Composition of Milk

Definition of Milk

Milk may be defined as the whole, fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy milch animals, excluding that obtained within 15 days before or 5 days after calving or such periods as may be necessary to render the milk practically colostrum free, and containing the minimum prescribed percentages of milk fat and milk solids-not-fat.

Milk constituents: the major constituents of milk are, water, fat, protein, lactose, ash or mineral matter. The minor constituents are: phospholipids, sterols, vitamins, enzymes, pigments, etc. the “true” constituents are milk fat, casein and lactose.

Chemical composition of milk of different species.

<table>
<thead>
<tr>
<th>Name of species</th>
<th>Water</th>
<th>Fat</th>
<th>Protein</th>
<th>Lactose</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ass</td>
<td>90.0</td>
<td>1.3</td>
<td>1.7</td>
<td>6.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Buffalo</td>
<td>84.2</td>
<td>6.6</td>
<td>3.9</td>
<td>5.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Camel</td>
<td>86.5</td>
<td>3.1</td>
<td>4.0</td>
<td>5.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Cat</td>
<td>84.6</td>
<td>3.8</td>
<td>9.1</td>
<td>4.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Cow (foreign)</td>
<td>86.6</td>
<td>4.6</td>
<td>3.5</td>
<td>4.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Dog</td>
<td>75.4</td>
<td>9.6</td>
<td>11.2</td>
<td>3.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Elephant</td>
<td>67.8</td>
<td>19.6</td>
<td>3.1</td>
<td>8.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Ewe</td>
<td>79.4</td>
<td>8.6</td>
<td>6.7</td>
<td>4.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Goat</td>
<td>86.5</td>
<td>4.5</td>
<td>3.5</td>
<td>4.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Guinea pig</td>
<td>82.2</td>
<td>5.5</td>
<td>8.5</td>
<td>2.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Human</td>
<td>87.8</td>
<td>3.6</td>
<td>1.8</td>
<td>6.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Llama</td>
<td>86.5</td>
<td>3.2</td>
<td>3.9</td>
<td>5.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Mare</td>
<td>89.1</td>
<td>1.6</td>
<td>2.7</td>
<td>6.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Reindeer</td>
<td>68.2</td>
<td>17.1</td>
<td>10.4</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Sow</td>
<td>89.6</td>
<td>4.8</td>
<td>1.3</td>
<td>3.4</td>
<td>0.9</td>
</tr>
<tr>
<td>Whale</td>
<td>90.1</td>
<td>19.6</td>
<td>9.5</td>
<td>-</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Chemical composition of milk of foreign breeds of cow

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Percentage Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Holstein</td>
<td>87.74</td>
</tr>
<tr>
<td>Shorthorn</td>
<td>87.19</td>
</tr>
<tr>
<td>Ashyre</td>
<td>87.10</td>
</tr>
<tr>
<td>Brown Swiss</td>
<td>86.59</td>
</tr>
<tr>
<td>Guernsey</td>
<td>85.39</td>
</tr>
<tr>
<td>Jersey</td>
<td>85.09</td>
</tr>
</tbody>
</table>
Food and Nutritive Value of Milk
Milk is almost an ideal food. It has high nutritive value, It supplies body-building proteins, bone-forming minerals and health-giving vitamins and furnishes energy-giving lactose and milk fat. Besides supplying certain essential fatty acids, it contains the above nutrients in an easily digestible and assimilable form. All these properties make milk an important food for pregnant mothers, growing children, adolescents, adults, invalids, convalescents and patients alike.

a. Protein: Milk proteins are complete proteins of high quality, i.e. they contain all the essential amino-acids in fairly large amounts.

b. Minerals: practically all the mineral elements found in milk are essential for nutrition. Milk is an excellent source of calcium and phosphorus, both of which, together with vitamin D, are essential for bone formation. Milk is rather low in iron, copper and iodine.

c. Vitamins: these are accessory food factors which are essential for normal growth, health and the reproduction of living organisms. Milk is a good source of vitamin a (provided the cow is fed sufficient green feed and fodder), thiamine, riboflavin, etc. However, milk is deficient in vitamin C.

