Unit 3

Performing Hand and Machine Milking

Introduction

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The profitability of a dairy farm solely depends on its milk productivity. Every day, dairy farmers have to manage animals and milk them in the most efficient manner so as to achieve the desired profits. The milking process involves several steps, which help obtain adequate milk let-down. Besides, these steps help in efficient milk harvesting and minimising chances of mastitis in animals. This Unit discusses milk let-down mechanism, different methods of milking, clean milk production, etc.

Session 1: Structure of the Udder, Milk Let-down and Milking of Dairy Animals

Structure of the udder

It is essential for a dairy farmer to understand the physiology of a dairy animal and the processes that help in milk secretion. Therefore, it is necessary to understand the functional aspects of the udder and the connected organs.

Milk is produced by a network of glands grouped together in the udder of cows and buffaloes. The mammary glands or udder is the modified sweat gland. The udder is,

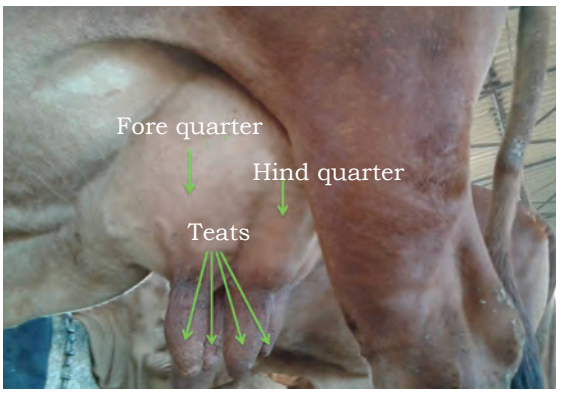


Fig. 3.1: Parts of the udder

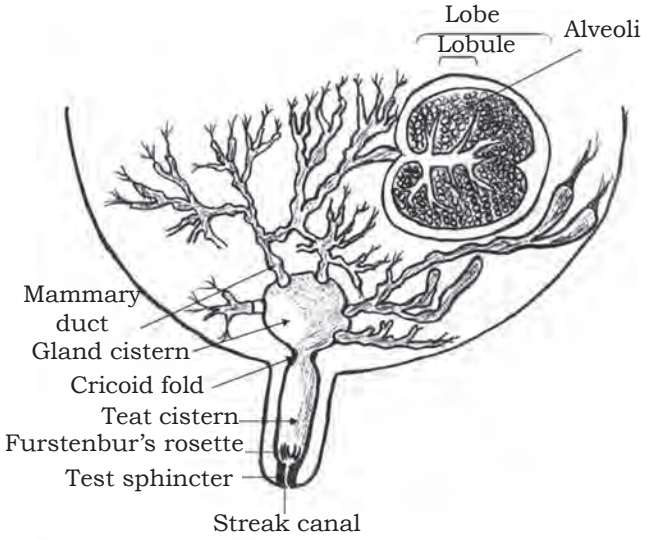


Fig. 3.2(a): Internal structure of the mammary gland

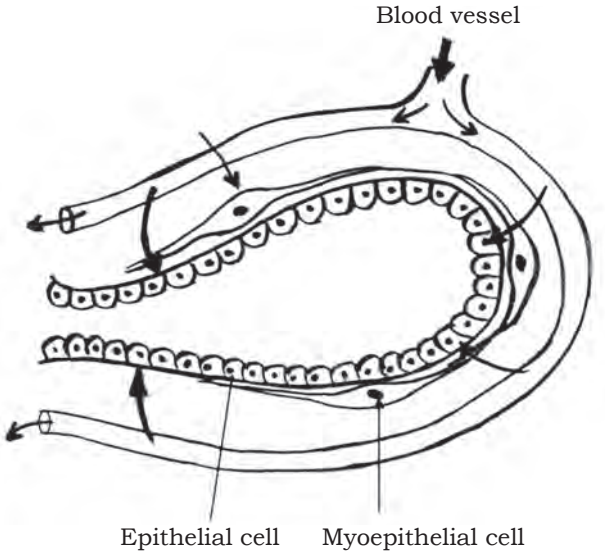


Fig. 3.2(b): Enlarged image of alveoli

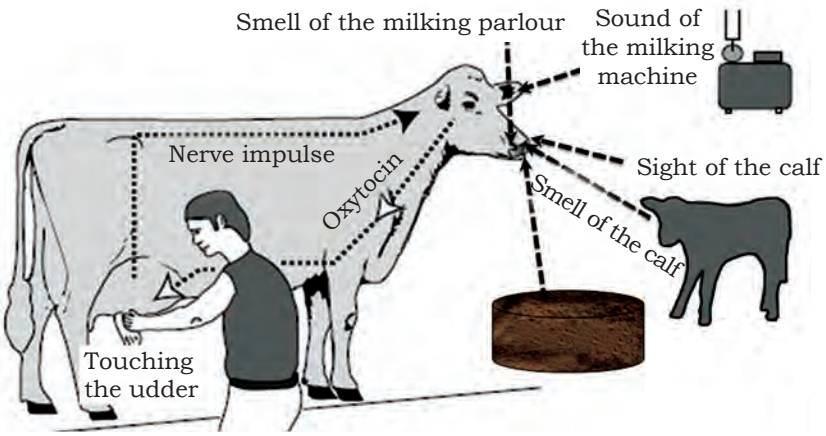


Fig. 3.3: Various stimuli that initiate milk let-down reflex

usually, covered with fine hair but the teats do not have hair. The udder of cows and buffaloes has four quarters with one teat hanging from each quarter (Fig. 3.1). Each quarter acts as an independent unit. The two fore quarters are smaller than the two hind quarters. The fore quarters contain less secretory tissues than the hind quarters. Therefore, the fore quarters produce about 40 per cent of the total milk, while the hind quarters produce 60 per cent.

