

Milk & milk products Spoilage

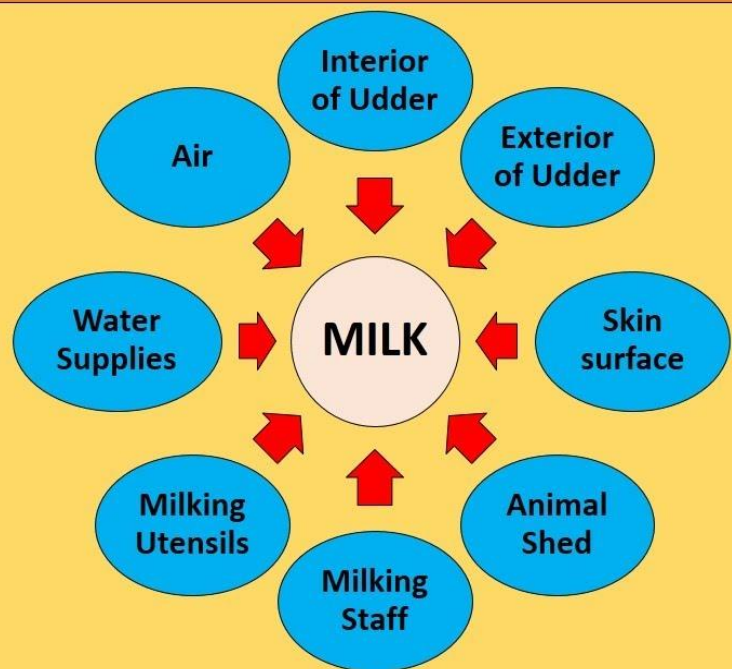
Milk products include milk, cream, butter, cheese, fermented milks, condensed & dried milk products.

The nutritional qualities of milk & milk products make the desirable foods for humans and young animals.

Milk is a product of animal origin, & its sanitary qualities are influenced by many factors in the course of its production, processing & delivery to the consumer.

Sources of Microorganisms in Milk

- Milk secreted in the udder of healthy animal is sterile.
- However, it gets contaminated during the process of milking, transportation and storage.
- Microbial contamination of milk takes from the number of sources.



1. Under unusual conditions milk is subjected to contamination from the animal

A. The Interior of the udder

The bacteria present in the udder, enter at the teat opening & are distributed internally by their own growth as well as physically movement. Then they are mechanically flushed out during milking.

During progress of milking bacteria are present in the largest numbers at the beginning & gradually decrease because of the mechanically dislodgement of the bacteria, particularly in the teat canal where their numbers are probably highest.

The bacteria which comes from the udder are:-

The streptococci & rods:- occurs less frequently.

The infected cows passed their pathogens throughout the milk to cause infections in humans. These disease of cows are:- Mastitis, Brucellosis, Bovine tuberculosis, Q fever.

B. The Exterior of the udder

Udder gets contact with soil, manure, bedding, water which increase the microbial load. Therefore good sanitation conditions has to be applied to prevent the entrance of many types of bacteria during milking operation.

Cleaning is done by wiping the udder with a disinfectant solution. Quaternary ammonium compounds are more effective sanitizer than chlorine for the udder & also less harmful.

C. The Coat of the cow

Coat of the cow may serve as a vehicle of contamination, by adding bacteria directly to the milk during milking.

The cows coat may carry bacteria from soil, manure, stagnant pools of water.

The Bacillus organisms causing ropy milk.

Coliform bacteria comes in presence of soil, manure & water. Therefore, daily brushing & cleaning of cow decrease bacterial load.

2. Contamination from milking utensils

Various utensils used for milking & handling are the most important sources to gain bacteria in the milk.

In mechanical milking ,the increase use of equipments, such as milking machines, permanent pipelines, & farm storage tanks preventing exposure of the milk to dust, insects, & external sources of contamination.

Bacteria should be physically removed from utensils, residual milk should be completely eliminated.