d. Fat: Milk fat (lipid) plays a significant role in the nutritive value, flavour and physical properties of milk and milk products. Besides serving as a rich source of energy, fat contains significant amounts of so-called essential fatty acids (lenoleic and arachi8donic). The most distinctive role which milk fat plays in dairy products concerns flavour of milk lipids is not duplicated by any other type of fat. Milk fat imparts a soft body, smooth texture and rich taste to dairy products. Lastly, milk lipids undoubtedly enhance the consumer acceptability of foods; they also serve the best interests of human nutrition through the incentive of eating what tastes good.

e. Lactose: The principal functions of lactose (carbohydrate) are to supply energy. However, lactose also helps to establish a mildly acidic reaction in the intestine (which checks the growth of proteolytic bacteria) and facilitates assimilation.

f. Energy value: the energy-giving milk constituents and their individual contributions are as follows:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Energy Value (C/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fat</td>
<td>9.3</td>
</tr>
<tr>
<td>Milk protein</td>
<td>4.1</td>
</tr>
<tr>
<td>Milk sugar</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Where 1 C (Food calorie) = 1000c (small calorie)
Note: the energy value of milk will vary with its composition. On average, cow milk furnishes 75 C/100 g and buffalo milk 100 C/100 g
Effect of processing

i. Pasteurizing carried out with reasonable care has no effect on vitamin A, carotene, riboflavin and a number of remaining vitamins B, and vitamin D. Of the remainder, a 10% loss of ascorbic acid may be expected.

ii. Sterilization increases the losses of thiamine and ascorbic acid to 30 – 40% and 50% respectively, though the remaining vitamins are but little affected.

Physico-Chemical properties of Milk constituents

A. Major Milk Constituents

a. Water
Constitutes the medium in which the other milk constituents are either dissolved or suspended. Most of it is “free” and only a very small portion in the “bound” form, being firmly bound by milk proteins, phospholipids, etc.

b. Milk fat (lipid)
The bulk of the fat in milk exists in the form of small globules, which average approximately 2 – 5 microns in size (range 0.1 to 20 microns). This is an oil-in-water type emulsion. The surface of these fat globules is coated with an adsorbed layer of material commonly known as the fat globule membrane, this membrane contains phospholipids and proteins in the form of a complex, and stabilizes the fat emulsion. In other words, the membrane prevents the fat globules form coalescing and separating from on another. The emulsion may however, be broken by agitation (at low temperatures), heating, freezing, etc. when milk is held undisturbed, the fat globules tend to rise to the surface to form a cream layer. The thickest cream layer is secured from milk, which has higher fat content and relatively large fat globules (such as buffalo’s milk when compared with cow’s milk).

Chemically, milk fat is composed of number of glyceride-esters of fatty acids; on hydrolysis, milk fat furnished a mixture of fatty acids and glycerol. The fatty acids are saturated or unsaturated. Saturated fatty acids are relatively stable. On the other hand, the unsaturated ones play an important role in the physico-chemical properties of milk fat.

c. Milk proteins
Proteins are among the most complex of organic substances. They are vital for living organisms as they constitute an indispensable part of the individual body cell. Proteins are composed of a large number of amino-acids, some “essential” and others “non-essential”. The essential amino-acids are necessary in the diet for the formation of body proteins. On hydrolysis, proteins furnish a mixture of amino-acids. The proteins of milk consist mainly of casein, β-lactoglobulin, α-lactalbumin, etc. casein exists only in milk and is found in the form of a calcium caseinate-phosphate complex. It is present in the colloidal state. It forms more than 8% of the total protein in milk. It may be precipitated by acid, rennet, alcohol, heat and concentration. Casein itself is
composed of α, β and γ fractions. The heterogeneous nature of α-casein can be observed through electrophoresis.

α-casein is the component in casein micelle that is responsible for the stabilization of the micelle in milk. Later studies have also revealed that α-casein is composed of at least two sub-fraction, viz. αs-casein precipitable by calcium-ion under certain conditions and also called “calcium-sensitive casein”, and K-casein, also called “calcium insensitive casein”, not precipitable by calcium-ion. K-casein is the richest repository of carbohydrates as against other casein fractions. It is also the site for rennin actions.

