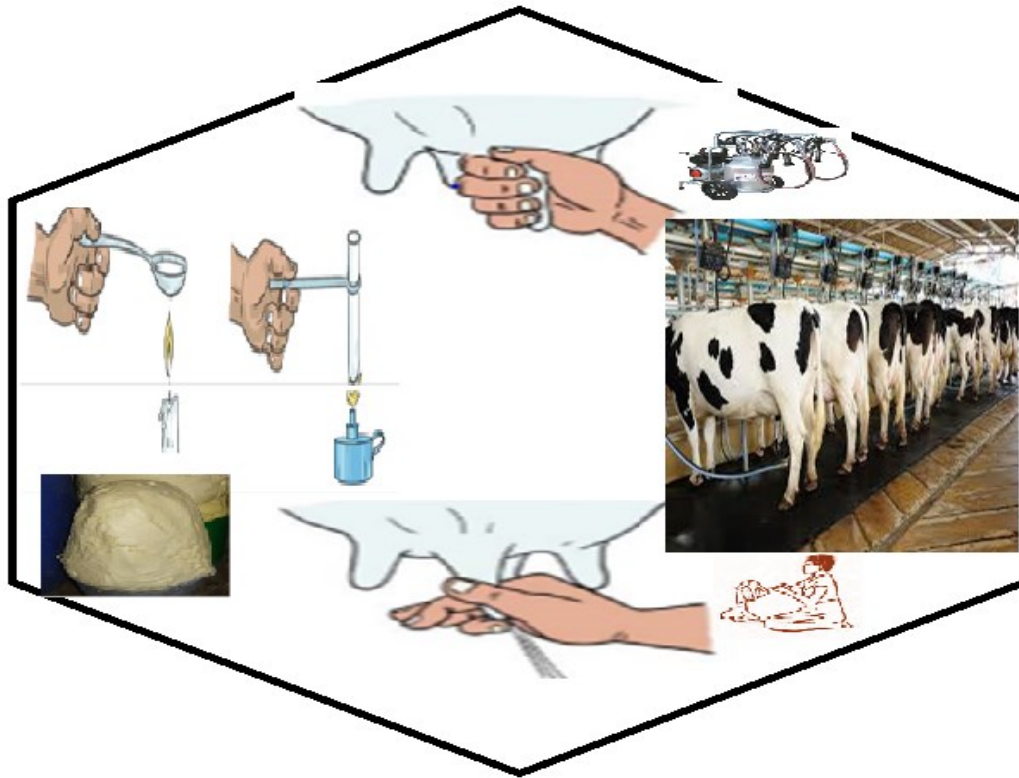


## Animal Production

## Level – III

**Based on March 2022, Version-4 Occupational Standard**



**Module Title: Undertaking Milk Handling and Processing**

**LG Code: AGR APN3 M02 LO (1-3) LG (4-6)**

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## Adama, Ethiopia

## Table of Contents

Introduction to the Module .....	1
<b>LO # 1- Undertake milking operation and Preservation .....</b>	<b>2</b>
Instruction sheet .....	2
Information Sheet – 1 .....	3
Self-check - 1 .....	27
Operation Sheet -1 .....	28
LAP TEST-1 .....	31
<b>LO # 2- Process milk into different products and Preservation .....</b>	<b>32</b>
Instruction sheet .....	32
Information Sheet - 2 .....	33
Self-Check – 2.....	50
Operation Sheet -2 .....	51
LAP TEST-2 .....	54
<b>LO # 3 – Clean up on completion of work .....</b>	<b>55</b>
Instruction sheet .....	55
Information Sheet-3 .....	56
Self-Check - 3 .....	61
Operation Sheet -3 .....	62
LAP TEST-3 .....	63
Reference Materials.....	64

## Introduction to the Module

- **Milk:-**is a nutrient rich white liquid food produced by the mammary glands of mammals. It is the primary source of nutrition for young mammals (including human who are breastfed) before they are able to digest other types of food.
- **Milking:** is the act of removing milk from the mammary gland of mammals. (cow, sheep, goat, camel, etc.).
- **Milk preservation:** Is the process of keeping milk safe as drinking milk for a definite period of time free from spoilage.
- **Milk pasteurization:** It is heating of every particle of milk or milk product to a specific temperature for a specified period of time

**LG # 4**

# **LO # 1- Undertake milking operation and Preservation**

## **Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Preparing and using required materials, tools and equipment
- Carrying out hygiene and sanitation
- Recognizing milk composition
- Conducting milking procedure, **schedule and methods**
- Undertaking milk quality tests

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Prepare and use required materials, tools and equipment
- Carry out hygiene and sanitation
- Recognize milk composition
- Conduct milking procedure, **schedule and methods**
- Undertake milk quality tests

## **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

## Information Sheet – 1

### 1.1 Preparing and using required materials, tools and equipment

A dairy farm, even if a small one requires a variety of equipment's for production, preservation, distribution of milk, processing and handling of milk products. Dairy equipment's are used for processing of milk in to different types of dairy products such as cream, butter, cheese and some others. These dairy equipment's help to boost the production, decrease time for packaging and labor charge as well. This equipment's perform well-known dairy activities such as manufacturing, milk processing, storing, pasteurizing, transporting and packaging. After collecting whole milk from different sources, the milk should pass through different steps for processing. In each step different materials and equipment are required. The materials and equipment must be cleaned and disinfected properly. The following are materials and equipment used for milking and processing of milk;

- **Milking materials and equipment:** Milking jar, pail, milk can, weighing scale, towel, rope, strip cup, milk storage tank, sieve, apron, teat cup, milking machine.
- **Materials for milk processing:**
  - ✓ **Homogenizer:** converting two equally non-soluble liquids into stable emulsion. Homogenizers are intended and constructed to make sure higher performance and flexibility.
  - ✓ **Cream separators:** are centrifugal equipment that separates milk into the cream and skimmed milk. These separators are very effective, easy-to-use and also provide a cost efficient solution to several dairy farms.
  - ✓ **Churner:** a vessel or device in which cream or milk is agitated to separate the oily globules from the gaseous and serous parts, used to make butter.
  - ✓ **Milk Tanks:** the dairy milk tanks are available in the different types such as storage tanks, cooling tanks, one-lay, two-lay and triple-lay tanks, isolated tanks, process tanks and fermentation tanks. These all tanks are very useful and helpful in dairy farm. The milk tanks are the main part of the dairy plants used for storing or receiving raw milk, skimmed milk and cream.
  - ✓ **Pasteurizers:** designed for thermal treatment of milk and dairy products and also other food products like juices and soft drinks. The process of pasteurization is to increase milk

safety for customer by destroying infection causing bacteria (pathogens) that presents in milk. Pasteurization is used to eliminate the dangerous microorganisms from the milk.

- ✓ **Milk cooling equipment:** Cold water container, cooling shed and refrigerator, milk chiller
- ✓ Milk boiling equipment: Boiler, boiling dish,
- ✓ **Milk processing equipment:** cream separator, churner, refrigerator, pasteurizer, homogenizer, ladle, cooking dish, cooking jar, table, graduated jug.
- ✓ **Other equipment and materials:** lacto meter, alcohol, spoon, salt, additive/ingredients, other miscellaneous materials.

## 1.2 Carrying out hygiene and sanitation working area and equipment

When milking is completed, clean work area and milking equipment. Follow routine procedures for cleaning equipment and utensils. Dry the teats of the cow before and after milking. Properly handle wastes in a responsible manner and use pressurized water to wash the milking area. Check waste removal system's functionality and take immediate action if there is malfunctioning system. Finally keep records of milk harvested per each cow and problems encountered and actions taken. This record is important input for effective management planning. Milking management should aim at minimizing microbial, chemical and physical contamination. Milking management covers all aspects of the process of obtaining milk from cow quickly and effectively, while protecting health of the cow and quality of milk.

The suggested practices for milking are;

- Ensure milking routines do not injure cows or introduce contaminants into milk
- Ensure milking is carried out under hygienic conditions
- Ensure milk handled properly after milking

When all cows have been milked, the shed and all milking equipment must be thoroughly cleaned. There are many dairy detergents and chemical sterilizes available, but misuse could lead to ineffective cleaning and sterilizing, or residues appearing in milk.

Good cleaning practice includes:

- Dry clean and remove all loose dirt and debris from the shade and yards
- Rinse or wet the surface, using cold or warm (not hot) water

- Hot wash using a detergent solution that holds contaminants (or soils) in suspension for a short time
- Rinse with cold water and drain
- Apply sanitizer to contact surfaces and allow drying

In order to reduce/eliminate contamination by spoilage and pathogenic organisms from the farm to the dairy plant, the cow's teats and surrounding udder area, and all utensils and equipment used during milking and processing should be properly cleaned.

#### **a) Milking barn or cowshed**

Everything within the milking barn, stable or cowshed should be kept clean and tidy. These rooms should be free of dirt and animal droppings. They should be kept free of dust and the floor should be dry, clean and fly and rodent proof. The interior and the surroundings of the barn, stable or cowshed should be kept clean and tidy. The walls, ceilings, windows and equipment should be free of filth, litter and vermin. Animal droppings and manure should be collected and disposed of properly.

#### **b) Utensils and Equipment**

General guide lines used to clean milk utensils and equipment should include:

- Be cleaned after each usage
- Be washed thoroughly after each usage
- Be sanitized before each usage
- Be protected from contamination and mishandling prior its usage
- Be stored free from flies and other vermin when not in use.

#### **c) Milk handlers**

- Keeping the milk handler level of personal hygiene high
- Washing of hands with detergents before handling milk
- The milk handler should always wear clean garments (PPE) while milking, transporting, storing and processing milk.

### 1.3 Recognizing milk composition

#### 1.3.1. Morphology of udder

Milk is a liquid secreted from the mammary gland of mammals to feed their young. The udder secreting this milk is composed of two halves, the right and left divisions which are separated by median suspensory ligament. Each half is further divided into two separate quarters by thin membranes. There is no communication among the four quarters of the udder. This relative isolation of quarters is helpful in minimizing the speed of infection within the udder. Each quarter is composed of secretory tissue and some supporting connective tissue. The secretory tissue consists of numerous alveoli or tiny chambers lined with many secretory cells. Small muscle fiber, called myoepithelial cells surround each alveolus which cause contraction of the alveoli and produce “let-down” of milk.

Milk is a white liquid produced by the mammary glands of mammals. It is the primary source of nutrition for young mammals before they are able to digest other types of food. Early-lactation milk contains colostrums, which carries the mother's antibodies to the baby and can reduce the risk of many diseases in the baby. The precise components of raw milk vary by species and by a number of other factors, but it contains significant amounts of saturated fat, protein and calcium as well as vitamin C. Cow's milk has a pH ranging from 6.4 to 6.8, making it slightly acidic

Milk contains almost all nutrients required by animals. Although milk products are excellent feeds, their cost prohibits extensive use for all but young animals; also, fresh milk products are bulky to handle and deteriorate rapidly in transport. Milk is deficient in iron and copper. If young animals are allowed to suckle for too long a period of time, they may suffer from anaemia, which accounts for the colourless meat of so-called white veal or calves fed entirely on milk.

#### 1.3.2. Milk Collecting System

Milk from the lumen of the alveoli is passed via many thousands of small ducts into eight to twelve main milk ducts. These lead into the gland cistern and the milk leaves the teat via the streak canal or papillary duct. Each cell of the udder including of epithelial cells of alveoli are in intimate contact with blood, lymph and nerve supply.



### 1.3.3. Milk ejection

Milk ejection, often called “milk let-down” is physiologically a separate function from milk synthesis. Milk ejection is triggered by stimulation of sensory nerves in the teats by either suckling the young or having the teats massaged. This stimulation results in the release of oxytocin hormone from the posterior pituitary. Oxytocin reaches the mammary gland by way of arterial circulation. It stimulates the myoepithelial cells surrounding alveoli and small ducts, forcing the milk down into larger ducts, gland cisterns, and teats, where it can be readily removed.

While stimulation of sensory nerves in teats will trigger the milk ejection reflex, milk ejection can become condition responses. The presence of young even though physically separated from their mother, will sometimes cause milk ejection. A similar response is sometimes seen in cows waiting to be milked in a milking parlor. Sounds and odours associated with milking may trigger the release of oxytocin. Excitement caused by a noisy environment or abusive treatment will inhibit the milk ejection reflex. This may be caused by epinephrine which is a vasoconstrictor of small arteries and veins. Therefore, epinephrine prevents sufficient oxytocin from reaching the myoepithelial cells to cause ejection of milk. Another effect of epinephrine might be inhibition of the release of oxytocin from the posterior pituitary.

### 1.3.4. Composition and source of constituents

Milk composed of water, lipid, protein, sugar, minerals, vitamins, enzymes & cellular materials. There is a great deal of variation in composition of milk between different breeds of cows and between individual cows within breeds. Variation in the composition of milk may be inherited.

**Table 1.1:** Approximate average composition of the milk of cows

Components	Cow (%)
Water	86.8
Total solids	13.2
✓ Fat	3.7
✓ Protein	3.2
✓ Sugar	4.6
✓ Ash	0.7

All of the constituents of milk come from the blood of the cow. Some are modified by the tissue of the mammary gland. Others appear in similar form in milk and in blood.

