IN VITRO BIOLOGICAL ACTIVITY OF ZINC-DOPED BIOGLASS FOR MULTIFUNCTIONAL CHITOSAN COMPOSITES

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Introduction

Biomaterials for bone reconstruction are subjected to continuous improvement [1-3]. However, their properties are still far from expectations, especially in the field of bacterial infections in bone tissue. Antibacterial properties of biomaterials would significantly reduce the problem of infections. The aim of the study was to obtain bioactive and bactericidal glasses for multifunctional composites using the sol-gel method.

Materials and Methods

The developed chemical formulations of bioglass belonged to the ternary CaO-SiO_2-P_2O_5 system. Bioglass of 70 wt% SiO_2, 5 wt% P_2O_5 and 25 wt% CaO was used as a basic material (P5). As for the composition of ZnO-doped bioglass, 2 wt% (P5Zn2) or 5 wt% (P5Zn5) of CaO in basic glass was replaced with ZnO. Having performed the reaction mixtures from sol to gel and after the drying process was completed heat treatment at 650°C for 15 h The samples were prepared in two grain sizes I and II.
The biological tests were carried out using Human osteoblast cell line hFOB 1.19 in accordance with PN-EN ISO 10993. Cell proliferation and cytotoxicity was determined by LDH and WST-1 tests. To determine antimicrobial properties of bioglasses cell cultures *Staphylococcus aureus* PCM 2602 and *Pseudomonas aeruginosa* PCM 2563 were used. Collected data were analysed and visualized using GraphPad Prism 8 (GraphPad Software, USA). Due to the limited number of experimental samples, normality of results distribution could not be confirmed. Thus, statistical calculations for different amounts of data obtained in the experiments were performed with the use of Mixed-effects Model which is based on Restricted Maximum Likelihood (REML) calculations ($p = 0,05$). In the next step, to control the false discovery rate, Benjamini, Krieger and Yekutieli multiple comparison test ($p = 0,05$) was carried out.

Results and Discussion

The results of in vitro biological tests are presented in FIGs 1-3. The cytotoxicity of bioglass containing 5% ZnO exceeded the permissible value of 10%, regardless of the grain size.

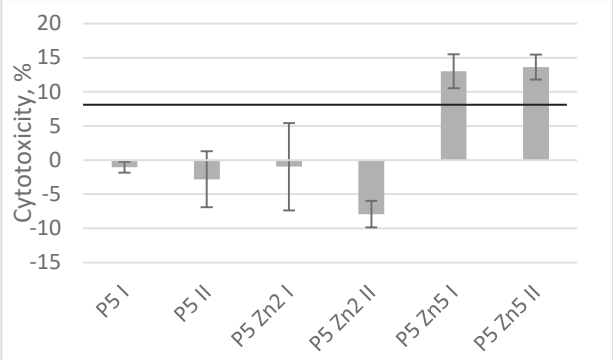

FIG. 1. Bioglass cytotoxicity after 48 h.

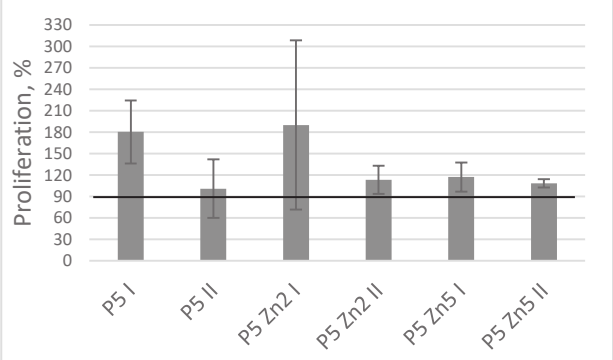

FIG. 2. Proliferation of the hFOB cell line after 48 h of contact with bioglass.

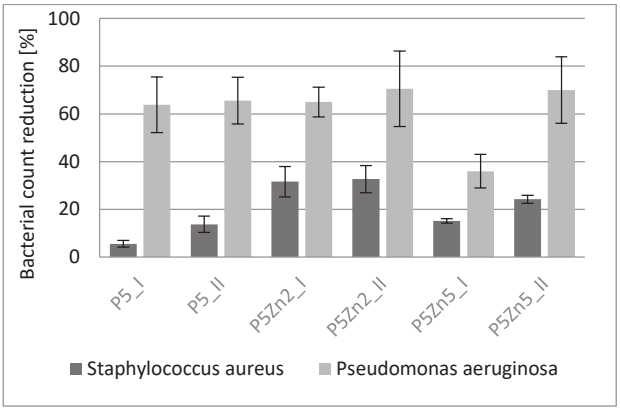

FIG. 3. The antibacterial activity of glasses on cells *Staphylococcus aureus* and *Pseudomonas aeruginosa.*

The proliferation of all tested glasses was higher than the required level of 90%. The highest antibacterial effect was demonstrated by bioglass containing 2% ZnO. The level of their antibacterial activity depended on the type of bacterial strain.

Conclusions

The rate of bactericidal reduction of the glasses depended on the ZnO concentration in the bioglass and the susceptibility of the cell culture.

Acknowledgments

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