich in biocompatible Hydroxyapatite as a natural source. The load bearing ability of pure Hydroxyapatite is very poor and it has limited its application as a bone grafting material. Polylactic acid is a biocompatible, biodegradable, and bioresorbable polymer which can be used to reinforce pure Hydroxyapatite to improve its mechanical properties. This study investigated the change of mechanical property of pure Hydroxyapatite when it is mixed with a varying ratio of Polylactic acid to form Hydroxyapatite-Polylactic acid composite. High purity Hydroxyapatite was extracted from cow bones using the thermal decomposition method by sintering at 900 ºC for 3 h. The composites were prepared by blending Hydroxyapatite with Polylactic acid in various ratios with and without maleic-anhydride compatibilizer. The resulting composite blends were subjected to tensile tests separately with three replicates per blend. The thermal-gravimetric analysis was performed to determine the purity of cow bone derived Hydroxyapatite in comparison to a commercial Hydroxyapatite sample. 30% Hydroxyapatite loading composite blend with 4% maleic-anhydride has increased the tensile strength of the composite by about 7-folds. Scanning electron microscope shows, the interfacial adhesion between Hydroxyapatite and polylactic acid was increased by the addition of maleic-anhydride resulting in improved mechanical properties. Fourier-transform infrared spectroscopy, X-ray diffraction, and Thermal-gravimetric analysis show that derived Hydroxyapatite has similar material properties as commercial hydroxyapatite. The prepared composite has the potential of using bone drafting applications in humans.

Keywords: Hydroxyapatite, Polylactic acid, Maleic-anhydride, Bone grafting biocomposites