β-lactoglobulin and α-lactalbumin are also known as whey or serum-proteins. They are also present in the colloidal state and are easily coaguable by heat.

d. **Milk sugar or lactose.**

This exists only in milk. It is in true solution in the milk serum. On crystallization from water, it forms hard gritty crystals. It is one-sixth as sweet as sucrose. Lactose is responsible, under certain conditions, for the defect known as “sandiness” in ice cream or sweetened condensed milk. Chemically, lactose is composed of one molecule each of glucose and galactose. Lactose occurs in two forms, α and β, both of which occur either as the hydrate or the anhydrite. It is fermented by bacteria to yield lactic acid and other organic acids and is important both in the production of cultured milk products and in spoilage of milk and milk products by souring.

e. **Mineral matter of ash.**

The mineral matter or salts of milk, although present in small quantities, exert considerable influence on the physicochemical properties and nutritive value of milk. The major salt constituents, i.e. those present in appreciable amounts, include potassium, sodium, magnesium, calcium, phosphate, citrate, chloride, sulphate and bicarbonate; the trace elements include all other minerals and salt compounds. The mineral salts of milk are usually determined after ashing. Although milk is acidic, ash is distinctly basic. Part of the mineral salts occurs in true solution while a part in the colloidal state.

B. **Minor Milk constituents**

a. **Phospholipids**

In milk, there are three types of phospholipids, viz. lecithin, cephalin and sphingomyelin. Lecithin, which forms an important constituent of the fat globule membrane, contributes to the “richness” of flavour of milk and other dairy products. It is highly sensitive to oxidative changes, giving rise to oxidized/metallic flavours. Phospholipids are excellent emulsifying agents and no doubt serve to stabilize the milk fat emulsion.

b. **Cholesterol**

This appears to be present in true solution in the fat, as part of the fat globule membrane complex and in complex formation with protein in the non-fat-portion if milk.
c. **Pigments**

These are (i) fat soluble, such as carotene and xanthophylls, and (ii) water soluble such as riboflavin. Carotene is the colouring (the pure substance of which has a reddish-brown colour) is fat soluble and responsible for the yellow colour of milk, cream, butter, ghee and other fat-rich dairy products. Besides contributing to the colour of cow milk, carotene acts as a precursor of vitamin A. One molecule of β-carotene yields two molecules of vitamin a while α-carotene yields only one.

Dairy animals differ in their capacity to transfer carotene from feeds to milk fat; this varies with species, breed and individuality. Hence, buffalo milk is white in colour. (The carotinoid content of buffalo milk varies from 0.25 to 0.48 µg/g, while that of cow milk may be as high as 30 µg/g)

d. **Enzymes**

These are "biological catalysts" which can hasten or retard chemical changes without themselves participating in the reactions. The enzymes are protein-like, specific in their actions and inactivated by heat; each enzyme has its own inactivation temperature. The important milk enzymes are as follows:

(i) Analase (diastase) – starch splitting
(ii) Lipase – fat splitting, leading to rancid flavour;

(iii) Phosphatase – capable of splitting certain phosphoric acid esters (basis of phosphatase test for checking pasteurization efficiency)

(iv) Protease – protein splitting;

(v) Peroxidase and Catalase decomposes hydrogen peroxide.

e. **Vitamins**

Although present in foods in very minute quantities, these are vital for the health and growth of living organisms. As of today, over 25 vitamins have been reported. Those found in milk are: fat-soluble vitamins A, D, E and K' and water-soluble of the "B-complex" group (such as thiamin or B₁, pantothenic acid, niacin, pyridoxine or B₆, biotin, B₁₂, folic acid, etc) and vitamin C. Absence of vitamins in the diet over prolonged periods causes "deficiency diseases".

**Physico-Chemical Properties of Milk**

a. **acidity**

Freshly drawn milk is amphoteric to litmus that it turns red litmus blue and blue litmus red. However, it shows certain acidity as determined by titration with an alkali (sodium hydroxide) in the presence of an indicator (phenolphthalein). This acidity is also called Titrable acidity (T.A) as it is determined by titration, is known as "natural" or "apparent" acidity and is caused by the presence of casein, acid-phosphates, citrates, etc. in milk. The natural acidity of individual milk varies...
considerable depending upon species, breed, individuality, stage of lactation, physiological condition of the udder, etc. but the natural acidity of fresh her milk is much more uniform. The higher the solids-not-fat content in milk, the higher the natural acidity (N.A) and vice versa. The titrable acidity of cow milk varies on an average from 0.13 to 0.14 percent and buffalo milk from 0.14 to 0.15 per cent. “Developed” or “real” acidity is due to lactic acid, formed as a result of bacterial action on lactose in the milk. Hence the titrable acidity of stored is equal to the sum of natural acidity and developed acidity. The titrable acidity is usually expressed as “percentage of lactic acid.

b. pH
The pH of normal, fresh, sweet milk usually varies from 6.4 to 6.6 for cow milk and 6.7 to 6.8 for buffalo milk. Higher pH values for fresh milk indicate udder infection (mastitis) and lower values, bacterial action. Note: The acidity and pH of fresh milk vary with (i) species, (ii) breed, (iii) individuality, (iv) stage of lactation and (v) health of the animal, etc.

