Załącznik nr 3

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ABSTRACT OF THE DISSERTATION

„Process of obtaining polymer-ceramic porous granulates for bone tissue regeneration"

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This dissertation describes the process for obtaining synthetic biomaterials in the form of granules and scaffolds produced from them, which can find application as a substrate for cell growth and reconstruction of bone tissue removed from the body, e.g., after bone tumor resection or tooth extraction. Particular emphasis has been placed on the presentation of process parameters influencing selected physical properties of the obtained materials and on in vitro studies to evaluate biological properties.

First, this dissertation presents the research topic and the subject of three-dimensional scaffolds for bone tissue regeneration. The physicochemical and biological phenomena occurring in the scaffolds during cell growth and the prevalence of materials in the form of synthetic granules are described. Author proposes a process for producing porous granules from polymers used in tissue engineering: poly(lactic acid), poly(lactic acid-co-glycolic acid), polycaprolactone, and chitosan. Included in the polymers was the addition of the osteoconductive compound calcium β-triphosphate, a mineral with a high resorption capacity and chemically similar to hydroxyapatite, of which bones are composed. The solvent-induced phase separation (SIPS) emulsification process was adapted from the literature regarding preparing porous microspheres for controlled drug release. The effects of process parameters such as polymer, calcium phosphate, surfactant concentration, temperature, and stirring rate on product properties such as porosity, particle size, and sphericity were analyzed. Selected granules were subjected to cytotoxicity evaluation according to ISO 10993-5. The granules were then subjected to thermal assembly to obtain a scaffold for culturing human and animal cells. L929 mouse fibroblast cell line, MG-63 human osteosarcoma cell line, and hMSC human mesenchymal stem cells were used. In vitro studies were aimed at evaluating the bioactive properties of the material obtained by the designed process, and such tests will be performed as observation of cells using scanning laser confocal microscopy, measurement of the amount of protein produced and alkaline phosphatase activity, and evaluation of bone mineralization by alizarin red staining. Tests were also performed to evaluate the mechanical properties of scaffolds, with particular emphasis on elastic modulus and ultimate compressive strength. Techniques for increasing cell adhesion on scaffolds using hydrophilization of materials by atmospheric plasma and polycatecholamine coatings (polydopamine and polynorepinephrine) were also studied.

This dissertation is concluded with a summary of the results and a discussion of them in the context of the three research theses. All of them were fulfilled, and the material with the most significant potential is composite in the form of granules composed from poly(lactic acid) Resomer LR 706S and β-TCP due to its high ultimate compressive strength, formability into scaffolds and bioactivity. The selected variant is a potential synthetic biomaterial produced in the SIPS process for repairing bone and tooth defects, obtained without human or animal origin materials.

Keywords: bone regeneration, tissue engineering, granulate, bone scaffolds, composite materials

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