Physiology and process of milk let-down

Milk let-down occurs because of a combination of various neural and hormonal actions in an animal. The milk let-down reflex starts with the activation of nerves, mediated by the brain of the animal. A single stimulus or a combination of the following external stimuli may initiate milk let-down reflex (Fig. 3.4).

- Physical touch like suckling by the calf, washing the udder (which is sensitive to touch and temperature), putting on the milking machine or massage of the udder by the milker
- The sight of the calf (especially, in indigenous cows) and approach of the milker
- The sound of milking machine and rattling of milk buckets
- The smell of milking parlour, calf, feed, etc.
- Feeding concentrates to the animal

Fig. 3.4: Suckling by a calf prior to hand milking results in milk let-down.

These stimuli send signals to the animal's posterior pituitary, a gland at the base of the brain that releases oxytocin in blood. The action of oxytocin lasts only for six to eight minutes because its concentration in blood decreases rapidly. This means that milking must be completed within this period.

Hindrances in milk let-down

In certain situations, the milk ejection reflex can be inhibited. Certain stimuli, such as rough handling of the animal, loud and unfamiliar noise, pain, irritation and fear cause release of 'adrenalin', a stress hormone that hinders milk let-down. Therefore, cows and buffaloes must be handled gently, and milked carefully at regular intervals. Milking must be a pleasant experience for the animal so that it is able to eject milk fully.

Pre-milking activities

Preparing the milking area

The milking area must be cleaned regularly, preferably with a disinfectant, before and after milking. The area must be made free from flies and insects. Loud noise or any other kind of disturbance during milking may cause stress to the animals or scare them, which may lead to reduced yield.

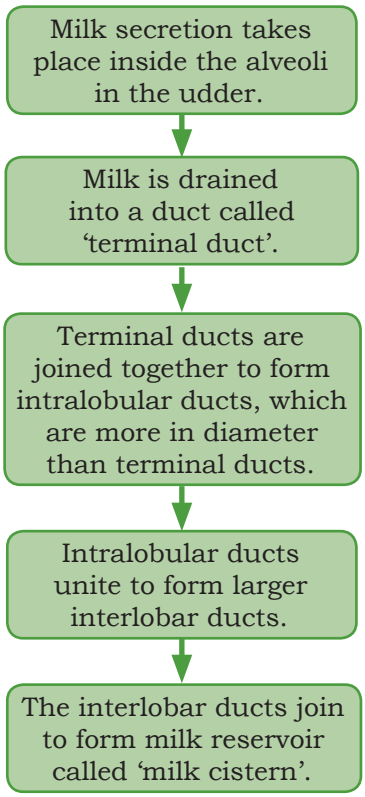


Fig. 3.5: The process of milk secretion in the udder

Fig. 3.6: Wash the animals before milking.

Fig. 3.7: Use a rope at the time of milking.

Fig. 3.8(a): Wash the udder with lukewarm water.

Preparing the animal

The animal can be conditioned for milk let-down reflex by:

- brushing or bathing it before milking as this removes dirt from the animal's body, which may accidentally fall into the milk (Fig. 3.6).
- following a milking schedule.
- offering concentrate mixture to it at the time of milking (one of the best stimuli for milk let-down).
- using an anti-kicker or milkman's rope to eliminate chances of kicking (by heifers) at the time of milking. If a heifer is groomed and handled appropriately, kicking can be averted (Fig. 3.7).

Disinfecting the udder and teats

The udder and teats must be washed with lukewarm water [Fig. 3.8(a)] or by mixing 0.001 per cent potassium permanganate solution in water [Fig. 3.8(b)]. After washing, the udder and teats need to be dried with a paper towel or cloth (Fig. 3.9).

Preparing the milker, milking pail and milking shed

The nails of the milker (a person who milks cows and buffaloes) must be cut. The person must wash ones's hands with an anti-bacterial

Fig. 3.8(b): Use potassium permanganate solution (0.001%) mixed in water to wash the udder.

Fig. 3.9: Wipe the udder with a clean paper towel or cloth.

soap before milking. The milking pail must be washed with a detergent. The milking shed must also be cleaned with water and disinfectant, and be made free from flies and insects.

Milking

Clean milk production is the primary goal of a dairy farmer. A milking method must ensure compliance of the following.

- Discarding initial few streams of milk as it carries bacterial load
- Production of dirt-free milk
- Causing no injury to the animal's udder or teats
- Prevention of transfer of mastitis causing organisms from the environment
- Efficient use of labour and equipment

Methods of milking

Hand milking

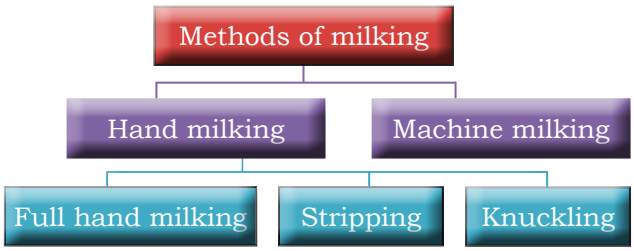


Fig. 3.10: Methods of milking

Milking by hand is the traditional way to draw milk from lactating animals for human consumption. In this method, it is common to apply restricted suckling, where a calf is used for initiating milk ejection reflex. The calf is allowed to suckle after milking. Dairy animals are, usually, milked from the left side. Hand milking is most commonly practised in India and other developing countries, where labour is cheap and readily available. Low to medium yielding animals are suitable for hand milking. Milking, ideally, needs to be completed approximately within 7–8 minutes. However, it may take longer. High yielding animals are not suitable for hand milking as it cannot be completed within eight minutes in them. In hand milking, two methods are, generally, practised — full hand milking and stripping. Knuckling is also a hand milking method but a faulty one.