B. Density and Specific Gravity
Whereas density of a substance is its mass (weight) per unit volume, specific gravity is the ration of density of the substance to density of a standard substance (water). Since the density of a substance varies with temperature, it is necessary to specify the temperature when reporting densities or specific gravities. The specific gravity of a substance (when referred to water at 4°C) is numerically equal to the density of that substance in metric system. The specific gravity of milk is usually expressed at 60°F (15.6°C). The density or the specific gravity of milk may be determined by either determining the weight of a know volume or the volume of a known weight. The weight of a known volume may be determined either with a pycnometer or with a hydrostatic balance; while the volume of a known weight is determined by using lactometers, the scale of which is calibrated not in terms of volume but as a function of either density or specific gravity. The common types of lactometers are Zeal, Quevenne, etc.

Milk is heavier than water. The average specific gravity ranges (at 60°F) from 1.028 to 1.030 for cow milk and 1.030 to 1.032 for buffalo milk and 1.035 to 1.037 for skim milk. The specific gravity of milk is influenced by the proportion of its constituents (i.e. composition), each of which has different specific gravity approximately as follows: water – 1.000, fat – 0.93, protein – 1.346, lactose – 1.666 and salts – 4.12 (solids-not-fat - 1.616).

As milk fat is the lightest constituent, the more there is of it the lower the specific gravity with be and vice versa. However, although buffalo milk contains more fat than cow milk, its specific gravity is higher than the latter’s; this is because buffalo milk contains more solids-not-fat as well, which ultimately results in a higher specific gravity.

The specific gravity of milk is lowered by addition of water and cream and increased by addition of
skim milk or removal of fat. The percentage of total solids or solids-not-fat in milk is calculated by using the following formula:

\[
\% TS = 0.25D + 0.72 \\
\% SNF = 0.25D + 0.22F + 0.72
\]

Where \( D = 1000 (d – 1) \)

\( D \) = density of sample of milk at 20 \( ^\circ \)C (68 \( ^\circ \)F)

Note: the specific gravity of milk should not be determined for at least one hour after it is drawn from the animals; else a lower-than-normal value will be obtained (due to the Recknagel phenomenon).

C. **Freezing Point of Milk**

Milk freezes at temperature slightly lower than water due to the presence of soluble constituents such as lactose, soluble salts, etc., which lower or depress the freezing point. The average freezing point depression of cow milk is 0.547 \( ^\circ \)C (31.02 \( ^\circ \)F) and buffalo milk 0.549 \( ^\circ \)C (31.01 \( ^\circ \)F); a freezing point depression lower than this value indicates added water. Mastitis milk shows a normal freezing point. The freezing point test of milk is a highly sensitive one and even up to 3% or watering can be detected.

While the freezing point of normal fresh milk is remarkably constant and employed mainly for detection of adulteration of milk with water, souring results in a lowering of the freezing point due to increase in the amount of soluble molecules. Hence the freezing point should be determined on unsoured samples for greatest accuracy. Boiling and sterilization increase the value of freezing point depression, but pasteurization has no effect. The fat and protein contents of milk have no direct effect on the freezing point of milk. The drawbacks of the freezing point test are; (i) it does not detect the addition of skim milk or removal of fat from the milk sample and (ii) watered milk, which has subsequently soured, may pass the test.

D. **Colour of Milk**

The colour is a blend of the individual effects produced by: (i) the colloidal casein particles and the dispersed fat globules, both of which scatter light and (ii) the carotene (to some extent xanthophylls) which imparts a yellowish tint. Milk ranges in colour from yellowish creamy white (cow milk) to creamy white (buffalo milk). The intensity of the yellow colour of cow milk depends on various factors such as breed, feeds, size of fat globules, fat percentage of milk, etc. Certain breeds of cow impart a deeper yellow tint to their milk than others. The greater the intake of green feed, the deeper yellow the colour of cow milk. The larger the fat globules and the higher the fat percentage, the greater the intensity of the yellow colour. Skim milk has a bluish, and whey a greenish yellow colour (which in milk is masked by the other constituents present).

