ABSTRACT

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BACTERIAL BIOFILM – EFFECT OF CULTURE VARIANT ON CO-EXISTENCE AND CELL INACTIVATION

Bacterial biofilms pose problems in food processing plants, as they contribute to both economic losses and hazards to human health. *Listeria monocytogenes* is one of the food-borne pathogenic microorganisms. Its capability for adhesion and biofilm formation, including the co-existence with other microorganisms, requires systematic research to minimize its prevalence in the food processing environment. Biofilm eradication in the food industry involves washing and disinfection treatments, the efficacy of which depends on the form of occurring microorganisms (plankton or biofilm) and biofilm characteristics.

Considering the above, the aim of the study was to evaluate the capability of *Listeria*, *Lactobacillus*, *Pseudomonas* and *Staphylococcus* to form single-species biofilms and to form dual-species biofilms with *Listeria innocua* (non-pathogenic, phylogenetically closely related to *L. monocytogenes*), as well as to determine the inactivation level of single- and dual-species biofilms depending on applied disinfectant (quaternary ammonium compounds-, tertiary alkyl amine-, and chlorine-based disinfectants) and biofilm maturity. The results of these analyses provided information about the effect of microorganisms co-existence on biofilm formation dynamics and cells inactivation in the biofilms.

The results obtained in this study enabled concluding that the tested microorganisms formed biofilms on the polystyrene, polycarbonate and glass surface. *L. innocua* was able to grow and co-exist with other microorganisms, forming dual-species biofilms. It was shown that the single-species biofilms formed by *Listeria* spp. and *Staphylococcus* spp. were more resistant to the disinfectants in a mature biofilm (72 h), whereas the biofilms formed by *Lactobacillus* spp. and *Pseudomonas* spp. were more resistant in a young biofilm (24h).

The co-existence of microorganisms in the dual-species biofilms increased their resistance to disinfectants. The co-existence of *L. innocua* with *L. plantarum* and of *L. innocua* with *S. aureus* contributed to higher resistance of the mature biofilms, whereas the co-existence of *L. innocua* with *P. aeruginosa* contributed to higher resistance of the young biofilms. Results of microscopy analyses demonstrated a similar contribution of *L. innocua* cells in the biofilm with *L. plantarum* and *P. aeruginosa*, and the inhibited growth of *L. innocua* in the biofilm with *S. aureus*. The study also showed the protective effect of *L. plantarum* on *L. innocua* cells in the dual-species biofilm, where *L. plantarum* was located peripherally and hindered disinfectant penetration to the biofilm's interior.

The results of this study emphasize the severity of problems posed by bacterial biofilms in the food industry. Besides, they point to the importance of microbials co-existence and biofilm maturity to the effectiveness of disinfecting agents used in the food industry. Finally, the obtained results indicate the need for further research into the dual- and mixed-species biofilms and for the assessment of the effectiveness of various methods of their inactivation to prevent food from contamination with their constituent microorganisms.