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University of Gondar

Contamination of Milk

Adugna Berju (Dr.)

http://www.uog.edu.et

CONTAMINATION OF MILK

- Milk is one of the most valuable foods for humans and young mammals.
- It also provides an excellent medium for the growth of bacteria which may spoil the milk or render it unsafe for human consumption or unfit for further processing.

Contamination cont.

- Milk can be contaminated at any point in the milk production and processing.
- From the point of production to distribution, there are various points from where milk gets contaminated with different microbial and non microbial substances.
- The contaminants that are introduced into the milk can be classified under two major categories:

CONTAMINATION…Contd

- There is a constant challenge to those involved in milk production to prevent or minimize the entry and subsequent growth of bacteria in milk.
- Milk of good hygienic quality is necessary to produce milk products of ***good quality*** and ***adequate shelf-life*** and to provide a ***safe***, ***wholesome*** food for the consumer. If it is not the case, it is called as **contaminated milk.**

5.1 Sources of contamination

✓These sources may be grouped conveniently from the standpoint of dairy practice under the following headings;

- The interior of the udder
- The cow as a source of pathogens
- Milking utensils
- Miscellaneous sources of bacteria in milk

I. Non microbial contaminants

a) Physical contaminants:

- Physical contaminants like dirt particles, hair, leaves, rubber and mettle particles, paper pieces e.t.c can get entry in to the milk at the time of milking.
- The dirt particles from air even, unclean udder or body of the cow, unclean utensils and water supply can contaminate milk.
- The dairy barns should be maintained regularly and of good condition.

Non microbial cont…

- The surrounding area of the barn should be kept clean from the waste materials.
- The milking premises should be free from the cobwebs and accumulation of the dust particles.

b) Chemical contaminants: These include cleaning, agricultural and disinfecting chemicals can contaminate the milk.

Non microbial conta.

i) Veterinary and agricultural chemicals

- animal treated with any drug or antibiotic can contaminate milk with the residues of drugs.
- During milking, these chemicals may also be secreted along with milk.
- So that adequate precaution should be taken so as to minimize the risk of getting entry of such chemicals into the milk.

5.1.1 The interior of the udder

- At one time it was generally accepted that milk as it was removed from the udder contained no bacteria.
- It has subsequently been shown that the normal udder contains bacteria which enter the milk as soon as it is secreted.
- The number of bacteria in aseptically drawn milk varies from animal to animal and even from different quarters of the same animal.

The interior of …Contd

- Milk fresh from a healthy cow contains few bacteria, but contamination during handling can rapidly increase bacterial numbers.
- Milk is an ideal food and many bacteria grow readily in it.
- The fore milk contains many bacteria but numbers decrease during milking. This decrease is due to mechanical dislodgement of the bacteria particularly in the teat canal.

The interior of …Contd

- The species of bacteria found in milk as it comes from the udder are limited to a few genera.
- The micrococci are generally present in the greatest proportion followed by streptococci and rods. Micrococci are comparatively slow growing but if allowed to grow in milk they cause proteolysis (protein breakdown) and acid formation resulting in a very distasteful product.

The interior of …Contd

- The streptococci in uninfected udders occur less frequently than the micrococci but they are more important owing to their action in milk.
- *Streptococcus agalactiae* is the organism commonly present even when there is no clinical evidence of mastitis.

The interior of …Contd

- The number of *S. agalactiae* increases before the time the udder shows inflammation and persists after the recovery of the animal from active mastitis.
- This organism is not pathogenic to humans and is killed by pasteurisation (72°C for 15 seconds).

5.1.2 The cow as a source of pathogens

- There are various pathogens that may be present in the milk of infected cows many of which can cause illness to humans.
- Fortunately, the incidence of disease transmitted by milk has been greatly reduced by better husbandry, disease prevention and eradication programmes and better sanitation methods of milk production.

The cow as …Contd

- Mastitis infections may result in large numbers of bacteria in milk.
- Mastitis is caused by *Streptococcus pyogenes* or *Staphylococcus aureus* which constitute a health hazard to consumers.

The cow as …Contd

- *Brucella abortus* is found in the milk of cows suffering from the disease brucellosis.
- This disease is very infectious and is the cause of contagious abortion in cattle and undulant fever in humans.

The cow as …Contd

- Tuberculosis, caused by *Mycobacterium tuberculosis*, is another disease that may occur in cattle and which may be transmitted to humans who drink raw milk.

