Unit 4

Fermented food:

Dairy products – The commercial and the home production of many of fermented foods and products produced by use of appropriate starter cultures. A small lactic starter is a basic starter culture with widespread use in the dairy industry. Lactic starter are used in cheese making, butter cultured buttermilk, cottage cheese, and cultured sour cream.

Lactic starters include bacteria that convert lactose to lactic acid, L. lactis, L. cremoris, or L. diacetilactis. Starter cultures may consist of single or mixed strains.

Yogust (yoghurt) is produced with a yoghurt starter, which is a mixed culture of S. thermophilus and L. bulgaricus in a 1:1 ratio.

Other fermented foods :– dosa sauerkraut, soy sauce and tempeh and probiotics.

cultured buttermilk is produced from pasteurized and homogenized light cream with a lactic starter. These products owe their tart flavor to lactic acid and their buttery aroma and taste to diacetyl.

Yogurt (yoghurt) is produced with a yogurt starter, which is a mixed culture of *S. thermophilus* and *L. bulgaricus* in a 1:1 ratio. The coccus grows faster than the rod and is primarily responsible for acid production, while the rod adds flavor and aroma. The associative growth of the two organisms results in lactic acid production at a rate greater than that produced by either when growing alone, and more acetaldehyde (the chief volatile flavor component of yogurt) is produced by *L. bulgaricus* when growing in association with *S. thermophilus* (see 88).

The product is prepared by first reducing the water content of either whole or skim milk by at least one-fourth. This may be done in a vacuum pan following sterilization of the milk. Approximately 5% by weight of milk solids or condensed milk is usually added. The concentrated milk is then heated to 82° to 93°C for 30 to 60 min and cooled to around 45°C (83). The yogurt starter is now added at a level of around 2% by volume and incubated at 45°C for 3 to 5 h, followed by cooling to 5°C. The titratable acidity of a good finished product is around 0.85 to 0.90%, and to get this amount of acidity the fermenting product should be removed from 45°C when the titratable acidity is around 0.65 or 0.70% (20). Good yogurt keeps well at 5°C for 1 to 2 weeks. The coccus grows first during the fermentation followed by the rod, so that after around 3 h, the numbers of the two organisms should be approximately equal. Higher amounts of acidity such as 4% can be achieved by allowing the product to ferment longer, with the effect that the rods will exceed the cocci in number. The streptococci tend to be inhibited at pH values of 4.2 to 4.4, while the lactobacilli can tolerate pHs in the 3.5 to 3.8 range. The lactic acid of yogurt is produced more from the glucose moiety of lactose than the galactose moiety. Goodenough and Kleyn (43) found only a trace of glucose throughout yogurt fermentation, while galactose increased from an initial trace to 1.2%. Samples of commercial yogurts showed only traces of glucose, while galactose varied from around 1.5 to 2.5%.

Freshly produced yogurt typically contains around 10^9 organisms/g but during storage, numbers may decrease to 10^6/g, especially when stored at 5°C for up to 60 days (47). The rod generally decreases more rapidly than the coccus. The addition of fruits to yogurt appears not to affect the numbers of fermenting organisms (47).

The antimicrobial qualities of yogurt, buttermilk, sour cream, and cottage cheese were examined by Goel et al. (40) who inoculated *Enterobacter aerogenes* and *Escherichia coli* separately into commercial products and studied the fate of these organisms when the products were stored at 7.2°C. A sharp decline of both coliforms was noted in yogurt and buttermilk after 24 h. Neither could be found in yogurt generally beyond 3 days. While the numbers of coliforms were reduced also in sour cream, they were not reduced as rapidly as in yogurt. Some cottage cheese samples actually supported an increase in coliform numbers, probably because the products had higher pH values. The initial pH ranges for the products studied by these workers were as follows: 3.65–4.40 for yogurts, 4.1–4.9 for buttermilks, 4.18–4.70 for sour creams,

and 4.80–5.10 for cottage cheese samples. In another study, commercially produced yogurts in Ontario were found to contain the desired 1:1 ratio of coccus to rod in only 15% of 152 products examined (7). Staphylococci were found in 27.6% and coliforms in around 14% of these yogurts. Twenty-six percent of the samples had yeast counts more than 1,000/g and almost 12% had psychrotroph counts more than 1,000/g. In his study of commercial unflavored yogurt in Great Britain, Davis (20) found *S. thermophilus* and *L. bulgaricus* counts to range from a low of around 82 million to a high of over 1 billion/g, and final pH to range from 3.75 to 4.20. The antimicrobial activities of lactic acid bacteria are discussed further in Chapter 11.

Kefir is prepared by the use of kefir grains, which contain *L. lactis*, *L. bulgaricus*, and a lactose-fermenting yeast held together by layers of coagulated protein. Acid production is controlled by the bacteria, while the yeast produces alcohol. The final concentration of lactic acid and alcohol may be as high as 1%. **Kumiss** is similar to kefir except that mare's milk is used, the culture organisms do not form grains, and the alcohol content may reach 2%.

Acidophilus milk is produced by the inoculation into sterile skim milk of an intestinal implantable strain of *L. acidophilus*. The inoculum of 1 to 2% is added, followed by holding of the product at 37°C until a smooth curd develops. **Bulgarian buttermilk** is produced in a similar manner by the use of *L. bulgaricus* [illegible] *L. acidophilus*. *L. bulgaricus* is not