आज़ादी का अमृत महोत्सव

आजीविका से उद्यम विकास की ओर...

How to produce quality, hygienic milk on your farm.

Department of Animal Husbandry and Dairying
Ministry of Fisheries, Animal Husbandry and Dairying
Government of India

What is Milk ?

Milk is the lacteal secretion obtained from milking of healthy milch animals – whole, fresh, clean and free from colostrum.

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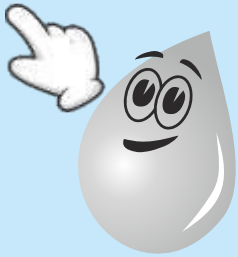
Milk is an ideal food

It supplies many body building proteins; bone forming minerals and health-giving vitamins and furnishes energy giving lactose and milk fat. It is an excellent source of calcium and phosphorus, both of which together with vitamin D are essential for bone formation. All of these properties make milk an important food for pregnant women, adults, invalids, school going children, old persons and patients alike.

How to define clean Milk

- Comes from healthy, milch animals.
- Should be devoid of bad smells, dirt and filth.
- Should contain relatively small number of bacteria.
- Should be free from disease causing pathogens.
- Should have normal composition and acidity.



Sources of Contamination

The sources of contamination of milk on the farm can broadly be categorized as :

- Interior of the Udder
- Exterior of the Udder

The interior reflects the health of the animal, while the exterior depends on hygienic conditions and practices on the farm, equipment used, persons, water etc.

1. Interior of the Udder

- The animal by itself is one of the most significant contributors of microorganisms in milk.
- Microorganisms enter the udder through the duct at the teat tip.
- During the milking process, bacteria are present in the largest number at the beginning and they gradually decrease. This is mainly due to mechanical dislodging of bacteria, particularly in the teat canal where the number is probably highest. Discarding the first few streams of milk results in a lower count of microbes in milk.
- Most of the bacteria are excreted in the fore milk. When the animal is suffering from some disease, the causative organisms are also likely to come into milk depending upon the severity of infection.

- The most common disease in milch animals is mastitis and the primary causative organism; Streptococcus agalactiae is commonly present, even though no clinical evidence of mastitis is present in the cows. The other common mastitis causing organisms potentially harmful to humans are Staphylococcus aureus and Escherichia coli, occasionally Streptococcus uberis and Streptococcus dysgalactiae. Some of the other organisms encountered occasionally are Listeria sps, Leptospira sp, Bacillus cereus, Pasteurella multocida, Clostridium perfringens, Actinomycetes, Coxiella burnetti and the Yeast Cryptococcus neoformans. The other organisms, which can come through the animal, include, Mycobacterium tuberculosis, Brucella abortus, etc.

Control

- Animals should be maintained in a clean, dry environment, free from dust and dirt.
- Milk from the first few streams should be discarded.
- Milk from the infected udder should be discarded.
- Dairy animals should be periodically vaccinated against susceptible diseases.

2. Exterior of the Udder

- Number and type of organisms associated with udder vary, depending on the type and amount of soil. Udder and teat become soiled with dung, mud, bedding material, such as saw dust, straw etc. With heavily soiled udder teats the counts may be 1 lakh cfu/ml.
- Bedding material has a higher number of bacteria in winter. Psychrotrophs, coliforms and Bacillus sp are the main organisms in descending order as per numbers. In summer since the cows are returned to pasture, the number of bacteria in bedding declines.
- Udder micro flora is not affected very much by washing. Sodium hypochlorite washing and accompanied by drying help in reducing the number.
    1. Teat surface and animal body
    2. Teat surface

Teat surface may also contain clostridia spores that are usually found in cow's fodder, bedding and faeces.

Prevention strategies

- Prevent regular soiling of teat surface.
- Wash with disinfectant. Quaternary ammonium compounds can act effectively, but presence of organic matter interferes with action of Chlorine and it is also an irritant to hands.
- Drying of teats before milking.
- A fresh cloth should be used for every cow and it should be moistened in sanitizers after each use. Paper towels are preferable.

Coat of Cow

The Coat serves as a vehicle to contribute bacteria directly to milk.	Clipping of hair around udder, flanks and tail reduces the count of bacteria in milk.	The Coat may indirectly contribute organisms into the air of the barn, especially Bacillus sp. The Coat may carry bacteria from stagnant water pools especially ropy milk organisms.	Coliforms may gain from soil and manure.

Prevention strategies

Periodic clipping of hair and regular brushing of coat should be done. Machine milking practice should be adopted.

2. Milking barn and the environment

- The housekeeping practices in the milk producing area also decide the level of contamination.
- Accumulation of mud, animal urine and faeces, left-over straw and feed in the milking barn can directly or indirectly contaminate the milk through air.