### Milk composition of different dairy animals

Many factors influence the composition of milk, the major components of which are water, fat, protein, lactose and minerals.

**Table: 1.2.** Percentage composition of milk from different dairy animals

Source of milk species	Water	Fat	lactose	protein	minerals
Cow	87.35	3.75	4.75	3.40	0.75
Sheep	80.25	6.97	4.96	6.72	0.90
Goat	81.04	4.63	4.22	4.35	0.76
Camel	87.10	2.91	5.39	3.90	0.70

**Table 1.3:** Approximate composition of milk of the five major dairy breeds

Breeds	Fat	Protein	Solid not fat
Ayrshire	4	3.5	9
Brown Swiss	4	3.5	9
Guernsey	4.9	3.7	9.4
Holstein	3.6	3.2	8.7
Jersey	5.4	3.8	9.4

The water content of milk acts as a carrier for other nutrients. Some of the nutrients are in solution in the water. Others are in suspension, which accounts for the water opaque appearance of milk. The water in milk is removed directly from blood. About 95% of the milk fat in cows is triglycerol, with the fatty acid portion of the molecule having carbon chain length of 4 to 18. About half of these fatty acids are synthesized within the mammary gland. The most important milk protein is casein, accounting for over 80% of the milk protein. Lactose is a milk sugar. It is formed from blood glucose. Mineral (ash) in milk are similar to that found in the blood because they are in a soluble form and are therefore in equilibrium with the same minerals in blood.

## **Factors that affect the milk composition and constituents**

Milk composition varies among species, breeds within the same species, and even among individual animals within the same breed.

### **a) Effect of milking practices**

Incomplete milking results in low milk yield and low fat content because the last milk (stripping) contains more fat than the foremilk. Changing the milking interval will also interfere with the composition and yield of the milk. Poor hygiene will result in milk with high numbers of spoilage microbes.

### **b) Stage of lactation**

Immediately after calving, a cow produces colostrum during the first five days after which the milk reverts to its normal composition. Colostrum is heavier than normal milk and contains 10 times more whey proteins. Colostrum is also more alkaline (pH 6.8–6.9) than normal milk. Hence, only the milk produced after five days from calving should be sold.

### **c) Season**

Milk fat and protein percentages are highest during the fall and winter and lowest during the spring and summer. This variation is related to changes in both the types of feed available and climatic conditions. Lush spring pastures lows in fiber depress milk fat.

### **d) Effect of disease (mastitis)**

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).

### **e) Effect of feeding**

Cows have to be properly fed to produce a high volume of milk of good composition. If cows are fed a diet low in forages and high in starch, the butterfat content of the milk may fall below 2.5%. A good forage-to-concentrate ratio is important to enable cows produce good quality milk to their potential.

### **f) Effect of storage temperature**

If raw milk is not cooled soon after milking, the inherent lactic bacteria will multiply within two to three hours, converting lactose into lactic acid and causing the milk to start souring. Such milk is unsuitable for processing and will be rejected at milk collection centers and processing plants.

If the milk is overly sour, it will be unacceptable to milk collection centers, processors as well as

buyers of raw milk who invariably boil their milk before drinking it. Raw milk with high levels of acidity will also have high numbers of bacteria. Such milk will be rejected or down-graded at milk collection centers or by processors.

#### **g) Effect of heating**

Pasteurization kills more than 90% of bacteria and causes minor denaturation of proteins and loss of some water-soluble vitamins. Heating milk above 90°C causes more than 65% denaturation of whey proteins. Both pasteurization and boiling of milk cause calcium to become insoluble and unavailable in coagulation of milk by rennet. Both pasteurization and boiling destroy the milk enzyme phosphatase.

### **1.4 Conducting milking procedure, schedule and methods**

#### **1.4.1. Efficiency and effectiveness of milking operation**

Milking procedures must be monitored for efficiency and effectiveness. Incomplete milking is very dangerous to the cow as it may cause mastitis and loss to the owner as it may cause total yield reduction. Inappropriate milking procedures are also very devastating to the farm in general. Therefore, always check different milking methods for effectiveness. Avoid using faulty machines. Repair all machinery according to manufacturer's instruction and controls must be marked clearly. Check cleanliness of equipment, milking personnel and milking area.

#### **1.4.2. Milking schedule**

Milking is the process of removing milk from udder. This process requires experience and skill. It is important that a cow milked at a faster rate at regular interval. Proper milking is enjoyable to the cow and profitable to the owner. This could be achieved if milking is programmed in coordinated steps. Milking schedule depends on the organization's milking policy as different milking schedules need different resource inputs.

#### **Important points to be considered during milking;**

- **Milking time:** milking can be done twice or three times a day. But this interval must be regular. A sudden change in the time of milking affects the total yield
- **Milking order:** clean cow should be milked first. A suggested order
  - ✓ First calf heifers free of mastitis
  - ✓ Older cows free of mastitis
  - ✓ Cows with history of mastitis but not showing the symptoms
  - ✓ Cows with quarters producing abnormal milk

### 1.4.3. Milking Methods /systems

Methods of milking influence the quality and quantity of milk produced at the dairy farm. Proper method of milking results in the removal of entire milk present in the udder resulting in optimal milk production in a particular lactation besides avoiding injuries to the teat and udder and improving the udder health.

There are two types of milking methods, namely

- a) Hand milking (Manual)
- b) Machine milking (Mechanical)

The choice of the system depends on the level of operation, economic efficiency and number of cows to be milked

### 1.4.4. Milking procedures

Requirements: clean water, towel, strip cup, teat dip, bucket, milking machine/if possible/

#### Hand milking methods

There are two techniques of hand milking methods.

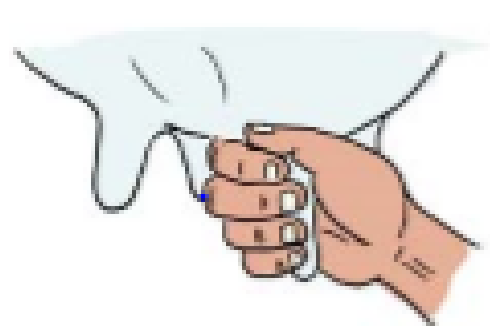
#### a) Hand strip (using finger)

Stripping method is adopted in small cows with narrow teats. Few strips of milk from each teat are let on strip-cup to check for possible incidence of mastitis. Combination of initial full hand milking method followed by stripping at the end is a good method of milking. The first

#### b) Hand squeeze (full hand milking)

Full hand milking stimulates natural suckling of a calf. Cows with large teats and buffaloes are milked with full hand method. Full hand method removes milk quicker than stripping because of no loss of time in changing the position of the hand.

The recommended method is full hand followed by stripping.



**Figure 1.1:** Hand Squeezes



**Figure 1.2:** Hand Strip

## Hand milking procedures

The process of hand milking starts with the same procedures as does machine milking & follows the same procedures both for cows and heifers.

- Place a milk bucket under the cow's udder instead of the machine
- Milking is done by hand pressure applied at the upper portion of the teat with the thumb and first finger. The pressure traps the milk in the teat
- The teat is squeezed against the palm of the hand by the remaining three fingers, with pressure first applied by middle finger then follows the other fingers, this causes milk to squirt from the canal
- When the milk is squeezed out of the teat, the pressure applied by the finger is released and the milk is free to flow from the cistern of the udder to the teat. Then apply the above procedure to the teat to remove the milk. Continue this process until the cow is milked out.
- If the teats are very short use only the thumb and first two fingers. With extremely short teats, stripping may be necessary. Stripping – milking by applying pressure with the thumb and first finger at the top of the teat as in step 2
- Immediately after milking, the teats should be dipped in an effective teat-dip solution

## Rules for clean hand-milking

Milking cows by hand can be as hygienic and satisfactory as milking machines and is often more gentle to the udder. However, precautions must be taken to get the healthiest milk. If the correct milking procedures are followed, the cows can give more milk and if you are selling your milk, there will always be a ready buyer.

Tips on how to get the cleanest milk when milking by hand;

- The persons milking the cows should be clean, healthy and free of infectious diseases.
- Keep the cows free of dirt.
- Groom the cows regularly to remove loose hair and dirt because these can fall into the pail during milking.
- Detect and treat all cows showing signs of udder infection.
- Tie the cow's hind legs so that the tail does not swish around.
- Do not use a cloth to clean the udder and teats because it is unhygienic and can cause problems such as mastitis.

- Wash your hands before milking. Your hands should be moist but not dripping wet.
- Do not dip your hands into the milk because this can spread diseases.
- Pour the milk into a container through a fine metal gauze strainer or muslin. Tie the muslin so that dirt cannot bypass it.
- Keep the milk refrigerated or in a cool place after milking.

Follow these rules on the correct procedures of milking by hand;

- Milking should be done at regular times, if possible by the same person
- Avoid noise in the dairy because it will have a negative influence on the release of milk.
- Get proper training in the correct procedures and have patience with the cows.
- Milk cows with dry hands and never use milk to lubricate the cow's teats. Use a milking salve if needed.
- Always test the first milk to come out for mastitis
- Wash dirty udders and teats by hand under running water. If they are clean, massage the udders for about 1 minute.
- Complete milking in 5 to 7 minutes because the cow will stop giving milk after that.
- After milking, if the cow's calf does not suckle, use a teat dip to prevent mastitis.
- Supervise the milking process and maintain the same routine in every milking. This will get the cows used to the process and will also reduce stress, which will result in a successful dairy operation.

### **Machine milking method**

Milking is done by using machine and generally adopted for herds with large number of cows and with high yielders. Most milking in the developed world is done using milking machine. Teat cups are attached to the cow's teat and then the cups alternate between vacuum and normal air pressure to extract the milk. 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.

## Machine milking procedures

### A) Milking first – calf heifers

Training first-calf heifers to milking is an important management skill on a dairy farm. The way a fresh heifer is handled during the first days after her first calf is born determines her attitude towards the milking procedures for the rest of her life. She can be a calm and easy to milk or an “outlaw” nearly impossible to milking.

#### Requirements/ equipment needed/

- Milking machine
- Parlor or stanchion
- Water hose or bucket of water / continuous water supply/
- Paper towel
- Strip cup
- Halter
- Teat dip, sanitizer

#### Step by step procedures

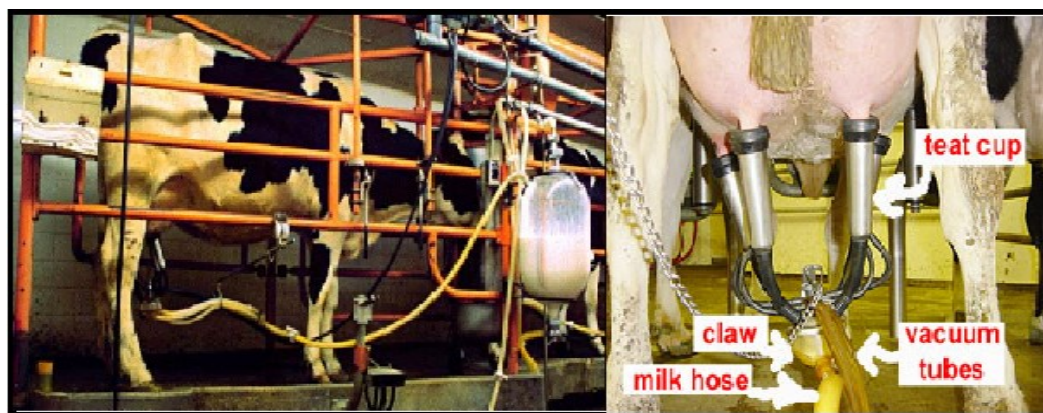
1. Provide stress free environments
2. Assemble all the necessary equipment: equipment must be clean and sanitized
3. Move the fresh heifer into the parlor /stanchion. Avoid shouting
4. Wash the udder, teats /especially teat ends should be thoroughly washed with warm (110°F) sanitizer solution/
5. The udder should be thoroughly massaged and dried with an individual towel for each heifer
6. The first milk from each quarter should be striped in to a strip cup and discarded or can be striped directly to the floor and hosed with pressurized water. If milk is abnormal / contains clot, flakes, blood, serum/ should be milked in a separate container and discarded. It is better if stripping is done before washing then washing follows

### B) Milking experienced cows (procedures)

1. Provide stress free environment
2. Assemble all the necessary equipment: equipment must be clean and sanitized
3. Move the cow into the parlor /stanchion. Avoid shouting
4. Wash the udder especially teat ends thoroughly washed with warm (110°F)



5. Udder should be thoroughly massaged & dried with an individual towel for each heifer
6. The first milk from each quarter should be striped in to a strip cup and discarded or can be striped directly to the floor and hosed with pressurized water. If milk is abnormal / contains clot, flakes, blood, serum/ should be milked in a separate container and discarded. It is better if stripping is done before washing then washing follows
7. The milkier or the milking machine should be adjusted under the cow so that it is at right angle to the floor of the udder
8. Remove the milking machine up on completion of milking. The vacuum should be turned off and the machine removed
9. Immediately after the milkers are removed, the teats should be dipped in an effective teat dip solution. This removes the last drop of milk from the end of the teats and helps to reduce new infections of mastitis, helps to keep the teats pliable and guards against chapping and sunburn
10. All milking equipment must be thoroughly cleaned, sanitized and properly stored immediately after milking. Follow the approved procedures for the equipment used and satisfy requirements of the milk market regulations if there is any