Full hand milking

It is the best method of milking and most suited for animals having big teats. This method is similar to the calf's suckling style. The method starts with holding

Fig. 3.11: Full hand milking

Fig. 3.12: Stripping

Fig. 3.13: Knuckling

the teats in the hand and fingers encircling them. The base of a teat is blocked by the fore finger and thumb forming a ring. Milk is trapped in a teat cistern and may not return to the gland cistern. Concurrently, the teat is squeezed between the middle, ring and little fingers, and the hollow palm, thereby, forcing milk to come out of the sphincter (Fig. 3.11). Immediately after the squeeze, there will be complete relaxation of the teat to draw more milk in the teat cistern. However, the position of the hand over the teat remains the same. Alternate compression and relaxation of two teats (by using both the hands) is done in quick succession to draw milk at a fast pace so that it comes out in the form of a continuous stream.

Stripping

Stripping is preferred, where the teats of an animal are small in size. In this method, a teat is squeezed firmly at the base with the thumb and fore finger. Then, the teat is pulled down the entire length and pressed simultaneously to cause the milk to flow down in a stream (Fig. 3.12). Both the hands are used to milk two teats at the same time but they, usually, strip alternate ways. The process is repeated in quick succession. This may sometimes cause discomfort to the animal. As stripping requires changing the hand position each time, it is more time taking than full hand milking.

Knuckling

It is a faulty method of hand milking (Fig. 3.13). The milker bends the thumb against a teat. Chances of injury to the teats are high in this method. The teats often get swollen during knuckling. Sometimes, they may even get completely blocked.

Fig. 3.14(a): A mobile automatic milking machine

Fig. 3.14(b): A cow being milked with the help of a machine

Machine milking

It refers to the process of harvesting milk from the udder of dairy animals using a milking machine [Fig. 3.14 (a) and (b)]. Increase in labour costs has led to the use of milking machines, especially, in developed countries. It reduces the hard work that goes into hand milking.

Table 3.1: Parts of milking machine and their functions

Parts	Functions
Vacuum pump	It creates vacuum by sucking out air from the system (consisting of pipes, receivers, etc.) to generate negative pressure in the teats.
Teat cups (four)	These collects milk when the teats are exposed to vacuum.
Claw	It collects milk from all teat cups.
Pulsator	It is an air valve that creates 'pulsation' or opening and closing of the liner. Teat cups are attached with rubber liners from the inside. When vacuum is created, the liner gets pulled open around the teat and milk starts flowing because of that vacuum.
Connecting tubes	
Short milk tube	It helps draw milk from the soft rubber liner to claw, which is mostly transparent.
Long milk tube	It helps draw milk from the claw to the milk bucket or milk line, which is often transparent.
Short pulse tube	It carries air from the shell to the air fork and vice versa to produce the required pulsation. The tube is often dark coloured.
Long pulse tube	It carries air from the air fork to the pulsator and vice versa to produce the required pulsation. It is often dark coloured.

Principle of machine milking

The principle of machine milking is to draw milk from the udder of a cow or buffalo by applying vacuum. Machines are designed to apply constant vacuum to the end of a teat to draw milk and transfer it to a container, and give periodic squeezes to the teat to maintain blood circulation.

How does a milking machine work

The double-chambered teat cup and pulsator create vacuum (milking phase) and atmospheric pressure (massage phase) in the teats on an alternate basis. When air is removed from the pulsation chamber (area between the shell and liner or inflation), the liner opens as the pressure inside the chamber and vacuum line are same. The vacuum at the end of the teat forces milk to come out of the teat cistern into the liner. However, when air is trapped inside the pulsation chamber, the liner collapses beneath the teat as the pressure inside it is lower than the pulsation chamber. During this period of 'rest', the teat canal closes but not the teat cistern. As a result, milk flow stops and body fluids that were 'aspirated' in the tissue of the teat may leave. This massaging action of the teat cup during the pulsation cycle prevents fluid congestion and oedema.

Difference among hand and machine milking, and suckling

The basic processes behind hand milking, machine milking and suckling by calves are different as depicted in Table 3.2. The calf can suckle more milk per unit time than a milking machine as it applies both negative and positive pressure.

Table 3.2: Milk removal by various methods

Hand milking	Machine milking	Suckling
• Uses positive pressure • Slow process	• Uses negative pressure • Fast process	• Uses both positive and negative pressure • Fastest process

Post–milking activities

Teat dipping

The streak canal in a teats stays open for about an hour after milking. If the teats of a cow or buffalo come in contact with mastitis causing pathogens during this period, they may easily enter the animal's body and cause infection(s). One of the most effective methods of checking mastitis is dipping the teats into a germicide solution post–milking. This prevents the entry of organisms through the teat ends. It leaves a film on the teats, providing a barrier for ensuring longer protection, until the teat sphincter closes after milking. It is different from pre–dipping. Teat dipping does not control or eradicate an existing infection. However, the rate of new infection can be reduced by up to 50 per cent.

Storage and transportation of milk

Milk must be always stored and transported in clean containers having their lids on. It must be kept in a cool and shady place (4 °C). It must reach the milk collection centre within two to three hours after milking and refrigerated.

