MICROORGANISMS IN MILK

- Milk is sterile at secretion in the udder but is contaminated by bacteria even before it leaves the udder. Except in the case of mastitis, the bacteria at this point are harmless and few in number. Further infection of the milk by microorganisms can take place during milking, handling, storage, and other pre-processing activities.
- The bacteria can bring in beneficial effects or spoilage to milk. Some of the beneficial bacteria especially the lactic acid bacteria are called probiotics. These probiotics are finding a better place in the neutraceutical dairy and other food products which bring health benefits to the consumer like control of diarrhea, anti hypertensive, hypocholesterolemic, immunostimulatory, anticarginogenic etc

Lactic acid bacteria

This group of bacteria are able to ferment lactose to lactic acid called homofermentative and with more end products called heterofermentative. They are normally present in the milk and are also used as starter cultures in the production of cultured dairy products such as yogurt. Some examples in milk are:

- Lactococci
- *L. delbrueckii* subsp. *lactis* (*Streptococcus lactis*)
- *Lactococcus lactis* subsp. *cremoris* (*Streptococcus cremoris*)
- lactobacilli
- *Lactobacillus casei*
- *L.delbrueckii* subsp. *lactis* (*L. lactis*)
- *L. delbrueckii* subsp. *bulgaricus* (*Lactobacillus bulgaricus*)
- *Leuconostoc*

Other species present in milk includes strains of *Bacillus, Clostridium, Cornebacterium, Arthrobacter, Lactobacillus, Microbacterium, Micrococcus , and Streptococcus* can survive pasteurization and grow at refrigeration temperatures which can cause spoilage problems.

Coliforms

- Coliforms are facultative anaerobes with an optimum growth at 37° C. Coliforms are indicator organisms; they are closely associated with the presence of pathogens but not necessarily pathogenic themselves. They also can cause rapid spoilage of milk because they are able to ferment lactose with the production of acid and gas, and are able to degrade milk proteins. They are killed by HTST treatment, therefore, their presence after treatment is indicative of contamination.*Escherichia coli* is an example belonging to this group.

Significance of microorganisms in milk

- Information on the microbial content of milk can be used to judge its sanitary quality and the conditions of production
- If permitted to multiply, bacteria in milk can cause spoilage of the product
- Milk is potentially susceptible to contamination with pathogenic microorganisms. Precautions must be taken to minimize this possibility and to destroy pathogens that may gain entrance
- Certain microorganisms produce chemical changes that are desirable in the production of dairy products such as cheese, yogurt.

Spoilage microorganisms in Milk

- The microbial quality of raw milk is crucial for the production of quality dairy foods. Spoilage is a term used to describe the deterioration of a foods' texture, colour, odour or flavor to the point where it is unappetizing or unsuitable for human consumption. Microbial spoilage of food often involves the degradation of protein, carbohydrates, and fats by the microorganisms or their enzymes.
- In milk, the microorganisms that are principally involved in spoilage are psychrotrophic organisms. Most psychrotrophs are destroyed by pasteurization temperatures, however, some like *Pseudomonas fluorescens, Pseudomonas fragi* can produce proteolytic and lipolytic extracellular enzymes which are heat stable and capable of causing spoilage.

Pathogenic microorganisms in milk

- Hygienic milk production practices, proper handling and storage of milk, and mandatory pasteurization has decreased the threat of milk borne diseases such as tuberculosis, brucellosis, and typhoid fever. There have been a number of foodborne illnesses resulting from the ingestion of raw milk, or dairy products made with milk that was not properly pasteurized or was poorly handled causing post-processing contamination. The following bacterial pathogens are still of concern today in raw milk and other dairy products:
  - *Bacillus cereus*
  - *Listeria monocytogenes*
  - *Yersinia enterocolitica*
  - *Salmonella* spp.
  - *Escherichia coli* O157:H7
  - *Campylobacter jejuni*
- It should also be noted that moulds, mainly of species of *Aspergillus* , *Fusarium* , and *Penicillium* can grow in milk and dairy products. If the conditions permit, these moulds may produce mycotoxins which can be a health hazard.
  M. luteus, M. varians, and M. freudenreichii, are sometimes referred to as milk micrococci and can result in spoilage of milk products.

MICROBIAL SPOILAGE OF MILK AND MILK PRODUCTS

Spoilage type	Organisms involved	Signs of spoilage
Souring	*Lactobacillus sp.* *Streptococcus sp.*	Sour milk, Curd formation
Proteolysis	*Pseudomonas sp.Bacillus sp. Bacillus subtilis,* *B. cereus var. mycoides,* *Pseudomonas putrefaciens, p. viscose, Streptococcus, liquefaciens*, and proteus spp.	Bitterness
Sweet curdling	*Bacillus sp.* *Proteus sp.* *Micrococcus sp.*	Alkaline pH Curd formation
Lipolysis	Pseudomonas sp. Pseudomonas fluorescens Achromobacter lipolyticum; yeasts, e.g., Candida lipolytica; and moulds, e.g., Pencillium spp.,Geotrichum candidum.	Rancid odour
Gas production	*Clostridium sp.* *Coliform* bacteria, Certain yeasts, e.g., *Torula cremoris,* *Candida pseudotropicalis, and Torulopsis sphaerica*	Gassiness
Ropiness	*Alcaligenes sp.,Klebsiella sp.,Enterobacter sp.*	Stringy or slimy milk
Red rot	*Serratia marcescens*	Red coloration
Grey rot	*Clotridium sp.*	Gray coloration, Foul smell
Dairy mould	*Aspergillus sp. Penicilium sp., Geotrichum sp.*	Mouldy appearance