**Figure 1.3:** Milking machine on a cow at milking parlor

The machine should be removed immediately after milk out of the udder or when the milk ceases to flow. Over milking is thought to be one of the major causes of mastitis. Immediately after milking when the cow is returned to the housing area take care that she is not exposed to extreme cold or wind; the udder, and particularly the teat ends might freeze. To prevent this, the cow udder and teats should be thoroughly dry before she leaves the milking parlor

### Advantages milking machine

- Clean milk/with less contaminants
- Fast milking/time saving
- Less man power
- Complete milking
- Important for large scale farm
- More manageable
- Less injury to teats
- Hygienic method of milk production

### Disadvantages milking machine

- Machines are expensive
- Require skilled man power
- Require facilities (electricity, road, etc.)
- Requires maintenance cost

### Types of milking machines

1. **Portable milking machines/ systems:** These are ideal for small herds (up to 20 cows)



**Figure 1.4:** Portable milking machine for two cows per time



**Figure 1.5:** Portable milking machine for one cow per time



**Figure 1.6:** Tulsan Mini Portable Milking Machine (for small teat cow and dairy goat)

2. **Barn milking systems:** These are installed on farms where cows are kept tied in stalls and no separate milking parlours is present (20-100 cows)



**Figure 1.7:** Barn milking systems



3. **Milking parlor:** These are constructed on large farms; they are of various types (more than 100 cows)



**Figure 1.8:** Milking parlor

Selection of appropriate milking machine / system;

- Number of lactating animals you have
- Actual and intended yield levels as well as calving patterns.
- Labor cost, qualifications and availability will decide level of automation.
- Technical matters like existing buildings, access to electric power, water quality and availability and access roads will influence plant specifications.
- Financing and operation costs have to be considered.
- Local laws and regulations have to be considered.

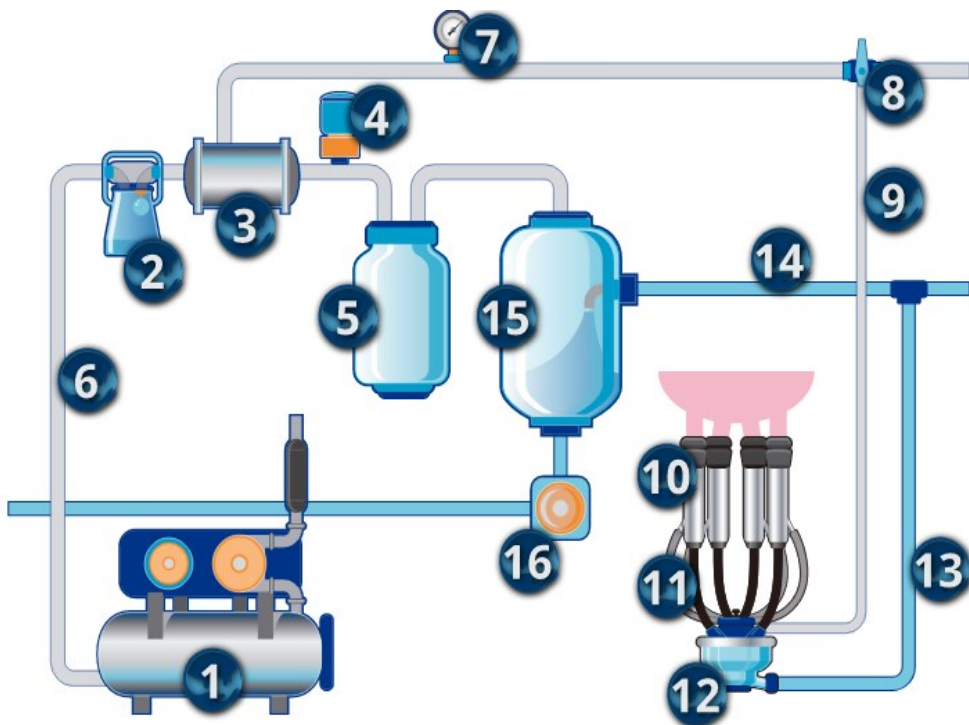
Points to be considered in construction of milking machine;

- Design of vacuum system to handle milk extraction, milk transport and cleaning
- It has to operate with a stable level to assure optimal extraction.
- Consider disturbances like kicked off units or air inlet during putting on the unit.
- Capacity to transport the milk without too strong agitation which will harm the milk quality.
- Capacity of giving strong turbulence in the cleaning water during the cleaning process.
- Gentle milking with sufficient capacity to handle high flows of milk without harming teats during low flows. You want the milking to be fast but not harmful.
- The capacity for milking has to be matched by the cooling capacity to safeguard the milk quality.

## Parts of a milking machine

A milking machine is a device composed of several parts, when properly assembled and supplied with a source of energy, will remove milk from an animal's udder and transport milk to a storage vessel.

The main parts of milking machine are the following:



**Figure 1.9:** Parts of milking machine

1. **Vacuum pump:** extracts the air from the milking system, creating a vacuum that sucks the milk out of the udder and through the pipes.
2. **Interceptor vessel:** used for collecting foreign body and liquid to prevent them from sucking into pump where it working
3. **Balance tank:** distribute vacuum to all components and provide a reserve of vacuum
4. **Vacuum regulator:** allows the controlled leakage of air to main consistent vacuum
5. **Sanitary traps:** reserves any milk or water reaching main vacuum line and other air pipe lines. Prevent dust from vacuum lines.
6. **Main vacuum line:** connect vacuum with sanitary trap
7. **Vacuum gauge:** indicate level of vacuum in the system

8. **Pulsator:** Act as valve that alternates between applying vacuum and admitting air to pulsation chamber and teat liner
9. **Pulsation line:** connect vacuum supply to pulsation chamber
10. **Cluster (teat cups):** flexible parts of milking unit and the only element that is in contact with the cow. It composed of shell and liner
11. **Short milk tube:** it is usually made up of rubber, which connect the teat liner with claw piece.
12. **Claw piece:** point of connection four teats cups where the milk from each teat is collected.
13. **Long milk tube:** made up rubber or silicon, it connects the claw to milk line
14. **Transfer pipeline:** bring the milk from the cluster to milk receiver.
15. **Milk receiver:** first point of connection between milk system and vacuum system. It collect the milk from all milk units being delivered to the tank by milk pump
16. **Milk pump:** releases the milk to bulk tank

### 1.5 Undertaking milk quality tests

Milk quality should be checked starting from the first drop up to the total milk collected. Milk being made up of 87% water is prone to adulteration by unscrupulous middlemen and unfaithful farm workers. Good-quality raw milk has to be free of debris and sediment, free of off-flavours and abnormal colour and odour, low in bacterial count, free of chemicals (e.g., antibiotics, detergents), and of normal composition and acidity. Good-quality milk products can be produced only from good-quality raw milk. To achieve this quality, good hygiene practices should be applied throughout the dairy chain.

#### Factors affecting milk quality

- Adulteration
- Milk hygiene
- Temperature
- Disease problem (commonly Mastitis)

Factors impacting the quality of milk a cow gives include:

- **Cow health:** A cow's health has the biggest impact on the quality of the milk it produces. Cows can susceptible to irritation or inflammation of their udders if stall conditions are poor. Exposure to mud, manure and runoff can expose the herd to more pathogens, increasing incidents of infection.

Page 20 of 71	Ministry of Labor and Skills Author/Copyright	Animal Production Level - III	Version -1
			May, 2023

- **Milk adulteration:** Adulteration of milk by intentional addition of water or other substances is a common problem in many developing countries. Adulteration is illegal because it alters the natural composition of milk and can introduce harmful bacteria and other dangerous substances into milk. Water adulteration lowers the specific gravity and increases the freezing point of milk; normal whole milk has specific gravity range of 1.026 to 1.032 while its freezing point is minus 0.54°C.
- **Diet:** Just as a cow's diet impacts the quantity of the milk it produces, it also affects the quality composition. In times of food scarcity, both will suffer. When feed is plentiful, farmers have more room to adjust feed to enhance the components of milk. Better composition means a better paycheck.
- **Milk handling:** Because milk is a naturally good place for bacteria to thrive, bacteria counts taken during processing can show whether milk was taken with clean equipment and cooled quickly. The cleaner the equipment and the faster the milk is cooled, the lower the bacteria count will be.

### Requirements for maintaining milk quality

Milk from health cow, having good flavor, free from dirt and filth, contains relatively small number of bacteria and essential free from pathogens is clean milk. Clean milk production is always profitable for producers, manufacturers and consumers. Therefore, producing quality milk requires the following activities.

- **Herd health:** the dairy animal must be free from pathogens and should be periodically checked in every year for all of contagious diseases
- **Clean animal:** the milker must clean the flanks and udder of cows just before milking to prevent entry of dirt into the milk
- **Clean surrounding:** milking area should be clean and dust free
- **Control of flies:** fly control measures must be arranged as they may carry contagious disease like typhoid, dysentery etc.
- **Milkers cleanliness:** must be free from infectious diseases. Should keep personal hygiene, wear clean cloths, trimmed nails and cover hair. Never spit around or talk while milking. The milker must cover cuts and wounds.
- **Clean utensils:** all milking equipments and containers must be clean and free from pathogens.

- **Straining:** is done to remove sediments and other foreign materials. Use clean dry cloth to maintain quality of the milk.
- **Feeding:** should be done an hour before milking. During milking give the animal some concentrate which is less dusty and to keep the cow busy.

### Common milk testing techniques

Good quality dairy products can only be made from good quality milk. Therefore, it is important to grade milk, so that poor quality samples are rejected and only good quality milk is sold to retailers and processors. They should be able to identify off-flavors, and understand what causes these problems. Here, we describe four simple quality control tests. These tests will meet the requirements of most farmer cooperatives, collection centers and small-scale processing units. If the tests are done properly and consistently, it will ensure that poor quality milk is rejected, and only good quality milk is sold to processing factories, milk bars and shops.

#### a) Organoleptic test

This is the simplest test: just looking (eyesight) and smelling. If the milk has a bad smell, or abnormal color, or contains particles, it should be rejected. The organoleptic test permits rapid segregation of poor quality milk at the milk receiving platform. No equipment is required, but the milk grader must have good sense of sight, smell and taste. The result of the test is obtained instantly, and the cost of the test is low. Milk which cannot be adequately judged organ must be subjected to other more sensitive and objective tests.

#### b) Clot on boiling (COB)

This test is quick and simple. It is one of the old tests for too acid milk ( $\text{pH} < 5.8$ ) or abnormal milk (e.g. mastitis milk). High-acid milk should be rejected. The test allows you to identify colostrum milk (which is produced in the first few days after parturition) or mastitic milk. Colostrum milk should be rejected, because it has a very high percentage of whey proteins, which create problems when the milk is boiled or heated during processing.

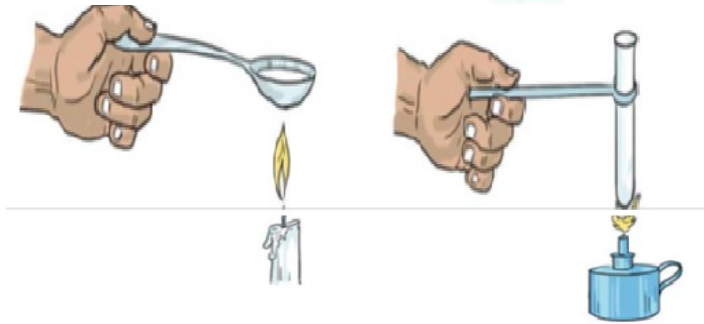
### Materials

- Test tube or spoon
- Paraffin burner or Bunsen burner

### Procedure

- Boil about 2 ml of milk in a test tube or spoon or any other suitable container.





**Figure 1.10:** Clot on boiling

## Results

If there is clotting, coagulation or precipitation, the milk has failed the test and should be rejected.

### c) Alcohol test

The test is quick and simple. It is based on instability of the proteins when the levels of acid and/or rennet are increased and acted upon by the alcohol. Also increased levels of albumen (colostrum milk) and salt concentrates (mastitis) results in a positive test.

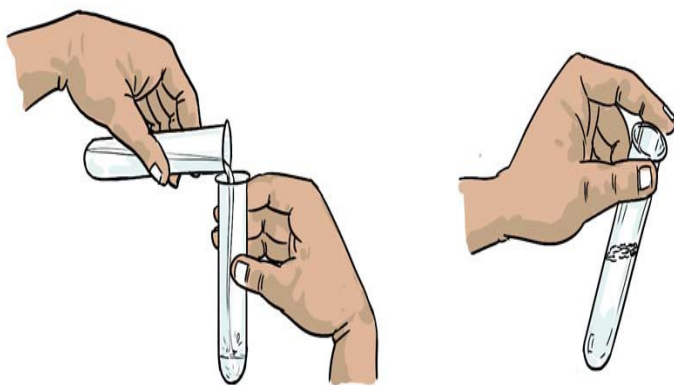
The alcohol test is more sensitive than the COB test. COB only detects milk which is highly acidic ( $\text{pH} < 5.3$ ). The alcohol test detects even medium-acidity milk ( $\text{pH} < 6.4$ ). Therefore, milk which passes the COB test, may fail the alcohol test. Colostrum and mastitic milk may also fail the alcohol test.