Cleaning milking utensils

Milking areas and utensils must be cleaned to avoid contamination of milk. Fig. 3.15 depicts the process of cleaning milking utensils. It must be noted that milk obtained from sick animals is not suitable for consumption. Equipment and utensils used for milking such animals must be cleaned immediately and thoroughly to check cross-contamination.

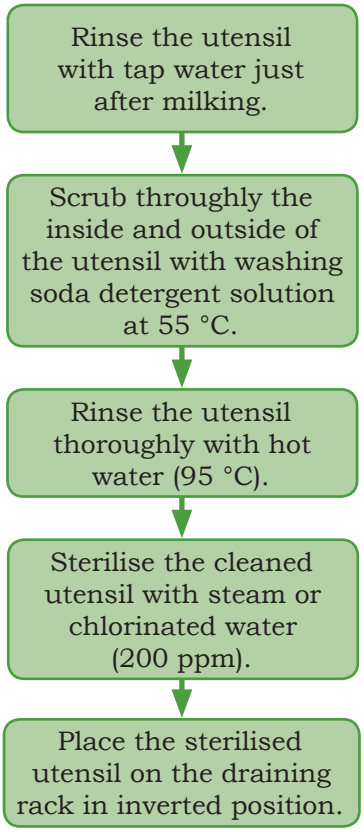


Fig. 3.15: Process of cleaning milking utensils

Factors affecting milk composition and production

Milk yield is the main factor that determines profitability for a farmer. The price of milk is, usually, determined by its composition. The major components of milk are water, fat, protein, lactose and minerals. Among these, fat, usually, shows the maximum variation and lactose the least. The colour of milk is yellowish as in case of

Table 3.3: Summary of the milking process

Pre-milking activity	Milking activity	Post-milking activity
• Clean the milking area or parlour with water and disinfectant. • Clean or wash the animal, and its udder and teats. • Take the animal to the milking area. • Rinse the utensils and machine or equipment required for milking with water. • Offer concentrate feed to the animal. • Prepare the udder for milking. • Strip and discard the fore milk.	• Milk the animal either by machine or hand.	• First, apply post-milking teat dip. • Transfer the milk drawn into a storing can having a lid. • Store the milk at 4 °C. • Take back the animal to the shed. • Clean the milking area or parlour with water and disinfectant. • Wash the milking machine and utensil(s) using water and detergent.

cows and creamy white in case of buffaloes. The colour of buffalo milk is due to the presence of calcium caseinate. Buffalo metabolises all carotene present in the feed into vitamin A, which is passed into its milk, whereas, cows cannot metabolise carotene. Cow milk is from opaque to yellowish in colour due to the presence of beta-carotene. A number of factors influence the quantity and quality of milk. These are broadly classified into genetic, physiological, temperature, humidity, feeds and feeding, and management practices. Milk yield is largely determined by genetic and nutritional factors, although there are other factors, too, that affect milk yield and its quality.

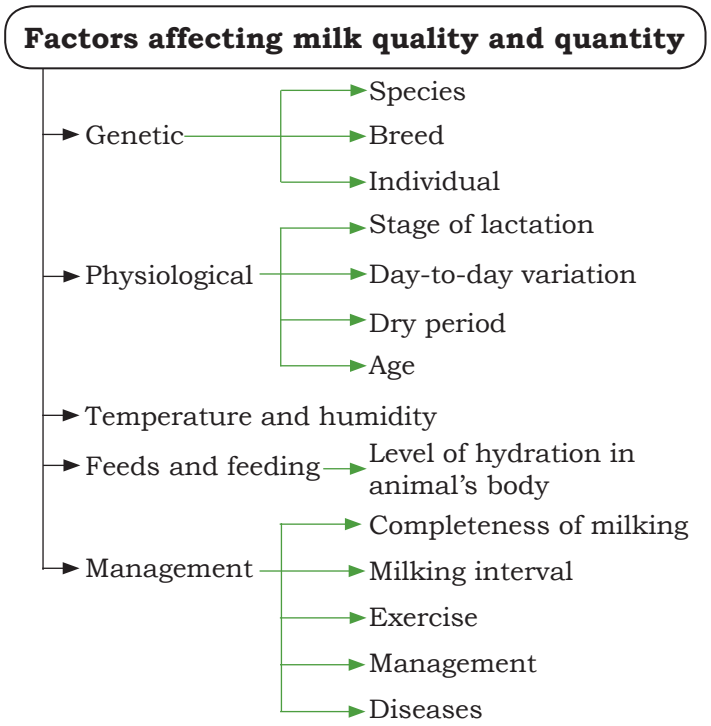


Fig. 3.16: Various factors influencing milk quality and quantity

Genetic

Milk quantity and quality are affected by both genetic, as well as, environmental factors.

Species

There is a wide variation in milk quality and quantity among different species and breeds. On an average, an Indian buffalo yields more milk than an average Indian cow. Goats and sheep yield less milk compared to cows and buffaloes. The composition of milk of different species is shown in Table 3.4.

Breed

High yielding cows produce milk with low fat content. The composition of milk produced by individual cows of a particular breed may differ greatly (Table 3.5). Jersey cows produce milk having about 5 per cent fat content, while the milk of Holstein–Friesian contains about 3.5 per cent fat. Zebu cow's milk contains up to 5.5 per cent fat.

