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SYNTHESIS AND EVALUATION OF BIOLOGICALLY ACTIVE NANOCRYSTALLINE HYDROXYAPATITE IN CHITOSAN HYDROGEL

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Composites consisting of nanodisperse inorganic part and polymer or biopolymer matrix are promising materials for biomedical applications. The large number of polymer matrices is used in the development of materials for bone replacement, while the inorganic part of such materials is predominantly hydroxyapatite or other calcium phosphates. Chitosan is a promising polymer of biological origin which in recent years has been attracting attention as a good matrix for bone-like composites and scaffolds for tissue engineering. It allows obtaining hydrogels with controllable solubility. Mineral calcium phosphate part can be formed in such gels in a relatively simple way. In our work, the chitosan solution in acetic acid was used for the synthesis of nanocrystalline hydroxyapatite (HAP). The Ca^{2+} and PO_4^{3-} salts were introduced to the chitosan solution keeping Ca/P ratio equal to 1.67. Increasing the pH value of the solution leads to the deionization of the previously ionized chitosan; insoluble deionized chitosan consequently forms the three-dimensional stochastic network in which the formation of hydroxyapatite nanocrystals takes place (Figure).

The physico-chemical properties of nanocrystalline hydroxyapatite in the chitosan network were studied using X-ray diffraction analysis, scanning electron microscopy, infrared spectroscopy. Biological activity of the HAP/chitosan composite material was evaluated by in vitro and in vivo experiments.

The obtained material can be described as polymer-mineral nanocomposite which is similar to the bone tissue in its physical properties. After annealing at 900 °C the tricalcium phosphate phase emerges along with the basic hydroxyapatite phase. This is the evidence of Ca-deficiency and non-stoichiometry of the starting material, and the same is also characteristic for natural bone mineral. In the Ringer-Locke solution the deposition of calcium salts onto the surface of composite material takes place. The ability of the synthesized materials to stimulate osteogenesis was confirmed in the in vivo tests.

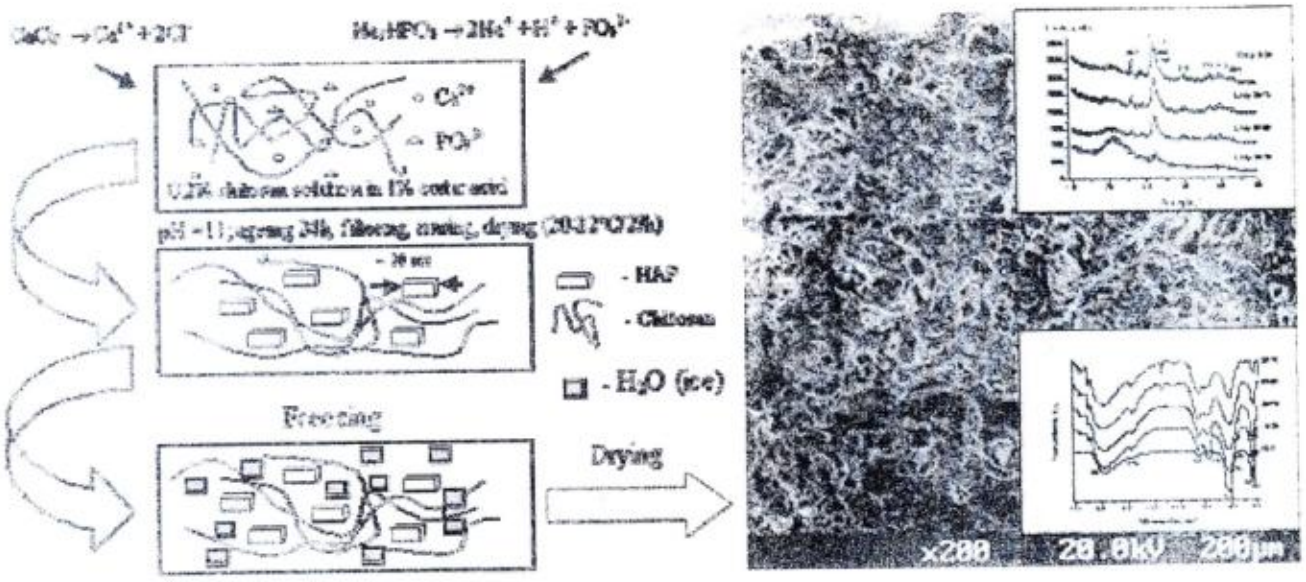

Figure. The general outline of the synthesis and physico-chemical characterization of nanocrystalline hydroxyapatite in chitosan matrix.

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