Where science
& creativity meet

Functionally proven commercial preparation of natamycin

NATAMAX® FOOD ANTIFUNGAL

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One of the most effective and reliable antifungal solutions available to the food industry to secure quality over shelf life

NATAMAX® is the IFF trade name for commercial preparations of natamycin (sometimes also called pimaricin). It is used around the world by food manufacturers to control yeast and mold spoilage in their products. Being a naturally occurring antifungal, natamycin is manufactured by fermentation, isolated, concentrated and dried before blending with various food grade carriers best suited for specific applications.

The NATAMAX® product range of effective antifungal solutions has been designed with a strong focus on ease of use. It offers each food manufacturer a highly effective, convenient and label-friendly way to protect and extend product quality throughout the desired shelf life in a wide range of food and beverage applications.

By partnering with IFF, you gain access to the industry's most robust portfolio of food protection solutions combined with experts who can help you solve challenges and win in the market.

Features and benefits

NATAMAX®	NATAMAX® helps to
• A naturally occurring antifungal • Produced via fermentation • Non-GMO • Manufactured in Europe	• Satisfy consumer demand for simple and straightforward ingredient label declarations • Capture loyalty of food consumers concerned with food quality, safety and sustainability
• Strong antimycotic efficacy • Reduces mycotoxin risk	• Extend and secure your product shelf life reducing returns and waste • Improve food safety to help protect your brand image
• Effective only against yeast and mold	• Protect desired bacterial starter cultures in your product
• Does not alter flavor, odor, or appearance of food	• Contribute to a positive eating experience
• Easy and safe to use • Stable through most of the standard food processing and storage conditions • Unlike traditional preservatives, independent of pH	• Secure rapid development of new and innovative food products • Ensure antifungal protection even in challenging products and processes

Your daily challenges

- Maintain product quality throughout desired shelf life
- Inhibit yeast and mold spoilage
- Formulate with effective, label-friendly solutions
- Protect your brand image and equity
- Comply with local regulatory guidelines
- Contribute to minimize global food loss and reduce waste

Examples of food spoilage molds inhibited by NATAMAX®

Molds	Spoiled food occurrence
• *Aspergillus* spp.	• Bread, cheeses, sausages, fruit juices
• *Byssochlamys* spp.	• Fruit juices
• *Cladosporium* spp.	• Cheeses, fruit juices, milk, sausages
• *Didymella* spp.	• Cream cheeses
• *Eurotium* spp.	• Bread, cakes, cheeses, sausages, preserves (grape)
• *Galactomyces* spp.	• Fresh cheeses
• *Geotrichum* spp.	• Cheeses, sausages
• *Gilbertella* spp.	• Fruit juices
• *Mucor* spp.	• Bread, cheeses, yogurt, fruit juices and jams, bacon, sausages
• *Penicillium* spp.	• Bread, cheeses, sausages, wine, yogurt
• *Rhizopus* spp.	• Bread, sausages
• *Scopulariopsis* spp.	• Cheeses
• *Syncephalastrum* spp.	• Cheeses
• *Talaromyces* spp.	• Fruit juices (pineapple)
• *Trichosporonoides* spp.	• Fruit juices and jams (melon)
• *Wallemia* spp.	• Bread, cheeses, sausages, jams

Examples of food spoilage yeasts inhibited by NATAMAX®

Yeasts	Spoiled food occurrence
• *Brettanomyces* spp.	• Beer, wine, fruit yogurt, fruit juices
• *Candida* spp.	• Beer, cream cheeses, fruit juices, sausages, wine, yogurt
• *Cryptococcus* spp.	• Cheeses
• *Debaryomyces* spp.	• Beer, cheeses, fruit juices, sausages
• *Dekkara* spp.	• Beer, soft drinks
• *Hanseniaspora* spp.	• Ciders
• *Hansenula* spp.	• Fruit juices, wine
• *Lodderomyces* spp.	• Fruit juices
• *Kloeckera* spp.	• Wine, fruit juices (grape)
• *Meyerozyma* spp.	• Cream cheeses, yogurt
• *Pichia* spp.	• Bread, cheeses, fresh cheeses, fruit juices
• *Rhodotorula* spp.	• Fresh cheeses, sausages, yogurt
• *Saccharomyces* spp.	• Bread, cheeses, fruit juices, soft drinks, yogurt
• *Schizosaccharomyces sp* spp *p.*	• Fruit juices (grape)
• *Torulopsis* spp.	• Sausages, wine
• *Torulaspora* spp.	• Lemonade
• *Trichosporon* spp.	• Fresh cheeses, sausages
• *Williopsis* spp.	• Fruit juices
• *Yarrowia* spp.	• Cheeses, sausage
• *Zygosaccharomyces* spp.	• Bread, confectionery, fruit juices and syrups, sauces, wine, ciders