Table 3.4: Milk composition of various farm animals

Species	Fat (%)	Protein (%)	Lactose (%)	Ash (%)	Total solids (%)
Buffalo	5–8	3.8–4.3	4.9	0.78	17
Cow	3.2–5	3.2–4	4.9	0.72	13.9
Sheep	3–5.5	3.5–5.5	4.6	0.9	16.3
Goat	3–5.5	3.1–3.7	4.6	0.79	12

Table 3.5: Cow and buffalo breeds, and fat content in their milk

Cow and buffalo breeds	Yield (kg)	Fat (%)
Exotic cows *(Bos taurus)*		
Holstein–Friesian	4,200–4,633	3.3–4.1
Jersey	3,548–4,105	4.9–5.5
Indian cows *(Bos indicus)*		
Sahiwal	1,548–2,283	4.6–5.1
Red *Sindhi*	1,514–1,634	4.9–5.2
Gir	1,312–1,804	4.7–5.0
Tharparkar	1,456–2,177	4.6–4.9
Hariana	721–1,436	4.4–4.8
Buffalo *(Bubalus bubalis)*		
Murrah	1,031–2,565	5.5–7.2
Nili Ravi	1,586–1,955	6.5–7
Surti	1,086–2,015	6.3–8.1
Bhadawari	1,110–1,252	8–12

Physiological

Stage of lactation

Milk production and its composition change during the normal course of lactation. Milk production in cows and buffaloes increases after calving and reaches its peak during the second month of lactation. It decreases

gradually as lactation progresses. The rate of change in milk production between two intervals is called 'persistency of milk yield'.

Low persistency at any stage of lactation may be caused because of environmental, reproductive or health related factors like reduced feed intake due to estrus, infections, changes in management, ration or weather. Changes in milk yield persistency may also be due to changes in herd social interactions, resulting from regrouping or introduction of new animals, metabolic and digestive disorders and mastitis. Consistently low post–peak persistency in individual cows and buffaloes or a lactation group are commonly due to inadequate nutrition.

Milk fat percentage decreases during the first three months after calving. It remains constant for the next three months. After five to six months at the end of the lactation period, noticeable increase in fat content is witnessed. Milk protein content, gradually, increases with advancing lactation. Lactose and mineral concentration increase slightly during advancing lactation.

Day-to-day variation

Day-to-day variation in milk yield and composition are common in dairy animals. When an animal is in heat, the yield may temporarily decrease for a day or two, which is primarily due to increased physical activity and lowered feed intake.

Dry period

A dry period of 60 days between two lactations is essential for optimum milk production. Cows and buffaloes denied dry period will yield less milk in subsequent lactation than others.

Temperature and humidity

Milk production drops significantly when the temperature rises above 30 °C. Heat stress adversely affects dairy animals and is harmful during peak production period. High humidity adversely affects production only when the temperature exceeds 24 °C. Lowered appetite due to high temperature and humidity is the primary cause of reduced milk yield.

Feed and feeding

For optimal milk production, the feed must contain sufficient energy, protein, crude fibre, vitamins and minerals. Cows and buffaloes produce approximately half of their total milk yield during the first 100 days of lactation. Therefore, it is essential to feed them at short intervals during the early days of lactation. Feed intake is poor at the beginning of lactation but improves gradually. As the feed intake is not proportional to milk production requirements, cows and buffaloes utilise their body reserves for milk production. Therefore, a lactating cow or buffalo, usually, loses weight in the beginning of lactation. Even under conducive feeding conditions, cows and buffaloes can lose as much as 66 kg of body mass during the first three months of lactation. From 120 days after calving, the body mass of the animal gradually increases until calving.

Feed quality affects the composition of milk. A change in the diet of the animal changes the composition of milk.

Change in milk fat percentage

Acetic acid, a volatile fatty acid produced in the rumen, affects milk fat content. Feed, which favours the production of Acetic acid, causes an increase in milk fat percentage. On the other hand, feed lowering Acetic acid production causes a decrease in milk fat percentage. Rations reducing fat percentage are based on high level of concentrate, pelleted feed, finely ground hay, lush pasture grasses, low level of roughage, etc. Vegetable oil and adequate amount of fibre can be added to the ration (17–18 per cent) to improve the milk fat percentage.

Changes in protein and Solid Not Fat (SNF)

When the animal is underfed, there is reduced milk production. Besides, the milk has low protein and fat content.

Management

Completeness of milking

Fat content differs significantly in the first and last milk. Fat percentage is almost five times higher in the

last milk (7–9 per cent) as compared to the first milk (1–2 per cent). Therefore, if a cow or buffalo is not milked fully, some of the fat remains in the udder. Hence, the overall milk fat percentage will be low. Optimal milking time for most cows and buffaloes is just over five minutes to achieve maximum milk ejection. An inefficient milker is not able to milk a cow or buffalo completely. This affects the milk flow, and therefore, the milk fat content. Incomplete milking occurs when the cow or buffalo is upset during the milking process. Leaving more residual milk in the udder for few consecutive days permanently reduces the yield for the entire lactation period.

Milking interval

Milking thrice a day increases production by 10–25 per cent than twice a day. Milking four times a day further increases production by 5–15 per cent. In case of uneven milking intervals, cows and buffaloes produce less milk after a short interval but this milk will have a higher fat content compared to milking the animals thrice a day. However, when they are milked twice a day at regular intervals, there will be little difference between the fat percentage and milk production at different milking times. Usually, the yield in the morning is little more with a slightly lower fat percentage. When the animals are milked three or four times a day, the milk yielded in the middle of the day will contain a little more fat content as compared to the morning.

