THE IMPACT OF SILICA FUNCTIONALIZED MICROSPHERES ON THE ABILITY OF MICROORGANISMS TO ADHESION AND BIOFILMS FORMATION

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The microorganisms existing naturally as biofilms have a number of advantages compared to planktonic forms. One of such advantages is the increased resistance to antimicrobial agents, disinfectants, and adverse environmental conditions. Thus, a rate of antimicrobial compound resistance of microorganisms that form biofilms may be twice or even three times higher than the one of the planktonic forms. In addition, it is believed that the formation of mixed biofilms that consist of different species of microorganisms is one of the mechanisms of infectious processes become chronic. Traditional antimicrobial therapy is not always effective enough toward biofilms. That is why the study of a modern nanocomposite materials capacity to inhibit the initial stages of the adhesion and further development of biofilms allows establishing the new generation of antimicrobial agents that will prevent the formation of biofilms on any of biotic and abiotic surfaces.

It is known that a cell adhesion is a crucial stage of biofilm development, as further processes such as persistence of pathogenic cells and the formation of biofilm itself will depend on it. The action of advanced antimicrobials shall be directed to the inhibition of biofilm growth. One of the strategies of such effects may be blocking the initial stages of adhesion. In view of this, in the paper, it was studied the effect of functionalized silica microspheres with adsorbed Cu^{2+} ions on their surface and without them toward the ability of test cultures (*C. albicans* UCM Y-690, *C. ammoniagenes* UCM Ac-732, *S.aureus* ATCC 25923) to adhere and form biofilms in general. As in previous studies, we have found that the functionalized silica microspheres mentioned above inherent antimicrobial activity. It was shown that test cultures were different in their ability to adhere. For a 120-minute exposition, the highest index of adhesion (AI=92.1%) was found for *C. albicans* UCM Y-690, while for *S. aureus* ATCC 25923 and *C. ammoniagenes* UCM Ac-732, it was 89.9 and 61.3%, respectively. After a contact with functionalized silica microspheres (with a concentration of 0.01%) for 120 minutes, a decrease of microbial cell adhesion in 1.4 times was reported. Implementing microspheres with Cu^{2+} ions absorbed led to significant adhesion inhibition. The most compelling impact on adhesion compared to control cells was reported for *C.albicans* (AI=34.5%). The effect of such microspheres on S. aureus was lower (AI=56.5%), and almost no effect on *C.ammoniagenes* cells was found (AI=51.6%). Using Kraskela-Wallis criteria (p=0.05), it was shown a statistically significant difference in the ability of *S.aureus* ATCC 25923 (p=0.033) and *C.albicans* UCM Y-690 (p=0.02) to form biofilm in the presence of silica microspheres compared to a control group. However, under similar conditions, no statistically significant difference (p=0,095) for *C.ammoniagenes* UCM Ac-732 was found.

The examination of the adhesive properties of test cultures and their ability to form biofilms was performed using plastic Petri dishes, where sterile glass slides were placed.

Thus, the results showed that functionalized silica microspheres, especially those consisting of Cu^{2+} ions absorbed can be considered as promising agents used against the biofilm formation.

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