JUST AGRICULTURE
multidisciplinary e-Newsletter

Clean Milk Production and Different Types of Milking System

TANIA ROY

ARTICLE ID: 011

Introduction:

Milk is a liquid food containing high nutrition, protein, lactose. In 2011, dairy farms produced around 730 million tonnes (800 million short tons) of milk from 260 million dairy cows. India is world's largest milk producer with milk production of 163.7 MT in year 2016-17. Clean milk refers to the raw milk obtained from healthy dairy animals, it has been produced and handled under hygienic conditions, it should contain very small number of harmless bacteria, it should be free from hazardous chemical substances. It should be produced by healthy milker in an environment that ensures safety from physical or biological hazard and it must possess a good keeping quality without being heated. Village entrepreneurship is the main reason for bringing India as number one milk producer in the world. As a result there is limited scope for mechanizing milking procedures but does not mean that India is not able to produce clean milk. By launching vigorous campaign, clean milk production is possible by good animal Husbandry practices in villages, small farms with the help of Dairy Development Boards, different Cooperative Dairy Federations etc.

Need of Clean Milk Practices:

The objective of the clean milk can be achieved by practical application of science based system such as Hazard Analysis Critical Control Point (HACCP). Not only it should produce quantum milk, but must also be free from the debris, microbes and must stay so, till it is consumed. Raw milk becomes sour very fast when it is stored for long periods at high ambient temperatures prevalent in tropical and subtropical countries. This is because, the inherent lactic acid bacteria and contaminating microorganisms from milk vessels or the environment break down the lactose in milk to lactic acid. When sufficient lactic acid has accumulated in the milk , it becomes sour and coagulates. Raw milk that contains so much lactic acid, even if it does not appear to be curdled, will coagulate when it will be heated.

JUST AGRICULTURE
multidisciplinary e-Newsletter

This acidity is known as "developed acidity" and this milk is not acceptable for the sale. Dirty milk is a medium for the transmission of food born and zoonotic diseases. Cross contamination with such conditions such as mastitis will reduce productivity of the dairy farm. Clean milk helps to control the spread of infectious disease like tuberculosis, diphtheria etc. As in business, the milk which is not available for human being and economical use is a loss to the producing farmer. The following reasons will justify why every farmer should try to produce clean and wholesome milk:

- Farmers are not paid for that milk which is rejected from the market. So as a result, they lose in labour and other inputs used in producing this milk.
- Dirty milk will have the particular keeping period and if it cannot be used in that period of time, then it is thrown away and consider as useless food.
- Rejected milk due to dirt in it means a total loss as a source of food for the nation. The nation will therefore spend money to import such food, which we can produce easily in our nation and that money spent could have been used for other development projects .

Chemical and Physical Characters of Clean Milk:

On dry basis, raw whole milk contains 29.36% fat, 26.98% protein (22.22% casein, 4.76% whey proteins), 38.1% lactose, and 5.56% ash. The composition of non-fat solids of skim milk is: 52.15% lactose, 38.71% protein (31.18% casein, 7.53% whey protein), 1.08% fat. The pH of normal raw milk is about neutral (pH 6.7) with a corresponding titratable acidity of 0.16-0.17 per cent due to the natural buffering capacity of the raw milk proteins and salts. Fresh milk from a healthy animal is practically free from bacteria, but it must be protected against contamination just after, it leaves the udder. There are mainly four categories of inspection for the processing plant: visual, organo-leptic, chemical, and microbiological. Milk proteins are basically of two types, whey protein (serum proteins) and caseins.

- The physical properties of milk include fluid flow, mixing and churning, emulsification and homogenization, as well as heat transfer processes such as pasteurization, sterilization, evaporation, dehydration, chilling, and freezing.

Factors affecting nature of milk

Depending on how milk is handled during and after milking, the natural composition and physical-chemical properties of raw milk may change.

