Materiały kompozytowe na bazie poli(sebacynianu gliceryny) do potencjalnego wykorzystania w inżynierii tkankowej kości

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Abstract in English

According to the World Health Organization, osteodegenerative diseases as well as mechanical injuries of bone tissue occur more frequently in human population after 50 years of age. Therefore, beside promoting the appropriate prophylaxis, medicine must research more effective solutions in the scope of tissue engineering, which support the local cellular regeneration. The presented doctoral dissertation aims to showcase the potential of applying porous composites based on poly(glycerol sebacate) (PGS) and apatite ceramics (HAp) in bone tissue engineering along with thorough physicochemical, mechanical and biological evaluation of the materials. The research area includes performing two alternative synthetic routes of the prepolymer: thermal polycondensation and enzymatic synthesis catalyzed with Lipase B derived from *Candida antarctica* yeast (CALB). During analysis of structure and properties of pPGS, the material synthesised with thermal method was selected for further analysis. Hydroxyapatite was synthesised with wet precipitation technique from Na_2HPO_4 and $Ca(CH_3COO)_2$ salts.

In the course of the experiments both bulk and porous materials were obtained. Thermal cross-linking of the material resulted in the increased water contact angle value. Porous scaffolds have been manufactured with TIPS-TCL-SL technique: a combination of thermally induced phase separation coupled with thermal crosslinking and salt leaching. Obtained materials possessed high porosity with less than 0.02% of closed pores. Thermal stability and energy dispersive spectroscopy allowed to confirm qualitatively and quantitatively the presence of HAp in the composite scaffolds matrix. Dynamic mechanical testing and static compression indicated foam with 20% of apatite filler as the sample with superior mechanical resistance among all tested specimens.

In addition, the thesis tackles the biological cytosafety of the manufactured biomaterials and their potential application in bone tissue engineering. During a 14-day incubation in various physiological liquids, foams showed a potential for degradation which is essential in contemporary regenerative medicine. Evaluated PGS-based materials did not exhibit cytotoxicity against L929 fibroblasts under ISO normative

study. Most importantly, scaffolds were subjected for osteoconductive potential assessment against hFOB 1.19 human preosteoblast cell's cultures. A statistically significant increase in mediators important in bone tissue regeneration was observed for porous composite scaffolds containing apatite filler. Those include osteocalcin, osteopontine, alkaline phosphatase (ALP) and selected immunomodulatory cytokines (IL-1β, IL-6, IL-10, TNF-α). Presentation of porous PGS/HAp scaffolds forms a solid background for introducing these biomaterials for in vivo evaluation.