The following should NOT be done as they contaminate milk in the milking barn.

- Sweeping right before milking
- Handling hay and feed just before milking
- Brushing animals just before milking
- Having dusty bedding material
- Allowing dust and dirt to accumulate on the wall and the ceiling.

Prevention

- The environment in the milking barn should be clean.
- Aerial contamination can be prevented by the use of small top milk pails and milking machines.

3. Milking utensils

- Improperly cleaned 'milk contact surfaces' like milking equipment including buckets, pails, cans, bulk tanks etc. are the only source of contamination in milk after it leaves the udder.
- The most hazardous situation arises when the milking utensils are not thoroughly cleaned after use and the milk solids with some moisture are left on the surfaces.
- These allow growth of microorganisms and heavily contaminate the fresh milk, which comes in contact with these utensils later on.
- When mastitis is prevalent in the herd, the utensils may contain Streptococcus agalactiae, Staphylococcus aureus, E. coli or Corynebacterium sp.
- When hot cleaning of equipment is done, the predominating organisms are thermoduric, mainly Bacillus sp. and Micrococcus.
- When cold cleaning is followed, heterogeneous microfloras are present.

Control

- The milking utensils and equipment should be cleaned and sanitized before and after milking.
- The tanks used for bulk transport of milk should be cleaned and sanitized immediately after the unloading of milk.

4. Milker

- When hand milking is done, the contribution from milker is high.
- Milker, with infected wounds on hands, can contribute pathogenic Streptococcus & Micrococcus
- Activities like sneezing, coughing etc. increase the risk of contamination.

- During wet hand milking process lubricant enters milk and adds bacteria from the hands and teats. Pathogens causing typhoid, paratyphoid, dysentery, scarlet fever, septic sore throat, diphtheria, cholera etc. are contributed from humans. Action of milker may also dislodge dust and dirt and increase air contamination.

Control

- The hands of the milker should be clean and he may dip his hands in antiseptic solution before milking.
- Unhealthy milkmen should be avoided.
- Bad habits like coughing and sneezing should be prevented within the milking barn.
- Milkers should do their health checkup at every 6 months' interval, as a routine practice.
- They should receive vaccines against cholera, typhoid, dysentery etc. which generally gets transmitted from human beings to milk.

5. Water Supply

- Water used should be potable and good in terms of bacteriological quality.

Direct sources of contamination are:

- Storage tanks, not protected from rodents, birds, insects and dust.

- Hoses
- Water troughs
- Untreated water supplies from bore wells, lakes and rivers may be contaminated at source with faecal Streptococci, Coliforms, G-ve rods, Lactic acid bacteria, Bacillus sp., and Corynebacterium sp.

Control

Water used for cleaning should be free from faecal contamination and water may be chlorinated before use. Chlorination – with hypochlorites is recommended.

6. Milking Machine

- Milking machines are used when large number of animals are to be milked at a time.
- As milk production in India is mainly through marginal farmers on a very small scale, the milking machine is rarely used.

- However, when they are used, proper care is required not only in their cleaning but also in their use, because improper use may damage the udder and thereby increase risk of contamination.
- When pipelines are reused for direct milk collection, their improper cleaning and sanitation add to the microbial load of milk.
- The types of microorganisms coming from milking machines are similar to those coming from other equipment.

Control

Milking machines should be cleaned and sanitized by using iodine sanitizers as a routine practice.

7. Storage and Transport

- Mainly the psychotropic and thermoduric bacteria contaminate the milk through unclean milk cans and bulk milk transport tankers.
- Among the psychotropic genera in stored milk, Pseudomonas sps. flourescens generally predominates.

Control

Milk should be stored and transported between the temperatures of 0–5 ° C.

Methods of detection of common adulterants in Milk and Milk Products

(A) Milk

Tests which can be done at home

S. No.	Food Article	Adulterant	Method of detection	Remarks
1	Milk	Water	The presence of water can be detected by putting a drop of milk on a polished slanting surface. The drop of pure milk flows slowly leaving a white trail behind it, whereas milk adulterated with water will flow immediately without leaving a mark.	
2		Starch	Add a few drops of tincture of Iodine or Iodine solution. Formation of blue colour indicates the presence of starch.	Iodine solution is easily available in medical stores
3		Urea	Take a teaspoon of milk in a test tube. Add half a teaspoon of soyabean or arhar powder. Mix up the contents thoroughly by shaking the test tube. After 5 minutes, dip a red litmus paper in it. Remove the paper after half a minute. A change in colour from red to blue indicates the presence of urea in the milk.	

