The Effect of Zinc and Magnesium Ions on the Development of Staphylococcal Biofilm

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Short Communication

In view of the presence of protein components in the staphylococcal biofilms, it may be interesting to study the effect on the biofilm formation of metal ions, since it is known that the activity of certain peptidases and proteases, as well as a number of enzymes associated with the functioning of the genome, depends on the concentration of some bivalent metal ions. The aim of the research was to study an influence of zinc and magnesium ions on the development of staphylococcal biofilm. The study of the influence on the formation of biofilms by staphylococci of Mg²⁺ and Zn²⁺ ions was carried out when these ions were added in the form of nitrate salts to synthetic medium (the final concentrations were from 0.05 to 12.8 mM). The control sample was the medium without the addition of the specified compounds. Contents of synthetic medium described in [1]. The pH value of the medium for growing of staphylococci was 7.5–7.6. 200 μl of a sterile base medium was added to the wells of a 96-well plate (Medpolimer, RF) with or without addition of ions and 100 μl of a bacterial suspension contained 1.0 × 10⁴ cells / ml were sowed. Plates incubated for 72 h at 37 °C.

The development of biofilm was studied by method [2]. The results of studies on the influence of ion of bivalent metals showed that the concentrations of zinc and magnesium cations in the culture medium from 0.05-12.8 mM resulted as a decrease of the number of cells and the biofilm-formation index (BI). That is, there was a suppression of the formation of biofilms. In particular, the use of ions Mg²⁺ already in the concentration in the nutrient medium of 0.05 mM led to a decrease in the number of cells of biofilm 10.5 times, while the index of BI was reduced by 1.2 times, and at a concentration of 12.8 mM the number of cells decreased by 4.0 × 10⁵, and the index of BI – 14 times compared with the control.

According to the results of similar studies of other authors [3] an increase in the concentration of Ca²⁺, Mg²⁺ and Mn²⁺ ions in the culture medium provokes a decrease in a activity of formation of staphylococcal biofilms. For example, an increase in the medium of cultivation of ions Mn²⁺ to 12.5 mM reduced the formation of biofilms by 5 times. The addition of Ca²⁺ and Mg²⁺ ions into the culture medium reduced the intensity of biofilm formation of Staphylococcus epidermidis strains by an average of 2 and 3 times, respectively. Other authors [4] cite data, indicate that in the presence of iron ions in the culture medium suppress the formation of biofilms by Staphylococcus aureus, and the deficiency of iron ions, by contrast, enhances the formation of the biofilm. Consequently, compared to the natural concentration of the metals ions in the media have a negative effect on the formation of the film, however, and the lack of these ions has negative consequences. In particular, in another studies [5] have shown that a staphylococcal biofilm is not formed if the Zn²⁺ ions are absent in the culture medium, because they are elements of intercellular interactions at the level of the surface proteins of bacterial cells.

References