FAO/WHO listing[1]

Dairy	Culinary
• Unripened cheese [01.6.1] • Ripened cheese [01.6.2] • Processed cheese [01.6.4] • Cheese analogues [01.6.5] • Whey-protein cheese [01.6.6]	• Cured (including salted) and dried non-heat treated processed meat, poultry, and game products in whole pieces or cuts [08.2.1.2] • Cured (including salted) and dried non-heat treated processed comminuted meat, poultry, and game products [08.3.1.2]

[1] *Refer to regulatory guidelines for specific application criteria and usage levels from the "Codex General Standard for Food Additives" (GSFA, Codex STAN 192-1995)*

Additional categories/subcategories approved in some countries[2]

Dairy	Culinary	Bakery	Beverages
• Cottage & cream cheese • Yogurt • Sour cream	• Marinating sauces, dressings and dips	• Bread • Tortillas • Cakes • Sweet baked goods	• Fruit juices • Malt-based non-alcoholic drinks • Wine

[2] *Refer to Food Protection regulatory or to your local regulatory office*

NATAMAX® product range

Product name	Natamycin concentration, % w/w on dry weight basis	Supporting ingredients and carriers	Main food and mode of application
NATAMAX®	≥ 50.0	Lactose	• All authorized food applications including fresh dairy such as yogurt
NATAMAX® B	≥ 95.0		• Spraying on or incorporating into baked goods
NATAMAX® B PLUS	≥ 12.5	γ-Cyclodextrin Salt (NaCl)	• Spraying on baked goods • Incorporating into beverages
NATAMAX® G	≥ 50.0	Glucose	• All authorized food applications
NATAMAX® SALT	≥ 50.0	Salt (NaCl)	• Surface treatment of shredded cheeses and fermented sausages • Dipping fermented sausages and cheeses
NATAMAX® SF	≥ 95.0		• Surface treatment (using either spray or dry blends) of shredded and blocked cheeses
NATAMAX® SALT DA	≥ 6.5	Salt (NaCl)	• Applications with low natamycin level requirements • Products with higher viscosity (which makes distribution more difficult), such as salad dressings and cream cheese spreads
NATAMAX® GEL	≥ 8.0	Hydroxypropyl methylcellulose Salt (NaCl)	• Dipping fermented sausages and cheeses

Fungal spoilage in foods and beverages

Fungi (yeasts and molds) are prolific food spoilage organisms capable of contaminating and growing in a large variety of processed foods and beverages which in turn leads food loss and substantial economic and safety challenges for manufacturers and consumers. Fungal development leads to food sensory defects varying from visual deterioration to noticeable odor, flavor or texture changes. Some fungi can have negative health impacts via mycotoxin production and mold-related allergies. All these aspects have a negative impact on brand image.

Fungal spoilage results in significant annual global revenue losses for the food and beverage industry. Approximately 25% of food waste and loss in North America is due to microbial spoilage, and fungi represent the most important group of spoilage microbes responsible for these losses. It is estimated that fungal spoilage accounts for 5–10% of all food waste and loss in developing countries. Filamentous fungi commonly referred to as “molds” within the food industry, are the most common food spoilage microbes throughout the supply chain, across food sectors, and are even associated with spoilage of highly processed and stable products. However, the identity of the spoilage microorganism(s) responsible for the spoilage of raw ingredients or finished products is influenced by a combination of the intrinsic and extrinsic factors of the food.

Produced naturally by *Streptomyces natalensis* during fermentation, the antifungal natamycin effectively inhibits yeast and mold growth by disrupting fungal cell enzymes and preventing cell division. Paired with our science-based production technologies, IFF’s NATAMAX® solutions outperform potassium sorbate, a commonly used synthetic preservative, with their broad spectrum fungal inhibition and other beneficial properties.