Care and supervision

High yielding cows and buffaloes are, usually, looped tightly with a rope. Excitement causes a decrease in milk production. Supervision before and during milking is essential for optimal production. Cows and buffaloes must never be taken for milking in a hurry. Regularity must be maintained in milking and feeding schedules. It must be ensured that cows and buffaloes are milked completely. Incomplete milking occurs when milkers are inefficient or the milking machine hurts the animal. This can even cause mastitis through inflammation.

Diseases

Diseases adversely affect both milk production and its composition. Diseases, such as mastitis, ketosis, milk fever and digestive disturbances, can cause a decrease in the yield. Clinical mastitis causes 10 per cent decrease in production. In case of mastitis, fat and SNF content decrease, while there is an increase in protein and chloride.

Practical Exercise

Activity

Observe pre-milking activity in a dairy farm and discuss the process being followed there in class.

Material required: writing material

Procedure

- Visit a dairy farm in your locality.
- Note down the milking schedule being followed there.
- Note down the various steps being followed there before milking.
- Present your observations before the class.

Check Your Progress

A. Multiple Choice Questions

1. What kind of pressure is applied on the teat end in machine milking?
   (a) Positive pressure (b) Negative pressure
   (c) Both (a) and (b) (d) None of the above
2. Milk must be stored in clean containers with the lid on and kept at what temperature?
   (a) −4 °C (b) 0 °C
   (c) 4 °C (d) 10 °C
3. Which of the following stimuli initiates milk let-down reflex in a dairy animal?
   (a) Washing the udder (b) Sight of a calf
   (c) Smell of a calf (d) All of the above
4. Which of these ensure an efficient milking method?
   (a) Removal of maximum milk quantity
   (b) Production of dirt-free milk
   (c) Efficient use of labour and equipment
   (d) All of the above
5. Which of the following statements about knuckling is not true?
   (a) Fast milking method
   (b) Milker bends the hand against the teat
   (c) Chances of injury to the teats are high
   (d) Faulty method of milking

B. Fill in the Blanks

1. Mammary glands or udder is a modified _____ gland.
2. Milk let-down is the result of a combination of neural and _____ actions in the animal body.
3. Secretion of _____ causes inhibition of milk ejection despite the release of oxytocin.
4. Dairy animals are, usually, milked from the _____ side.
5. The action of oxytocin only lasts for _____ minutes because its concentration in the blood decreases rapidly.

C. Mark 'True' or 'False'

1. Kicking can be eliminated, if a pregnant heifer is groomed and handled carefully.
2. The size of the two fore quarters is larger than the two hind quarters.
3. The basic principle of milking machine is to draw milk from a teat through the application of positive pressure at the teat end.
4. A loud noise or any kind of disturbance during milking can cause stress to animals, which may lead to reduced milk yield.
5. Teat dipping does not reduce an existing infection.

D. Match the Columns

A	B
1. Milker	(a) Buffalo milk
2. Milking shed	(b) Cow milk
3. Creamy white	(c) Anti-cow kicker
4. Yellowish	(d) Person who milks animals
5. Kicking	(e) Where milking is done

E. Crossword

		[1]L					[2]S	
							T	
							R	
		W	[3]S			[4]M		
						I	P	
[5]A		R		N			I	N
		M	A			K		
			T				G	

Across

5. It is a hormone that inhibits milk let-down in cows and buffaloes.

Down

1. Before milking, the udder and teats must be washed with _____ water.
2. _____ milking method is preferred where the teats of an animal are small.
3. Mammary glands or udder is a modified _____ gland.
4. The primary goal of a dairy farm is to produce _____.

SESSION 2: CLEAN MILK PRODUCTION AND PREVENTION OF MASTITIS IN DAIRY ANIMALS

Sources of milk contamination

Milk is considered to be the most nutritious food. It remains in sterile condition while in the udder of a healthy animal. It becomes contaminated only during milking, cooling, storage, transportation and processing. Post–milking contamination may be due to handling the udder or milk with contaminated hands. Milk serves as a medium for the growth of bacteria, yeast and moulds. Their rapid growth, particularly, at high ambient temperatures can spoil the milk, making it unfit for consumption. This, in the long run, adversely affects the manufacturing of other dairy products. Some of the sources of milk contamination are as follows.

- Infected animal
- Unclean udder
- Unclean coat of the animal
- Unclean hands of the milker and milk handler
- Contaminated drinking water
- Unhygienic shed and surroundings
- Unclean milking equipment
- Air-borne contamination

Clean milk production

This implies milking healthy animals in hygienic conditions. Therefore, the milk is free from dust, dirt,

flies, manure, etc. Clean milk has normal composition, possesses natural flavour, contains small amount of harmless bacteria, is free from hazardous chemical residues, and hence, safe for human consumption. It is collected in clean dry milking pails. The aim of dairy farmers is to maximise the yield.

Some of the advantages of clean milk production are as follows.

- The milk is free from disease causing organisms.
- It ensures better quality of processed milk products.
- Raw milk can be stored unprocessed for three to four hours at room temperature.
- The milk is safe for long distance transportation.
- It is suitable for human consumption.

Importance of healthy animal in clean milk production

The animal itself is one of the most important sources of milk contamination. A healthy animal is foremost for ensuring clean milk production. The animal must be yearly checked for tuberculosis, brucellosis and other contagious diseases. If it is suffering from infections, such as mastitis, its milk will contain harmful pathogenic microorganisms. Milk produced from diseased animals must be kept separately and disposed of safely.

