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Elimination of Mixed-Culture Biofilms Using Biological Agents

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Abstract : The attachment of microorganisms to different surfaces and the development of biofilms can lead to outbreaks of food-borne diseases and economic losses due to perished food. In food processing environments, bacterial communities are generally formed by mixed cultures of different species. Plants are sources of several antimicrobial substances that may be potential candidates for the development of new disinfectants. We aimed to investigate cinnamon (Cinnamomum zeylanicum), marjoram (Origanum majorana), and thyme (Thymus vulgaris). Essential oils and their major components (cinnamaldehyde, terpinene-4-ol, and thymol) on four-species biofilms of E. coli, L. monocytogenes, P. putida, and S. aureus. Experiments had three parts: (i) determination of minimum bactericide concentration and the killing time with microdilution methods; (ii) elimination of the four-species 24– and 168-hours old biofilm from stainless steel, polypropylene, tile and wood surfaces; and (iii) comparing the disinfectant effect with industrial used per-acetic based sanitizer (HC-DPE). E. coli and P. putida were more resistant to investigated essential oils and their main components in biofilm, than L. monocytogenes and S. aureus. These Gram-negative bacteria were detected on the surfaces, where the natural based disinfectant had not total biofilm elimination effect. Most promoted solutions were the cinnamon essential oil and the terpinene-4-ol that could eradicate the biofilm from stainless steel, polypropylene and even from tile, too. They have a better disinfectant effect than HC-DPE. These natural agents can be used as alternative solutions in the battle against bacterial biofilms.

Keywords : biofilm, essential oils, surfaces, terpinene-4-ol
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