E. **Flavour**

This is composed of smell (odour) and taste. The flavour of milk is blend of the sweet taste or lactose and salty taste of minerals, both of which are damped down by proteins. The phospholipids, fatty acids and fat of milk also contribute to the flavour.
Changes in the flavour of milk occur due to type of feed, season, stage of lactation, condition of udder, sanitation during milking and subsequent handling of milk during storage. The sulfydryl compounds significantly contribute to the cooked flavour of heated milk.

Note: A pronounced flavour of any kind is considered abnormal to milk. The source of abnormal flavours may be due to: (i) bacterial growth; (ii) feed; (iii) absorbed odour; (iv) chemical composition; (v) processing and handling; (vi) chemical changes and (vii) addition of foreign materials.

MICROBIOLOGY OF MILK

A. Introduction

Nearly all the changes which take place in the flavour and appearance of milk, after it is drawn from the cow, are the result of the activities of micro-organisms. Of these, the most important in dairying are bacteria, mould, yeast and virus – the first on predominating. Micro-organisms are visible only with the aid of a microscope. A few are desirable while most cause undesirable changes, a relative small proportion are disease-producing types, and are called “pathogens”. In the dairy industry considerable spoilage is expended in controlling micro-organisms which cause spoilage. The greater the bacterial count in milk, the lover is its bacteriological quality. Bacteria are microscopic, unicellular fungi (plants without chlorophyll) which occur principally in the form of spherical, cylindrical or spiral cells and which reproduce by transverse fission. In milk and its products, the spherical and cylindrical forms are predominant. Most bacteria vary from 1 to 5 microns in size. Although individual bacterial cells are invisible to the naked eye, they form bacterial colonies (consisting of large number of individual cells) which are visible. Bacteria are found nearly everywhere in nature. They are found in large numbers in the soil, sewage, decaying plants or animals, and are also present in air, water, etc. Under favourable conditions, bacteria multiply very rapidly and may double their number in 15 minutes or less. Some bacteria also form “spores”, which are tough resistant bodies within the bacterial cell. Spores, when placed in an environment favourable to growth, form new vegetative cells. Spores forming bacteria cause trouble in the dairy industry because of their resistance to pasteurization and sanitation procedures.

Moulds are multi-cellular, differing greatly in most respects from bacteria. Although the individual cells are not visible to the naked eye, at maturity they may be observed readily as “Mycelium”. They are found in soil, feeds, manure and poorly-washed utensils. Most spores of moulds are destroyed by pasteurization. They are of considerable importance in cheese-making and are responsible for some defects in butter and other milk products.

Yeasts are unicellular but are somewhat large in size than bacteria. Spores of yeast are readily destroyed during pasteurization. Viruses include ultra-microscopic forms of life. In the dairy industry,
only those viruses those are parasitic on lactic acid bacteria and known as Starter Bacteriophage (or simply Phage) are of special importance. The viruses range in size. The viruses range from 0.22 to 0.23 microns. The lactic phages are usually not destroyed by normal pasteurization of milk employed for cheese and cultured buttermilk, but they can be destroyed by higher heat treatment.

B. Growth of Micro-organisms.
In microbiology, growth refers to increase in numbers. Milk drawn from a healthy cow already contains some bacteria. Their number multiplies during production and handling, depending on the cleanliness of these operations. Subsequently, their number may grow still further (either substantially or only slightly) depending on storage conditions.

The changes which take place in the physio-chemical properties of milk are the result of the activities of the individual microbial cells during their period of growth (development and reproduction) or of substances produced during such activity.

a. Stages of Growth. The growth of micro-organisms normally takes place in the following stages: (i) initial stationary phase; (ii) lag phase (phase of adjustment); (iii) accelerated growth phase (log phase); (iv) maximum stationary phase and (v) phase of accelerated death.

