INFLUENCE OF NANOFIBERS ON MECHANICAL PROPERTIES OF BIOCOMPOSITES

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INTRODUCTION

There are nowadays numerous available composite bone graft materials, that combine the advantages exhibited by each component of the material, with a structure and composition similar to that of natural bone. A bioinspired bone implant with the desired nanofibrous and nanocrystalline structure can be prepared using collagen or gelatine and hydroxyapatite. Collagen, as a natural extracellular matrix protein available in bone tissue has excellent biocompatibility, biodegradability and non-toxicity, which make it a prime and safe source of materials for use in a variety of biomedical applications in the bone tissue engineering area [2]. This study is focused on confrontation of two types of composite: type A: gelatine and collagen are in homogenous form, type B: gelatine and collagen are in nanofibres form. Influence on mechanical properties was the main task of passed tests of these two types of composites.

METHODS

For verifying the nanofibers influence on the mechanical properties two sets of each biocomposite have been prepared. During the preparation were used the same materials in the same concentration, but with different structure (homogenous gelatine and collagen/gelatine and collagen nanofibers).

Type A: (GELHA) has been prepared by introduction of hydroxyapaptite (HA) powder into porcine gelatin (GEL) matrix and mixed by screw kneading machine at room temperature. Mixture has been formed followed by drying at ambient atmosphere, pressure and humidity. The same procedure was aplicated on COLHA-the second type of composite, instead of gellatine were used the collagen.

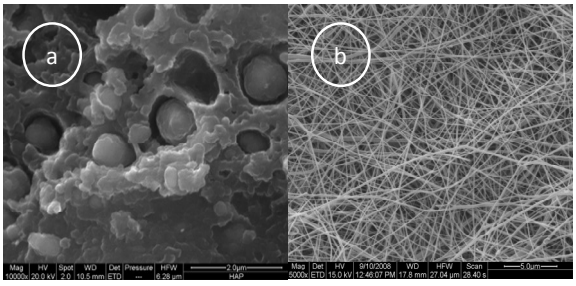

Figure 1: a) SEM image of GELHA composite (magnification 10000x), b) SEM image of NF-GELHA composite (magnification 5000x)

Type B: collagen and gellatin nanofibers loaded by HA have been provided by ELMARCO s.r.o. (NF-GELHA, NF-COLHA). Sixty four layers of NF-GELHA have been placed into the form and pressed at 40°C under the pressure of 35 MPa for 5 minutes. Sample from NF-COLHA were prepared from 96 layers, pressed at 32°C under the pressure of 30 MPa for 10 minutes.

Dried samples of both types (A and B) were cut into rectangle-shaped pieces for testing of mechanical properties. The ultimate tensile strength (Rm) for both types of composites was determined with Inspekt 100 HT material tester with respect to ISO 527.

Differences in HA concentration and structure in matrices has been analyzed by Raman microscopy.

RESULTS AND DISCUSSION

The purpose of the mechanical testing was test the behaviour of the composite and, with regard to the future potential application in bone tissue engineering, to compare these results with the properties of the human bone. The ultimate tensile strength (Rm) for both types of composites was determined. The results (see Table 1) indicate that tensile strength is comparable to that of human bone.

Material	Tensile strength Rm [MPa]
Cortical bone	50-150 [1]
Cancellous bone	10-20 [1]
COLHA	25
GELHA	30
NF-COLHA	40
NF-GELHA	50

Table 1: Results of the mechanical tests

CONCLUSIONS

This study has investigated the influence of nanofibers on mechanical properties of composites based on the biodegradable materials. Results confirmed the positive influence of nanofibers on the mechanical properties of composite. According to these results, composites based on gelatine and collagen are suitable rather for low load applications. Mechanical properties are one of the many aspects for biocomposite evaluation. *In vivo* and *in vitro* tests are subjects of the future research.

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