## Materials

- Alcohol gunner or syringe
- Beaker or glass
- 68% alcohol

## Procedure

- Put equal volumes of milk and 68% alcohol in a test tube (e.g. 2 ml of milk in 2 ml of 68% alcohol).
- Invert the test tube several times, keep your thumb pressed tightly over the open end of the tube.
- Examine the tube to see whether the milk has coagulated. If it has, fine particles of curd will be visible.



**Figure 1.11:** Alcohol test

### Results

If the milk is of good quality, there will be no coagulation, clotting or precipitation. If the milk has become acidic (pH below 6.4) it will flocculate. To quickly see whether milk is acidic, you can use a litmus paper. For more accuracy, a titration test can be done in a laboratory.

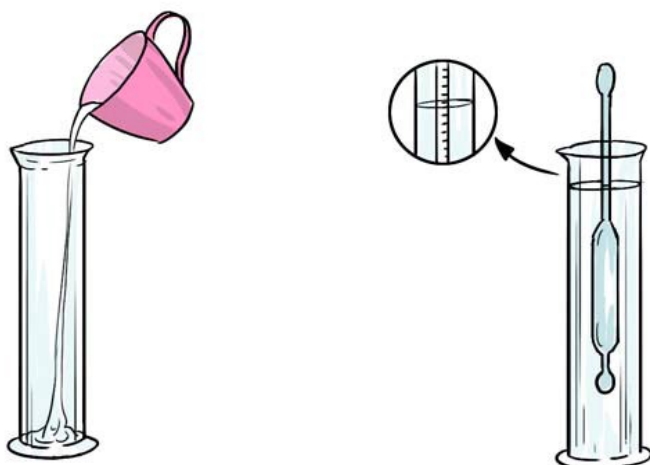
### d) Lactometer test

Lactometer is an instrument used to measure the density of milk. Pure milk has a density (specific gravity) of 1.028 to 1.033 grams per ml. Addition of water or other substances changes the density. Addition of water reduces the density, while addition of solids increases the density considerably. If density is outside the normal range, it means the milk has been adulterated.

The lactometer test serves as a quick method to determine adulteration of milk by adding water. With a lactometer the specific density of milk is measured. At 20°C the normal density of the milk ranges from 1.028 to 1.033 g/ml, whereas water has a density of 1.0 g/ml. So when the lactometer reads a value closer to 1.0, probably water has been added to the milk. If possible the lactometer reading can be combined with the fat test. The density of fat is lower than that of milk. So in case the results of the fat test are low and the found density is still high (e.g. 1.035), then the milk might have been skimmed. If the results of the fat test are low and the density is low (e.g. 1.025), then water might have been added to the milk. Always read the temperature of the milk first; the lactometer reading varies according to temperature. Calibration temperature of lactometer is 20°C.

### Materials

- Measuring cylinder 200-250 ml
- Lactometer



**Figure 1.12:** Lactometer test

### Procedure

First, ensure that the milk temperature is about 20°C. Hot milk should be left to cool at room temperature for at least 30 minutes. If the milk was cooled below 10°C, warm it to 40°C, and then cool it to 20°C. Mix the milk sample and gently pour about 200 ml into a measuring cylinder.

- Slowly dip the lactometer into the milk and leave it. It will sink a little and then stop.
- Read and record the last Lactometer degree (°L) just above the surface of the milk.
- If the temperature of the milk is different from the calibration temperature (Calibration temperature may be=20°C ) of the lactometer,
- Calculate the temperature correction. For each °C above the calibration temperature add 0.2°L; for each °C below calibration temperature subtract 0.2 °L from the recorded lactometer reading.

**Table 1.4:** Calibration temperature of lactometer 20°C

Sample	Milk temperature	Lactometer reading	Correction	True reading
No.1	17 °C	30.6 °L	- 0.6 °L	30.0 °L
No.2	20 °C	30.0 °L	Nil	30.0 °L
No.3	23 °C	29.4 °L	+ 0.6 °L	30.0 °L

#### e) **Acidity test**

Bacteria that normally develop in raw milk produce more or less of lactic acid. In the acidity test the acid is neutralized with 0.1 N Sodium hydroxide and the amount of alkaline is measured. From this, the percentage of lactic acid can be calculated. Fresh milk contains in this test also "natural acidity" which is due to the natural ability to resist pH changes. The natural acidity of milk is 0.16 - 0.18%. Figures higher than this indicates develop acidity due to the action of bacteria in milk.

Self-check - 1	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

### Test I: Multiple choices

- Centrifugal equipment that separates milk into the cream and skimmed milk is---- (2pts.)  
A. Cream separator      B. Homogenizer      C. Churner      D. Pasteurizer
- Hand milking methods that adopted for small cows with narrow teats is--- (2pts.)  
A. Hand strip      B. full hand milking      C. pinch
- Which one of the following is disadvantage of milking machine? (2pts.)  
A. Fast milking/time saving      C. Machines are expensive  
B. Less man power      D. Complete milking

### Test II: Short Answer Questions

- Mention the two types milking methods (2 pts.)
- List down the five materials, tools and equipment used in milk processing (5pts.)
- Mention importance of milk homogenizer (2 pts.)
- List down the common milk ingredients and its importance (4 pts.)
- Mention factors that affect the milk composition and constituents (7 pts.)
- List down common milk quality testing methods (4pts.)
- What are the factors that affect milk quality? (4pts.)

Satisfactory rating - 30 points

Unsatisfactory - below 30 points

You can ask you teacher for the copy of the correct answers.

## Operation Sheet -1

### 1.1. Procedures of Hand milking

#### a. Tools and equipment's

- PPE
- Feed
- Towel
- Strip cup
- Halter
- Record book
- Teat dip

#### b. Procedures

- Provide feed for cow
- Identify and collect all necessary material that required for milking operation.
- Clean, wash and disinfect materials.
- Restrain the cow
- Wash teat and udder by using warm water
- Clean and drying the teat and udder
- Check mastitis by strip cup
- Start milking until completely out
- Dipping the teat by using iodine solution/ savlon
- Measure the milk /record/
- Transfer to main storage.
- Wash, clean and disinfect all materials.

### 1.2. Technique of performing machine milking

#### a. Tools and equipment

- PPE
- Towel
- Strip cup
- Record book and teat dip

## **b. Procedures**

- Make sure all equipment and tools are at hand and in proper condition. Use clean suitable clothing and wash your hands thoroughly before starting milking.
- Handle animals with care and in a calm manner. No yelling or beating if you want them to give you all their milk.
- Clean and massage the cow's udder. Use towel for each cow or individual towels that are cleaned in a washing machine between every milking.
- Pre-milk by hand in a test cup. Take a few squirts from each teat and check for flocculation or blood.
- Put on the milking unit within one minute after preparation.
- Monitor the milking and adjust the unit if it starts squeaking or if the cow appears uncomfortable.
- Take off the unit when the milk flow has ceased or is very low. Check that the udder is empty before you remove the unit.
- Teat dips the cows within one minute after takeoff.
- Register the observations you do on the individual cows during milking

## **1.3. Technique of carrying out milk quality test by Alcohol test**

### **a. Tools and equipment's**

- PPE
- Test tubes (150 mm long and 16 mm diameter)
- Test tube holder
- 75% alcohol

### **b. Procedures**

- Put equal volumes of milk and 75% alcohol in a test tube.
- Invert the test tube several times with the thumb held tightly over the open end
- Examine the tube to determine whether the milk has coagulated.
- If it has, fine particles of curd will be visible.

#### 1.4. Technique of carrying out milk quality test by Lactometer test/density test

##### a. Tools and equipment

- PPE
- Measuring cylinder
- Lactometer
- Thermometer

##### b. Procedures

- Heat the sample of milk to 40°C and hold for 5 minutes. This is to get all the fat into a liquid state since crystalline fat has a very different density to liquid fat, and fat crystallizes or melts slowly. After 5 minutes, cool the milk to 20°C.
- Mix the milk sample thoroughly but gently. Do not shake vigorously or air bubbles will be incorporated and will affect the result.
- Place the milk in the cylinder. Fill sufficiently so that the milk will overflow when the lactometer is inserted.
- Let the Lactometer sink slowly into the milk.
- Allow the lactometer to float freely until it is at rest. Read the lactometer at the top of the meniscus
- Calculate the temperature correction.
- Immediately, read the temperature of the milk; this should be 20°C. If the temperature of the milk is between 17 and 24°C, the following correction factors are used to determine L:

Temp°C	17	18	19	20	21	22	23	24
Correction	-0.7	-0.5	-0.3	0	+0.3	+0.5	+0.8	+1.1

For example if the lactometer reading is 30.5 and the temperature is 23°C:

$$\text{Corrected lactometer} = L_c = 30.5 + 0.8 = 31.3$$

Calculations always use  $L_c$ , the corrected lactometer reading. To calculate the specific gravity, divide the corrected lactometer reading by 1000 and add 1.

$$\text{In our example: Sp. gr.} = (31.3/1000) + 1 = 1.0313$$



LAP TEST-1	Performance Test
------------	------------------

Name.....

ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour. The project is expected from each student to do it.

**Task 1:** Perform hand milking

**Task 2:** Perform machine milking

**Task 3:** Carryout milk quality test by Alcohol test

**Task 4:** Carryout milk quality test by Lactometer test/density test

<b>LG #5</b>	<b>LO # 2- Process milk into different products and Preservation</b>
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<b>Instruction sheet</b>
<p>This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:</p> <ul style="list-style-type: none"> <li>• Determining types of milk products</li> <li>• Preparing whole milk processing ingredients</li> <li>• Processing milk</li> <li>• Preserving milk and milk Product</li> </ul> <p>This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:</p> <ul style="list-style-type: none"> <li>• Determine types of milk products</li> <li>• Prepare whole milk processing ingredients</li> <li>• Process milk</li> <li>• Preserve milk and milk Product</li> </ul>
<b>Learning Instructions:</b>
<ol style="list-style-type: none"> <li>1. Read the specific objectives of this Learning Guide.</li> <li>2. Follow the instructions described below.</li> <li>3. Read the information written in the information Sheets</li> <li>4. Accomplish the Self-checks</li> <li>5. Perform Operation Sheets</li> <li>6. Do the “LAP test”</li> </ol>

## Information Sheet - 2

### 2.1. Determining types of milk products

Milk can be processed further to convert it into high-value, concentrated and easily transportable dairy products with long shelf-lives, such as butter, cheese and ghee. Some of the common milk products that are made locally or commercially are;

- **Liquid milk** is the most consumed, processed and marketed dairy product. Liquid milk includes products such as pasteurized milk, skimmed milk, standardized milk, reconstituted milk, ultra-high-temperature (UHT) milk and fortified milk. Worldwide, less and less liquid milk is consumed in its raw form.
- **Cream:** A portion of milk containing not less than 18% milk fat. Cream may be taken from milk by “skimming” or “separating” Skimming is the process of removing manually the cream, which rises to the surface, after milk stands in a container. The remaining part of the milk is called skimmed milk. Separating is the process of removing cream mechanically. The remaining part is called separated milk.
- **Curd/yoghurt:** The coagulated part of milk if milk is stands in a container for some time at room temperature, it forms clots called curds which are contained in a clear liquid called whey.
- **Whey:** This is the watery part of milk after separation of the curd from the whole milk. It contains protein, lactose, minerals and salts.
- **Cheese:** This is the clotting casein of milk. Cheese is made from separated milk or whole milk. The milk curd, after being removed from the whey, is pressed into solids and through other processes and forms cheese. Genuine cheese must contain no fat other than that obtained from milk. Cheese is also the product of cultures and an aging process that causes fermentation. There is a wide range of production methods that yield many different flavors and forms of cheese. In general, you should follow the same storage tips as milk and yogurt. If mold is on cheese, the block of cheese can generally still be eaten. If a small patch of mold appears on a piece of cheese, trim it off completely by cutting at least one-quarter inch below the mold and plan to consume the cheese soon.



**Figure 2.1:** cheese

- **Butter:** This is the solidified milk fat or cream prepared by churning. The cream produced from milk is violently churned up and shaken so that the fat globules are broken up and closed together into pieces of mass called butter



**Figure 2.2:** Fresh butter

Butter is a fatty product derived exclusively from milk. Butter must contain a minimum of 80% fat and a maximum of 16 % water and 2% SNF. Butter is a water-in-oil emulsion in which fat globules, fat crystals, water droplets, and air bubbles are dispersed. There are normally two fat phases in butter: continuous fat phase & fat globules

Butter is manufactured in four varieties with different flavors and tastes;

- 1) Sweet cream, unsalted butter: typically used within the confectionary and bakery industry and in the production of recombined milk, is vulnerable to microbial deterioration.
- 2) Sweet cream, salted butter: relatively high salt content, for example, 2 g/100 g. Extra salted varieties containing 3–4 g salt/100 g are also marketed.