b. Factors influencing growth: the growth of micro-organisms is influenced by the following factors: (i) Food Supply. Milk and most dairy products furnish all the food requirements of microorganisms, (ii) Moisture: Milk contains adequate moisture (dry products, due to their low moisture content, keep longer), (iii) Air: supplies oxygen to aerobic types of bacterial and to moulds in general, (iv) Acidity or pH: Most common types prefer a pH from 5.8 to 7.5. (v) Preservatives: These check or destroy growth depending on their concentration (vi) Light: Is more or less harmful. (vii) Concentration: High sucrose or salt content in product checks growth and (viii) Temperature: An important means for controlling growth. Each species of microorganism has its optimum, maximum and minimum temperatures of growth. According to their optimum growth temperatures, bacteria can be classified into:

- Psychotropic: Can grow at refrigeration temperature (5 – 7 °C).
- Mesophylic: can grow at temperatures ranging between 20 °C to 40 °C.
- Thermophylic (Heat loving): Can grow at temperatures above 50 °C.

Note: In general, low temperatures (below 10 °C) retard microbial growth. Hence milk and dairy products should be adequately refrigerated to prevent rapid spoilage. The optimum growth rate of the majority of micro-
organisms will be found at temperatures between 15 to 38 °C or above.

c. **Products of microbial growth:**
   These are: (i) Enzymes;
   (ii) decomposition of products (fat, proteins, sugars, etc.)
   (iii) pigments, (iv) toxins and (v) miscellaneous changes.

d. **Results of microbial growth in milk.**

These are:

(i) **Souring.** Most common. Caused by transformation of lactose into lactic acid and other volatile acids and compounds, principally by lactic acid bacteria. (The development of sour acid flavour is not due to lactic acid, which is odourless, but due to volatile acids and compounds).

(ii) **Souring and gassiness:** Caused by Coli group, which are commonly found in soil, manure, feed, etc. and therefore indicate contamination of milk and dairy products.

(iii) **Aroma production.** Due to production of desirable flavour compounds such as diacetyl (in ripened cream butter).

(iv) **Proteolysis.** Protein decomposition leading to unpleasant odours (Sometimes desirable flavours may develop, as in cheese curing).

(v) **Ropiness.** Long threads of milk are formed while pouring.

(vi) **Sweet Curdling.** Due to production of a rennin-like enzyme, which curdles milk without souring.

C. **Destruction of Microorganisms**

This may be done by means of:

(i) **Heat.** Most widely used. Different types of heat treatment (temperature-time combination) are employed, such as pasteurization, sterilization, etc.

(ii) **Ionizing Radiation.** Such as ultra-violet rays, etc.

(iii) **High frequency sound waves.** Here, the microorganisms are destroyed, actually by the heat generated.

(iv) **Pressure.** Should be about 600 times greater than atmospheric pressure and

(v) **Chemicals.** These include acids, alkalis, hydrogen peroxide, halogens, etc.

**Milk and Public Health**

It is well established that milk can be a potential carrier of diseases producing organisms. Milk-borne epidemics have occurred in the past
throughout the world. Unless proper precautions are taken, such outbreaks of milk-borne diseases can occur anywhere, any time, especially if raw milk is consumed.

Diseases which are known to be transmissible through milk are listed which they may enter the milk.

(i) *Infection of milk directly from the cow.* These diseases are essentially bovine. The causative organisms enter the milk through the mammary glands or through faecal contamination and may cause a diseased condition in milk. Examples: Bovine tuberculosis, Undulant fever, diphtheria, etc.

(ii) *Infection from man to cow and then to milk.* These diseases are essentially human but can become established in the cow’s udder. Examples: septic sore throat; Scarlet fever, Diphtheria, etc.

(iii) *Direct contamination of milk by human beings.* These are human diseases, the pathogenic organisms of which enter the milk through contaminated bottles or other utensils, water supply, insects and dust. Examples: Typhoid or Paratyphoid fever, dysentery or Diarrhoea, etc.

**Safeguarding the Milk supply**

Whereas “cleanliness” implies freedom from extraneous matter (such as manure, dust, etc.), “safety” means freedom from pathogenic micro-organisms. For human consumption, milk that is both clean and safe is highly desirable.

The sanitation of the milk supply can be safeguarded in two ways:

(a) Production and handling of raw milk in such a manner as to prevent its contamination by pathogenic organisms. This will require

(i) Ensuring the health of dairy cattle by various control measures

(ii) Safeguarding the health of employees by regular medical examination

(iii) Protection of water supply from contamination by pathogenic organisms

(iv) Flies and their control

(b) Pasteurization of milk, so as to kill all pathogenic organisms and avoidance of any post-pasteurization contamination.