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Synthesis of hydroxyapatite nanoparticles by the Sol-Gel method, investigation of its morphology and comparison of its structure with intact tooth

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Abstract

In this study, calcium nitrate tetrahydrate (Ca $(NO_3)2.4H_2O$) and phosphorus pentoxide (P_2O_5) were used to synthetize hydroxyapatite nanoparticles through the sol-gel method at the ambient temperature. In order to examine the structure and identify the chemical bonds and to compare them with the intact tooth, X-ray diffraction analysis (XRD) and Fourier transform infrared spectrum (FT-IR) were used, respectively. Also, through scanning electron microscope (SEM) images, the microstructure and morphology of both synthesized hydroxyapatite nanoparticles and intact tooth were investigated. The results of X-ray diffraction analysis and Fourier transform infrared spectrum indicated that the produced powder was pure hydroxyapatite, i.e. without any discernible amount of impurity in the sample. Crystal structure of the synthesized hydroxyapatite was nearly identical to the crystal structure of intact tooth; moreover, the chemical bonds of the intact tooth were also seen in hydroxyapatite. Furthermore, the synthesized sample featured a high degree of crystallinity. On the other hand, analysis of SEM images showed that the morphology of the synthesized hydroxyapatite and intact tooth (with nanoscale dimensions and average particle size distribution of 25.69 nm and 23.15 nm, respectively), was almost spherical, thereby confirming the similarity of the synthesized nanoparticle structure to thr intact tooth. In these images, the agglomeration of the synthesized nanoparticles was also seen. Compressive strength of the synthesized sample was equal to 5.5 MPa, which was approximately the same as that of the cancellous bone.

Keywords: hydroxyapatite, tooth, sol-gel, nanoparticle, microstructure

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