UNIT 3

MILK AND DAIRIES

A. MICROBIOLOGICAL ASPECTS OF MILK

A.1 THE NEARLY PERFECT FOOD

Milk is a white, opaque liquid secreted by female mammals to nourish their newly born offspring. Milk is an especially valuable food because it is meant to be the sole sustaining food of the animal during its early life. Nearly all milks contain the same substances – water, proteins, fat, milk sugar, or lactose, various vitamins and minerals – but the relative proportions of these substances vary greatly from species to species.

Human milk is more easily digested than cow's milk both because there is less protein in it, and because less of that protein curdles in stomach acid. Homogenization, pasteurization, and *cooking* all cause milk proteins to form weaker, looser curds, and so improve the digestibility of cow's milk.

Human milk alone contains the so-called 'bifidus factor', a substance that promotes the growth of *Lactobacillus bifidus*, a harmless bacterium which excretes as a waste product lactic acid, which in turn helps to inhibit the growth of harmful microbes.

The milk sugar lactose – which is found in no other food - is a disaccharide. Each lactose molecule consists of one glucose and one galactose unit joined together. All multiunit sugars must be broken down into their components by digestive enzymes in the small intestine before they can be absorbed and used by the body. The lactose-breaking enzyme is lactase.

Both physically and chemically, milk is a complex material.

Globules of milk fat, complexes of protein and salts, dissolved sugar, vitamins and salts all swim in the water that accounts for the bulk of the fluid. The fat and proteins are by far the most important components.

Milk fat carries the fat soluble vitamins, essential fatty acids, and about half the calories; it contributes to milk's characteristic taste and texture, and the higher the milk fat content, the more butter or cream can be made from the milk.

There are a great many different kinds of proteins floating around in milk but we can reduce the protein population to two basic groups: curds and whey. The two are distinguished by their reactions to acid and rennin, an enzyme used to make cheese. The curd protein, casein, coagulates and forms solid clumps, while the whey proteins remain suspended in the liquid.

All of the recognized vitamins are present in milk, though some, such as vitamin C, come only in tiny quantities. Vitamin A and its chemical precursor carotene are carried in the fat globules and give milk and butter a yellowish cast; riboflavin, which has a greenish colour, can sometimes be seen in skim milk or in the whey that separates during cheese making.

A wide range of salts is found in milk, with sodium, potassium, calcium, magnesium, chloride, phosphate, sulphate, citrate, and bicarbonate ions among the more populous. Milk is also highly acidic, with a pH between 6.5 and 6.7.

(from: McGee, *On Food and Cooking*, Unwin Hyman)

1 *Ask questions to which the sentences underlined in* The nearly perfect food *are the answers.*

2 *Choose synonyms (among* A *words) and antonyms (among* B *words) of the adjectives below from* The nearly perfect food*. Tip: copy the adjectives in your indexed book.*

A: broad, composite, delicate, great, hard, initial, innocuous, little, main, milky, precious, similar

B: big, different, harmful, late, low, narrow, simple, soft, strong, transparent, trivial, worthless

a. opaque: ....
b. valuable: ....
c. early: ....
d. same: ....
e. weak: ....
f. harmless: ....
g. small/tiny: ....
h. complex: ....
i. important: ....
j. high: ....
k. solid: ....
l. wide: ....

3 *Write comparative sentences using the suggested elements.*

a. Cow's milk / human milk / rich in proteins and minerals.
b. Homogenized milk / raw milk / digestible.
c. Fat and proteins / vitamins / important components of milk.
d. Vitamin C / vitamin A / abundant in milk.
e. Water / milk / acidic

A.2 MILK TREATMENT

Milk is sold in a variety of forms today, but very few of us ever see raw milk any more. Ordinary drinking milk is routinely subjected to pasteurization and homogenization and sometimes to vitamin fortification too.
Most milk sold for direct human consumption has been pasteurized, or heated hot and *long* enough to destroy all disease-causing organisms and most others as well. The great French scientist Louis Pasteur studied the spoilage of wine and beer in the 1860s and developed a heat treatment that preserved these fluids without greatly injuring their flavour. Nowadays, pasteurization is a practical necessity. It extends the shelf life of milk not only by killing microbes, but also by inactivating enzymes native to milk, especially the fat-splitters, whose slow but steady activity can make it unpalatable. There are many different combinations of temperature and time that pasteurize milk, but a few are by far the most *commonly* employed. One *standard* method is to heat the milk to 62°C and hold it there for 30'; another keeps it at 71°C for 15". The first has the advantage of staying well below the temperature at which a cooked *flavour* develops, and while the second *flirts* with this limit, it is much faster. Ultrapasteurization, in ▶

which a temperature of 138°C is held for one second, is a more severe treatment that does leave behind a cooked flavour.
Homogenization, whose name comes from the Greek for 'of the same kind', involves forcing the milk at high pressure through a very small nozzle onto a hard surface; it breaks the fat globules up into more uniform particles about a quarter of their original size. As a result, the fat remains evenly dispersed in the milk. Homogenized milk is whiter, blander, less stable to heat, and more sensitive to spoilage by *light* than unhomogenized milk. All milk is pasteurized before or simultaneously with homogenization.
In addition to being pasteurized and homogenized, milk may be fortified with the fat-soluble vitamins A and D.
Low-fat milks are made by centrifuging some of the globules off before homogenization. Whole milk is about 4% fat, low-calorie milks 1 or 2% and skim milk between 0.1% and 0.2%. 'Acidophilus' milk is designed for people with lactose intolerance; it has been cultured with *Lactobacillus acidophilus*, a bacterium that consumes the lactose and produces lactic acid in the process.
Milk is a highly perishable food. Even pasteurized milk contains millions of bacteria and will *sour* quickly unless refrigerated.
The flavour of milk can be altered by the electrical energy carried in ordinary daylight. This chemical reaction is called "autoxidation". So, for both nutritional and gustatory reasons, clear glass or plastic containers of milk should be kept in the dark as much as possible.