Equipment should be stored under dry conditions to prevent growth. Before the use of equipment, bacteria should be killed by applying of heat or chemical germicidal.

3. Contamination from miscellaneous sources

Organisms occur in air, varying in numbers & present in a dormant condition. The number of these bacteria are relatively low. The air may be expected to add, during hand milking, 5-15 bac/ml of milk.

Continuous raising of dust can also add hundreds of bac/ml of milk. Dust particles originating from manure, soil, & feed may contain bacteria.

Control measures to avoid contamination

For mechanical milking:- Before use, the milking machines & equipments should be well cleaned & sanitized.

For hand milking:- Hands must be free from any infections, cuts, wounds because infected hands can add pathogenic streptococci, micrococci to milk & cause subsequent human infection.

Wet hand milking should be avoidable because it add bacteria from hands to teats.

Milk Preservation

Milk is such a delicately flavored, easily changed food. So the prevention of contamination or spoilage of milk is important in its preservation.

Keeping quality is usually increased when smaller no. of organisms are present. Normally lower the microbial load better the keeping quality.

To increase the keeping quality of milk one should have to decrease the no. of undesirable kinds of micro-organisms :-

These undesirable organisms are:-

1. lactis & coliforms:- they grow well in market milk.
2. the psychrotrophs:- grow well at refrigeration temperature in stored milk.
3. the thermotolerants:- which survive pasteurization.

Methods of preservation

1. Removal of micro-organisms

Once organisms have enter to milk, it is difficult to remove them effectively.

Centrifugation process is done to as in seperating, will remove some organisms from milk.

This process is also known as bacto-fugation.

High speed centrifugation removes (atleast 10,000) 99 % of the spores & more than half of the vegetative cells of bacteria plus some protein.

2. Use of heat

a. Pasteurization

Pasteurization is done with 3 methods:-

1. **Low temperature holding method**:- the process of heating every particle of milk or milk products to atleast 62.8 degree C., and holding at such temperature continuously for atleast 30 min.

2. **High temperature, short time**:- when milk is pasteurized at 72.1 degree C., for 15 sec followed by the quick cooling.

3- **Ultra high temperature**:- 135 degree c for 1 sec

Objectives of pasteurization:-

- a. To destroy pathogenic organisms which may present in milk.
- b. To enhance the keeping quality of milk & milk products.
- c. To destroy organisms that would interfere with the desirable organisms such as starter culture.

b. Steam Under Pressure

Evaporated milk is canned & then heat processed by steam under pressure, often with accompanying rolling.

The fore-warming of milk at about 93 to 100 °C or higher, to kill all or more resistant bacterial spores. Sealed canes of evaporated milk are processed at about 115-118 °C for 14-18 min, which results in a commercially sterile product.

3. Use of low temperatures

Most dairy products require the use of low temperatures, except canned milk & dry milk.

A. Refrigerated Storage:-

For the production of milk of good quality it is essential to cooling the milk after it withdrawn from cow.

Grade A raw milk for pasteurization shall be cooled 1 °C or less within 2 hours after being drawn & kept that cold until processed.

Newly pasteurized milk is to be cooled to 7.2 °C or less.

Milk is held at refrigeration temperature during storage on the farm, in the truck or tank during transportation to the receiving station.

B. Freezing

Ice cream, & other frozen dairy deserts are frozen as a part of manufacturing process. It also stored at low temperatures in the frozen state, where microbial multiplication is impossible.

Freezing kills relatively few of the bacteria & storage in the frozen state permits survival of most of the organisms for long period. Butter in storage is held at -17 to -18 or lower, where no microbial growth occur.

4. Drying

Dry products are made by removing different percentage of water from whole milk.

Enough moisture is removed to prevent the growth of organisms.

A. Condensed Products:-

Evaporated milk is made by removing about 60% of the water from whole milk, so about 11.5% lactose would be in solution plus twice the organic salts. This high concentration of sugar is inhibit the growth of bacteria.

- So these products is of good keeping quality.

