

Types of microorganisms and their activity in milk

By

Assist. Prof. Dr. Ali Aldeewan

The following points highlight the three types of microorganisms that occur in milk.

The types are:

1. Biochemical Types

2. Temperature Characteristic Types

3. Pathogenic Types.

1. Biochemical Types:

This group consists of those microorganisms occurring in milk which bring about biochemical changes in it.

They are:

(i) Acid forming microbes.

(ii) Gas forming microbes.

(iii) Ropy-milk forming microbes,

(iv) Proteolytic microbes, and

(v) Lipolytic microbes.

(i) Acid Forming Microbes:

Acid forming microorganisms are certain bacteria that bring about natural fermentation of milk. The most common type is lactic acid fermentation which takes place during the souring of milk under natural conditions.

Milk of good sanitary quality when kept under conditions that allow growth of

1- *Streptococcus spp.* (e.g., *S. cremoris*) and

2- *Lactobacillus species* (e.g., *L. casei*, *L. plantarum*, *L. brevis*, and *L. fermentum*) develops a clean, sour flavour.

***Streptococcus spp.* ferment lactose quickly but do not produce as high a concentration of lactic acid-as members of the genus *Lactobacillus*.**

3- *Micrococcus* species, e.g., *M. luteus*, *M. varians* and *M. freudenreichii* produce small amount of acid from lactose fermentation and sour the milk.

4- *Escherichia coli* and *Enterobacter aerogenes* also ferment lactose to a mixture of end products like acids, gases and some neutral compounds. These are considered undesirable as they produce CO₂, H₂ and unpleasant flavour.

5-*Microbacterium lacticum* is also reported in milk and ferments lactose to lactic acid and other end products.

(ii) Gas Forming Microorganisms:

There are certain coliform bacteria like

1- *Clostridium butyricum* which ferment lactose to acids accompanied with accumulation of gases, the gas being usually a mixture of CO₂ and H₂.

Clostridium butyricum produces large amount of CO₂ whereas coliform bacteria produce H₂ in addition.

2- Certain yeasts, e.g., *Torula cremoris*, *Candida pseudotropicalis*, and *Torulopsis sphacrica* are reported in milk They, too, ferment lactose and produce CO₂.

(iii) Ropy-milk Forming Bacteria:

The conversion of liquid milk to viscous material by the action of microbes is called 'ropy fermentation'. These microorganisms synthesize a viscous polysaccharide material that forms a slime layer or capsule around their cells.

Alcaligenes viscolactis, *Enterobacter aerogenes*, *Streptococcus cremoris*, and some species of *Micrococcus* are responsible for ropy fermentation. Ropy milk is not deleterious to health but is usually objectionable due to its appearance and is frequently used as the culture medium.

(iv) Proteolytic Bacteria:

Bacillus subtilis, *B. cereus* var. *mycoides*, *Pseudomonas putrefaciens*, *P. viscosa*, *Streptococcus, liquefaciens*, and *Proteus spp.* are the proteolytic bacteria present in the milk.

These microorganisms hydrolyse milk protein and increase the pH. Proteolysis may be preceded by coagulation of the casein by the **enzyme rennin** elaborated by bacteria resulting in the formation of soluble form of casein. Proteolysis degrades the casein to peptides which may be further degraded to amino acids which are responsible for alkaline reaction and bitter taste of milk.

(v) Lipolytic Microorganisms:

Some of the microorganisms produce enzyme (lipases) which split milk fat to glycerol and fatty acids. Some of these fatty acids have a sharp flavor which causes imparting rancid flavour and-odour to milk. Lipolytic microorganisms present in the milk are the bacteria *Pseudomonas fluorescens*, *Achromobacter lipolyticum*; yeasts, e.g., *Candida lipolytica*; and moulds, e.g., *Penicillium spp.* and *Geotrichum candidum*.

2. Temperature Characteristic Types:

On the basis of their optimum temperature for growth and heat resistance, the bacteria encountered in milk are of the following four types:

(I) Psychrophilic.

(II) Mesophilic.

(III) Thermoduric and

(IV) Thermophilic.

I- Psychrophilic Bacteria:

Psychrophilic bacteria (also called cryophilic) grow best at relatively low temperatures, usually below 10°C. Pasteurized milk stored in refrigerator may be satisfactorily preserved for a week or even longer. But eventually, microbial deterioration manifested by ‘off’ flavor or odour will become evident because of the accumulation of metabolic products of psychrophilic bacteria. The latter can be exemplified by species of Pseudomonas, Flavobacterium, Alcaligenes, and some coliform bacteria.

II- Mesophilic Bacteria:

Mesophilic bacteria grow best between 10°C and 45°C, usually at 25-40°C. **Lactic streptococci and some coliform bacteria** are the examples. These are mainly the 'acid producing types'. In addition to acid they may produce gas that results in 'off' flavors in milk. *Streptococcus lactis* var. *maltigenes* produce a malty or caramel taint. *Pseudomonas*, however, imparts a fishy flavor.

III- Thermoduric Bacteria:

Thermoduric bacteria survive pasteurization in considerable numbers but do not grow at pasteurization temperatures. Since they are not killed by pasteurization, they may contaminate, the containers.

As a result of the faulty cleaning of the containers, the subsequent batches of milk processed through the same containers will become heavily contaminated.

***Microbacterium lacticum, Micrococcus luteus, Streptococcus thermophilus, and Bacillus subtilis* exemplify this category.**

IV- Thermophilic Bacteria:

Thermophilic bacteria develop best at 55-65°C with minimum and maximum of 40°C and 80°C respectively.

Bacillus stearothermophilus is an example of this type.

3. Pathogenic Types:

A variety of diseases are potentially transmissible through milk. The source of disease causing microorganisms occurring in milk may be either the dairy cattle or humans.

Diseases transmitted through milk either from infected cows or other sources are listed below:

Source	Diseases		Causal organism
	Cow	Man	
Cow	Tuberculosis	Tuberculosis	<i>Mycobacterium tuberculosis</i>
	Mastitis	Sore throat	<i>Micrococcus piogenes</i>
	Brucellosis	Undulant fever	<i>Brucella abortus</i>
	Anthrax	Anthrax	<i>Bacillus anthracis</i>
Other	—	Typhoid	<i>Salmonella typhi</i>
	—	Diphtheria	<i>Corynebacterium diphtheriae</i>
	—	Scarlet fever	<i>Streptococcus pyogenes</i>
	—	Q. fever	<i>Coxiella brunetti</i>
	—	Cholera	<i>Vibrio coma</i>
	—	Enteric fever	<i>Salmonella paratyphi,</i> <i>S. typhimurium</i>