DAIRY

Handary
SHELF LIFE

KEY CHALLENGES

- Prevention against Pseudomonas, Clostridium, yeast and mold;
- No Organoleptic impact;
- Non-GMO source;
- Shelf Life Extension;
- Natural; Customer-friendly label

OUR NATURAL SOLUTIONS

- **NataP® Pure Natamycin**
- **Natalac® Natamycin Blend with Lactose**
- **Lysoch® E4 Egg-White Lysozyme**
- **NisinZ® Vegetal Nisin**
- **Planteria® BF Berry Extracts**

NATURAL SHELF-LIFE SOLUTIONS IN DAIRY

Spoilage is a significant concern in the dairy industry, as it can lead to the deterioration of dairy products, compromising their quality, safety, and shelf life. Dairy products, including milk, cheese, yogurt, and butter, are highly susceptible to spoilage due to their nutrient-rich composition, favorable pH, and moisture content.

The spoilage of dairy products can result from various factors, including microbial contamination, enzymatic activity, chemical reactions, and physical changes. These spoilage issues not only lead to economic losses for the food industry but also pose potential health risks to consumers.

Microbial contamination is one of the primary causes of spoilage in dairy products. Bacteria, yeasts, and molds can readily grow in dairy products, utilizing the available nutrients, moisture, and suitable environmental conditions. Common spoilage microorganisms in dairy include lactic acid bacteria, psychrotrophic bacteria, yeasts, and molds. These microorganisms can cause off-flavors, off-odors, texture changes, gas production, and visible spoilage, rendering the products unpalatable and unfit for consumption.

Dairy products like milk and cream may contain preservatives like benzoic acid or sorbic acid to inhibit the growth of yeasts and molds. However, it is important to note that some chemical preservatives used in dairy products have potential health implications.

APPLICATIONS

Fluid Milk

Cheese

Yogurt

Milk Drink

Gram Positive Bacteria Spoilage

While **gram-positive bacteria** play important roles in various dairy applications, some species can also cause spoilage and quality issues in dairy products. Here are a few examples of gram-positive bacteria that can lead to spoilage in dairy applications:

Bacillus species, such as *Bacillus cereus*, can produce heat-resistant spores which survive pasteurization processes and can germinate and grow under favorable conditions, producing toxins which lead to foodborne illnesses.

Clostridium species, such as *Clostridium tyrobutyricum*, are capable of fermenting lactose and producing butyric acid, leading to off-flavors and a rancid smell, causing defects in dairy applications.

Micrococcus species are known to be present in raw milk and can produce enzymes which break down milk proteins, leading to proteolysis and the development of off-flavors and textures in the final product.

Staphylococcus species, including *Staphylococcus aureus,* can produce heat-stable enterotoxins which can cause food poisoning symptoms.

Growth of Yeast and Molds

Yeast and mold are common types of spoilage microorganisms affecting dairy products. They can cause various quality issues such as off-flavors, texture changes, and visual defects.

Yeast spoilage: Yeasts are single-celled fungi which can ferment sugars present in the milk, producing carbon dioxide and alcohol. This leads to gas production, texture changes, and off-flavors in dairy products. Yeast spoilage is often characterized by a yeasty or fermented aroma, fizzy appearance, and increased viscosity.

Mold spoilage: Molds are multicellular fungi growing on the surface of dairy products. They require oxygen and moisture to thrive. Molds produce visible structures called hyphae, which appear as fuzzy or powdery growth on the product surface. This leads to flavor changes, discoloration, and the production of mycotoxins, which are harmful compounds pos a health risk if consumed. Some molds commonly associated with dairy spoilage include *Aspergillus, Penicillium,* and Mucor species.

Gram Negative Bacteria Spoilage

Gram-negative bacteria are often associated with off-flavors, texture changes, and product deterioration causing spoilage issue in dairy:

Pseudomonas species, such as *Pseudomonas fluorescens* and *Pseudomonas putida*, are common genus of gram-negative bacteria known to grow at low temperatures, producing enzymes which break down proteins and lipids, leading to off-flavors, sliminess, and product spoilage.