Some of the advantages of natamycin over potassium sorbate

Natamycin	Potassium sorbate
Naturally occurring	Mostly synthetically produced
Fungicidal	Fungistatic
No effect on bacteria	Bactericidal
Minimal migration into food	Penetrates into food
No flavor	Bitter flavor
Effective at 1 – 40 ppm	Effective at 1000 – 2000 ppm
Effective at pH 3 – 9	Effective only at acidic pH

DAIRY

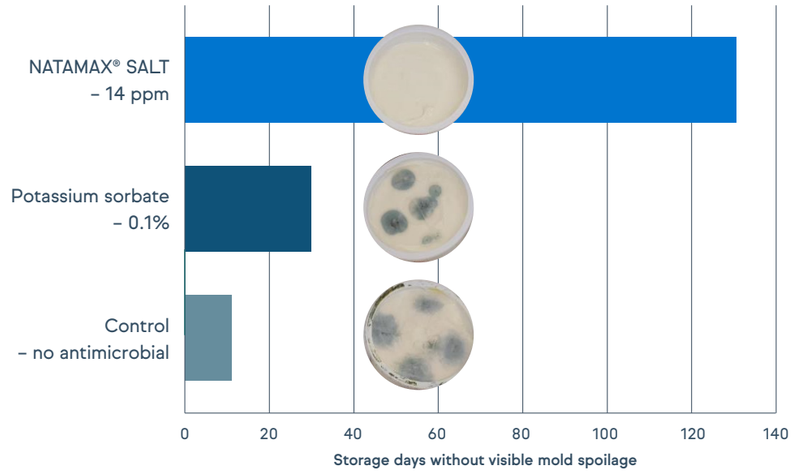
NATAMAX® is a unique preservative as it is effective only against yeasts and molds but not bacteria. This makes it especially useful in the production of fermented fresh dairy products, where it prevents yeast and mold spoilage without inhibiting yogurt starter cultures. NATAMAX® can be added to the dairy ingredients prior to pasteurization and is exceptionally heat stable at pH values common to dairy products.

In cheeses, NATAMAX® is usually applied via surface treatments. The main methods are spraying the cheese with a NATAMAX® suspension, dipping or showering the cheese in a suspension, or incorporating NATAMAX® in a polyvinyl acetate (PVA) or carboxymethyl cellulose (CMC) coating applied to the cheese surface. Regardless of the chosen method, an evenly applied NATAMAX® coating will protect the cheese product from spoilage and can significantly extend its shelf life.

Product examples	Application method	NATAMAX® or NATAMAX® SALT*
Yogurt Soft cream cheese Cottage cheese dressing	Add directly	• 10 – 30 mg/kg
Various feta-type cheeses Cheeses soaked or stored in brine solutions	Add NATAMAX® to cheese brines	• 20 – 40 mg/l
Hard cheese Cheese blocks Shredded cheese Blue cheese Dried, cured sausages	Spray surface with a NATAMAX® solution	• 2500 – 5000 mg/l with 8-10% salt
	Dip into a NATAMAX® solution	• 2000 – 5000 mg/l with 8-10% salt
Ripened cheese	Incorporate NATAMAX® in a in a PVA or CMC emulsion coating	• 500 – 2000 mg/l

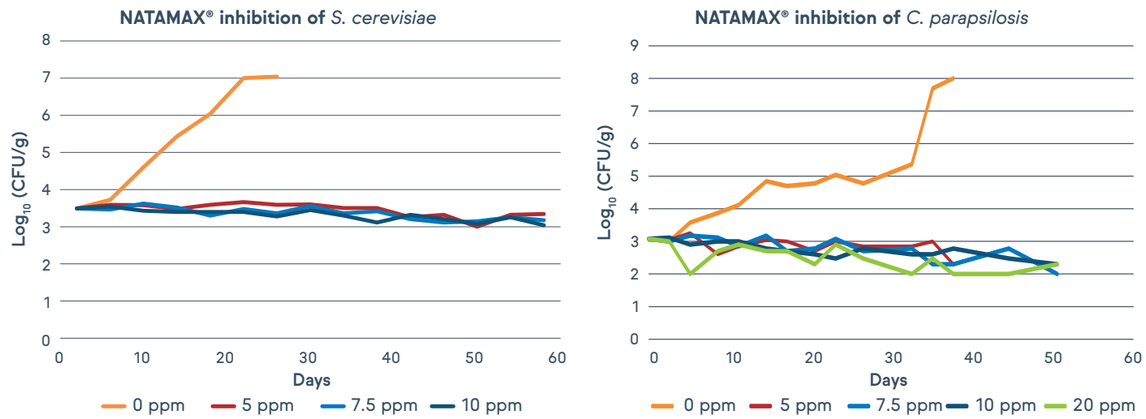
**Indicated dosages are typical and can be limited by product properties or country-specific regulatory limits.*

