OSTEOCONDUCTIVE POTENTIAL OF PLGA/BIOGLASS COMPOSITE BIOMATERIALS

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Introduction

Composite materials with the polymer matrix and bioactive glasses as modifiers are potential materials for regenerative medicine [1]. It is known, however, that in addition to the chemical composition, important factors determining the bioactivity of the biomaterial are also its surface properties and structure [2].
Compared to two-dimensional materials, porous three-dimensional materials, due to having interconnected pores of the right size, facilitate cell adhesion, proliferation, differentiation and even tissue regeneration in a more natural way, because their structure resembles living tissue [3].
The aim of this study was to investigate the effect of two- and three-dimensional PLGA/bioglass composite biomaterials on *in vitro* cell culture, ultimately on normal human osteoblasts (NHOst). The reason for these considerations was potential application of the biomaterials in tissue engineering for regeneration of bone tissue losses.

Materials and Methods

Materials

PLGA/BG composite materials in the form of foils (2D) and porous scaffolds (3D) were fabricated using solvent casting and solvent casting particulate leaching techniques, respectively. Dichloromethane and NaCl (315-400 µm) were used as a solvent and porogen, respectively. The molar ratio of L-lactide to glycolide in the copolymer was 85:15. The volume fraction of BG in the composites was 21%. Bioactive glass particles (<45 µm) with chemical composition of (mol.%) $80SiO_2$-$16CaO$-$4P_2O_5$ (S2) and $40SiO_2$-$54CaO$-$6P_2O_5$ (A2) were prepared using sol-gel method. The biomaterials thus obtained were tested for biocompatibility and functionality.

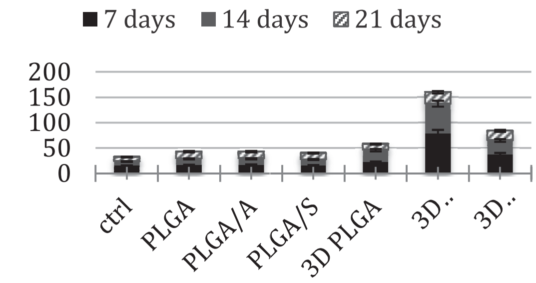
Cell study

The effect of biomaterials on bone cell differentiation was studied by testing the activity of early and late markers of bone formation: alkaline phosphatase (ALP), osteopontin (OP) and osteonectin (ON). Normal human osteoblasts (Lonza, USA) were cultured with biomaterials for 7, 14, and 21 days. The activity of ALP was measured after 7 and 14 days of cell culture using 4-MUP (Sigma, USA) test. The level of OP and ON secretion was measured with ELISA tests (Cloud-Clone Corp., USA).

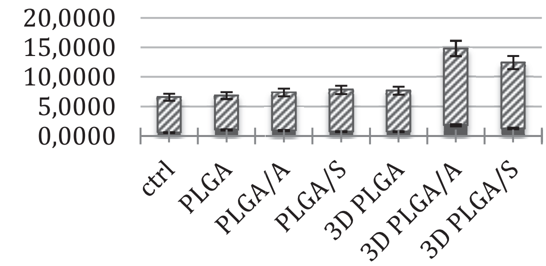
Results and Discussion

The effects of conducted studies suggest a positive influence of bioglass additives and 3D structure on cell differentiation. Among the studied biomaterials the best results showed the 3-dimensional composite material containing A2 bioglass (FIG. 1).

a)



b)



c)

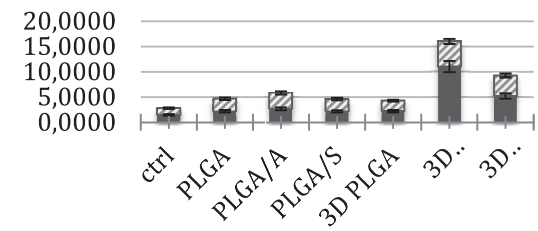


FIG. 1. a) The activity of ALP, and the level of b) ON and c) OP secreted by NHOst cultured on biomaterials.

Conclusions

The addition of bioglass together with the 3D structure of composite significantly increases the osteoconductive potential of obtained biomaterials.

Acknowledgments

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