The cow as …Contd

- The exterior of the udder can be a major source of bacterial contamination to milk.
- Cleaning and removal of soil, bedding material and manure from the udder and flanks of the cow before milking is necessary to prevent the entry of many types of bacteria into the milk.

The cow as …Cont

- Special care must be given to the cloths used for cleaning the udder.
- The re-use of cloths for cleaning and sanitizing may result in re-contamination of the udder.
- It is therefore recommended that separate cloths be used for cleaning and sanitizing and, if possible, each cloth should be used for one cow only.

The cow as …Cont

- Clipping and grooming the udder and flanks makes cleaning and sanitizing more effective.
- In addition to the exterior of the udder, the cow's coat may also serve as a vehicle of contamination by adding bacteria directly to the milk during milking.

The cow as …Cont

- The coat may carry bacteria from stagnant pools of water and muddy grazing areas.
- Coliform bacteria and members of the genus *Bacillus* may enter the milk from soil and manure adhering to the coat of the cow.

The cow as …Contd

- The presence of such organisms in milk is undesirable as they may cause off flavours and a reduction in the quality and shelf-life of milk and milk products.
- Periodic clipping in addition to daily washing and brushing the coat are recommended practices in the production of milk of good hygienic quality.

5.1.3 Milking utensils

❖The term **"utensils"** is intended to include *all containers* or *equipments* in which, milk or its products are *handled*, *processed*, *stored*, *transported*, or *merchandised*.

❖Utensils are usually the ***most prolific source*** of microorganisms as far as numbers are concerned.

Milking utensils …Contd

❖A milk can, *improperly washed, inadequately sanitized or "sterilized" or insufficiently dried*, may contribute ***millions of bacteria*** to every milliliter of milk placed in it.

❖Utensils used for milking and handling milk can be a most important cause of milk contamination.

Milking utensils …Contd

- Increased mechanisation of milking, handling and storage has contributed significantly to the production of clean milk.
- However, it has been shown that where milking equipment, milk pipelines and storage tanks are improperly cleaned and maintained the hygienic quality of the milk is worse than that obtained through manual milking and handling.

Milking utensils …Contd

❖It is important, therefore, that milking and milk handling utensils are properly cleaned and maintained.

❖An effective cleaning procedure for milk handling equipment is important. **Otherwise**, *a neglected milking machine* is ***a very fertile source of milk contamination.***

Milking utensils …Contd

❖The ***pipes*** and ***pumps*** so commonly employed in a modern dairy plant are often responsible for excessive contamination **unless** they are ***cleaned and sterilized thoroughly.***

5.1.4 Miscellaneous sources of bacteria in milk

✓These sources include those contaminants arising from the atmosphere, various ingredients added to dairy products, and from milkers or milk handlers.

✓Micro-organisms occur in the air and in dust particles originating from manure, soil and feed.

Miscellaneous …Contd

✓Conditions that increase the dust content in the air around the milking area will increase the microbial population and lead to increased bacterial contamination of the milk particularly where hand milking is practiced.

Miscellaneous …Contd

❖To reduce the dust content of the air the following practices should be avoided:

- Sweeping the milking area before milking
- Handling hay and feeds before and during milking
- Brushing the cow immediately before milking
- Dusty bedding
- Accumulation of dirt and dust on the walls and ceiling.

Miscellaneous …Contd

✓Flies, insects and rodents must be kept out of the milking house since their presence on milking equipment contributes not only to the total bacteria entering milk but also to the possibility that pathogens may be introduced. The milk house should have screened doors and windows.

Miscellaneous …Contd

✓The health of milkers and personnel handling milk is of considerable importance. These people should be in good health and their hands free from any infections.

✓Hands with infected wounds can add pathogenic streptococci or micrococci to milk and cause subsequent human infections. Wet-hand milking is also discouraged.

Miscellaneous …Contd

- ✓Milk may serve as a carrier of human pathogens from one person to another. Typhoid and paratyphoid fever, dysentery, scarlet fever, septic sore throat, diptheria and cholera have been found to be milk-borne and to enter the milk from infected workers.

Miscellaneous …Contd

- ✓In a creamery or cheese factory, the mold spores may be spread through the *air*; consequently butter and cheese must be protected from such contamination.
- ✓Ventilation and suitable barn construction are the best preventive measures. Cows should not be milked in a dusty stable.