JUST AGRICULTURE
multidisciplinary e-Newsletter

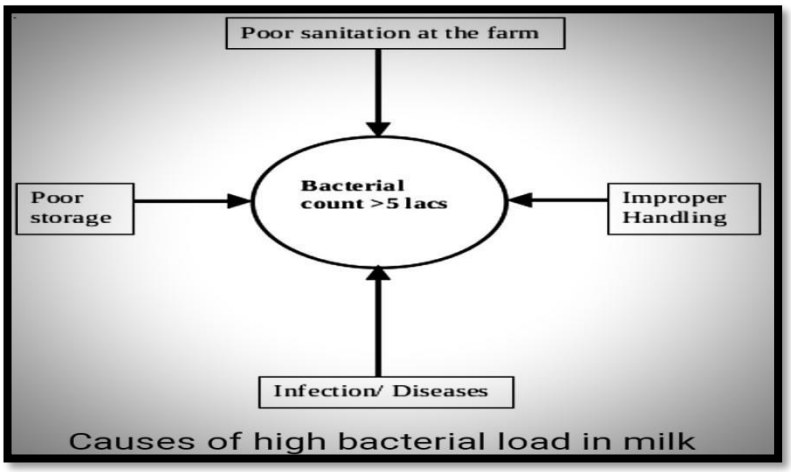
- **Effect of milking practices:** Incomplete milking practice results into low milk yield and low fat content because last milk (strippings) contains more fat than the foremilk.
- **Stage of lactation:** Immediately after calving, a cow produces colostrum during the first four to five days, after which the milk converts to the normal composition. Colostrum is also more alkaline (pH 6.8–6.9) than normal milk.
- **Effect of mastitis:** On farms practicing good husbandry, 20 to 30 per cent of lactating cows have one or more quarters infected with sub-clinical mastitis. With poor hygiene, up to 70–80 per cent of the cows may be affected. The composition of mastitis milk approaches that of blood. It has more whey proteins, less casein and less water-soluble vitamins. It also tends to be more alkaline, has a higher chloride content than normal milk, and tastes salty like the milk of very old cows (more than six lactations) or milk of cows in late lactation (near drying off).
- **Effect of feeding:** Cows have to be fed properly. If cows are fed a diet low in forages and high in starch, the butterfat content of the milk may fall below 2.5 per cent. A good forage-to-concentrate ratio is important to enable cows produce good quality milk to their potential.
- **Effect of cold storage:** On cooling milk, the multiplication of bacteria delays, except for a few cold-tolerant bacteria (psychographs) which can even grow at refrigeration temperatures. If milk is kept chilled at 4°C for more than 72 hours, the cold-tolerant bacteria will multiply and produce lipase and protease enzymes that, respectively, break down milk fat and proteins. These enzymes are also heat resistant, and can cause spoilage of pasteurised milk and other processed dairy products. Extended cooling also makes calcium in the milk less soluble and unavailable during coagulation of milk by rennet in cheese making.
- **Effect of heating:** Pasteurisation of milk involves heating it to 63°C for 30 minutes or 72°C for 15 seconds in order to destroy harmful microorganisms. Pasteurisation kills more than 90 per cent of bacteria and causes minor denaturation of proteins and loss of some water-soluble vitamins.
- **Effect of treatment of cows with antibiotics:** When cows suffer from mastitis they are treated with antibiotics by intramammary or intramuscular injection. The antibiotics circulate in the blood and are secreted in the milk for up to 72 hours. Longer acting (slow release) antibiotics, such as are used in dry cow therapy against mastitis, remain in the blood longer. Drug residues in milk are undesirable because they can trigger allergies and drug resistance in