B. Dry Products:-

Most dry milk is prepared by roller process, with or without vacuum or by spray process.

Usually milk is preheated before drying. This preheating process pasteurizes the milk& kills less heat-resistant bacteria.

The high temperature of the roller process without vacuum destroy almost all organisms except spores.

5. Use of preservatives

A. Added Preservatives:-

Sorbic & propionic acid or their salts is permitted in cottage cheese, yogurt, to prevent growth of molds on their surface & increase their shell life

They also added in some of the hard cheeses & processed cheeses to prevent the surface growth of molds.

Added sugar acts as a preservative of sweetened condensed milk; & making moisture unavailable to organisms.

The sodium chloride in salted butter decrease the number of those who are not salt tolerant.

B.Developed Preservatives

Most fermented products are micro-biologically more stable or have longer shelf life than the initial substrate.

Fermented milks & cheese are preserved partly by the developed acidity produced by bacterial culture.

Therefore they have longer shelf life than the fluid milk.

Spoilage

Milk & milk products have limited keeping time & after that they spoil readily.

Spoilage may also occur, if the methods of preservation are inadequate.

1. Spoilage of raw milk:-

Because of the fermentable sugar (lactose) present in milk, an acid formation by bacteria occurs in raw milk. Acid formation cause 1st sour flavor of milk, then coagulation of milk gives solid jellylike curd or a weaker curd that releases clear whey.

Lactic acid fermentation takes place in raw milk at room temperature.

In raw milk at temperature from 10-37 °C, *Streptococcus lactis* cause the souring, with possibly some growth of coliform bacteria, enterococci, lactobacilli, & micrococci.

Little formation of acid occurs at temperature near freezing.

2. Spoilage of pasteurized milk:-

Pasteurization of milk kills the more active acid forming bacteria but permit the survival of heat resistant *lactis* which cause lactic acid fermentation.

E.g. Enterococci

Coliform bacteria, *Streptococcus thermophilus* & lactobacilli. produce some lactic acid, and some amounts of volatile products such as H₂, CO₂, acetic acid, formic acid, alcohol.

Butyric acid may be produced in milk by Clostridium under conditions that inhibit the normal lactic acid formation. Clostridium spores survive even after the heat treatment.

3. Gas Production

Gas production is usually accompanied by acid formation.

The chief gas formers are:- Clostridium, gas forming bacillus species- yield H₂ & CO₂. The yeast, propionics & hetero-fermentative lactis- produce only CO₂.

Milk heated at pasteurizing temperature or above :- the chief acid formers will be killed, the spores of Clostridium & Bacillus species will survive, and gas formation by the spore formers may take place.

4. Proteolysis

The hydrolysis of milk proteins by organisms is produced bitter flavor in taste due to some of the peptides released.

Actively proteolytic bacteria found in the species of :- Micrococcus sp., Pseudomonas sp., Flavobacterium sp., Bacillus sp., Clostridium sp.

5. Ropiness

Ropiness can occur mostly in market milk & cream. Bacterial ropiness caused by slimy capsular material from the cells, usually gums or mucins & develops best at low temperatures.

The ropiness usually decrease, as the acidity of the milk & cream increases

6. Changes in milk fat

Milk fat may be decomposed by various bacteria, yeasts, & molds.

Changes occur in milk fat are:-

Oxidation of the unsaturated fatty acids:- yields aldehydes, acids, ketones & results in tallowy odors & taste.

Hydrolysis of the butterfat to fatty acids & glycerol by the enzyme lipase.

Combined oxidation & hydrolysis to produce rancidity.

lipase forming bacteria :-

Pseudomonas, Alcaligenes, Bacillus, Micrococcus, Clostridium

7. Alkali Production

Alkali formers are:-

Pseudomonas fluorescens & *Alcaligenes viscolactis*.

8 . Flavor Changes

As a result of fermentation, proteolysis and lipolysis

9. Colour Changes

The color may be due to the surface growth of pigmented bacteria *Streptococcus lactis*
Pseudomonas putrificiens