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Preparation and characterization of silver doped hydroxyapatite scaffolds with chitosan for controlled drug delivery

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Silver doped hydroxyapatite (HAp/Ag) is a promising biomaterial for hard tissue regeneration due to the silver antibacterial properties and hydroxyapatite osteoconductivity, bioactivity and biocompatibility. The main advantages of HAp/Ag materials for controlled drug delivery are their antibacterial properties and constant and continuous drug levels with limited side effects [1]. Chitosan was chosen because it's ecologically safe biopolymer and it contains amino and hydroxyl groups that can be easily functionalized. Dexamethasone sodium phosphate (Dex) was chosen due to its high anti-inflammatory capacity. Chemical structure of Dex is suitable for its immobilization on chitosan films [2].

The aim of this work was to prepare controlled Dex delivery system which is based on HAp/Ag and chitosan composite materials. Monophasic and biphasic HAp/Ag particles were synthesized using modified wet precipitation methods, with CaO or CaNO₃ as raw materials. Synthesized HAp/Ag composites contain up to 3% of silver. Chitosan and Dex solutions in sintered HAp scaffolds were incorporated using vacuum infiltration and release of dexamethasone sodium phosphate was determined using high performance liquid chromatography method. Scanning electron microscopy (SEM) was used to evaluate the surface morphology and inner structure of the scaffolds and Fourier transform infrared spectroscopy was used to identify materials and their chemical interactions. The structure of prepared composites was evaluated with x-ray diffraction and X-Ray fluorescence spectrometry methods.

Results showed that crystalline structure and distribution of Dex depends on the porosity of HAp/Ag materials and incorporated silver phase composition (Fig.1.)

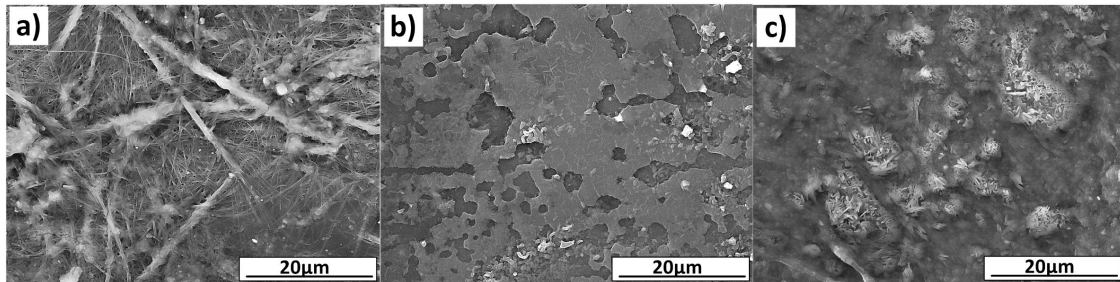


Fig.1. SEM images of fracture surface: a)HAp/chitosan/Dex; b)Biphasic HAp/Ag/chitosan/Dex; c)Monophasic HAp/Ag/chitosan/Dex.

It was discovered that the release of Dex from prepared scaffolds is affected by open porosity and silver phase composition. Dex was immobilized on the chitosan coating and silver ions and Dex was released at the same time providing antibacterial and antiinflammatory effect.

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References:

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