World Academy of Science, Engineering and Technology
International Journal of Nutrition and Food Engineering
Vol:18, No:03, 2024

Effects of Culture Conditions on the Adhesion of Yeast Candida spp. and Pichia spp. to Stainless Steel with Different Polishing and Their Control

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Abstract : An abundant growth of unwanted yeasts in food processing plants can lead to problems in quality and safety with significant financial losses. 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, and many natural substances have been found to exhibit antifungal properties. This study aimed to investigated the impact of growth medium (Malt Extract broth (MEB) or Yeast Peptone Dextrose (YPD) broth) and temperatures (7°C, 37°C, 43°C for Candida strains and 7°C, 27°C, 32°C for Pichia strains) on the adhesion of Candida spp. and Pichia spp. to stainless steel (AISI 304) discs with different degrees of surface roughness (Ra = 25.20 – 961.9 nm), a material commonly used in the food industry. We also evaluated the antifungal and antiadhesion activity of plant extracts such as Humulus lupulus, Alpinia katsumadai and Evodia rutaecarpa against C. albicans, C glabrata and P. membranifaciens and investigated whether these plant extracts can interfere with biofilm formation. The adhesion was assessed by the crystal violet staining method, while the broth microdilution method CLSI M27-A3 was used to determine the minimum inhibitory concentration (MIC) of plant extracts. Our results indicated that the nutrient content of the medium significantly influenced the amount of adhered cells of the tested yeasts. The growth medium which resulted in a higher adhesion of C. albicans and C. glabrata was MEB, while for C. parapsilosis and C. krusei was YPD. In the case of P. pijperi and P. membranifaciens, YPD broth was more effective in promoting adhesion than MEB. Regarding the effect of temperature, C. albicans strain adhered to stainless steel surfaces in significantly higher level at a temperature of 43°C, while on the other hand C. glabrata, C. parapsilosis and C. krusei showed a different behavior with significantly higher adhesion at 37°C than at 7°C and 43°C. Further, the adherence ability of Pichia strains was highest at 27°C. Based on the MIC values, all plant extracts exerted significant antifungal effects with MIC values ranged from 100 to 400 µg/mL. It was observed that biofilm of C. glabrata were more resistance to plant extracts as compared to C. albicans. However, extracts of A. katsumadai and E. rutaecarpa promoted the growth and development of the preformed biofilm of P. membranifaciens. Thus, the knowledge of how these microorganisms adhere and which factors affect this phenomenon is of great importance in order to avoid their colonization on food contact surfaces.

Keywords : adhesion, Candida spp., Pichia spp., plant extracts
Conference Title : ICFSFTN 2024 : International Conference on Food Science, Food Technology and Nutrition
Conference Location : Dubai, United Arab Emirates
Conference Dates : March 11-12, 2024