NATAMAX® protects your cream cheese products – and your brand image



Growth of NATAMAX®-inhibited *Penicillium* sp. cocktail in cream cheese stored for more than 110 days at 10°C, allowing at least 80 or 100 days longer mold-free shelf life in comparison to sorbate-treated and untreated samples, respectively. Photos show observed mold growth on day 57.

Without affecting the viability of the desired bacterial cells, NATAMAX® efficiently inhibits spoilage-related yeast and molds in your fermented dairy products



NATAMAX® inhibited the growth of the yeasts *S. cerevisiae* and *C. parapsilosis* in yogurt stored for more than 60 days at 8°C, even in concentrations as low as 5 ppm. Similar results were achieved in yogurt smoothies.

CULINARY

A wide variety of cured or fermented meats and sausages are popular with consumers from many countries – examples include highly popular Chorizo, Pepperoni, Salami and more.

The microflora of fermented sausages is naturally derived from the environment of the production plant and is seen as a desirable attribute to consumers. However, during wholesale distribution or retail storage, there is a high potential for unwanted fungal growth, particularly if the storage temperature becomes too high and moisture accumulates on the sausage surface. This unwanted mold growth is often pigmented (green, gray, or yellow) and visually unappealing. Not only do these molds cause visible spoilage, but some of the species also have the potential to produce mycotoxins that pose a risk to human safety.

Previously, a frequent practice among some manufacturers has been to wipe any unwanted mold growth from the surface and treat the sausage as unspoiled. However, now that it has been clearly shown that mycotoxigenic molds can grow on fermented sausages, this practice is highly discouraged. A further public health concern is the allergenic potential of some mold metabolites.

There have been many studies demonstrating the success of natamycin in preventing fungal spoilage during the aging and storage of dried fermented sausages, such as Italian dried salami, and German and Dutch raw sausages. In contrast to sorbates, natamycin remains on the surface of the product where the spoilage occurs and does not inhibit the bacterial starter culture or the ripening process. As a result, sausage products treated with natamycin maintain their organoleptic and other characteristic qualities while being protected against fungal spoilage through storage, distribution and its improved shelf life. NATAMAX® solutions capture all the described efficiency of natamycin and provide an easy-to-use way to protect your sausage products.

Suspensions of NATAMAX® and NATAMAX® SALT can be applied to the sausage products by dipping or spraying immediately after stuffing or later, prior to distribution or by soaking the sausage casings.

In NATAMAX® GEL, the preservative efficacy of natamycin is optimized by blending it with a commercial food grade thickener, hydroxy propyl methyl cellulose. Hence, adherence of the natamycin to the surface of the meat is improved, giving higher and more homogeneous levels of antifungal protection, and resulting in better natamycin performance and further cost savings.

NATAMAX® inhibits the growth of the most common molds that tend to grow on the surface of cured sausages – unprotected sausage (left) vs protected sausage using a NATAMAX® GEL solution (right).

NATAMAX® helps you reduce food waste and environmental impact of spoiled foods while preventing consumer complaints and costly product returns

BAKERY

To support bakery producers in the US in satisfying today's bakery consumers who want label friendly products without compromising on the flavor, we have developed NATAMAX® B PLUS, a cost-effective, fermentation derived antifungal that inhibits mold growth on the surface of bakery products like pan bread, English muffins and tortillas.

NATAMAX® B PLUS is a US-patented GRAS complex composed of 12.5% natamycin and γ-Cyclodextrin that protects your product naturally while maintaining its freshness and taste for a longer period of time.