JUST AGRICULTURE
multidisciplinary e-Newsletter

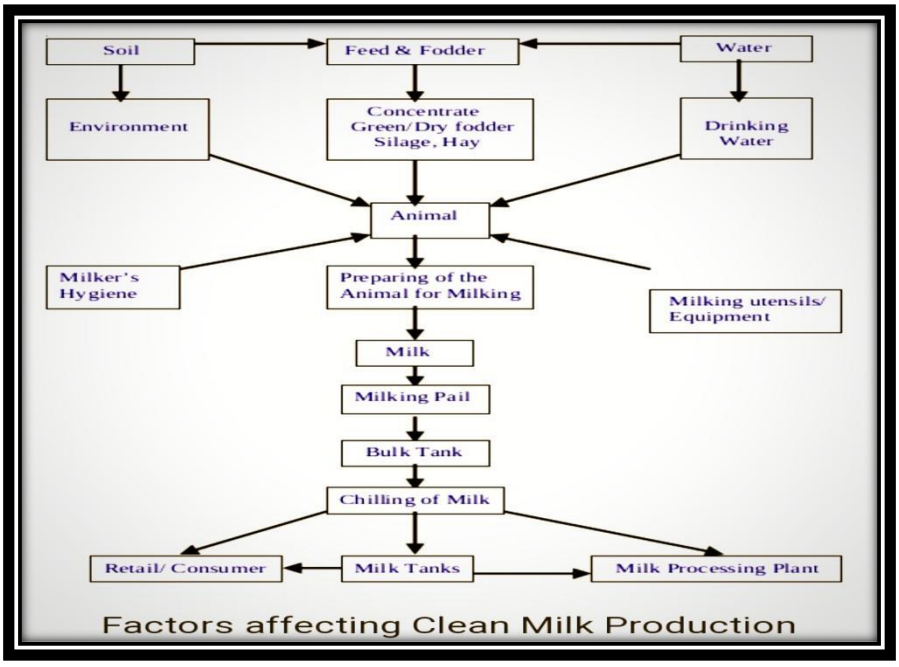
humans, and inhibit the lactic acid starter cultures used in the manufacture of fermented milk products. For this reason, milk processors routinely screen raw milk for antibiotic.

Factor Affecting Clean Milk Production:

Around 63% of the available animal proteins comes from the milk. Milk is the most easily contaminated and perishable commodity as it is an ideal medium for the bacteria to grow. Hence, the employment of the hygienic practices from milking at the farm level to the factory is essential. The causes of high bacterial load in milk and the factors affecting the clean milk production are presented in Figures.



The factors affecting the production of clean and safe milk can be classified into two categories *viz.*, **internal and external factors.**



JUST AGRICULTURE
multidisciplinary e-Newsletter

i) Internal factors includes:

- Udder infection – Mastitis
- Foremilk – First few streams of milk contains a large number of bacteria

ii) External factors includes:

- **Cow/animal's body** – especially dirt and dung from hind quarters and tail.
- **Udder and teats**: Check for mastitis with a strip cup or any other method.
  - Isolate sick animals and milk them at the last (Their milk should not be mixed with good milk).
  - Wash udder, teats and flank of animals with clean water preferably add the disinfectant. Wipe with a clean cloth.
  - Always groom and cut the hair around the under.
  - Dispose fore-milk as it is full of dirt and germs.
  - Tie tails of troublesome animals during milking.
- **Milker – Hygiene and habits**: **Milker should: –**
  - Be healthy and clean during milking.
  - Maintain short finger nails and hair cut of milker (ladies can cover their heads when milking as it guards to falling hair)
  - Avoid smoking during milking .
  - Be quick and efficient in milking.
  - Milk continuously (no interruptions).

Milking:

a. Preparation

- Do not excite the animals before milking.
- Regularize the milking intervals.

b. Method

- Squeeze the teat and do not pull.
- All milk should be got from the under i.e. avoid incomplete milking
- Use a teat dip after milking
- Wet hand milking and fisting causes contamination of milk. Milkers in rural moisten their fingers with milk, water or even saliva, while milking. This should be avoided. Wet hand milking should be avoided. Wet hand milking makes the teats look harsh and dry chokes,

JUST AGRICULTURE
multidisciplinary e-Newsletter

cracks and sores appear which causes contamination. Twisting causes damages to the teat tissue which leads to udder infection. So dry hand milking may be practiced to avoid contamination of milk. Major contamination of milk is caused by bacterial entry. So steps to be taken to, monitor such bacterial entry like avoiding unsanitary conditions of the barn. Milker, Utensils and avoiding unfair milking practices.