S. No.	Food Article	Adulterant	Method of detection	Remarks
4		Detergent	Shake 5-10 ml of sample with an equal amount of water. Lather indicates the presence of detergent	
5		Synthetic milk	Synthetic milk has bitter after taste, gives a soapy feeling on rubbing between the fingers and turns yellowish on heating	Synthetic milk is made by adding white colour water paint, oils, alkali, urea and detergent, etc.
6		Synthetic milk - test for protein	The milk can be easily tested using Urease strips. Colour chart in Urease strips helps to arrive at the quantity of urea present in the milk.	Urease strip is a biostrip based on enzymatic assay.
7		Test for Glucose / Invert sugar	Take a strip of Diacetric strip and dip into the milk for 30 sec to 1 min. If the strip changes color then it shows the sample of milk contains glucose. If there is no change in the color of the strip, then glucose is absent.	Glucose / invert sugar syrup if added to milk increases its consistency and improves the taste.

Tests which have to be done in the Laboratory

S. No.	Food Article	Adulterant	Method of detection	Remarks
1		Vanaspati	Take 3 ml of milk in a test tube. Add 10 drops of Hydrochloric Acid. Mix one teaspoonful of sugar. After 5 minutes, examine the mixture. The red colouration indicates the presence of vanaspati in the milk	
2		Formalin	Take 10 ml of milk in a test tube and add 5 ml of concentrated Sulphuric acid from the sides of the wall without shaking. If a violet or blue ring appears at the intersection of the two layers then it shows the presence of formalin	Formalin enhances the life of milk and thus is added for preservation purpose.
3		Ammonium Sulphate	• Take 5 ml of hot milk in a test tube. Add a suitable acid, eg., Citric Acid. The whey obtained is separated and filtered. Take the whey in another test tube and add 0.5 ml of 5% Barium Chloride. Appearance of precipitate indicates the presence of Ammonium Sulphate. • Take 5 ml of milk in a test tube. Add 2.5 ml of 2% Sodium Hydroxide, 2.5 ml of 2% Sodium	The presence of sulphate in milk increases the lactometer reading

S. No.	Food Article	Adulterant	Method of detection	Remarks
			Hypochlorite and 2.5 ml of 5% Phenol Solution. Heat for 20 seconds in a boiling water bath. If bluish colour turns to deep blue, it indicates the presence of Ammonium Sulphate. However, in case it turns pink, it shows that the sample is free from Ammonium Sulphate.	
4		Salt	Take 5 ml of Silver Nitrate reagent in a test tube. Add 2-3 drops of Potassium Dichromate Reagent. Add 1 ml of milk in the above test tube and mix thoroughly. If the contents of the test tube turn yellow, then milk contains salt. If it turns to chocolate colour or reddish brown, the milk sample is free from salt	Addition of salt in milk is mainly resorted to with the aim of increasing the corrected lactometer reading
5		Hydrogen Peroxide	• Take 5 ml milk in a test tube. Add 3 drops of Paraphenylene Diamine and shake well. Change in colour of the milk to blue confirms that the milk is adulterated with Hydrogen Peroxide, Or	

S. No.	Food Article	Adulterant	Method of detection	Remarks
			• Take 10 ml of milk sample in a test tube and add 10-15 drops of Vanadium Pentoxide reagent and mix. Pink or red colour indicates presence of Hydrogen Peroxide.	
6		Sugar	Take 3 ml of milk in a test tube. Add 2 ml of hydrochloric acid. Heat the test tube after adding 50 mg of resorcinol. The red colouration indicates addition of sugar in the milk.	
7		Sodium bicarobonate /Neutralizer	Take 3 ml of milk in a test tube and add 5 ml of rectified spirit to it. Then add 4 drops of rosalic acid solution. The appearance of red / rosy colouration indicates the presence of Sodium bicarbonate in the milk.	
8		Boric acid	Take 3 ml of milk in a test tube. Add 20 drops of hydrochloric acid and shake the test tube or mix up the contents thoroughly. Dip a yellow paper strip, and remove the same after 1 minute. A change in colour from yellow to red, followed by the change from red to green, by addition of one drop of ammonia solution, indicates that boric acid is present in milk.	To prepare the yellow paper strip, dip strips of filter paper in an aqueous solution of turmeric and dry it up.

S. No.	Food Article	Adulterant	Method of detection	Remarks
9		Removal of Fat	The Lactometer reading will go above 26.	The milk will apparently remain thick.