Your business gains	Your product benefits	Features
• Cost efficiency • Faster process • Easier maintenance and cleaning of equipment	• Higher amount of active natamycin available than in other complexes • No agitation is required after preparing the solution	• > 98% of the natamycin in NATAMAX® B PLUS is soluble in water
• Increased product shelf life • Cost efficiency	• More than three times higher protection against mold in baked goods than pure natamycin • Even distribution of natamycin in the solution • Optimized dosage on baked goods	• Optimal dispersion when sprayed
• Fewer product returns, reduced liability • Maintained visual appeal and taste of the product	• Enhanced protection throughout shelf life • No visible particles at the bottom of the bottle	• No separation or sedimentation
• Enhanced brand image	• Friendly label	• Naturally occurring ingredient

NATAMAX® B topical application vs. in-dough ingredients

Antimicrobials used in baked goods typically provide a limited shelf life and may have a negative impact on flavor or be expensive to use. An example of this is a commonly used synthetic preservative, calcium propionate, which may adversely affect product flavor.

Main features of NATAMAX® B are that it is flavorless and thus has no effect on product flavor and that it significantly improves shelf life. The key to the effectiveness of NATAMAX® B is its application and adherence to the bread surface, where mold grows. Unlike most preservatives, NATAMAX® B is active at low concentrations and over a wide pH range (3-9).

	NATAMAX® B	Cultured whey Cultured whey starch	Calcium propionate
Naturally occurring	■	■	
Low usage level	■		
Flavorless	■		
Improves shelf life	■	■	■
Lower yeast use	■		
Cost effective	■		■
Allergen free	■		■

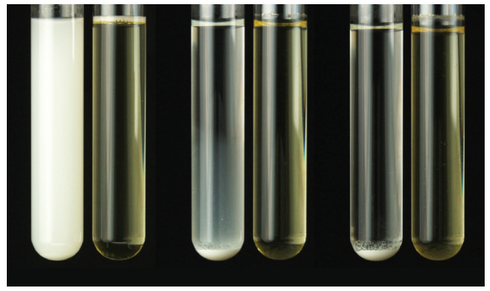
Because NATAMAX® B is used at very low levels (7-20 ppm), the cost-in-use may be comparable to synthetic preservatives and is significantly lower than other natural inhibitors.

NATAMAX® B can also be used in combination with lower dosages of other in-dough antimicrobials, resulting in flavor and cost benefits including reduced yeast required for proofing.

NATAMAX® B PLUS is designed to provide optimal clarity and increased dispersion

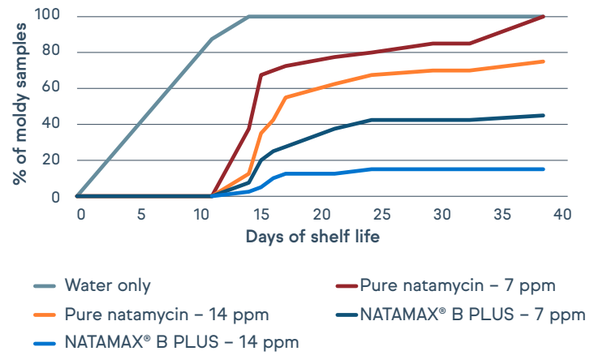
While standard natamycin has low solubility, >98% of the natamycin in NATAMAX® B PLUS dissolves instantly in water, creating a clear and easy-to-use solution. Thanks to its even distribution in liquids, NATAMAX® B PLUS allows you to optimize dosages, and reduce your energy and maintenance costs, while efficiently protecting your product throughout shelf life.

The illustration shows pure natamycin (left) in comparison to a NATAMAX® B PLUS solution (right).



NATAMAX® B PLUS provides more than three times better protection against mold at the same dosage than pure natamycin when sprayed on baked goods.

The graph shows that NATAMAX® B PLUS outperforms pure natamycin in the protection of bread shelf life.



BEVERAGES

Consumption of fresh juices has increased dramatically in recent years. Due to the freshness, high vitamin content and low calorie content of juices, consumers recognize them as a valuable source of antioxidants, vitamins and minerals essential for the human diet.

