Ain Shams University
University College of Women
(Arts, Science, and Education)
Physics Department

Synthesis and characterization of hydroxyapatite composites from natural sources suitable for medical application

By

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For

Ph.D. Degree in Physics (Biophysics)

A Thesis Submitted

To

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University College of Women (Arts, Science, and Education)
Ain-Shams University

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إهداء

إلي أساتذتى وأبى وأمى و زوجي وأخواتى

وأصدقائى الأحباء الذين أعانوني حتي أتم هذا

العمل وأمدوني بالحب, العطاء, الامل , الصبر

ولتحملهم لي طوال فترة الرسالة .

مع حبى وتقديرى،،،

إيمان

Abstract

Each year million tons of fish bones and shellfish are caught, so it causes a serious environmental problem. Although these wastes contain valuable minerals, their use is not widespread. The main objective of the present study is the extraction and developing of nano-hydroxyapatite (n-HA) powder from natural resources such as fish bone skeletons and of (n-HA) scaffolds coated with PCL to be used as degradable bone substitution. The production of unique porous bioactive microstructure scaffolds and 3D architecture by cheap and ecofriendly method is an additional aim of the present study. The prepared scaffolds were characterized in terms of the *in vitro* and *in vivo* tests and biochemical studies were conducted to observe the changes found in blood. The results revealed that Porous HA scaffolds prepared via polymeric sponge method calcined at 1250°C for 3 h with rate of 5°/min possess high porosity with interconnected pores structure. The porosity of the obtained 3D scaffolds is 85 ± 0.4 and the median pore diameter ranging between about 974.1nm to 3.112 μm. The compressive and bending strengths of the scaffolds calcined are 0.13± 0.007 MPa and 1.72 ± 0.02 MPa respectively, which is very near to the strength of trabecular bone.

Reinforcement of hydroxyapatite scaffolds by coating with PCL using polymer impregnating method revealed that the most suitable socking time present for coating was 4 % w/v PCL for (10 min). The porosity of the obtained 3D scaffolds of 4 % w/v PCL/HA composites was 70 ± 0.4. Also it was noticed that the compressive strength and bending strength was enhanced. The *vitro* test revealed that the coated scaffolds have excellent bioactivity as well as biodegradability. Biological studies indicated the degradation products of the blank HA & 4 % w/v PCL/HA scaffolds did not cause liver disorder, kidney failure, carcinogenic effect, oxidative effect and does not cause the liberation of oxygen radicals that could destroy the tissues, and no inflammatory effect.

Key Words: Fish bone, Biogenic hydroxyapatite, polymeric sponge method, Porous scaffolds, HA bioactivity, HA/PCL composites, *In vitro, In vivo*.

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