Miscellaneous …Contd

- It has been found that under ordinary farm conditions, the exterior of the cow's body may contribute *as many as 10,000 bacteria to a milliliter of milk.*
- This is a significant contamination and must be reduced when attempt is being made to produce milk with a low bacterial count.

Miscellaneous …Contd

- The use of *hygienic methods* in the stable, the maintenance of *clean stalls*, the *wiping* of the *flanks* and *udder* with *a clean damp cloth* just before milking, and the employment of *a small-mouthed pail*, or properly ''sterilized'' milking machine, will remarkably reduce the contamination from this source.

Miscellaneous …Contd

- The types of organisms which may gain access to milk from this source often are among the most undesirable of all the organisms found in milk or its products.

5.2 Cooling milk

- To prevent or retard growth of bacteria in milk and to maintain its quality for domestic consumption or during transport to the processing plant, it is essential to cool the fresh milk as quickly as possible.

Cooling milk …Contd

- The temperature to which milk can be cooled on the farm will depend on the facilities available. If mechanical refrigeration is available then the milk can be cooled to 3–4°C and the frequency of delivery to the processing plant need be no more than three times a week. However, refrigeration does not reduce bacteria numbers it only slows down their growth.

Cooling milk …Contd

- Some bacteria are capable of growing at low temperatures so the importance of contamination of milk by unclean utensils, poor water supplies, unhealthy cows and general unhygienic milking practices and conditions should be emphasized.

Cooling milk …Contd

- In the absence of mechanical cooling facilities other means of cooling milk to the lowest possible temperature must be employed.
- In some situations water supplies may be inadequate so the milk container should be placed in a cool, shaded area. The milk can may be placed in a trough of cool water or in a stream.

Cooling milk …Contd

- It may also be placed in a box or cabinet surrounded with sacking material and a layer of sand or charcoal.
- At high ambient temperatures the temperature of the cooling box and therefore of the milk can and its contents can be reduced to about 20°C by spraying the outside of the box with water.

Cooling milk …Contd

- The evaporation of the water (evaporative cooling) reduces the temperature within the cooling box.
- Other methods of cooling milk which require large quantities of water include in-can coolers and surface coolers.

Cooling milk …Cont.

- In both cases cold water passes through metal tubes giving indirect contact with the milk outside the metal tubes.
- Whatever method of milk cooling is employed the fresh milk should be cooled quickly to the lowest possible temperature.

Effect of temperature on the growth of bacteria in milk produced under

Production Conditions		Storage temperature (°C)	Bacterial numbers ('000) per ml		
			Fresh	***24 hrs***	***48 hrs***
1	Clean cows	4.5	4	4	4.6
	Clean environment and	10.0	4	14	128
	Clean utensils	15.5	4	1600	33 000

Effect of temperature …Contd

Production Conditions		Storage temperature (°C)	Bacterial numbers ('000) per ml		
			Fresh	***24 hrs***	***48 hrs***
2	Clean cows	4.5	39	88	122
	Clean environment and	10.0	39	180	832
	Clean utensils	15.5	39	4500	99 100

Effect of temperature …Contd

Production Conditions		Storage temperature (°C)	Bacterial numbers ('000) per ml		
			Fresh	***24 hrs***	***48 hrs***
3	Clean cows	4.5	136	282	540
	Clean environment and	10.0	136	1200	13 700
	Clean utensils	15.5	136	24 700	640 000

Summary of important points in the production of clean milk from healthy cows

1. **Udder washing:** Before milking, the udder should be washed with clean water. A clean cloth or, if possible, disposable towels should be used.
2. **Use of strip cup:** A strip cup should be used to check for mastitis in each quarter before milking starts. This will prevent mixing mastitic milk with good milk.

Summary of important …Contd

3. **Milking:** The body of the cow should be free of soil, dirt and manure and contamination of milk from external sources such as animal hairs, dust, flies and dirty water dripping from the cow's body should be minimized.

✓Avoid using dusty bedding and avoid feeding animals during milking.

✓Milking equipment should be clean and well maintained.

Summary of important …Contd

4. **Milkers:** Milkers and milk handlers should be in good health and their hands should be clean and free from cuts and sores.

Summary of important …Contd

5. **Milk house:** The milking barn should have a good floor that is easy to clean and drain. There should be good ventilation and lighting and facilities for manure disposal and washing cows.
   - A good supply of clean water is required.
6. **Cooling milk:** Cooling milk is essential to prevent an increase in bacterial numbers and spoilage of the milk.