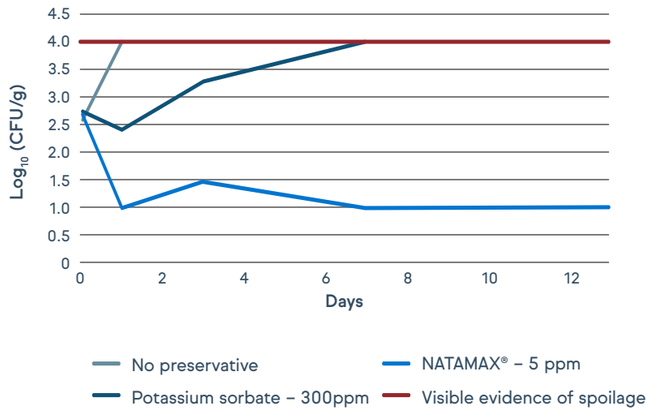
Fruit juices are, however, easily affected by the development of various microorganisms because of their high water content and nutritive composition. Yeasts are a major cause of spoilage in fruit juices as they are highly acid tolerant and able to grow in anaerobic conditions. Although heat treatment (pasteurization) eliminates most of the microbes, certain heat-resistant yeast and mold species may survive it and cause spoilage. Additionally, there is a risk of post-processing contamination as some yeasts and molds may be present in the juice product filling systems.

NATAMAX® may be exposed to high temperatures for a short period of time without any loss of activity. Hence, it can be added prior to pasteurization, which makes it a great tool to ensure the microbial stability of a broad range of fruit juices. In addition, its stability in the presence of ascorbic acid prevents the risk of benzene formation in vitamin C-containing beverages.

A premium solution within the NATAMAX® portfolio – NATAMAX® B PLUS – is an outstanding tool for the protection of even very clear beverages like apple juice. Its excellent solubility and neutral taste, as well as its optimal clarity and negligible sedimentation when dissolved into liquids, makes it the ideal solution for naturally-derived antifungal protection.

NATAMAX® is highly effective against the most common yeasts and molds found in a variety of spoiled beverages

NATAMAX® outperforms potassium sorbate in protection against *Saccharomyces cerevisiae*, one of the most common spoilage yeasts in orange juices



NATAMAX® can be applied in beverage products such as:

- Juices and juice-based beverages
- Fruit/vegetable flavored beverages
- RTD
- Vitamin C-enriched beverages
- Fruit & dairy-based smoothies
- Healthy for you/nutritional type beverages
- Mixers for alcoholic beverages
- Wine

Please consult your local representative for regional and country-specific regulatory guidance.

What else to know about NATAMAX®?

NATAMAX® dosage conversion table.*

Natamycin, mg/kg	NATAMAX®, mg/kg	NATAMAX®, %	NATAMAX®, g/l
7	14	0.0014	0.014
10	20	0.002	0.02
20	40	0.004	0.04
30	60	0.006	0.06
40	80	0.008	0.08
50	100	0.01	0.1
250	500	0.05	0.5
500	1000	0.1	1
1000	2000	0.2	2
1250	2500	0.25	2.5
2000	4000	0.4	4
2500	5000	0.5	5
4000	8000	0.8	8

**Data in this table refer to NATAMAX® products which contain 50.0 % of natamycin (w/w on dry weight basis), such as NATAMAX®, NATAMAX® SALT and NATAMAX® G.*

Data on functionality and technology along with safety assessments supported key regulatory approvals around the world. And today as IFF we continue to lead food application approval expansion to support food manufacturers with additional means to improve their product safety and shelf life.

Food regulatory information

- Recognized as safe by the Joint FAO/WHO Expert Committee on Food Additives (JECFA)
- Codex Alimentarius General Standard for Food Additives (CODEX GSFA) listed (INS235)
- GRAS status in the US (FDA)
- Approved as a food additive in the EU as E235
- Food Chemicals Codex (FCC) Grade
- Regulations on country-specific permissibility in applications must be checked – please reach out to our local regulatory experts

NATAMAX® is a step forward to reaching your sustainability goals

Every piece of food saved from the trash helps contribute to a more responsible consumption system. Drastically reducing the amount of compromised food in the manufacturing process means a significantly reduced amount of waste and more food in consumers' kitchens. Our products help foster consumer confidence in brands while keeping environmental impact at a minimum. Along with the other IFF Food Protection solutions, NATAMAX® is in alignment with the objectives of the United Nations' Sustainable Development Goals.

Discover more from the IFF Food Protection portfolio

BIOVIA® Naturally protective blends; GRINDOX® Traditional antioxidants; GUARDIAN® Plant-based antioxidants and flavorings; MICROGARD® / FERM Fermentates; NISAPLIN® Naturally occurring antimicrobials; NOVAGARD® Antimicrobial blends

Danisco®, part of the IFF family

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