Types of Storage Utensils to be used:

- Use seamless utensils preferably aluminium or stainless steel made.
- Use cans, sufurias and metal buckets in milking.
- Provide a good and hygienic washing place.
- Washing procedure must be proper.
- Rinse the excess milk with cold and clean water.
- Scrub with the brush using hot water mixed with the detergent e.g. soap or detergent
- Rinse with the cold water and place the utensils to dry on a rack upside down during the day.

Storage

- Utensils should be stored at night in a safe and clean place, which is well ventilated.

Feed and water: The daily water intake for different type of dairy cattle is shown in *Table I:*

Livestock class	Age or Production	Gallons/day[2]
Calves	1 month	1.3 to 2.0
	2 months	1.5 to 2.4
	3 months	2.1 to 2.8
	4 months	3.0 to 3.5
Heifers	5 months	3.8 to 4.6
	15 to 18 months	5.9 to 7.1
	18 to 24 months	7.3 to 9.6
Holstein cows	Lactating	18.0 to 40.0
Dry cows	Pregnant, 6 to 9 months	9.0 to 13.0

Even a small limitation in water intake will decrease dry matter intake by 1–2 pounds daily, which could limit peak milk production by 2–5 pounds. Lactating dairy cows require 4.5–5 pounds of water per pound of milk produced. This equates to roughly one-half gallon of water for every pound of milk secreted. As an example, a cow producing 100 pounds of milk daily could consume as much as 50 gallons of water. For lactating cows, 1kg of concentrate mixture (compounded feed) (0.14-0.16 kg DCP and 0.70 kg TDN) may be required for **every 2.5 – 3.0 kg of milk over** and above the maintenance allowance.

Milking Environment: The shed can be permanent or movable

- Where possible, provide a cement floor for the easy and proper cleaning.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Water should drain in easy process and away from the shed.
- Provide a clean feed, water and protected store.
- There should be a good source of water nearby the milking shed.
- The shed should be located away from bad odours.
- It should be cleaned after each and every milking.
- Livestock should not have access to the shed during day time. An analysis of an interaction with farmers results that only17.5% farmers keep their milking environment clean, disinfectant and free from flies and vermins.

Milking barns:

Milking barns with good ventilation and neat flooring avoids contamination from this sources, Dry feeds or forage should be fed after milking.

Flies and other vermin:

External parasites like the flies, lice; mosquitoes etc. may have their entry in to milk. So care should be taken to avoid these parasites from the barn by spraying fly spoors or by fly traps. Breeding places for these parasites like stagnant water, moist atmosphere etc. may be avoided.

Milk Handling

a. Filtering

- Use a white filter cloth
- Filter immediately after milking
- Disinfect, wash and dry the filter cloth after use

b. Storage

- Store milk in cool and clean place
- The room used to store milk should without other materials such as chemicals and should also be lockable.

c. Marketing or Disposal

- Milk should be delivered to the market as soon as possible
- It is advisable to delivery milk early in the morning and evening to avoid hot periods of the day.

Detergents and disinfectants:

Detergents increase the 'wetting' potential over the surfaces to be cleaned, displace

JUST AGRICULTURE
multidisciplinary e-Newsletter

milk deposits, dissolve milk protein, emulsify the fat and aid the removal of dirt. Detergent effectiveness is usually increased with increasing water temperature, and by using the correct concentration and time of application. Detergents contain inorganic alkalis (e.g. sodium carbonate and silicates and tri-sodium phosphate), surface-active agents (or wetting agents), sequestering (water-softening) agents (e.g. polyphosphates) and acids for de-scaling. Many proprietary, purpose-made detergents are usually available, but otherwise, an inexpensive mixture can be made to give a concentration in solution of 0.25% sodium carbonate (washing soda) and 0.05% polyphosphate (Calgon). Disinfectants are required to destroy the bacteria remaining and subsequently multiplying on the cleaned surfaces. The alternatives are either heat applied as hot water or chemicals. Heat penetrates deposits and crevices and kills bacteria, providing that correct temperatures are maintained during the process of disinfection. The effectiveness of chemicals is increased with temperature but even so, they do not have the same penetration potential as heat and they will not effectively disinfect milk contact surfaces which are difficult to clean. When hot water alone is used, it is best to begin the routine with water at not less than 85°C, so that a temperature of at least 77°C can be maintained for at least 2 minutes.