(B) Milk Products

Tests which can be done at home

S. No.	Food Article	Adulterant	Method of detection	Remarks
1	Khoya and its products	Starch	Boil a small quantity of sample with some water, cool and add a few drops of Iodine solution. Formation of blue colour indicates the presence of starch.	
2	Chhena or Paneer	Starch	Boil a small quantity of sample with some water, cool and add a few drops of Iodine solution. Formation of blue colour indicates the presence of starch	

Tests which have to be done in the Laboratory

S. No.	Food Article	Adulterant	Method of detection	Remarks
1	Sweet Curd	Vanaspati	Take 1 teaspoon of curd in a test tube, add 10 drops of hydrochloric acid. Mix up the contents shaking the test tube gently. After 5 minutes, examine the mixture. The red colouration indicates the presence of vanaspati in the curd.	
2	Rabri	Blotting paper	Take a teaspoon of Rabri in a test tube. Add 3 ml of hydrochloric acid and 3 ml of distilled water. Stir the contents with a glass rod. Remove the rod and examine. Presence of fine fibres on the glass rod will indicate the presence of blotting paper in Rabri.	
3	Ghee, Cottage Cheese, Condensed Milk, Khoya, Milk Powder etc.	Coal Tar Dyes	Add 5 ml of diluted Sulphuric Acid or concentrated Hydrochloric Acid to one teaspoon of product sample in a test tube. Shake well. Pink colour (in case of diluted Sulphuric Acid) or crimson colour (in case of concentrated Hydrochloric Acid) indicates presence of coal tar dyes. If Hydrochloric Acid does not give colour, dilute it with water to get the colour to see the result.	

Tests which have to be done in the Laboratory

S. No.	Food Article	Adulterant	Method of detection	Remarks
4	Ghee	Vanaspati or Margarine	Take about one teaspoon of melted sample of ghee with equal quantity of concentrated Hydrochloric acid in a test tube with stopper and add to it a pinch of sugar. Shake for one minute and let it stand for five minutes. Appearance of crimson colour in lower layer (acid layer) indicates presence of vanaspati or margarine.	• The test is specific for sesame oil which is compulsorily added to vanaspati and margarine. • Some coal tar dyes also give a positive test. • If the test is positive i.e. Red colour develops only by adding strong Hydrochloric acid (without adding crystals of sugar), then the sample is adulterated with coal tar dye. If the crimson or red colour develops after adding and shaking with Sugar, indicates presence of vanaspati or margarine only.

Milking - Suggested best practices

1. Dry wipe any debris from the teats of the cow
2. Dip or spray each teat
3. Massage each teat
4. Strip each teat, check for flecks of milk that indicate infection.
5. Dip or spray each teat again
6. Wait 60 to 90 seconds for let down
7. Dry each teat with a clean towel, one per cow. Towel should be moved in a twisting motion from the top of the teat pulling downwards.
8. Be sure to clean the tip of each teat.

If using milking machine;

9. Attach milking unit
10. Position the hose support.
11. After the milking unit is detached apply a good post dip. Be sure to completely cover the teat with the dip.

Getting ready to Milk

- Long udder hairs should be clipped regularly to help keep udders clean. If udders are visibly dirty, they should be cleaned with dry paper towels, if possible. When possible, avoid using water to clean udders because water will travel down the dirty udder onto the teat, possibly contaminating the teat opening. If it is necessary to wash the udder, use a disinfectant wash and dry the udder and teats thoroughly before continuing with the pre-milking protocol.

- After teats are visibly clean (no obvious dirt or manure), apply a pre-dip half-way up the teat, ensuring a drop is observed hanging from the teat end. Pre-dips are commercial preparations proven to be effective germicides. Common products include chlorhexidine or one-percent iodine.

- Pre-dips can be sprayed on or applied with a dip cup; the former method is more sanitary but the latter is more effective. If dip cups are used, they should be stored in sanitary locations, dumped and cleaned if visibly contaminated, and disinfected periodically.

- Leave the pre-dip on for the amount of time specified by the manufacturer — this is often about 30 seconds. After that, thoroughly remove the pre-dip by drying the teat with a new paper towel or clean, single-use towel; pay particular attention to cleaning and drying the teat end.

Discard the fore milk

After removal of the pre-dip, milk three or four squirts of milk onto a strip cup. This is a container with a black strainer that helps identify animals with abnormal milk. Also, it is good to remove these first squirts of milk because they tend to contain the highest number of inflammatory cells if they are present. Never check milk by squirting it onto the floor or on your hand or boot—this is a good way to spread mastitis.

