



INTRODUCING CHOOZIT® CHEESE CULTURES

CHOOZIT® Cheese cultures, part of the DuPont™ Danisco® portfolio, are ideal for use by every type of cheese manufacturer, from high-volume, industrial companies to specialty cheese makers. With its multi-layered product line, these easy-to-use cultures for direct inoculation provide controlled acidification profiles and allow for a wide range of textures, flavors and colors.

From mass-market to artisanal, let DuPont help you to naturally enhance your cheese processing.



DANISCO®

CHOOZIT® Cheese cultures – a complete offer

Cheese is the oldest and most natural way to preserve milk while enhancing its nutritional value and sensory properties. In relation to its long history, cheese is now characterized by an enormous variety.

Textures ranging from hard to spreadable, and flavors from intense to mild, distinguish the many different types from one another.

The broad range of CHOOZIT® Cheese cultures gives manufacturers the opportunity to choose exactly the right culture for their particular needs and daily challenges – this supreme flexibility and breadth is reflected in our offer.

Your daily challenge

Achieve high productivity,
process efficacy and consistency

Differentiate your products

Comply with high safety and quality standards
to secure customer and consumer trust

Ensure your company's sustainability

Cheese making is essentially a means of preserving milk and preventing spoilage, and is principally a dehydration process. But many traditional practices, as well as industrial processes, create cheeses with a great number of tastes and forms. This in turn calls for an extensive variety of cultures used for acidification, ripening and flavoring.

Cheese cultures play five important roles in the process:

- They produce acid, converting the milk sugar lactose into lactic acid
- During ripening or maturation stage, cultures contribute to breaking down protein and fat, resulting in texture and flavor development
- Specific cultures can also be used to produce the eyes or holes associated with particular cheese types
- In some cases, cultures growing on the surface of the cheese will also contribute to the typical color and appearance
- In all cases, acidification and competition for substrate controls the growth of undesirable microorganisms

In some cases, the acid-producing cultures contribute to the typical color and appearance of cheese, although an additional adjunct or surface-ripening culture can be required.

The CHOOZIT® Cheese cultures range comprises individual culture-building blocks, enabling manufacturers to produce their own customized cheese culture solutions. Acid-producing strains can be selected separately from strains with a flavor and textural enhancement role. This gives manufacturers greater choice and control over exactly what is added to the cheese vat.

We also provide ready-to-use blends for each type of cheese application. These blends contain various strains that deliver a complete functional solution in just one bag.

CHOOZIT® Cheese cultures are suitable for direct inoculation into the milk vat (DVI) and are available in frozen pellet or freeze-dried form.



A complete offer

| Product sub-range | Functionalities |
|---------------------------|--|
| Acidifiers | Acidification for texture and flavor development |
| Adjunct cultures | Flavoring with minor impact on texture, potentially eye forming |
| Surface ripening cultures | Surface covering and flavoring with controlled impact on texture and eye formation |

Acidifiers



Mesophilic acid cultures

These lactic cultures are generally referred to as O (or homo-fermentative) cultures and comprise the following species:

- *Lactococcus lactis* subsp *lactis*
- *Lactococcus lactis* subsp *cremoris*

Their primary purpose is to convert lactose into lactic acid in the production of many cheese types, including Cheddar, cottage, feta, fresh and continental. As they do not ferment citrate, they do not produce gas. These cultures are generally defined blends of pure strains.

The CHOOZIT® Mesophilic cultures convert citrate into diacetyl, which contributes flavor and CO₂, which is necessary for small eye formation. These cultures are generally undefined multi-species cultures composed of O, D and L cultures. DuPont can also supply defined blends of these strains, including:

- *Lactococcus lactis* subsp *lactis* biovar *diacetylactis* (*D culture*)
- *Leuconostoc species* (*L culture*)

Thermophilic acid cultures

These cultures are used in the production of stretched cheeses, such as Mozzarella or pizza cheese; hard cheese like Emmental and soft stabilized cheeses.