Dairy disinfectants are sold as concentrates and in this form are often corrosive and damaging to the skin and eyes. They should always be so labelled, handled with care and stored out of reach of children. Disinfectants should not be mixed unless specific instructions are given and disinfectant powders must be kept dry. If any concentrated detergent and/or disinfectant comes in contact with the skin or eyes the affected area should be washed immediately with copious amounts of clean water. Clean and disinfect the ancillary equipment such as coolers, foremilk cups and udder cloths effectively using hot detergent/disinfectant solution. Drain and store all the milking and ancillary equipment in a clean place such as the dairy of the milking premises.

However, contamination of milk can be corrected at various levels as follows:

- The animal management- includes feeding, housing and health
- Hygiene of milking equipment and utensils
- Milker and milking practices
- During storage and transport

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Personal hygiene of those who are involved in production, processing and delivery activities related to milk and milk products.

Types of milking methods:

Hand milking and machine milking are the two methods of which in India .

Full Hand Milking:

It is the best method of milking as it causes minimum injuries to the teats. In this method, teat is circled with index finger and thumb at the junction of teat and udder, the other portion of teat is closed with remaining fingers and pressed on all sides against the palm. Cows are milked from left side, after let down of milk, the milker starts milking teats either cross wise or fore quarters together and then hind quarters together or teats appearing most distended milked first few streams of fore milk from each teat be let on to a strip cup. This removes any dirt from the teat canal. and gives the operator a chance to detect mastitis.

Stripping:

Stripping is done by firmly holding the teat between the thumb and fore finger and drawing it down the length of the teat and at the same time pressing it to cause the milk to flow down in a stream. Grasping the teat with all the five fingers and pressing it against the palm does fisting or full hand milking. The teat is compressed and relaxed alternatively in quick succession, thus the method removes milk much quicker than stripping as there is no loss of time in changing the position of the hand. Further full hand method is superior to stripping as it stimulates the natural suckling process by calf and moreover the method exerts an equal pressure on the large teats of cows and buffaloes.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Knuckling :

Many milkers during milking tend to bend their thumb against the teat. The method is known as knuckling which should always be avoided to prevent injuries of the teat tissues. Thus milking should always be done with full hand unless the teats are too small or towards the completion of milking. The first few strips of milk from each quarter should not be mixed with the rest of the milk as the former contains highest number of bacteria.

Machine **Milking:**

Modern milking machines are capable of milking cows quickly and efficiently, without injuring the udder, if they are properly installed, maintained in excellent operating conditions, and used properly. The milking machine performs two basic functions.

- It opens the streak canal through the use of a partial vacuum, allowing the milk to flow out of the teat cistern through a line to a receiving container.
- It massages the teat, which prevents congestion of blood and lymph in the teat.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Advantages:

The advantages of this milking machine are manifold. It is easy to operate, costs low, saves time as it milks 1.5 litre to 2 litres per minute. It is also very hygienic and energy-conserving as electricity is not required. All the milk from the udder can be removed. The machine is also easily adaptable and gives a suckling feeling to the cow and avoids pain in the udder as well as leakage of milk.

Conclusion:

Clean milk is a food commodity and there is chance to have adverse effect on its quality if the proper care is not take while it produce, or in the time of procurement and transit. If the raw milk will have good quality then finished products will also have the better quality. Some of the strategies like cleanliness of milch animals, healthy animals, cattle care and personal hygiene of milking person, cleanliness of milking place and cattle -shed, cleanliness of milking vessel and utensils of milk collection at the society and responsibility lies with producers for speedy and time bound follow ups of all activities night from the point of the milk production. Proper hygiene in dairy farm improves economics benefits of the farmer and health safety perspectives in consumers. It is very important to make sure that high quality raw-milk produced from healthy animals under hygienic conditions and that particular control measure are applied to protect human health.