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Bacteriocins as excellent biopreservatives in the food industry

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Lactic acid bacteria (LAB) are Gram-positive, rod-shaped (bacilli) or spherical (cocci), acid-tolerant, non-aerobic (but aero-tolerant) microorganisms. They are able to ferment carbohydrates for energy and lactic acid production (hence named lactic acid bacteria). Examples include Lactobacillus lactis, Lactobacillus acidophilus, Lactobacillus casei, Lactococcus lactis, Enterococcus sp., etc. They are present in milk, fermented products, meat as well as vegetables, and are able to maintain the nutritive quality of foods by inhibiting the growth of pathogenic as well as spoilage microorganisms. Therefore, the LAB are given the GRAS (generally recognised as safe) status. They are also used as probiotics as they greatly contribute to the healthy microbiota of the mucosal surfaces in the human body. Some LAB can also produce antimicrobial peptides known as bacteriocins that can kill other closely related or non-related species against pathogens. The ribosomally synthesised peptides are very active (even in small amounts) against pathogens. The bacteriocins are divided into different classes and each class shows a different mode of action against pathogenic microbes. The Class I bacteriocins (lantibiotics, such as nisin) interfere with the pathogenic cell wall synthesis and then kill the pathogen by promoting pore formation in the cell membrane. Through this dual-action mechanism, they can exhibit broad-spectrum antimicrobial action against different strains of Staphylococcus sp., Bacillus sp. and other pathogens. Class II bacteriocins (such as pediocin) cause pathogenic cell death by inserting ions in the target cell membrane and promoting membrane depolarisation. Class III bacteriocins promote direct lysis of the cell wall of target microbes. Therefore, bacteriocins have the potential to function as biopreservatives by destroying the spoilage as well as pathogenic microbes present in foods.

The assessment of the cytolytic abilities of bacteriocins is also important before applying them in food products. In this field, the two most-studied bacteriocins are nisin and pediocin. Nisin has been utilised for preserving acidic foods, canned foods, liquid eggs, flavoured milk, wine, beer, etc. On the other hand, pediocin has the ability to effectively reduce the populations of sub-lethally stressed spoilage microbes in ice cream, sausage, beef as well as whole milk. Therefore, it is evident that extensive research studies on bacteriocins must be performed so that they can be used as effective biopreservatives and help in reducing the utilisation of chemical preservatives and heat treatments. With this approach, the food industries can manufacture different naturally preserved foods (rich in organoleptic properties) and satisfy the increasing consumer demands for safe, fresh and minimally-processed foods. In the future, biopreservation can definitely solve economic losses caused by microbial spoilage of food products as well as raw materials and reduce the incidence of food-borne illness.

Keywords: Lactic acid bacteria (LAB), Bacteriocins, Biopreservatives, Nisin, Pediocin, Food industry

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