They typically comprise one or more of the following species:

- *Streptococcus thermophilus*
- *Lactobacillus bulgaricus*
- *Lactobacillus helveticus*

In addition to lactic acid, *Lactobacillus* cultures produce acetaldehyde and other flavor components. Their comparatively well-developed proteolytic enzyme systems mean they not only contribute to acidification, but also proteolysis during ripening. This influences consistency and flavor formation.

Mesophilic / thermophilic acid culture blends

Defined blends of mesophilic and thermophilic strains have been developed for a large category of Cheddar, cottage, semi-hard and hard cheeses.

Applied together, both species exploit the technologically given temperature profile, and influence the texture through both the short lag-phase, and the ripening. Additional benefits include robust acidification and, where required, temperature flexibility.





Kefir cultures

These unique cultures are based on real Kefir grains that have been freeze-dried or frozen and supplemented with lactic acid bacteria for an improved flavor and texture.

The composition is similar to the natural microflora in fresh Kefir grains, however, the combination of the grains themselves with the Kefir yeasts and lactic acid bacteria (which are isolated from the Kefir grains) impact the flavor, acidification and texture of the final product.

The blend provides the requisite sensory properties and ensures that the final product is a typical Kefir.

Benefits of CHOOZIT® Acidifiers in cheese production

| Your process benefits | Your product benefits |
|------------------------------|--|
| Enhanced process consistency | Optimized yield |
| Robustness for cost saving | Premium cheese quality with all levels of milk standardization |
| Flexibility of use | Multiple cheese recipes all with high consistent quality |

Adjunct cultures

Certain cultures can be used as adjuncts to add specific functionalities to the final cheese product. These adjunct cultures are a good value-for-money option for manufacturers seeking to increase cheese yield, reduce cheese maturation time or the development of cheese with a unique, appealing flavor.

CHOOZIT® Adjunct cultures include:

- Polysaccharide-forming cultures that improve texture and yield in reduced fat and full fat soft and semi-hard cheeses
- Flavor-enhancing cultures that speed up cheese ripening, breakdown bitter peptides and give distinct flavors. The flavor adjunct range accommodates a broad palette of cheese tastes
- Citrate-fermenting cultures that produce flavor (e.g. diacetyl) and CO₂, contributing to desirable flavor and textural changes in specific cheese types
- CHOOZIT® Eyes propionibacteria that convert lactic acid into gas and propionic acid to obtain the typical eye and flavor of Swiss and Maasdam type cheeses

Benefits of CHOOZIT® Adjunct cultures in cheese production

| Your process benefits | Your product benefits |
|---|--|
| High yield and productivity | Consistent cheese quality |
| Optimal ripening time for cost saving | Appealing taste and texture |
| Flexible flavor differentiation with minimal process impact | Authentic, distinctive product identity over a wide cheese range |

Surface ripening cultures

Brevibacteria

Brevibacterium linens and other *Corynebacteria* are an important component of the so-called red-smear flora, which are commonly used in the production of smeared cheeses such as Munster and Limburger. *Brevibacteria* serve three primary functions:

- Provide the right color and appearance
- Secure flavor formation
- Protect against contaminating molds

CHOOZIT® *Brevibacteria* contribute colors ranging from bright red to creamy orange to neutral. The species used are *Brevibacterium linens* (partly renamed *Brevibacterium aurantiacum* recently), *Brevibacterium casei*, and *Arthrobacter sp.* The range is suitable for the traditional cheese types while also meeting industrial needs for pH robust cultures, ideal for more buffered matrices.

Yeasts

Yeast is very common across all cheese types and has a number of ripening functions, including:

- Neutralization of the cheese surface by assimilating lactic acid
- Stimulation of the desired, acid-sensitive flora (e.g. *Brevibacterium linens*) and inhibition of undesirable bacterial contaminants
- Formation of flavor components through lipolytic and proteolytic activity

CHOOZIT® Yeasts include *Debaryomyces hansenii*, *Candida utilis* and *Kluyveromyces lactis* strains selected for their performance and suitability in cheese processes (fast development, rapid neutralization, salt and pH tolerance, flavor production).