Enterobacteriaceae is a family of gram-negative bacteria, such as *Escherichia coli, Salmonella,* and *Klebsiella*, associated with foodborne illnesses their presence in dairy products indicates contamination and can pose healthy risks.

Acinetobacter species are gram-negative bacteria which can grow under a wide range of conditions, including refrigerated temperatures, and is known to produce proteases which can cause protein breakdown and off-flavors.

Total Aerobic Bacteria Contamination

Total aerobic bacteria are a broad category of microorganisms which can be found in the environment, including on surfaces, equipment, and raw materials. When present in high numbers or under unfavorable conditions, they can cause quality issues in dairy products.

Shelf life reduction: High levels of total aerobic bacteria in dairy products can multiply and consume nutrients present in the product, produce enzymes, and generate metabolic byproducts which can degrade the quality and sensory characteristics of the dairy items.

Off-flavors and odors: Total aerobic bacteria can produce volatile organic compounds, which contribute to off-flavors and unpleasant odors in dairy products. This can result in a sour, putrid, or rancid smell and taste.

Textural changes: Proliferation of total aerobic bacteria can lead to changes in texture, including sliminess, curdling, or separation of components in dairy products. This is primarily due to the enzymatic activities of these bacteria.

Lactic Acid Bacteria Spoilage

Lactic acid bacteria (LAB) are primarily known for their beneficial role in dairy applications, but under certain conditions, they can contribute to spoilage in dairy products. While LAB generally have a positive impact on flavor development and preservation, their spoilage potential is relatively low compared to other microorganisms. However, here are a few scenarios where LAB can cause spoilage in dairy:

Late-stage fermentation: In some cases, when LAB fermentation continues beyond the desired level, it can lead to off-flavors and texture changes.

Abnormal acid production: LAB may produce excessive amounts of lactic acid, causing an overly acidic taste and texture in dairy products.

Undesirable LAB strains: While LAB strains used in dairy production are generally selected for their desirable characteristics, contamination by other LAB strains can occur and produce off-flavors or causing texture defects in dairy products.

Dairy

Natural Shelf-Life Solutions

To answer all challenges and the spoilage issues in Dairy applications Handary has developped a range of natural solutions with specific fonctionalities:

Nisin® Z / Nisn® A: a standard food grade Nisin concentrate, produced by fermentation using bacterium Lactococcus lactis obtained from sauerkraut. It is used in dairy applicationsto extend shelf life by decomposing Gram-positive bacteria.

NataP® / Natalac®: Natamycin is a naturally occurring anti-fungal agent produced during fermentation by the bacterium "Streptomyces natalensis". It is used to effectively eliminate the risk of Yeasts and Molds in dairy products.

Lysoch® E4 / Lysoch® G4: A range of Lysozyme product extracted from egg-white (Lysoch® E4) or produced by microbial fermentation (Lysoch® G4) used to lyse the cell wall of Gram-positive and Gram- Negative Bacteria bacteria in dairy applications.

Planteria® BF / Planteria® RF: A group of selected berry extracts efficient against Yeast and Molds in Dairy Products.

Fig.1 Lysoch® E4 in Milk

Skim milk, also known as fat-free or non-fat milk, has reduced fat compared to whole milk. However, it faces challenges such as spoilage due to microbial contamination. Preventing these issues is vital for the food industry.

Microbial contamination is a common concern for skim milk. Bacteria, yeasts, and molds can contaminate it during processing, handling, or storage. Unchecked, these microorganisms multiply and cause spoilage, resulting in off-flavors, odors, and potential health risks. Preventing contamination ensures product safety and quality.

Lysoch® E4 was tested to deactivate microorganisms in skim milk compared to a control with no additives. The results clearly show that **Lysoch® E4** significantly enhances skim milk's ability to inactivate microorganisms, demonstrating its efficiency.

