PLANT EXTRACTS AS ANTIFUNGAL AND ANTI-ADHESION AGENTS AGAINST YEAST CONTAMINANTS

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Introduction

Yeasts are used in food and drink fermentation, but they can also cause spoilage in a wide range of fermented and non-fermented foods. Food spoilage is a serious sensorial and economical problem for the food industry as microbial contamination can occur during processing, storage and consumption of the end products. *Candida* and *Pichia* are the genera mainly involved in spoilage of products in the food and beverage industry. These contaminating microorganisms can form biofilms on food contact surfaces, being difficult to eradicate, increasing the probability of microbial survival and further dissemination during food processing. It is well known that biofilms are more resistant to antimicrobial agents compared to planktonic cells and this makes them difficult to eliminate. Among the strategies used to overcome resistance to antifungal drugs and preservatives, the use of natural substances such as plant extracts has shown particular promise in controlling biofilms. Taking this into account, our study was designed with the objectives of evaluating the effects of *Humulus lupulus*, *Alpinia katsumadai* and *Evodia rutaecarpa* extracts on the initial phase of biofilm formation and preformed biofilms of *Candida albicans* ATCC 10261, *Candida glabrata* ZIM 2369 and *Pichia membranifaciens* ZIM 2417 to the surface of stainless steel.

Experimental

The minimal inhibitory concentrations (MICs) of plant extracts were determined using the broth microdilution method CLSI M27-A3, while the method used to assess antibiofilm activity was crystal violet staining.

Results and discussion

Based on the MIC values, all plant extracts exerted significant antifungal effects with MIC values ranged from 100 to 400 μg/mL. Our data showed a significant reduction of biofilm formation and preformed biofilm of *C. albicans* ATCC 10261 to stainless steel surface after exposure to the *H. lupulus*, *A. katsumadai* and *E. rutaecarpa* extracts at concentrations of 1/2 × MIC and 1 × MIC. All three tested extracts were equally effective against *C. albicans*. In the case of *C. glabrata* ZIM 2369, it was evident that both concentrations (1/2 × MIC and 1 × MIC) of *A. katsumadai* extract significantly reduced the initial phase of biofilm formation during 24 h of incubation. However, exposure of preformed 24 h biofilms with *A. katsumadai* extract for 3 h had no effect on the formed biofilm. These findings highlighted that the extracts were more efficient in the case of *C. albicans* than in *C. glabrata*. Regarding *P. membranifaciens* ZIM 2417, it was found that *A. katsumadai* and *E. rutaecarpa* extracts significantly increased biofilm formation at a concentration of 1/2 × MIC. The enhanced biofilm development observed upon

exposure to some extracts in this study may be due to the presence of certain compounds within the extracts that favour the development of these biofilms.

Conclusion

The obtained data may contribute to a better understanding of the antifungal properties of plant extracts such as *H. lupulus*, *A. katsumadai* and *E. rutaecarpa* which can be promoted as an alternative antifungal agents.

Acknowledgements

Ružica Tomičić thank Provincial secretariat for higher education and scientific research, Autonomous Province of Vojvodina, Republic of Serbia (project no. 142-451-2623/2021-01).