- 3) Cultured, unsalted butter

Page 34 of 71	Ministry of Labor and Skills Author/Copyright	Animal Production Level - III	Version -1
			May, 2023

- Its pH is typically between 4.6 and 5.2 and this acidification inhibits microbial deterioration.

4) Cultured, salted butter:

- ✓ The combination of salt and low pH value inhibits spoilage MO, but at the same time it enhances oxidative deterioration.
- ✓ A salt content below 1 g/100 g is normally preferred in this type of butter.
- **Ghee:** This is butter which has been heated and clarified. Butter is boiled over heat until the water is evaporated. It is then strained and ghee is produced.

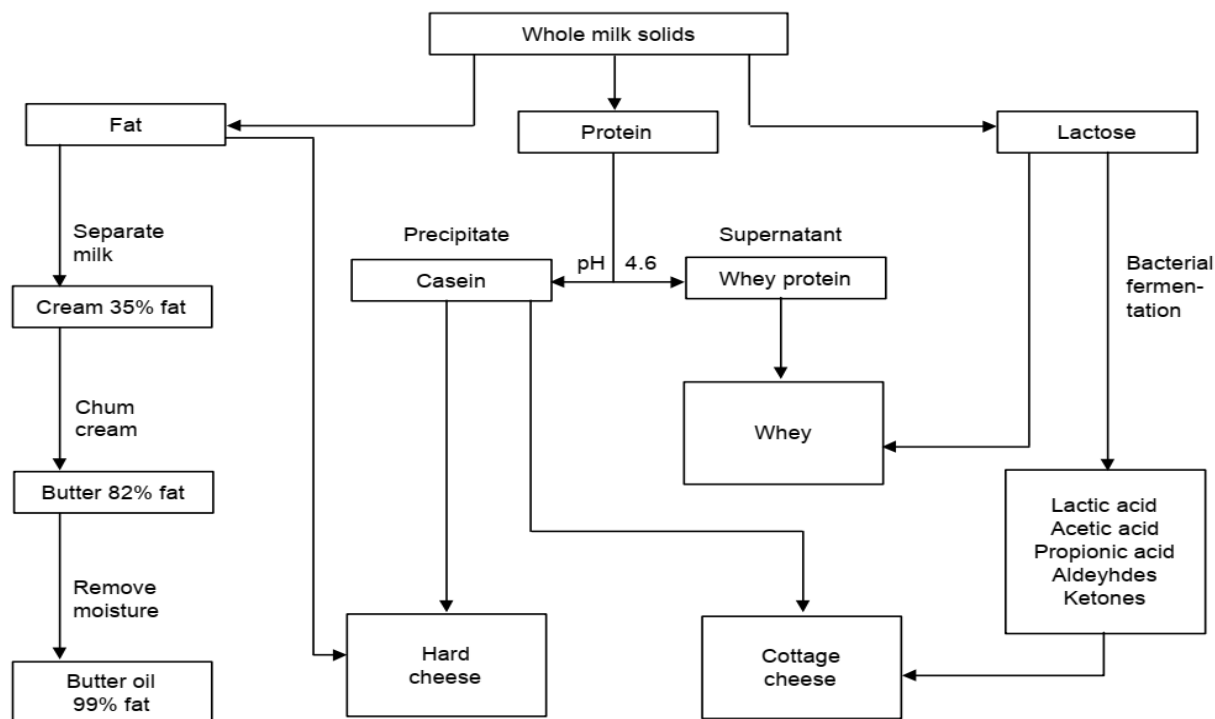


**Figure 2.3:** Ghee

**Ice cream:** This is cream made by mixing milk products with other ingredients and then freezing them into a semi solid state. The principal ingredient of the cream is usually milk or cream flavoring and coloring materials, etc. Ice cream is a rich, sweet, creamy frozen milk product, made from variously flavored cream and milk, churned or stirred to a smooth consistency during the freezing process and often contains gelatin, eggs, fruits, nuts, etc. The mixture must be suitably heated before freezing. The ice cream should contain no less than 10% milk fat, 3.5% protein, and 36% total solids. The ice cream is packaged in plastic containers.



**Figure 2.4:** Ice cream



**Diagram 2.1:** Major milk solid fractions in milk product

## 2.2. Preparing whole milk processing ingredients

### 2.2.1. Conditions for clean milk production

Here are some important points to observe in order to produce clean milk:

- Milking should be carried out in a well-ventilated barn with adequate lighting.
- The floor of the milk barn must be durable & easy to clean, preferably made of concrete.
- After use, milking vessels and equipment must be cleaned with potable water, sanitized and dried in the sun on a drying rack.
- Milkers must be healthy and not suffering from contagious diseases or ulcers.
- Only healthy cows should be milked. Cows suffering from mastitis should be milked last and their milk discarded.
- Milk handlers need to pay particular attention for the type of milking and handling equipment.
- Plastic equipment is also unsuitable for milk handling as they are sensitive to heat and prolonged exposure to cleaning agents.
- Where possible, raw milk should be cooled using simple methods such as immersing milk cans in a trough of running cool water or evaporative cooling

### 2.2.2. Addition of milk ingredients

Most of the time milk ingredients are added to the whole milk to keep the flavor/ odor and aroma of milk. Flavorings may be added depending on the type of product. Some common ingredients include herbs, spices, hot and sweet peppers, horseradish, and port wine. The most common milk ingredients in Ethiopia are: Salt, garlic, flavoring spices like “Besobila” etc.

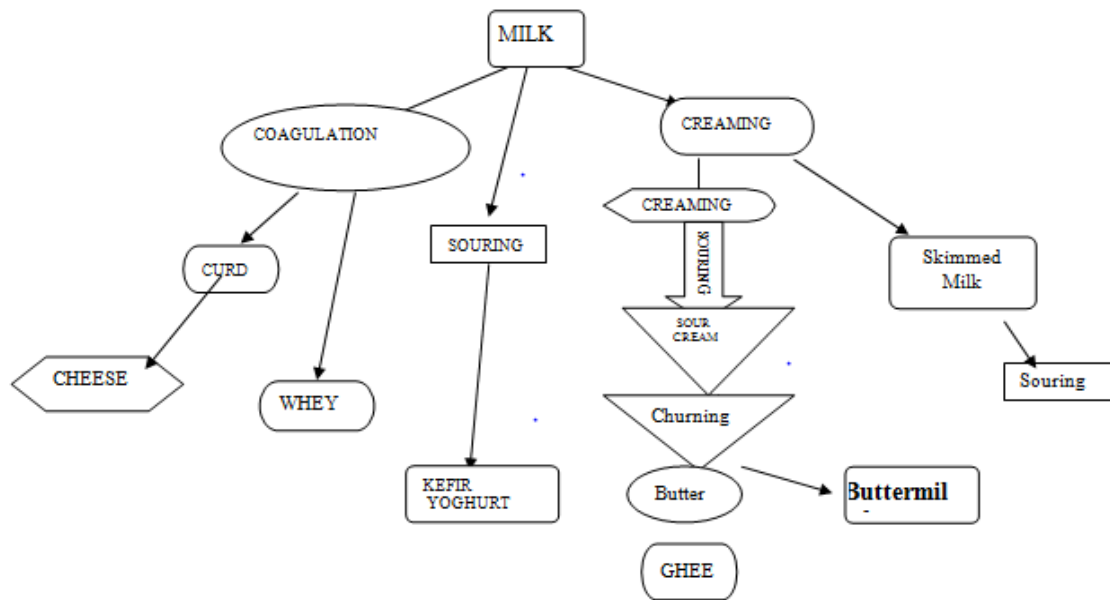
### 2.3. Processing milk

Milk is processed in a number of milk products in the form of concentrated, cultured and dried products, to be reconstituted in to milk as required or mixed with other ingredients to provide mixes such as solid cheeses of various flavors and types, and in condensed or evaporated forms for convenient transportation and longer shelf life.

Basically milk is processed to increase deliciousness of milk products and their shelf life. It is processed in different ways in to different products; traditional or industrially. The types of products to be processed are determined based on the enterprise requirements. Raw milk can be processed in to the following products include: Cream, yoghurt, butter, cheese, whey and other special products. Cow's milk has been processed into dairy products such as cream, butter, yogurt, kefir, ice cream, and especially the more durable and easily transportable product, cheese. Modern industrial processes produce casein, whey protein, lactose, condensed milk, powdered milk, and many others.

The spoilage of milk can be forestalled by using ultra-high temperature (UHT) treatment; milk so treated can be stored unrefrigerated for several months until opened but has a characteristic "cooked" taste. Condensed milk, made by removing most of the water, can be stored in cans for many years, unrefrigerated, as can evaporated milk. The most durable form of milk is powdered milk, which is produced from milk by removing almost all water. The moisture content is usually less than 5% in both drum and spray dried powdered milk.





**Diagram 2.2:** Different products of milk

### Homogenization

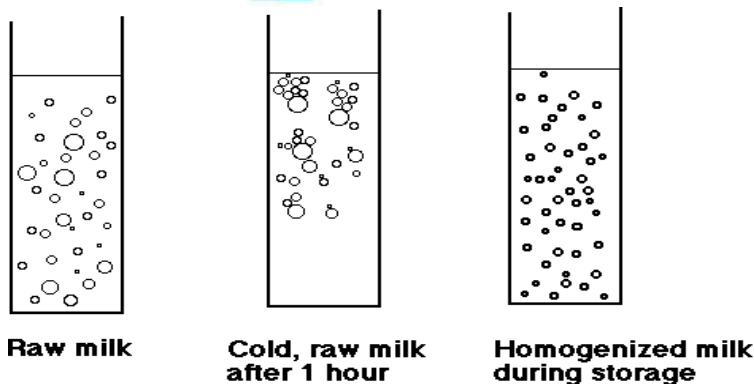
Milk is an oil-in-water **emulsion**, with the fat globules dispersed in a continuous skim milk phase. If raw milk were left to stand, however, the fat would rise and form a cream layer. Homogenization of milk causes disruption of milk fat globules into smaller ones. The milk fat–plasma interface is thereby considerably enlarged, usually by a factor of 5 to 10. The new interface is covered with milk protein, predominantly micellar casein.

Homogenization is a mechanical treatment of the fat globules in milk brought about by passing milk under high pressure through a tiny orifice, which results in a decrease in the average diameter and an increase in number and surface area, of the fat globules. The net result is a much reduced tendency for creaming of fat globules. Three factors contribute to this enhanced stability of homogenized milk:

- ✓ a decrease in the mean diameter of the fat globules
- ✓ a decrease in the size distribution of the fat globules (causing the speed of rise to be similar for the majority of globules) and
- ✓ an increase in density of the globules (bringing them closer to the continuous phase) owing to the adsorption of a protein membrane.

In addition, heat pasteurization breaks down the cryoglobulin complex, which tends to cluster fat globules causing them to rise.





### Effect of homogenization

The effect of homogenization on the physical structure of milk has many advantages:

- Smaller fat globules leading to no cream-line formation
- Whiter and more appetizing color
- Reduced sensitivity to fat oxidation
- More full-bodied flavor, better mouth feel
- Better stability of cultured milk products

However, homogenization also has certain disadvantages:

- Homogenized milk cannot be efficiently separated.
- Somewhat increased sensitivity to light, sunlight and fluorescent tubes – can result in “Sunlight flavor”
- Reduced heat stability, especially in case of single-stage homogenization, high fat content and other factors contributing to fat clumping.
- The milk will not be suitable for production of semi-hard or hard cheeses because the coagulum will be too soft and difficult to dewater.

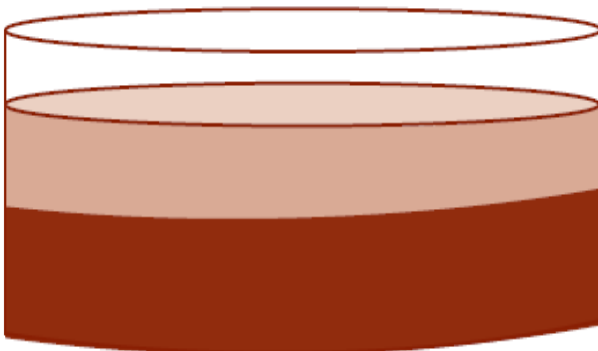
#### 1. Cream separation

Cream separator used to separate milk into cream and skim milk. All incoming raw milk is passed through separators, which are essentially high-speed centrifuges to produce standardized milk. Once the milk has been separated the resulting products can be combined in a variety of process systems to make products with standardized milk fat contents. Use of a separator also permits fractionation of whole milk into standardized milk (or skim milk, low-fat milk) and cream. Skim milk should normally contain 0.1% fat or less. Standardization means that the proportion between fat and fat-free milk solid and between fat and other components shall be adjusted to make milk products reach product standards.

This process is generally called standardization. Standardization of fat content involves adjustment of the fat content of milk, or a milk product, by addition of cream or skim milk as appropriate to obtain a given fat content.