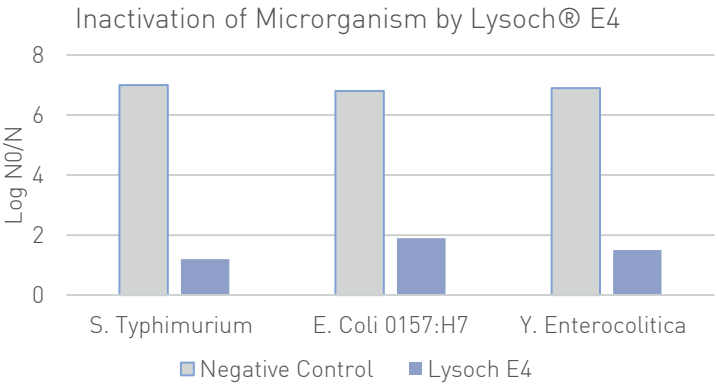

Fig. 2 NataP® in Yogurt

While yoghurt is generally considered microbiologically stable, it can still be susceptible to contamination by acid-resistant fungi, which significantly contribute to the deterioration of dairy products. These fungi, including many molds, can thrive within a pH range of 3 to 8 and tolerate low water activity levels of 0.7 to 0.8.

To counteract this, natamycin is commonly used in dairy products like cottage cheese, sour cream, and yoghurt. Unlike other synthetic antifungals, natamycin offers the advantage of broad-spectrum antifungal properties even at low levels, while preserving the sensory qualities of food products such as cheese, meats, and juices.

The figure below demonstrates the effectiveness of 10ppm of **NataP®** against yeast and molds in yoghurt when stored at 4 degrees Celsius under refrigeration.

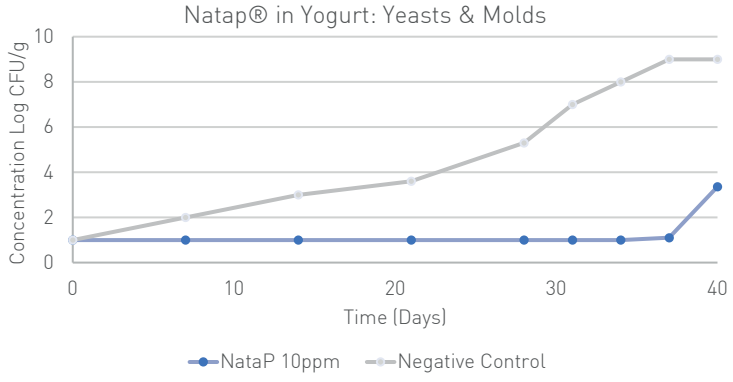

Fig. 3 Natalac® in Cheese

The study examined the inhibitory effect of **Natalac®** and **Potassium sorbate** on mold growth in Egyptian fresh soft cheese. By adding 20 ppm of **Natalac®**, the growth of molds was successfully prevented in this application.

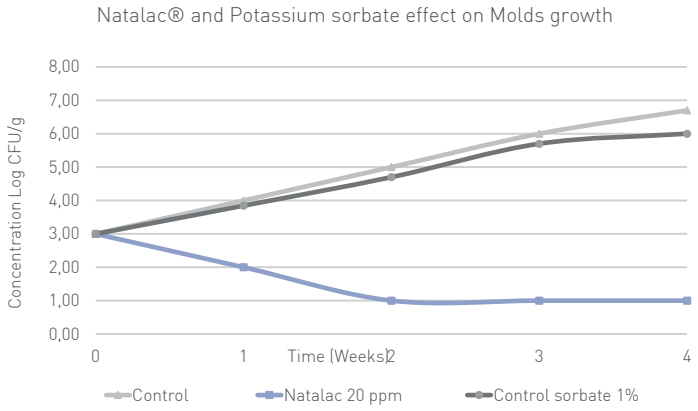

Fig. 4 Nisin® Z in Cheese

The graph showcases a 60-day study comparing different quantities of **Nisin® Z** with a negative control in ricotta cheese. The results demonstrate the inclusion of **Nisin® Z** effectively controlled the foodborne pathogen *Listeria Monocytogens* when stored at temperatures ranging from 6 to 8°C.