Signs of Mastitis

- Swollen udder (quarter, half, or whole)
- Udder or teat redness
- Hot udder
- Pain when udder touched
- Abnormal milk (clots, clumps, blood, watery color, gas, smell)
- **Positive California Mastitis Test**

  The California Mastitis Test (CMT) is an easy way to check for subclinical (not visible) mastitis. The CMT system involves a plastic paddle with four cells (one for each quarter of a dairy cow). Three or four squirts of milk are placed in the respective cells and an equal amount of the CMT reagent is added to each cell. The paddle is gently swirled to mix the milk and reagent. The reagent reacts with DNA from cells. Normal milk has no bacteria and few somatic (body) cells so the CMT result for normal milk will be normal (color and consistency will not change). Abnormal milk has more somatic cells (inflammatory cells and more shed epithelial cells, plus perhaps bacteria), so the reagent will cause this milk sample to darken and thicken into a gel. Such a result is evidence of mastitis and a veterinarian should be consulted.

Time to Milk

- Whether milking by hand or machine, milking should start 60 to 90 seconds after pre-dip removal from teats. This amount of time has been shown to be optimal for oxytocin to cause milk letdown.
- If there are multiple dairy animals on the farm, the youngest should be milked first and any with mastitis, high somatic cell levels, or known history of mastitis should be milked last.
- Milking units should be cleaned and disinfected before moving to another animal; if hand milking, wear clean disposable gloves before moving to another animal.

Post-milking

- Immediately after each animal is milked, her teats should be dipped with another germicide made for this purpose. This product will reduce the risk of bacteria entering the teat opening until the teat sphincter closes. This product is left on until the next milking. In very cold weather, however, leave the post-dip on for 30 seconds, then dry the teats or they may get frostbitten. If animals are habituated to going to a feeding area that is protected from wind and standing and eating for 30-60 minutes after milking, this will help protect teats and reduce the risk of new mastitis cases.

- Iodine-based products will leave the teats looking orangey-red; those unfamiliar with dairy animals sometimes mistakenly think that milking makes dairy animals' teats "bleed," when in reality they are just seeing teat dip.

- Paper or Cloth?

  When it comes to drying teats, should one use paper or cloth towels? Either is acceptable and both have their pros and cons. Paper towels are easy and promote sanitation via one-animal, one-use. However, they are an ongoing expense and generate more trash. Cloth towels are a longer-term investment and can be re-used, but involve labor to wash, dry, and store. If cloth towels are used, they should be washed in hot water after each use, bleach added during the rinse phase, dried in a hot dryer, and stored in a clean covered area until next use. Whether paper or cloth are used, it is critical to use one towel per animal only.

  You know, if not handled carefully during production, processing or marketing, milk and milk products may become source of pathogens and food poisoning outbreaks.

- Staphylococci, Enterococci and Escherichia rank first as the agent causing food poisoning due to the elaboration of enterotoxins. The Staphylococci enterotoxins once produced, are not destroyed by heating the milk at 60° to 100° C for 30 minutes. Several enteropathogenic serotypes of E.coli have been isolated from milk and milk products. Some of these serotypes are heat resistant and survive pasteurization temperature. The heat-stable property of the enterotoxins produced by E.coli causes food poisoning even if the food has been heat-treated before ingestion. Incidence of aflatoxin, the fungal metabolites produced by Aspergillus flavus, and A. parasiticus has been reported in milk and milk products in India.

Few Facts

Once the milk has left the animal, many avenues of subsequent contamination may be operative.

When milk is held at ordinary temperature, it curdles or putrefies within a few hours.

- The bacteria commonly found may grow rapidly and bring about undesirable changes when milk is held at the ambient atmospheric temperature. Among these, the acid forming bacteria, or those fermenting lactose into lactic acid are important groups of Streptococcus: (i) one of these is found in milk and other dairy products subjected to relatively high heat; these form acid and gas with objectionable proteolysis (Streptococcus liquifaciens); (ii) another is typical lactic acid organism of butter cultures (Streptococcus lactis, Streptococcus cremoris); it is frequently found in stagnation and surface water; and (iii) the third one causes rapid curdling of milk. These are also gas-forming (Aerobactor aerogenes, Bacillus polymyxa, Clostridium butyricum), ropy or slimy milk-forming (Alcaligenes viscosus), sweet-curding (Bacillus cereus) bacteria.

- Milk also contains yeasts (Saccharomyces delbruekii, Candida mycoderma) and moulds (Cladosporium, Penicillium, Rhizopus) which bring about its fermentation.

- Recently emphasis has been placed on cold-loving bacteria which can grow at refrigeration temperatures and are not reduced by pasteurisation.

- They are troublesome because they produce a high bacterial count during storage and may also create a ropy milk condition.

- They survive even UHT processing and can only be detected by using relatively high incubation temperatures.

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