IN VITRO STUDIES OF ANTIBACTERIAL ACTIVITY OF SOL-GEL BIOGLASSES CONTAINING Mg, Sr AND Au

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INTRODUCTION

The aim of the study was to determine in vitro antimicrobial activity of bioactive bioglasses doped with Mg, Sr and Au. The presence of magnesium in the composition of the biomaterial enhances its bioactivity [1]. Strontium improves the proliferation of bone cells [1]. Gold belongs to the group of “ultra elements” which show antibacterial activity and activate metabolism by acting on enzymes [2]. The silane used for the synthesis of sol-gel bioglasses may also increase bioactivity [3]. Physical and chemical properties of bioglasses containing Mg, Sr and Au produced by sol-gel method as well as its grain morphology and bioactivity in simulated body fluid and the results of in vitro cytotoxicity were presented in previous publication [4]. This paper presents the results of in vitro antibacterial activity of these bioglasses.

EXPERIMENTAL METHODS

Four bioglasses doped with Mg, Sr and Au and undoped bioglass as a reference material were used for the research. Bioglass PS-VS containing 70 wt.% of SiO₂ and 25 wt.% of CaO and 5 wt.% of P₂O₅ being a reference material was produced using tetraethoxysilane, vinyltriethoxysilane (VS), calcium nitrate tetrahydrate and triethyl phosphate as basic substrates. Bioglasses P5-VS-1_Mg, P5-VS-1_Sr, P5-VS-1_Au_nzk with the same composition as P5-VS were obtained by substituting 1 wt.% of CaO by MgO or SrO respectively. In the case of bioglasses P5-VS-Au_r-r and P5-VS-Au_nzk nanoparticles of Au in the form of 0.00065 wt.% colloidal solution and 0.002 wt.% nonionic colloidal gold respectively were added. The process of preparing bioglasses by sol-gel method was carried out according to procedures described in earlier reports [4].

Studies of antibacterial activity were performed by a dilution method, using precultures of test bacterial strains of Pseudomonas aeruginosa and Staphylococcus aureus which were deposited on substrates at concentrations of 1.0 mg/ml, 5.0 mg/ml, 10 mg/ml, 20 mg/ml and 50 mg/ml. The 24-wells plates with the bacterial strains were incubated at the temperature (37±1)°C. Antibacterial activity of bioglasses was identified by counting live bacteria population after 24h, 48h and 168h of incubation. The controls consisted of broth cultures of microorganisms without bioglasses.

RESULTS AND DISCUSSION

Results of in vitro antibacterial activity tests carried out with different concentration of bioglasses indicate that all of them lead to reduction of the number of bacteria. The best results were obtained using the highest concentration of bioglasses. Figures 1 and 2 show results of antibacterial activity tests of bioglass in different concentrations after 48h on Pseudomonas aeruginosa and Staphylococcus aureus, respectively. Figures 3 and 4 show duration dependency of survival of Pseudomonas aeruginosa and Staphylococcus aureus for the concentration of 20 mg/ml of investigated bioglasses. Figure 5 shows the result of antibacterial activity of bioglasses at concentration of 20 mg/ml on selected strains.

CONCLUSION

In vitro studies of antibacterial activity of bioglasses in selected strains of bacteria showed higher activity against strain of Staphylococcus aureus than Pseudomonas aeruginosa. Bioglass PS-VS-1_Sr is the one that inhibits growth of micro-organisms during the tested period most effectively.

REFERENCES


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