The animal's coat serves as a large surface for contamination. Dung, urine, uterine discharge, dirt, dust and hair can drop from the animal's skin and udder into the milk, thereby, passing infections or disease causing bacteria into the milk and contaminating it. Long hair on the flanks, hind legs, tail and udder must be trimmed at frequent intervals. Regular grooming of the animal can help check hair and dirt in the milk.

Cleaning of animal shed and surroundings

It is important to keep the animals clean and maintain hygiene in sheds. Their dung must be disposed of immediately, and arrangements for the drainage of dung, urine and wastewater be made. The manure pit must be about 15 metre away from a shed to prevent

insects and flies from entering the area. Flies carry as many as 1.25 million bacteria. They carry bacteria that may cause typhoid, dysentery and other contagious diseases like tuberculosis, E. Coli, brucella, salmonella, etc. The milking barn must have a concrete and non-slippery floor that is easy to clean. Before milking the animals, the sheds must be cleaned with water and a disinfectant, and dried. It must be cleaned in a similar way after milking too.

Healthy milkers and milk handlers

Milkers and milk handlers need to be healthy. Their hands must be clean, and free from cuts and sores. A milker must always wash one's hands with water and an anti-bacterial soap before handling milk. The person must wear clean clothes, gloves and gumboots while handling milk. Those suffering from communicable diseases or having an open sore or wound on the arms, hands, head or neck must not handle milk. Coughing or sneezing near milk or milk containers must be avoided. Smoking during milking is prohibited. If the milker suffers from tuberculosis, salmonella, dysentery or any other disease, the risk of milk contamination increases.

Milking sequence

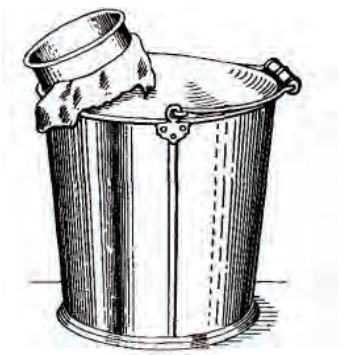
During milking, there are chances of transmission of diseases to dairy animals. To reduce such conditions, the animals must be milked in a sequential manner, which is as follows.

First calver→ other healthy cows→ sick cows

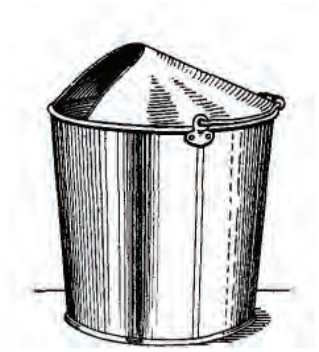
Sick animals must always be milked in the end. Then, the milking system (consisting of a milking machine, bucket or container used for storing milk) must be washed and sterilised.

Types of milking pail

Milking pails having a dome-shaped top instead of open buckets or vessels must be used for milking [Fig. 3.17 (a and b)].



(a)



(b)

Fig. 3.17 (a and b): Dome-shaped milking pails

Fig. 3.18: A milk strainer

Fig. 3.19: Aluminium cans for temporary storage of milk

Discard the foremilk

It is important to test the foremilk at each milking with a strip cup to identify cows and buffaloes suffering from clinical mastitis. Remove 2–3 squirts of the foremilk and examine with strip cup test. The milk of an animal diagnosed with mastitis is, usually, discoloured, watery and contains flakes or clots. Foremilk samples must be discarded as they have high bacteria content.

Storage and transportation

Always use a clean strainer to strain milk (Fig. 3.18) and store it in a seamless clean container. An aluminium container (Fig. 3.19) is commonly used for this purpose. Milk is sensitive to light. If exposed to direct sunlight, butterfat and some vitamins present in the milk get oxidised, and it develops a foul and oxidised taste. The containers must have a lid on, and be kept in a cool (4 °C) and shady place to check bacterial growth. Transport the milk as early as possible in clean containers within minimum transportation time. When continuously stirred or disturbed, the milk fat gets destabilised and it tends to oxidise easily, spoiling the taste. It must reach the milk collection centre, ideally within 2–3 hours after milking.

Mastitis in dairy animals

Mastitis is a disease caused in dairy animals by bacterial agents. Bacterial organisms invade the udder, multiply and produce harmful substances, causing inflammation. It causes reduction in the yield and alters milk composition. In mastitis, inflammation of the mammary gland is caused by bacterial infection, trauma or injury to the udder. Mastitis causes maximum losses to dairy farmers. Some of these loses are as follows.

- Discarding of milk
- Reduced milk production
- Additional treatment cost
- Damage to infected mammary gland
- Culling of animals

Mastitis is classified into clinical and sub-clinical, depending on the degree of inflammation in the mammary gland of dairy animals.

Clinical mastitis

This is characterised by abnormalities in the milk or udder. The udder is hot and swollen. The most obvious abnormalities in the milk are flakes and clots. Besides, the milk may have a watery appearance. Watery milk may emit a foul smell.

Fig. 3.20: Empty the strip cups for CMT for four corresponding teats.

Sub-clinical mastitis

This is characterised by inflammation of the mammary gland that does not create visible changes in the milk or udder. Although the milk appears normal, dairy animals with sub-clinical mastitis yield less milk, and the quality, too, is not up to the mark. In addition, infected animals may be a source of infection for other animals in the herd.

Fig. 3.21: Gel formation indicates the presence of mastitis in corresponding teat after addition of CMT reagent to the milk.

Mastitis detection methods

California Mastitis Test (CMT) or paddle test

It is a simple, inexpensive and rapid screening test for detecting mastitis in dairy animals (Fig. 3.20 and 3.21). The test is based on the amount of cellular nuclear protein present in an animal's milk sample. CMT indicates severity of the infection.