Molds

Molds grow in the form of a cell unit, so-called mycelium, and with the help of enzymes, break down larger molecular compounds into smaller molecules that they can exploit.

Specific proteolysis and lipolysis of mold cultures result in the formation of characteristic flavors and have a considerable influence on cheese consistency. Mold cultures grow under aerobic conditions. Due to their proteolysis and lipolysis activities, molds play a very important role during ripening:

- The breakdown of proteins in cheese by proteolysis is especially significant for the texture and organoleptic quality of the cheese. Insufficient proteolysis leads to a cheese which is either hard and crumbly or has a tough texture. Excessive proteolysis results in overly soft cheese, which binds water poorly and often leaves moisture in the package or on the cut of the cheese. Such cheese frequently has a bitter aftertaste
- The breakdown of fat through lipolysis is essential to the development of the typical taste and flavor of cheese. The free fatty acids that result are broken down into methyl ketones, which play a major role in the complex of flavor-forming substances in blue mold cheese. We supply a range of mold cultures which we can match to your production technology and desired cheese properties



Penicillium roqueforti

Penicillium roqueforti has a number of functions in the production of blue mold cheese such as Stilton, Danablu, Gorgonzola and Roquefort. These include:

- Creation of the typical bluish-green mottling
- Prevention of foreign mold growth
- Development of the typical blue cheese taste and creamy consistency of the cheese due to enzymes that develop during its growth

CHOOZIT® *Penicillium roqueforti* produces colors ranging from pale green to dark blue and has enzymatic activities that produce a very mild to sharp and blue cheese taste.

Penicillium candidum

Penicillium candidum (or *Penicillium camemberti*) is used in the production of white mold cheese such as Camembert and Brie, soft blue cheese with a white ring, goat cheese and whey (Sauermilch) cheese. It has a number of important functions:

- Creation of the characteristic appearance of white mold cheese
- Protection of the surface from foreign molds such as mucor and green mold
- Neutralization of the cheese through its capacity to break down lactic acid, influencing taste and structure considerably
- Contribution to the cheese ripening process by proteolytic and lipolytic properties that produce typical flavor components

CHOOZIT® *Penicillium candidum* covers all needs, ranging from strains with high enzymatic activity and a strong influence on taste, to strains with low activity that produce a thin, white rind which is very stable during shelf-life.

- High activity cultures are ideally suited to the most traditional or flavorful cheese types
- Low activity cultures address the specific needs of industrial, high productivity processes and long shelf-life products
- Some strains have a specific anti-mucor action

Geotrichum candidum

Geotrichum candidum is a very common mold in the dairy industry with morphological features that vary from strain to strain, depending on cultivation conditions.

There are three morphological types:

- Mold-like strains, forming loose or tomentose (air) mycelium of varying height
- Intermediate types
- Yeast-like strains, forming flat, white, yeast-like colonies

Geotrichum candidum cultures are used both alone and with *P. candidum* in the production of soft cheese such as Brie and Camembert. Due to its proteolytic and lipolytic activity, *Geotrichum candidum* plays a significant role in the ripening process and greatly influences cheese appearance, structure and flavor.

In applications such as goat cheese, *Geotrichum candidum* is used alone to cover the surface. In red-smear cheese, *Geotrichum candidum* helps neutralize the cheese surface and stimulates the development of desirable, acid sensitive flora such as *Brevibacterium linens*. Working with *Brevibacterium linens*, it produces the red and white surface typical of some European-style cheeses.