### Cream separation method

- a. **Gravitational separation:** When milk is allowed to stand for some time, there is a tendency for the fat to rise. Gravity separation is slow and inefficient. Cream can be separated from milk by allowing the milk to stand in a setting pan in a cool place. This can be done in either of two ways
  - **Shallow pan method:** Milk, preferably fresh from the cow, is poured into a shallow pan 40 to 60 cm in diameter and about 10 cm deep. The pan should be in a cool place. After 36 hours practically all of the fat capable of rising by this method will have come to the surface, and the cream is skimmed off with a spoon or ladle. The skim milk usually contains about 0.5 to 0.6% butter fat.



**Figure 2.5:** Shallow pan

- **Deep setting method:** Milk preferably fresh from the cow, is poured into a deep can of small diameter. The can is placed in cold water and kept as cool as possible. After 24 hours the separation is usually as complete as it is possible to secure by this method. The skim milk is removed through a tap at the bottom of the can.



**Figure 2.6:** Deep setting pan

- b. Centrifugal separation** – Centrifugal separation is quicker and more efficient leaving less than 0.1% fat in the separated milk compared with 0.5 - 0.6% after gravity separation. It also allowed removal of cream and recovery of the skim milk in a fresh state.



**Figure 2.7:** Centrifugal cream separator

Factors affecting efficiency of cream separation:

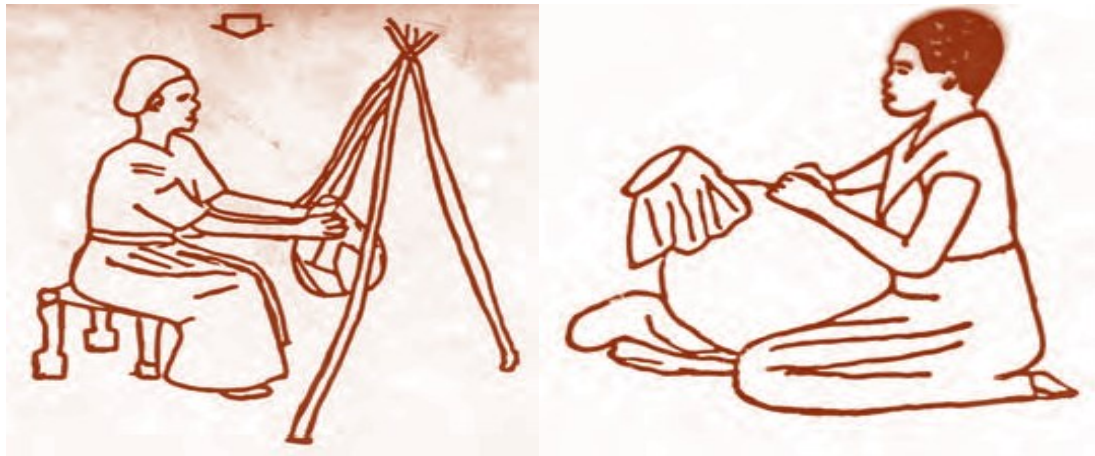
- Mechanical condition of machine
- Temperature of the milk
- Low speed of bowl
- High rate of inflow
- Clogging of bowl Acidity of the milk

## 2. Butter making

**Churning:** is the process of shaking up whole milk or cream to make butter. Butter production (changing whole milk to butter) is a process of transforming a fat-in-water emulsion (milk) to a water-in-fat emulsion (butter). The process can be summarized in 3 steps:

- Churning physically agitates the cream until it ruptures the fragile membranes surrounding the milk fat. Once broken, the fat droplets can join with each other and form clumps of fat, or butter grains.
- As churning continues, larger clusters of fat collect until they begin to form a network with the air bubbles that are generated by the churning; this traps the liquid & produces foam.

- The cream separates in to butter and buttermilk. The buttermilk is drained off, and the remaining butter is needed to form a network of fat crystals that becomes the continues phase, or dispersion medium, of a water-in-fat emulsion.



**Figure 2.8:** Traditional butter churning in a gourd (left), clay pot (right)



**Figure 2.9:** Simple hand driven butter churns



**Figure 2.10:** Modern electric churner

#### Factors affecting butter churning

- Milk acidity
- Churning temperature
- Degree of agitation
- Extent of filling the churn

#### Butter milk

This liquid product that is remaining after whole milk is churned and normally it contains more fat than skim milk. It is more acidic and can have more of a laxative action

### 3. Cheese making

Cheese is one of the most highly concentrated and nutritious dairy products. The most important ingredient in cheese is of course, the milk. Cheese can be made from just about any kind of milk including, cow, goat, sheep, mare and camels. It is the lucky home cheese maker who even has access to fresh cow's milk, let alone the other exotic types. Cheese making is a rather simple process in itself, but it involves complex chemical and physical phenomena. It is essentially a concentration process, beginning with the coagulation of casein and then controls the chemistry of the casein molecules. The physical or rheological characteristics of cheese are governed by interactions between casein molecules. There are two characteristics of commercial milk that conspire to make life difficult for the cheese maker. First of all, it is Pasteurized and the native flora and fauna are killed. This is not necessarily bad but simply puts a limit on the ultimate flavor potential of the cheese. However, this limit we can live with and as mentioned elsewhere is a good compromise in favor of safety.

The really serious problem with store milk is that it is *homogenized*. This is a process that breaks up the fat globules to such a small size that they are forever in suspension and never again separate as in fresh milk. The bad news is that it does something else to the fact that interferes with making good quality cheese. Cheese is obtained principally through coagulation of casein by milk-coagulating enzymes, acid precipitation, or a combination of the two.

Cheese may be classified based on the moisture content of the fat-free solids, the fat content of the dry matter or type of ripening.

Classification based on moisture content of the fat-free solids:

- Soft (69% or more)
- Semi-hard (57–69 %)
- Hard (49–56 %)
- Extra hard (less than 49 %).

Classification based on fat content of the dry matter:

- High fat (60 % or more)
- Full fat (45–59 %)
- Medium fat (25–44 %)
- Partially skimmed (10–24 %)
- Skimmed (less than 10 %)

## General Cheese Processing Steps

- **Standardize milk:** Milk is often standardized before cheese making to optimize the protein to fat ratio to make a good quality cheese with a high yield
- **Pasteurize/heat treat milk:** Depending on the desired cheese, the milk may be pasteurized or mildly heat-treated to reduce the number of spoilage organisms and improve the environment for the starter cultures to grow.
- **Cool milk:** Milk is cooled after pasteurization or heat treatment to 90°F (32°C) to bring it to the temperature needed for the starter bacteria to grow. If raw milk is used the milk must be heated to 90°F (32°C).
- **Inoculate with Starter & Non-Starter Bacteria and Ripen:** The ripening step allows the bacteria to grow and begin fermentation, which lowers the pH and develops the flavor of the cheese.
- **Add Rennet and Form Curd:** The rennet is the enzyme that acts on the milk proteins to form the curd. After the rennet is added, the curd is not disturbed for approximately 30 minutes so a firm coagulum forms.
- **Cut Curd and Heat:** The curd is then cut with cheese knives into small pieces and heated to 100°F (38°C). The heating step helps to separate the whey from the curd.
- **Drain whey:** The whey is drained from the vat and the curd forms a mat.
- **Texture curd:** This step is called cheddaring. Cheddaring helps to expel more whey, allows the fermentation to continue until a pH of 5.1 to 5.5 is reached, and allows the mats to "knit" together and form a tighter matted structure. The curd mats are then milled (cut) into smaller pieces.
- **Dry Salt or Brine:** for cheddar cheese, the smaller, milled curd pieces are put back in the vat and salted by sprinkling dry salt on the curd and mixing in the salt.
- **Form Cheese into Blocks:** The salted curd pieces are placed in cheese hoops and pressed into blocks to form the cheese.
- **Store and Age:** The cheese is stored in coolers until the desired age is reached. Depending on the variety, cheese can be aged from several months to several years.
- **Package:** Cheese may be cut and packaged into blocks or it may be waxed.



## Spreadable Cheese

Soft fresh cheeses that have a creamy smooth texture allow the cheese to be easily spread on bread or crackers, or mixed with fruits or vegetables. Packaging comes in plastic cups or tubs.

## Hard and semi hard cheeses

Most hard cheeses are pressed during production to remove moisture. As they age, they become firmer, more pungent and crumbly. Semi hard cheeses pass through a short process and are delivered fresh. Most of these cheeses are great for snacks and sandwiches, and many can be cooked without becoming rubbery or oily. Hard cheeses tend to have a longer shelf life than softer cheeses. The cheese is packed in slices, or as a block in vacuumed plastic wrappings this hard cheese is one of the great cheeses of the world. It is usually made with cow's milk, but I frequently made it from goat's milk.

Goat and ewe's milk both produce a slightly softer curd than cow's milk, and they require slightly reduced temperatures. The curds from these milks also need slightly less pressing. Sterilizes all the equipment in hot water and ensure that the room is not subject to cold draughts. Give yourself plenty of time, without the possibility of interruptions.

## Yoghurt

Yoghurt is a fermented milk product, with nutritional benefits beyond those of milk. Yogurt is a firm, creamy or liquid acidified milk product which is manufactured from pasteurized milk by using thermophilic LAB (38-42°C). For increasing DM content, milk can be concentrated, or powder is added or milk is concentrated by UF. Density range 1.035 – 1.060. Low-fat or skim milk yogurt has a softer gel than whole milk yogurt. The standard yogurt is not heat treated after fermentation and does not contain binding agents

Yogurt products/ Yoghurt is processed in three different methods: Stirred, Set and Drinkable.

- **Firm/ Set yogurt:** firm gel in pack, which is normally consumed by using a spoon
- **Stirred yogurt:** gel has been broken, cooled and packed after coagulation
- **Drinking yogurt:** like stirred yogurt, but the product has been homogenized & brought into a liquid form before filling; does not contain thickening agents but contain stabilizers.

### **Skim milk**

This is milk from which most of the fat has been removed but in which all the protein remains. The protein has a high biological value and is very digestible. Skim milk is a good source of Water soluble vitamins, whereas the Fat Soluble Vitamins (A and D) are removed with the fat.

### **Whey**

Whey is a liquid by-product that is remaining after cheese production. Its dry matter content is low around 7 %. Most of the fat and casein has been removed during the cheese making process, but it is high in lactose and minerals. In addition to providing nutrients whey can also be used as a source of water. There are two types of whey fresh and acidified. Fresh whey is fed prior to being allowed to ferment and produce acid.

## **2.4. Preserving milk and milk Product**

Among the oldest methods of preservation are drying, refrigeration, and fermentation. Modern methods include canning, pasteurization, freezing, irradiation, and the addition of chemicals. Advances in packaging materials have played an important role in modern food preservation.

### **Milk preservation method;**

#### **a) Cooling milk**

To avoid rapid deterioration of the milk after milking, it should be cooled down to 2-4<sup>0</sup>C within 2 hours. If you don't have access to electric power and/or artificial cooling it is important that you cool the milk by keeping it in the shade and putting it in water from the well or other cool water source. If you can't cool the milk, frequent milk collection at least once per day is required. The agitation of the milk in the tank has to be gentle to avoid milk quality deterioration. If you can avoid mixing warm milk in cooled that is an advantage from quality point of view. Clean the tank immediately after the milk has been collected by the truck.

#### **Cooling methods;**

- keep the milk in the shade not in the sun
- keep the milk in a well-ventilated place
- use cold water to cool the milk ( for example put the milk in a water bath, or in a stream)
- use ice to cool the milk



## b) Boiling

This is the easiest and most practicable method of making milk safe in every home. As soon as raw milk is produced or delivered it should be boiled. Boiling is raising the temperature of the milk to boiling point and maintaining the milk at this temperature for a few minutes. Then the milk should be immediately cooled. Boiling of milk destroys all microorganisms except the spore formers but it changes the nutritive value of milk, its flavors and palatability appearance and difficult to process on a large scale and is commercially uneconomical.

## c) Pasteurization

Pasteurization of milk is a universally known method of rendering raw milk safe through controlled heat treatment. Pasteurization of milk is not sterilization but it is a destruction of all pathogenic micro-organisms. Pasteurization means heating every particle of the milk or milk product to a specific temperature for a specified period of time (63°C for 30 minutes or 72°C for 15 minutes and immediate cool at 4°C). This destroys bacteria and other micro-organisms that may affect consumers' health. It makes the milk safe and healthy, and also improves the keeping quality, so that milk and milk products can be stored for longer periods without being spoilt. It is a process of heating a food, usually liquid, to a specific temperature for a definite length of time, and then cooling it immediately. This process slows microbial growth in food.

Pasteurization is used to kill harmful microorganisms by heating the milk for a short time and then cooling it for storage and transportation. Pasteurized milk is perishable, however, must be stored cold by both suppliers and consumers. Pasteurization improves the safety and storage life of products. Pasteurization can be of two types, low and high pasteurization. Although high pasteurization initially kills more bacteria, the resulting milk cannot usually be kept as long, because the high pasteurization temperature stimulates spores of some bacteria to germinate. The taste of high pasteurized milk has more or less the flavor of boiled milk. Pasteurized milk can be kept for about one week at 4-6°C.

