Cornell University
Milk Quality Improvement Program
Department of Food Science
Stocking Hall, Ithaca, NY 14853
Phone: 607-255-2893

Dairy Foods Science Notes

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Dairy Starter Cultures -- General Characteristics

Basic Definition

Dairy starter cultures are microorganisms that are intentionally added to milk in order to create a desired outcome in the final product, most often through their growth and "fermentation" processes. The most common use of starter cultures is for the production of lactic acid from lactose (milk sugar), which in most cases causes or assists in the coagulation of milk protein by lowering its pH value. Cultures that produce lactic acid are generally referred to as "lactic acid bacteria" (LAB). Certain starter organisms are added specifically for their ability to produce flavor compounds such as diacetyl, although lactic acid and other culture created compounds contribute to flavor as well. Starter organisms can also influence flavor and texture of cultured and/or aged products through the breakdown of proteins, fats and other milk constituents in addition to the pH effect. The lower pH of cultured products can be inhibitory to certain spoilage organisms, although inhibition is also associated with other by-products of growth with some starters. More recently, probiotic cultures are finding their way into cultured milk products. These are organisms that have some claimed health benefit for those that consume them, e.g., better digestion, anti-cancer compounds, and prevention of heart disease. Probiotic cultures may be added as adjuncts or they may be directly involved in the fermentation process.

Culture Selection

The type of starter culture used depends on the desired product. Culture supply companies can provide processors with a variety of cultures tailored for their operation that can be purchased frozen or dehydrated, typically as a mixture of several strains. It is very important to follow the supplier's advice on the handling, storage, rotation, use rate, and incubation temperature for their cultures. Generally, dairy cultures are classified as Mesophilic cultures with optimum growth at 70 - 90°F or Thermophilic cultures with optimum growth at 100 - 115°F. Varying the incubation temperature of certain cultures can influence the flavor profile and other attributes of the final product. A summary of common dairy starter cultures and their uses follows.

Factors Affecting Culture Activity

Slow acid development by cultures can result in an inferior product or the loss of a vat full of milk. Starter activity can be influenced by a number of factors including the age of the culture, handling and storage practices, incubation temperature, the quality of the raw milk, bacteriophage, and the presence of inhibitors such as drugs or sanitizers. Penicillin and related antibiotics can inhibit cultures at levels as low as 1-2 parts per billion. Sanitizers can cause inhibition, especially those that leave residues, such as quaternary ammonia compounds. Natural inhibitors associated with high somatic cells and late lactation can also slow growth.

Bacteriophage

Bacteriophage (phage) are viruses that attack and destroy bacteria. They are very small and cannot be seen with an ordinary microscope. Phage require a host cell to reproduce; one phage per bacterial infection can result in up to 200 phage being released, each of which can infect a new bacterial cell. Phage are very strain specific, which is why culture rotation and resistance are used as control mechanisms. Phage can enter the dairy plant through the raw milk supply although some culture strains are "carriers." Problems with "dead vats" due to phage can often be linked to phage in the plant environment (e.g., poor plant hygiene, residual culture). Stringent culture handling and plant sanitation programs are essential in preventing phage problems.

Provided with support from the NY State Dairy Promotion Board; dairy farmers dedicated to the production, manufacture & distribution of quality dairy products.

TAXONOMY OF DAIRY STARTER CULTURES[1]

Old Name	New Name	Major Function	Product Use
Mesophilic starters[2]			
Streptococcus lactis	*Lactococcus lactis* sub-sp. *lactis*	Acid Production	Buttermilk, sour cream, many types of cheese
Streptococcus cremoris	*Lactococcus lactis* sub-sp. *cremoris*	Acid Production	Buttermilk, sour cream, many types of cheese
Streptococcus diacetylactis	*Lactococcus lactis* sub-sp. lactis biovar *diacetylactis*	Flavor & Acid	Sour cream, ripened butter, cheese, buttermilk
Leuconostoc cremoris	*Leuconostoc mesenteroides* sub-sp. *cremoris*	Flavor	Buttermilk, sour cream cottage cheese, ripened butter
Leuconostoc lactis	Unchanged	Flavor	Buttermilk, sour cream cottage cheese, ripened butter
Thermophilic Starters[3]			
Streptococcus thermophilus	Unchanged	Acid (& Flavor)	Yogurts, fermented milks, Italian cheese, emmental
Lactobacillus bulgaricus	*Lactobacillus delbrueckii* sub-sp. *bulgaricus*	Acid & Flavor	Yogurts, fermented milks, Italian cheese, emmental
Lactobacillus lactis	*Lactobacillus delbrueckii* sub-sp. *lactis*	Acid & Flavor	Yogurts, fermented milks, Italian cheese, emmental
Lactobacillus helveticus	Unchanged	Acid & Flavor	Yogurts, fermented milks, Italian cheese, emmental

[1] Adapted from Dairy Microbiology, R.K. Robinson & Cheese and Fermented Milk Foods, F. Kozikowski
[2] Optimum Temperature Range 20 - 30°C. All are spherical shaped bacteria (coccus).
[3] Optimum Temperature Range 37 - 45°C. *Streptococcus* are cocci, *Lactobacillus* are rod shaped bacteria.

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