Benefits of CHOOZIT® Surface ripening cultures in cheese production

| Your process benefits | Your product benefits |
|---|-----------------------------------|
| Optimal ripening time for cost saving | Consistent cheese quality |
| Flexible cheese differentiation | Great appearance and taste |
| Fast color and flavor development | Wide cheese range, for all tastes |
| Ease of use in industrial and artisanal processes | Authenticity and product identity |
| Inhibition of surface contamination | |

Naturally enhance your cheese production

| Your daily challenge | The CHOOZIT® Cheese cultures offer |
|---|---|
| Achieve high productivity, process efficacy and consistency | Wide range of cultures with a high biodiversity: over 400 products, over 200 different micro-organisms, different genus including lactic as well as non lactic bacteria, yeast and molds. Most of our cultures have been originally isolated from natural and traditional dairy products |
| Differentiate your products | Natural, non-GMO ingredients, including a wide range of Halal and Kosher certified products Available in a wide range of packaging sizes; freeze-dried, liquid or frozen formats for optimal logistics and ease of use Developed and produced with a strong focus on safety and sustainability, and in accordance with recognized international quality and safety standards such as ISO9001 and ISO22000 |
| Comply with high safety and quality standards to secure customer and consumer trust | Supplied with allergen statements and including a selection of gluten free cultures as well as dairy free cultures complying with standard of identity for the type of milk used, e.g. sheep, goat etc. Creative innovation ensures that the portfolio of CHOOZIT® Cheese cultures continues to grow, open and protect breakthrough opportunities |
| Ensure your company's sustainability | The CHOOZIT® Cheese cultures range is supported by cheese experts from the DuPont global team who have more than 100 years' experience in supplying global cheesemakers with technical support Our application experts and laboratories assist manufacturers with formulations, and in applying the CHOOZIT® Cultures range alongside other DuPont™ Danisco® ingredients for cheese |

Other DuPont™ Danisco® ingredients for the cheese industry

- CARLINA® Animal rennets
- Marschall® and MARZYME® Microbial coagulants
- HOLDBAC® Protective cultures
- Accelase® enzymes for shorter ripening process
- Bulk set starters, cultures media and enzymes



CHOOZIT® Cheese cultures – discover our solutions for...

| Cheese type | Typical example of cheese |
|---|--|
| Continental cheese types | Gouda, Edam, Samsøe, Maasdammer, Saint Paulin, Havarti, Tilsit, Raclette, Manchego, Prato, Port Salut, Butterkäse, Limburger |
| Cottage cheese types | Cottage cheese, creamed cottage cheese |
| Cheddar & American cheese types | Cheddar, territorials, American Cheddar, Monterey Jack, Colby, Cheshire, Red Leicester, Double Gloucester, Cantal, Dunlop |
| Pasta filata cheese types | Mozzarella, pizza cheese, Provolone, Kashkaval, Scamorza |
| Feta cheese types | UF feta, traditional feta, feta type cheese (Teleme, Brinza, Chanakh), domiati type cheese |
| Hard cheese types | Emmental, Gruyère, Grana Padano, Parmesan, Sbrinz, Pecorino, Swiss cheese |
| Soft stabilized cheese types | Brie, brique type cheese, Crescenza, Munster |
| Lactic curd traditional soft cheese types | Caillé lactique, Camembert, Saint Marcellin, Pont l'Évêque |
| Blue cheese types | Roquefort, Danablu, Gorgonzola, Stilton |
| Fresh fermented cheese types | Fresh cheese, Quark, cream cheese, buttermilk, sour cream, Tvorog, Petit Suisse, crème fraîche |
| Kefir types | Kefir and kefir type drinks |

About DuPont™ Danisco®

DuPont™ Danisco® is the brand for a range of products that help provide enhanced bioprotection, an improved nutritional profile, and better taste and texture with greater cost efficiency and lower environmental impact, meeting the needs of manufacturers of food and beverages, dietary

supplements and pet food. Through the work of the global network of food scientists and technologists in DuPont, the Danisco® range is supported by a uniquely broad spectrum of know-how across applications and processing.

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Formulations - Application support

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