### Purpose of Pasteurization

- To increase milk safety for the consumer by destroying disease causing microorganisms (pathogens) that may be present in milk.
- To increase keeping the quality of milk products by destroying spoilage microorganisms and enzymes those contribute to the reduced quality and shelf life of milk.

Pasteurization of milk involves three essential steps:

- Heating raw milk to a predetermined temperature
- Holding at this temperature for a predetermined time
- Immediately cooling down to at least below 10<sup>0</sup>C (50<sup>0</sup>F).

Therefore, the two most important variables are pasteurization **temperature** and the exposure or holding **time**. At present there are at least three accepted methods of pasteurization of milk;

#### a) **Holding or vat method**

The holding or vat method, also known as the low temperature holding time process, is a method of holding the milk in a vat (container) to a temperature of 63<sup>0</sup>C (145<sup>0</sup> F) for 30 minutes.

#### b) **High temperature-short time method**

This is a continuous process by which milk is rapidly brought to a temperature of 71<sup>0</sup>C (161<sup>0</sup> F) and heated continuously for 15 seconds. During this process the milk has been preheated in the regeneration (heat exchanger) first and then its temperature is brought rapidly up to about 161<sup>0</sup>F, after which the milk is returned to the regenerator. The milk is then passed into the cooler and finally to a bottle filling device.

#### c) **The ultra-high temperature (UHT) method**

In this process the milk is heated to at least 88<sup>0</sup>C (191<sup>0</sup>F), held at this temperature for at least one second and then immediately cooled to at least below 10<sup>0</sup>C (50<sup>0</sup>F).

This method has been developed very recently and is used only in a few developed countries because it requires complex equipment and the highest levels of precision and handling.

In developing countries like Ethiopia pasteurization of milk has several limitations:

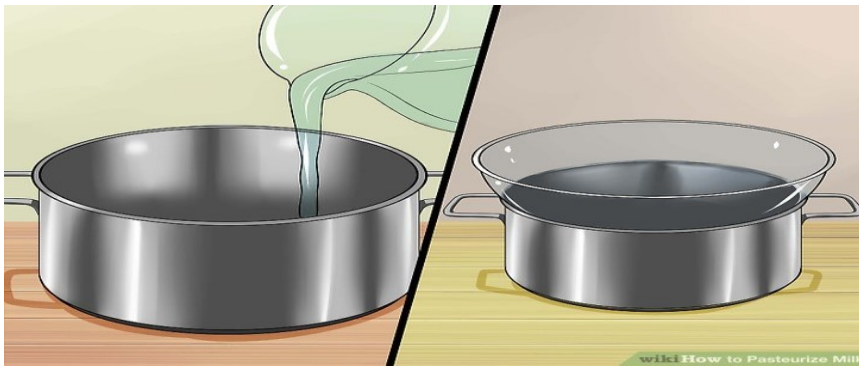
- It can only be effectively done on a commercial basis
- It requires special and expensive equipment and budget
- It requires skilled technicians to operate
- It requires a centralized collection, processing and distribution management center.

#### **Step of pasteurization with picture**

##### **Part -1: setting up**

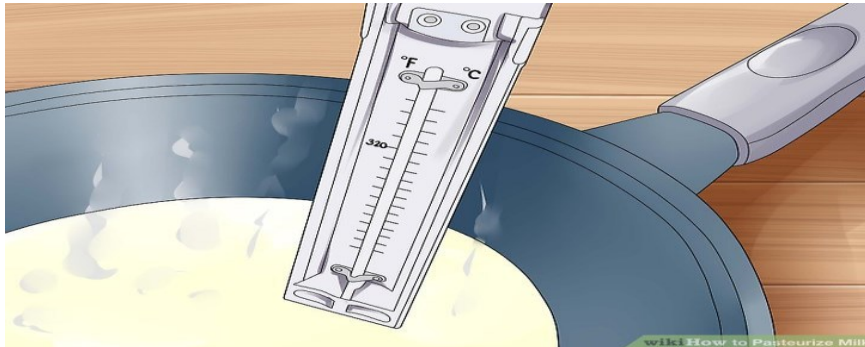
1. Set up a double boiler. Fill a large pan with about 3 to 4 inches (7.5 to 10 cm) of water. Place a slightly smaller pan in the water, ideally without the bases touching. This setup lowers the risk of scorching and burnt flavors.

Page 48 of 71	Ministry of Labor and Skills Author/Copyright	Animal Production Level - III	Version -1
			May, 2023



**Figure 2.11:** Set up a double boiler

2. Put a clean thermometer in the top pan. You'll want to track the temperature constantly, so a floating dairy thermometer or a clip-on candy thermometer works best. Wash the thermometer in hot, soapy water first, then rinse. Ideally, sanitize the thermometer by rubbing it with a single-use alcohol swab, then rinsing again.



**Figure 2.12:** Put a clean thermometer in the top pan

3. Prepare an ice bath. The faster you cool your milk after pasteurization, the safer and tastier it will be. Fill a sink or large tub with cold water and ice so you'll be ready to go.



**Figure 2.13:** Ice bath

## Part -2: Pasteurizing

1. Pour the raw milk into the inner pan: Pour through a strainer if the milk hasn't been strained since it left the animal.



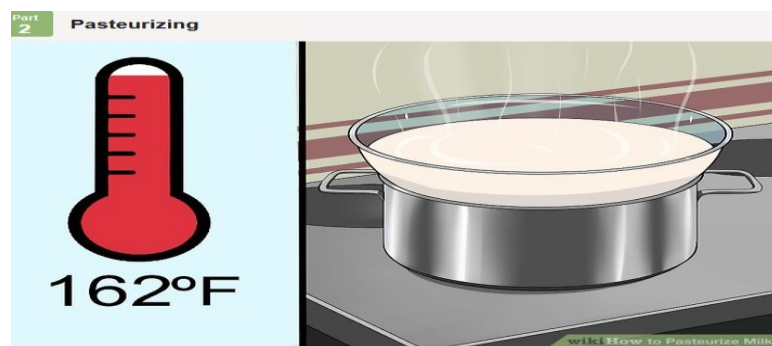
**Figure 2.14:** Pour the raw milk into the inner pan

2. Heat while stirring. Place the double boiler over medium–high heat. Stir frequently to help equalize the temperature and prevent scorching.



**Figure 2.15:** Heat while stirring

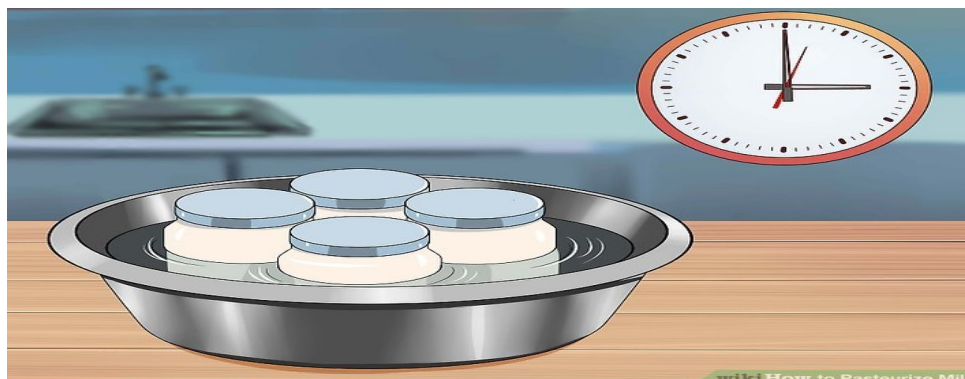
3. Watch the temperature closely. Make sure the thermometer probe is not touching the sides or base of the pot, or the measurement will be off. As the milk approaches the temperature listed below, stir constantly and draw milk from the bottom of the pan to eliminate hot and cold spots



**Figure 2.16:** Watch the temperature closely

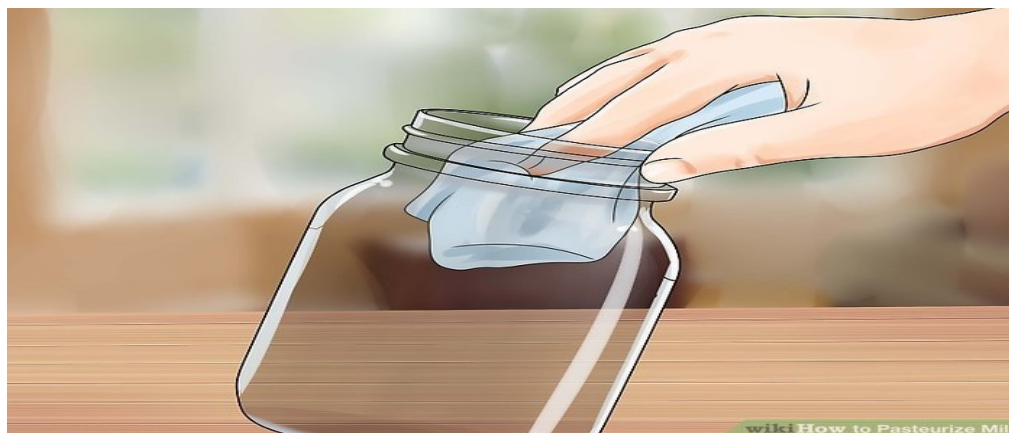
Page 50 of 71	Ministry of Labor and Skills Author/Copyright	Animal Production Level - III	Version -1 May, 2023
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4. Cool the milk rapidly in the ice bath. The faster you cool the milk, the better it will taste. Put it in the ice bath and stir frequently to help release heat. After a few minutes, replace some of the warming water with cold water or ice. Repeat this whenever the water warms — the more often, the better. The milk is ready once it reaches 40°F (4.4°C). This can take as long as forty minutes in an ice bath, or twenty minutes in an ice cream machine.



**Figure 2.17:** Cool the milk rapidly in the ice bath

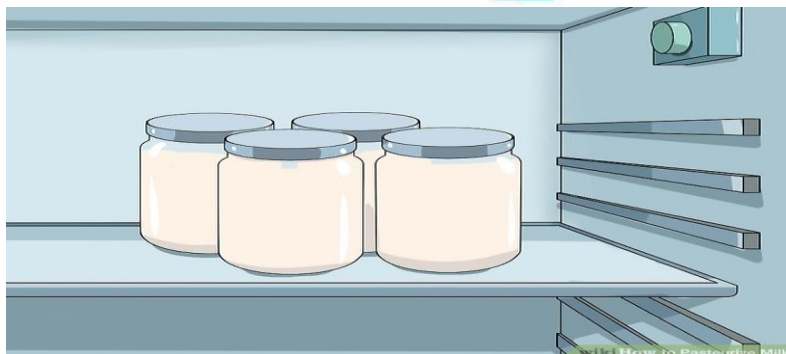
5. Clean and sanitize containers. Clean a milk container thoroughly with hot water and soap before using. For best results, sterilize a heat-safe container after cleaning by submerging it in hot water (at least 170°F / 77°C) for 30 to 60 seconds.



**Figure 2.18:** Clean and sanitize containers

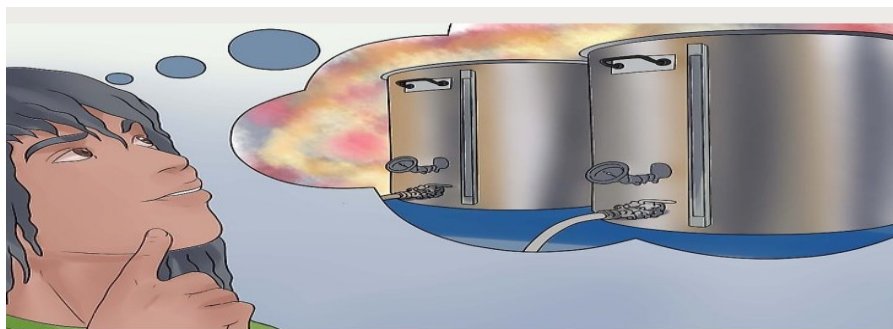
6. Store in the refrigerator. Pasteurization only kills 90 to 99% of bacteria in the milk. You still need to refrigerate the milk to prevent the bacteria population from growing to unsafe levels. Seal the container tightly and keep it away from light.





**Figure 2.19:** Store in the refrigerator

7. Upgrade to specialized tools. A machine can pasteurize larger batches and may do a better job preserving the milk's flavor. "Batch" or LTLT (low temperature long time) machines are the cheapest and simplest, but HTST (high temperature short time) machines are faster and usually have less effect on taste.



**Figure 2.20:** Upgrade to specialized tools

#### **d) Sterilization**

This refers to the complete elimination of all microorganisms. In this process milk is heated to destroy all micro-organisms including spore forming and can only be done by keeping the milk at a temperature above normal boiling point ( $100^{\circ}\text{C}$  or  $212^{\circ}\text{F}$ ) for at least 20 minutes. If the temperature of the heat treatment is higher and the sterilization effect is greater, there will be a more marked change in the color and taste of the milk.

