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Dairy Foods Science Notes

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Lactic Acid Bacteria – Homofermentative and Heterofermentative

Lactic acid bacteria (LAB) are bacteria that are common to the dairy industry, and while the definition of LAB may be imprecise, it is assumed that LAB are organisms that produce lactic acid as the principle by-product of sugar fermentations. LAB may be rods or cocci, are Gram-positive and are generally more tolerant of low pH environments than are other bacteria associated with milk and dairy products. LAB are common in nature and are often associated with plant materials. They can also be found as part of the resident microflora of humans and other mammals (e.g., oral cavity, GI track, etc.). LAB are most known in the dairy industry for their use in "starter" cultures and dairy fermentations. As starter cultures, they are added to milk and allowed to grow under controlled conditions in order to produce acid and/or modify the flavor and texture for the desired characteristics of a cheese or cultured product. LAB may also grow in dairy products as contaminants or under uncontrolled conditions, resulting in undesirable defects. LAB can cause milk to "sour" while some strains may produce gas in cultured products or cheese that will influence package appearance and cause product flavor defects. LAB may be classified as *homofermentative* or *heterofermentative* based on their by-products of sugar (e.g., glucose) fermentation.

Homofermentative LAB ferment glucose with lactic acid as the primary by-product. Homofermentative LAB include *Lactococcus* spp. that are used in dairy starter culture applications where the rapid development of lactic acid and reduced pH is desirable. Other homofermentative LAB include yogurt strains consisting of rods (*Lactobacillus delbruckii* subspecies *bulgaricus, Lb. acidophilus*) and cocci (*Streptococcus salivarius* subsp. *thermophilus*) and thermophilic strains that might be used in cheese (e.g., *Lb. helveticus*). Other homofermentative cocci that might be found in milk and dairy products, but are rarely used as starter cultures include other *Streptococcus* spp., *Enterococcus*, *Pediococcus* and *Aerococcus*.

Heterofermentative LAB ferment glucose with lactic acid, ethanol/acetic acid and carbon dioxide (CO_2) as by-products. Testing for heterofermentative fermentation generally involves the detection of gas (e.g., CO_2). With the exception of certain fermented milk products, heterofermentative LAB are rarely used as dairy starter cultures, although they are not uncommon in milk and dairy products. If allowed to grow to significant numbers, they can cause defects related to their acid and CO_2 production, such as slits in hard cheeses or bloated packaging in other dairy products. Heterofermentative LAB include *Leuconostoc* spp. (Gram-positive cocci) and Gram-positive rods such as *Lactobacillus brevis*, *Lb. fermentum*, and *Lb. reuteri*. Other *Lactobacillus* species are considered "facultatively" heterofermentative, meaning they will produce CO_2 and other by-products only under certain conditions or from specific substrates. These strains would include *Lb. plantarum*, *Lb. casei* and *Lb. curvatus*.

Other Gas Producing Pathways: Some LAB have the ability to produce gas from other substrates including citrate, gluconate and certain amino acids. Certain citrate fermentors are used in some dairy products to provide flavor (e.g., diacetyl). *Leuconostoc mesenteroides* sub-sp. *cremoris* and *Lactococcus lactis* sub-sp. *lactis* biovar *diacetylactis* are often used to make products such as buttermilk, sour cream and cultured butter. These organisms can also occur as wild contaminants causing defects in dairy products where certain flavors and gas are not desirable.

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