Strip cup test

Strip cup is an instrument made of plastic, stainless steel or aluminium. Strip cup test is relatively inexpensive than other mastitis diagnosis methods. It is, therefore, beneficial that the farmers make strip cups themselves.

Collection of milk sample for culture test

For culturing, milk needs to be collected from each of the four quarters of the udder, separately. Milk culturing can be done on a farm and the samples be sent to a laboratory for testing or analysis.

Control and prevention of mastitis

Mastitis cannot be eradicated but controlled by efficient management of the animals. A number of steps are followed to control the occurrence of mastitis in dairy animals.

Hygienic environment

Keeping cows and buffaloes clean is essential for controlling mastitis. Chances of udder and skin infection increase rapidly if the animals are kept in unhygienic conditions. Therefore, they must be provided with a clean and stress-free environment. Their teats must be washed with lukewarm water or by mixing 0.001 per cent potassium permanganate solution in water.

Dry cow therapy

The udder of the cow or buffalo requires a non-lactating or rest period prior to calving in order to optimise milk production in subsequent lactation. This phase of the lactation cycle is commonly referred to as 'dry period'. Dry cow therapy at the end of lactation is a standard part of mastitis control programme in a dairy farm. This therapy treats existing infections in the udder and prevents the occurence of new infections in the area. Administering long-acting intramammary antibiotics to all quarters of the animal after the last milking or lactation is a key step in dry cow mastitis control therapy.

Treating clinically infected animals

Early detection of clinical mastitis is important. This can be done by strip cup test or CMT. On the basis of the test, the veterinarian decides whether antibiotic infusions are required. Once the infusions begin, complete the course of treatment as directed by the veterinarian. The milk of such an animal is unfit for consumption till it is cured or the disease is in control. Follow the veterinarian's advice as it might be helpful for the animals and even in carrying out laboratory tests.

Applying Somatic Cell Count

Somatic cell count (SCC) must be done every month to monitor the health status of a herd. SCC of milk from a healthy mammary gland is, usually, less than 2 lakh/ml. SCC above 2 lakh/ml indicates bacterial infection and

sub-clinical mastitis. Sub-clinical mastitis affects milk quality (as regards to its composition) and production.

Culling of animals

This is a vital part of mastitis control programme. Culling is the process of removing unproductive animals from a herd based on symptoms like reduced milk yield, reduced growth, infertility, incurable diseases, etc., and keeping them separately. The treatment and retention of chronically infected cows and buffaloes is a threat to the production of quality milk. Cows and buffaloes that do not respond favourably to treatment and continue to flare-up clinical mastitis need to be culled promptly. Their continued presence in the herd may transmit infections to other animals in the farm.

Milk withdrawal period

It is important to observe the recommended withdrawal periods for milk, following treatment against mastitis. When clinical mastitis is treated with antibiotics, milk containing drug residues may adversely affect people with allergies and also cause antibiotic resistance in them. The milk must be discarded on treatment days and withholding period. In general, it is assumed that milk will be discarded for six days — three days of treatment and three days of withholding period.

Practical Exercise

Activity

Visit a dairy farm and write down the steps of clean milk production being followed there.

Material required: writing material.

Procedure

- Visit a nearby dairy farm.
- Observe the milking of dairy animals there.
- Note down the steps being followed to draw milk.
- Also, write down about the utensil in which the milk is being drawn.
- Present your findings before the class.

Check Your Progress

A. Multiple Choice Questions

1. Milk is not contaminated in _____ stage.
   (a) milking
   (b) transportation and processing
   (c) cooling
   (d) None of the above
2. Which of the following about clean milk is true?
   (a) Normal composition
   (b) Possesses natural milk flavour
   (c) Contains only a small number of harmless bacteria
   (d) All of the above
3. Which of the following conditions is true for clean milk production?
   (a) Trimming long hair on the flanks of the animal
   (b) Clipping the animal's tail
   (c) Grooming
   (d) All of the above
4. Foremilk samples must be discarded as they _____.
   (a) have high fat content
   (b) have high bacteria count
   (c) are sour in taste
   (d) None of the above

B. Fill in the Blanks

1. _____ cows must be milked in the end.
2. _____ animals regularly can help keep hair and dirt away from the milk.
3. _____ milk is, usually, discoloured, watery and contains flakes or clots.
4. Milk from _____ animals must be kept separately and disposed of safely.

C. Mark 'True' or 'False'

1. A milking pail must have a dome-shaped top.
2. Milk is not sensitive to light.
3. Clean milk is free from dust, dirt, flies, manure, etc.
4. When shaken vigorously, milk fat gets destabilised and tends to oxidise easily, spoiling the taste.
5. A dairy animal must be checked yearly for tuberculosis, brucellosis and other contagious diseases.

D. Match the Columns

A	B
1. Culling	(a) Discarding of milk
2. Milk withdrawal period	(b) End of lactation
3. Dry cow therapy	(c) 4 °C temperature
4. Milk storage	(d) Sub-clinical mastitis
5. SCC	(e) Process of removing unproductive animals from herd

E. Crossword

	[1]F			[2]S				
[3]D		M	E					
[4]G		O		M			G	
	[5]M		S				I	S
				I				
	L			C				
	K							

Across

3. This is the ideal shape of a milking pail.
4. Regularly following this process can help keep hair and dirt away from milk.
5. This is the maximum loss causing disease for dairy farm.

Down

1. _____ samples should be discarded as they have high bacteria count.
2. _____ cell count is an indicator of mastitis.

NOTES