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Role of Antibiotics
(Nisin) in Dairy Industry

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Introduction

Consumer demand today is for natural and minimally processed foods, with a fresh appearance and taste, ease-toeat and high safety. As a result, research and development of new products is leading to the reduction or even displacement of heat treatments and traditional preservatives by treatments capable of assuring the sensory and nutritional properties of the product without reducing food safety. Non-thermal preservation methods are thus of growing interest as alternative treatments, especially high intensity pulsed electric fields (HIPEF), high pressure (HP) and the addition of natural antimicrobial substances [2]. Nisin is a peptide composed of 34 amino acid residues, with a molecular mass of 3.5 kDa, and is classified as a class-Ia bacteriocin or antibiotic. It is produced by strains of Lactococcus lactis subsp. Lactis isolated from milk and vegetable-based products and its importance is due to its wide spectrum of activity against Gram-negative and Gram-positive bacteria.[6]

Importance of nisin in dairy industry

A low-density polyethylene film coated with nisin for inhibition of Micrococcus luteus as an indicator strain during the storage of milk. [11] The antimicrobial package retarded microbial growth and lowered the maximum growth levels in raw, pasteurized and UHT milk, although the activity and the release of nisin from the film strongly depended on pH and temperature. Since the solubility and stability of nisin decreases from the optimal pH 2.0 to 6.0 [6], a lower pH and a higher temperature favored the migration of the bacteriocin from the film. M. luteus However, the temperature reached in the process of cross-linking meant that the heat[12]. Nisin, a natural antimicrobial peptide, was isolated from Lacto-coccus lactis is the oldest known and most widely studied antibiotic [14] stability of the bacteriocin, if this was added previously, needed to be taken into account.

Combining nisin with other antimicrobial compounds, such as monolaurin, the lactoperoxidase system (LPS) or other bacteriocins, can induce the sensitization of

resistant spoilage and food-borne microorganisms. Monolaurin, the monoester of lauric acid, has received special attention because of its antimicrobial properties.[8] which may be intensified when combined with nisin. The combination of monolaurin and nisin has been found to be active against bacilli in milk.[8] in particular, the inhibition by both antimicrobial substances of B. licheniformis increased with increasing pH when they were added simultaneously to milk In addition, the combination of both compounds successfully exerted a bactericidal effect against different Bacillus species in skim milk, and also inhibited their regrowth and sporulation However, a high concentration of monolaurin may produce an unpleasant soapy odour and taste which is undesirable in dairy products.[1]

The LPS system in raw milk increases the storage stability of raw milk at ambient temperature. [13] The combination of LPS and nisin had a synergistic and long-lasting inhibitory effect on L. monocytogenes in reconstituted skim milk and, in addition, its effectiveness did not depend on pH.[4] Curiously, higher antibacterial activity was observed when the inhibitors were added to skim milk in two steps. The effect of the LPS–nisin combination was enhanced when nisin was added to skim milk inoculated with L. monocytogenes after the addition of LPS.[14] Clearly, the order of addition for maximum inactivation has received insufficient attention, extended shelf life of foods, extra protection during temperature abuse conditions, decreased risk of transmission of food-borne pathogens, reduced economic loss due to food spoilage. reduced use of chemical preservatives and, use of less severe heat treatments without compromising food safety. Recent studies show bacteriocins in food preservation offer several benefits.[6] Nisin was permitted as a safe food additive in over 50 countries around the world, particularly in dairy products, canned foods, plant protein foods, and cured meat.[13]

Limitations of using nisin in dairy products

The appearance of resistant cells in strains sensitive to nisin may constitute another limitation to its use. Str. thermophilus INIA 463 is a nisin sensitive strain, although it has been shown to become nisin-resistant after exposure in skim milk to subminimal inhibitory concentrations of nisin (1–3 IUmL_1) for less than 2 h, by the induction of a resistance mechanism based on changes in the cell wall.[5] In a similar way, nisin-resistant variants of wild-type Listeria isolated from hand-made cheeses commercialized in Spain were able to survive and grow in milk fermented by a nisin-producing Lactococcus.[9] The exposure of L. monocytogenes to acidic conditions in milk enhanced its long-term survival in the presence of nisin in refrigerated condition. Bacteriocins are antimicrobial peptides produced by various lactic acid bacteria (LAB) including *Lactococci*, *Lactobacillus* and *P ediococci.* Many LAB bacteriocins have a relatively broad antimicrobial spectrum against important food-borne pathogens, for example *Listeria monocytogens* and *Staphylococcus aureus* as well as spoilage. LAB bacteriocins may be used as natural food preservatives. [3]

Conclusion

In the journey through our exploration of the role of lysine-based antibiotics in the dairy industry, it's evident that these antibiotics play a pivotal function in maintaining animal health, optimizing milk production, and ensuring the safety of dairy products for consumers. The adoption of antibiotics, especially lysine derivatives, has undoubtedly brought about revolutionary changes, allowing the dairy industry to meet the ever-growing global demand for dairy products. This underscores the need for continuous research, education, and adherence to best practices among dairy farmers and industry stakeholders. The harmony of innovative practices with responsible antibiotic use will pave the way for a sustainable, healthy, and prosperous dairy industry in the future.

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