Self-Check – 2	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

### Test I: Multiple choice

- The solidified milk fat or cream prepared by churning is called----- (2pts)  
A. Butter      B. ghee      C. yoghurt      D. cheese
- Whey is a liquid by-product that is remaining after cheese production (2pts)  
A. Whey      B. Cheese      C. whole milk      D. ghee
- Complete elimination of all microorganisms (2pts)  
A. Pasteurization      B. Sterilization      C. Boiling      D. Cooling

### Test II: Short Answer Questions

- Define milk preservation (2 points)
- Mention way of cooling milk to prevent milk deterioration (3points)
- Write 4 limitations of milk pasteurization in developing countries like Ethiopia (4pts)
- List down 3 milk preservation methods. (2pts)
- Mention factors that affecting efficiency of cream separation (4points)
- What are the factors that affect churning? (5points)
- List down types of cheese based on moisture content of the fat-free solids (3points)

Note: Satisfactory rating - 25 points      Unsatisfactory - below 25 points

You can ask you teacher for the copy of the correct answers.

## Operation Sheet -2

### 2.1. Technique of cream separation

#### a. Tools and equipment

- PPE
- Milk
- Cream separator
- Thermometer
- Bowl

#### b. Procedures

- prepare all necessary materials and equipment
- Set bowl, fit the skim milk spout and the cream spout.
- Fit the regulating chamber on top of the bowl.
- Put the float in the regulating chamber.
- Put the supply can in position, making sure that the tap is directly above and at the centre of the float.
- Pour warm (body temperature) water into the supply can.
- Turn the crank handle, increasing speed slowly until the operating speed is reached.
- Open the tap and allow warm water to flow into the bowl.
- Pour warm milk (37 - 40°C) into the supply can. Repeat steps 6 and 7 above and collect the skim milk and cream separately.
- When all the milk is used up and the flow of cream stops, pour about again the separated milk in to the supply can to recover residual cream trapped between the discs.
- Continue turning the crank handle and flush the separator with warm water.

### 2.2. Technique of performing butter making

#### a. Tools and equipment

- PPE
- Milk/cream
- churner

Page 54 of 71	Ministry of Labor and Skills Author/Copyright	Animal Production Level - III	Version -1
			May, 2023



- Water
- Bowl
- Balance

#### **b. Procedures**

- Clarify or filtrate the milk as soon as it is milked & cool it.
- Wash & dry the churner.
- Sour the cream 2-3 days or add sweet cream to the churn after measuring the volume of cream to churn. The ideal volume of cream to be churned should not exceed one half the volumetric capacity of the churn.
- Churn the cream in cool temperature (morning or evening).
- When the butter grains appear, it may be necessary to add water (2<sup>0</sup>C below the churning temperature) to maintain butter grain butter grain of required size.
- Churning should cease when the butter grains & are the size of small wheat grains.
- Drain off the buttermilk or collect the butter grains & wash the butter with water several times. Adding only as much water as is needed to float butter in the container or churn does each washing.
- Add dry & evenly ground & of best quality salt available at a rate of 16 salts per kg of butter or according to the test & wash it.
- Roll out the 8 to 10 times or ridge with spatulas to remove excessive moisture.
- Take weight & pack it in container.

### **2.3. Technique of performing cheese making**

#### **a. Tools and equipment's**

- PPE
- Milk
- Heater
- Lemon juice
- Salt

#### **b. Procedures**

- Prepare all necessary materials tools and equipment

- Standardized the milk
- Heat to 83<sup>0</sup>c for 20 minutes
- Acid is added example Lemon juice or Lactic acids Acetic acid or Acid whey
- Stirring for 2minutes
- Coagulation to casein in denatured serum proteins, fat is incorporated
- Precipitation to settle the curd 15min
- Filtering
- Adding of salt 3-10g/l used milk
- Cooling
- Filling packs/ moulds & pressing
- packaging

## 2.4. Technique of milk pasteurization

### a. Tools and equipment

- PPE
- Milk
- Thermometer
- Salt

### b. Procedures

- Prepare all necessary materials, tools and equipment
- Reducing the temperatures to between /Chilling of milk: 2°C to 5°C
- Pre-heating (regeneration): to facilitate easy separation of butterfat
- Clarifying milk stage: filters regularly to some interval depending on the level dirt
- Standardizing filtered milk based on customer needs
- Homogenizing the milk stage to break down the milk fat globules
- Heating milk by raising the temperatures of the milk to predetermined temperature
- Holding milk holding for predetermined time.
- Cooling/chilling section: lowers the temperature of pasteurized milk to 4°C.
- Pumping /transferring cooled milk to the packaging machines for aseptic packaging

LAP TEST-2	Performance Test
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Name..... ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour. The project is expected from each student to do it.

**Task 1.** Carryout cream separation

**Task 2.** Perform butter making

**Task 3.** Perform cheese making

**Task 3.** Carryout milk pasteurization

## LG #6

## LO # 3 – Clean up on completion of work

### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Storing **and transporting** processed milk and milk by products
- Cleaning, maintaining and storing tools and equipment
- Storing reusable and disposing disposable materials
- Disposing all waste products
- Reporting work outcomes

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Store **and transport** processed milk and milk by products
- Clean, maintain and store tools and equipment
- Store reusable and disposing disposable materials
- Dispose all waste products
- Report work outcomes

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

### Information Sheet-3

#### 3.1. Storing and transporting processed milk and milk by products

The processed milk and milk by products are properly stored until transporting. All dairy products have a shelf life that varies according to how an item is processed, packaged, stored, how long a product has been allowed to stand unrefrigerated on a counter or the type of container used can alter the freshness period. Most milk, yogurt, sour cream and similar products are sold in date-coded cartons that indicate a product's peak freshness.

Important points to be considered in storing of milk and processed milk product:

- Avoid heat shock; do not leave milk out of refrigeration for a prolonged period of time.
- Try to keep the refrigerator door closed as much as possible,
- Keep the temperature steady.
- It is recommended that milk products be placed on refrigerator shelves & not on the door
- Check the temperature of your refrigerator often.

Milk and milk products should be stored in clean conditions at appropriate temperature and humidity to prevent deterioration or permit maturation.

**Table 3.1:** Recommended dairy product storage guidelines

Product	Shelf life	
	After opening T°/Time	Un opened T°/Time
Milk	35° 1 week	35° 10-14 days
Cream	35° 1 week	35° 2 weeks
Butter	35° 2weeks	35° 4 weeks
Processed cheese	35° 5 weeks	35° 24 weeks
Yogurt	35° 3 weeks	35° 4 weeks

The following are proper handling and storage of human milk that expressed breast milk:-

- Be sure to wash your hands before expressing or handling breast milk.
- When collecting milk, be sure to store it in clean containers, such as screw cap bottles, hard plastic cups with tight caps, or heavy-duty bags that fit directly into nursery bottles. Avoid using ordinary plastic storage bags or formula bottle bags, as these could easily leak or spill.
- Clearly label the milk with the date it was expressed to facilitate using the oldest milk first.

### **3.2. Cleaning, maintaining and storing tools and equipment**

#### **3.2.1. Cleaning materials, tools and equipment**

After each step during handling and processing of milk and by products the materials should be thoroughly washed and cleaned. If not thoroughly washed they become a source of microbial contamination and shorten the life span of the materials.

Cleaning: is removal of gross contamination, organic material, and debris from the premises or respective structures, via mechanical means like sweeping (dry cleaning) and/or the use of water and soap or detergent (wet cleaning).

The cleaning cycle in a dairy comprises the following stages:

- Recovery of product residues by scraping, drainage and expulsion with water , compressed air or manually removing dust
- Pre-rinsing with water to remove loose dirt
- Cleaning with detergent
- Rinsing with clean water
- Disinfection by heating or with chemical agents (optional); if this step is included, the cycle ends with a final rinse, if the water quality is good.
- Allow to dry upside down in a dust-free surrounding;
- This eases cleaning and minimizes the risk of contamination.

#### **3.2.2. Maintaining material, tools and equipment**

Maintenance: is the upkeep of plant and machinery in proper working condition at all times

The main objective of maintenance is to:

- Increase the efficiency and improve the performance of all processing and service equipment
- Increase the overall productivity of the entire plant by achieving coordinated and continuous operation of all plant equipment
- Increase the certainty of meeting daily production schedules
- Reduce unscheduled down time
- Extend the useful life of all plant equipment
- Minimize property and personnel hazards.

### **Milk cans**

Great care should be observed in the handling of milk cans i.e. that they are not dented or damaged more than necessary. During cleaning of cans, the cleaning solution should be kept at the proper strength as alkali or acid cleaner of high concentration remove the tin and allow rusting. Thorough drying of cans will increase their life span and also improve on milk quality handled.

### **Milk cooling equipment**

Various types of refrigeration equipment ranging from surface coolers, immersion coolers, ice-bank and direct expansion refrigeration systems are in use throughout the dairy industry. Special attention should be paid to lubrication of compressors and detection and timely repair of refrigerant gas leakages.

### **Cream separator maintenance**

- The gears must be well lubricated; Follow manufacturer's instructions.
- The level of the lubricant must be kept constant; observe the oil level through the sight glass.
- The bowl must be carefully balanced.
- The bowl should be cleaned thoroughly immediately after use to ensure proper functioning of the separator and for hygiene.

### **Churner maintenance**

- The churn and butter making equipment should be washed as soon as possible, preferably while the wood is still damp in the case of wooden churns.
- Wash the inside of the churn thoroughly with hot water.
- Invert the churn with the lid on in order to clean the ventilator; this should be pressed a few times with the back of a scrubbing brush to allow water to pass through
- Remove the rubber seal from the lid and scrub the groove.
- Scald the inside of the churn with boiling water or steam. Invert and leave to dry. Dry the outside and treat metal parts with food



### 3.3. Storing reusable and disposing disposable materials

The first goal of any waste management system is to maximize the economic benefit from the waste resource and maintain acceptable environmental standards. If wastes are not properly handled they can pollute surface and groundwater and contribute to air pollution.

Management that puts into practice the principles of the **four** Rs of **Reduce, Reuse, Recycle and Recover** is the best first option;

- Reduce the amount of waste product generated
- Reuse the waste product on the farm or provide it for others to use
- Recycle the product either on-farm, such as with land application of manure, or off-farm, such as with plastic recycling programs.
- Recover methane gas from manure waste.

### 3.4. Disposing all waste products

There are different waste materials or product which will be produced in work place but the common waste material which produced during handling and processing of milk are the following;

- Animal dung and urine
- Plant debris
- Plastic
- Metal and paper-based
- Dusty feeds or bedding materials
- Contaminated milk/Adulterated milk
- Milk-house wastes or washes hair, hoof and horns, etc.

Importance of waste management

- Eliminate threats of waste
- Convert waste into useful things
- Up scaling
- Modify the wastes
- Stops offensive odour from waste
- Prevention
- Destruction and disposal of waste

## Handling of waste materials

Disposable materials properly buried in deep enough trench and should be covered with quicklime and then with soil or use Burning. But Burning is the most difficult because the Fumes and smoke may be a problem to the surrounding environment. Mud holes should be frequently filled or exclude the animals away from it quickly.

**N.B.** Never dispose waste materials everywhere.

The farm should have to continuously reduce, reuse and recycle the quantity of waste and by-products of the harvest and processing that it generates.

### 3.5. Reporting work outcomes

There are many work outcomes in dairy farm while handling and processing of milk and milk products. The work out comes should be reported to the supervisor.

Some of them are:

- The amount and quality of product to be produced.
- Disease out breaks/ disease transmission
- Human labor attendance
- Mastitis
- Insufficiency of working facilities e.g. electricity, ventilation
- Contaminations (feed, water and feeding and watering trough)
- Malfunctions of machines and equipment like cream separator, churner, milking machine, etc.
- Suspected and dead animals and the others should be properly reported.

Self-Check - 3	Written test
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Name..... ID..... Date.....

Directions: Answer all the questions listed below.

**Test I: Short Answer Questions**

- The upkeep of plant and machinery in proper working condition at all times ----- (2pts.).  
A. Maintenance      B. Personal protective equipment      C. Cleaning      D. Risk
- Removal of gross contamination, organic material, and debris from the premises via mechanical means like sweeping or the use of water is----- (2pts.).  
A. Cleaning      B. Maintenance      C. Rinsing      D. Hazard

**Test II: Short Answer Questions**

- Mention 4 points that are reported to the supervisor (4pts)
- Write the advantages of cleaning and maintaining materials, tools and equipment. (4pts)
- Write the waste materials produced during handling and processing of milk (5pts)

Note: Satisfactory rating – 15 points

Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers

## Operation Sheet -3

### Techniques of cleaning equipment

#### a. Tools and equipment

- PPE
- Recording book
- Brush
- Water
- Soap
- Disinfectant

#### b. Procedures

- Wear appropriate PPE
- Manually removing dust by brush
- Pre-rinsing with water to remove loose dirt
- Cleaning with appropriate detergent
- Rinsing with clean water
- Disinfection by heating or with chemical agents (optional); if this step is included, the cycle ends with a final rinse, if the water quality is good.
- Allow to dry upside down in a dust-free surrounding;

<b>LAP TEST-3</b>	<b>Performance Test</b>
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Name: \_\_\_\_\_ Date: \_\_\_\_\_

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within 2 hours.

**Task 1.** Clean milk handling and processing equipment

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Page 68 of 71	Ministry of Labor and Skills Author/Copyright	Animal Production Level - III	Version -1
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