EFFECT OF A LOW PH ON HAp/GLUCAN COMPOSITE

Leszek Borkowski[1]*, Małgorzata Kiernicka[2], Anna Belcarz[1,3], Krzysztof Pałka[4], Mieczysław Hajnos[5], Grazyna Ginalska[1,3]

[1] Chair and Department of Biochemistry and Biotechnology, Medical University of Lublin, Chodzki 1, 20-093 Lublin, Poland
[2] Chair and Department of Periodontology, Medical University of Lublin, Karmelicka 7, 20-081, Lublin, Poland
[3] Medical Inventi Inc., Witosa 16, 20-315 Lublin, Poland
[4] Department of Materials Engineering, Lublin University of Technology, Nadbystrzycka 36, 20-618 Lublin, Poland
[5] Institute of Agrophysics, Polish Academy of Sciences, Doswiadczalna 4, 20-290 Lublin, Poland
*e-mail: leszek.borkowski@umlub.pl

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Introduction

The feature of polymer-based composites is volume increase related to swelling in aqueous media. Biomaterial implantation may induce inflammatory response that lead to small environmental changes such as pH. Value of pH may drop to 5.5 in inflamed tissue. Moreover, activated macrophages and osteoclasts can cause even more significant acidification (pH 3.0–3.5) in bone regeneration process [1,2]. These environmental changes may affect the structure and properties of some polymers. Besides, acidic environment may affect also the properties of the ceramic phase due to the dissolution in acids [3]. In this study we investigated the potential influence of microenvironmental changes on ceramic-polymer composite containing hydroxyapatite and β-1,3-glucan. The biomaterial samples were incubated in acidic media during the critical period (5 days) and their physicochemical properties were evaluated.

Materials and Methods

Tested biomaterial was prepared by mixing HAP granules with polysaccharide polymer (83 wt% granules and 17 wt% β-1,3-glucan) [4]. The fabricated material was cut into cylinders 10 mm in length and 9 mm in diameter, dried and sterilized. Individual components of composite, namely glucan samples (control 1) and HAp granules (control 2) were used for comparison. All samples were incubated in Mc Ilvaine citrate/phosphate buffer (pH 7.4, 5.0 and 3.0; 4 mL per well) and incubated in 37ºC for 5 days. The incubation buffer was replaced every 24 h with a fresh buffer. The weight of samples was measured before and during incubation in buffers at defined time points (after 1, 3, 10 min, and 2, 24, 48, 72, 96, 120 h). Ion reactivity of HAp granules used for composite synthesis was examined by analysis of the Ca^{2+} ion concentration in incubation buffers every 24 h for 5 days. Evaluation of physicochemical parameters was performed using microCT, XRD and FTIR analyses, SEM imaging and mercury intrusion technique.

Results and Discussion

The weight and volume of composite samples increased significantly in medium at pH 3 (FIG. 1a-b). Dissolution of ceramics phase in acidic media was confirmed (release of Ca^{2+} ions was presented at FIG. 1f). Pore size remodelling and ceramic phase rearrangement in the composite was shown at FIG. 2.

Conclusions

The elastic composite material (HAp/glucan) swells and undergoes remodeling in acidic media (pH 3.0–5.0). This study enables to predict the optimal quantity of implanted biomaterial and to avoid the overdose effects.

Acknowledgments

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FIG. 1.

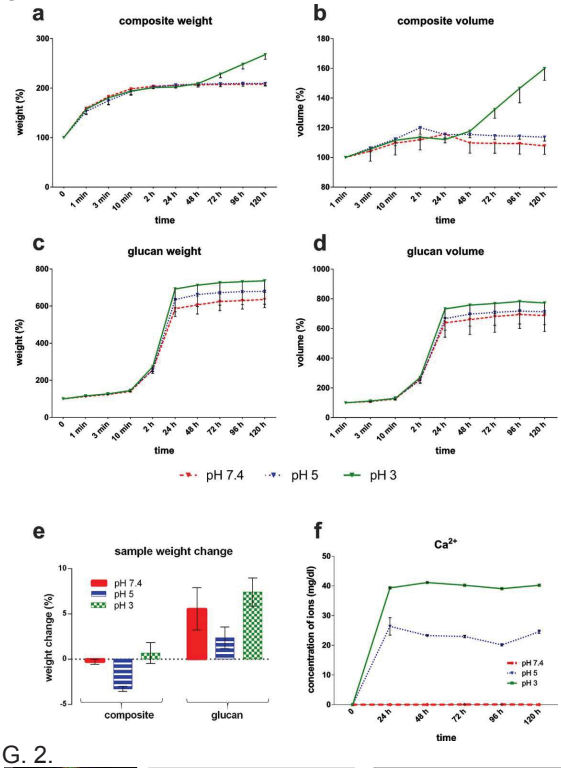

FIG. 2.