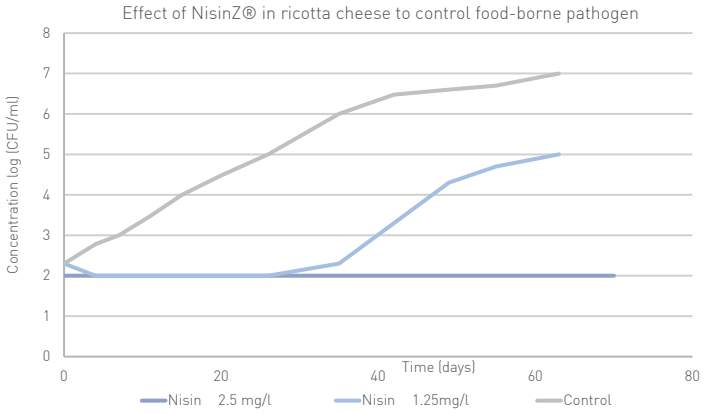

Fig. 5 Planteria® BF in Cheese

Fresh cheese is a popular soft white cheese consumed widely in the Hispanic region, known for its near-neutral pH of 6.5. When refrigerated, it typically has a shelf life of 2-3 weeks.

The graph demonstrates the effectiveness of **Planteria® BF** in inhibiting yeast and mold growth in fresh cheese applications. This contributes to an extended shelf life, providing a significant advantage for the food industry.

In the graph, fresh cheese trials produced with 2.5 g/kg of **Planteria® BF** and stored for 15 days under refrigeration conditions show undetectable growth of yeasts and molds.

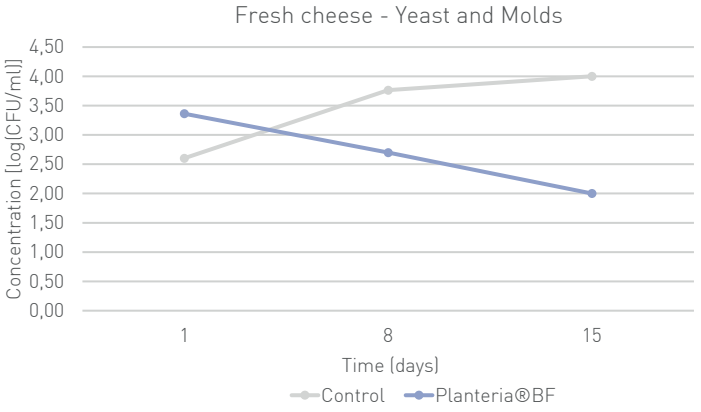

Table. Natural Solutions in Dairy

Applications		Challenges	Solutions	Dosage
Dairy	Fluid Milk	Gram Positive Bacteria	Nisin®A / Nisin®Z	50-200 mg/kg
			Lysoch® E4	20-40 mg/kg
			Lysoch® G4	2-4 mg/kg
		Gram Negative Bacteria	Lysoch® G4	2-4 mg/kg
	Cheese	Yeast & Molds	Natalac®	20-40 mg/kg
			Planteria® BF	2.5 -5 g/kg
		Total Aerobic Bacteria	Nisin®A / Nisin®Z	50-200 mg/kg
	Yogurt	Yeasts & Mold	NataP®	10-20 mg/kg
			Planteria® BF	2.5 -5 g/kg
		Lactic Acid Bacteria	Nisin®A / Nisin®Z	50-200 mg/kg
	Milk-Based Drinks	Yeast & Molds	NataP®	10-20 mg/kg
			Planteria® BF	2.5 -5 g/kg
		Total Aerobic Bacteria	Nisin®A / Nisin®Z	50-200 mg/kg