(from: McGee, *On Food and Cooking*, Unwin Hyman)

4 *Use these words to complete the short summary of* Milk treatment: bacteria, bacterium, dispersed, enzymes, fat globules, flavour, harmful, intolerance, light, nutritional, pathogens, percentages, refrigerated, sour. *Tip: copy the summary in your exercise book.*

Most milk sold for beverage purposes is pasteurized to destroy (1) ..... which may have contaminated milk. Pasteurization kills all (2) ..... microbes and inactivates fat-splitting (3) ..... which would soon make milk unpalatable. Standard pasteurization slightly changes the (4) ..... of milk.
In homogenization the (5) ..... of milk are broken down into very small particles which remain uniformly (6) ..... in the liquid.
The (7) ..... value of milk can be increased by adding vitamins.
Milk is sold in a variety of forms containing different (8) ..... of fat.
Milk cultured with Lactobacillus acidophilus, a lactose-consuming (9) ....., can be used by people with lactose (10) .....
Being a very perishable food, even pasteurized milk must be kept (11) ..... to prevent the millions of (12) ..... in it from causing it to become (13) .... Milk should also be kept in the dark because it is very sensitive to spoilage by (14) ..... which may alter its flavour.

5 *Use either* how *or* what *to complete the questions below, then answer them using your own words as far as possible.*

a. ..... is milk treated in pasteurization?
b. ..... are the advantages of pasteurization?
c. ..... is homogenization carried on?
d. ..... are low-fat milks made?
e. ..... is "acidophilus" milk produced?

B. DAIRIES

FOODS FROM MICROORGANISMS

Microorganisms are widely used in the food industry to produce various types of foods that are both nutritious and preserved from spoilage because of their acid content.
In the dairy industry, many products result from fermentation by microorganisms in milk and the products of milk. For example, buttermilk results from the souring of low-fat milk by lactic acid. The flavor is due to substances produced by species of *Streptococcus, Leuconostoc* and *Lactobacillus* as they grow.
A fermented milk product with a puddinglike consistency is yogurt. Two bacteria, *Streptococcus thermophilus* and *Lactobacillus bulgaricus*, are essential to its production. After the milk has been heated to achieve evaporation, the bacteria are added, and the condensed milk is set aside at a warm temperature to produce the yogurt. Sour cream is produced in a similar way, using cream as a starter material.
The protein portion of the milk, the casein, is used to produce cheese and cheese products. Precipitated from the milk, the protein curd is an unripened cheese such as cottage cheese. The leftover liquid, the whey, can be used to make cheese foods.
When the cheese is allowed to ripen through the activity of various microorganisms, various cheeses are produced. Soft cheeses, such as Camembert, do not spoil rapidly. Camembert cheese is a product of the growth of the fungus *Penicillium camemberti*. Hard cheeses have less water and are ripened with bacteria or fungi. Swiss cheese is ripened by various bacteria, including species of *Propionibacterium*, which produces gas holes in the cheese. Blue cheese is produced by *Penicillium roqueforti*, which produces veins within the cheese as it grows.
Other fermented foods are also the product of microbial action. Sauerkraut, for example is produced by *Leuconostoc* and *Lactobacillus* species growing within shredded cabbage. Cucumbers are fermented by these same microorganisms to produce pickles.
Bread is another product of microbial action. Flour, water, salt, and yeast are used to make the dough. The yeast most often used is *Saccharomyces cerevisiae*. This organism ferments the carbohydrates in the dough and produces carbon dioxide, which causes the dough to rise and creates the soft texture of bread. Unleavened bread is bread that contains no yeast.

6 *Complete the definitions choosing from the words underlined in* Foods from microorganisms.

a. ..... are vegetables preserved in vinegar or salt water.

b. ..... is a dairy product composed of the fat layer skimmed from the top of milk before homogenization.

c. ..... embraces the establishments where milk is processed into a variety of products.

d. ..... is a dairy product cultured with bacteria to give it a pungent taste.

e. ..... is a fine powder obtained by grinding grains.

f. ..... is a mixture of flour and water ready to be baked.

g. ..... is a substance, consisting mainly of casein obtained from milk by coagulation, which is used to make cheese.

h. ..... is a sweet milk-based dessert.

i. ..... is a type of cheese that has *Penicillum* mould in it which creates blue streaks.

j. ..... is bread baked without a rising agent.

k. ..... is curd drained but not pressed so that it still contains some whey.
l. ..... is finely cut cabbage fermented by lactic acid bacteria.
m. ..... is the liquid left over after churning butter.
n. ..... is the liquid remaining after milk has been curdled to produce cheese
o. ..... is the protein found in milk.

7 *Answer these questions about* Foods from microorganisms.

a. How is yogurt produced?
b. What is sour cream produced from?
c. What fraction of milk is used to produce cheese?
d. What are the holes in Swiss cheese produced by?
e. What are the blue veins in some cheeses produced by?
f. What is the basis of sauerkraut?
g. What is bread dough made of?
h. What is the function of *Saccharomyces cerevisiae* in bread production?
i. Is *Saccharomyces cerevisiae* used in the production of unleavened bread too?