Comparative Study on the Physical Properties of Bone Scaffolds from Hydroxyapatite and Natural Polymers

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Abstract

Comparative Study on the Physical Properties of Bone Scaffolds from Hydroxyapatite and Natural Polymers was conducted to investigate the physical properties of bone scaffolds from hydroxyapatite combined with natural polymers at different ratios, analyze their mechanical strength and porous structures, and evaluate their potential for bone substitute applications. Hydroxyapatite was synthesized from bovine bone and characterized using Fourier-transform infrared spectroscopy (FT-IR). Ten scaffold formulations were fabricated using the freeze-drying technique and evaluated for compressive mechanical properties, volumetric porosity using the liquid displacement method, and area porosity and pore size through scanning electron microscopy (SEM) combined with ImageJ analysis. The results confirmed the successful synthesis of hydroxyapatite, with characteristic functional groups consistent with reference data. All scaffold formulations exhibited comparable compressive strength, while their elastic modulus values were within the range of human cancellous bone. The composition and ratio of polymers significantly influenced scaffold porosity and pore size. Among all formulations, Formulation 7, consisting of 5 g hydroxyapatite, 1 g chitosan, and 4 g gelatin, demonstrated the most favorable overall properties, with a volumetric porosity of 61.11 ± 9.62%, an area porosity of 18.33%, and an average pore size of 101.18 ± 39.28 µm, providing a suitable environment for bone cell infiltration, attachment, and growth. These findings indicate the potential of this scaffold for further development as a bone substitute material for tissue engineering applications.

Keywords: Bone Scaffold, Hydroxyapatite, Natural Polymers, Biomaterials, Tissue Engineering