Dairy production

Level-III

Learning Guide 60

Unit of Competence: Handle and process milk

Module Title: Handling and Processing of Milk

LG Code: AGR DRP3 M16 L01 LG60

TTLM Code: AGR DRP3 TTLM 1219v1

LO 1: Conduct milk collection and preservation

Instruction sheet	Learning Guide 60

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
- Conducting Milking procedure
- Milk composition and constituents
- Undertaking Milk quality test
- Preserving milk

This guide will also assist you to attain the learning outcome 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
- Conduct Milking procedure
- Identify milk composition and constituents
- Undertake Milk quality test
- Preserve of milk

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 1 to 7.
3. Read the information written in the “Information Sheet (**1, 2,3,4 and 5**) in page **2,4,15,18 and 25** respectively
4. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
5. Accomplish the **“Self-check (1, 2, 3, 4 and 5)** in page**, 3, 14, 17, 24 and 24** respectively.
6. If you earned a satisfactory evaluation proceed to “Operation Sheet (1, 2 and 3) in page 35, 36 and 37 in page 19 respectively.
7. Do the “LAP test” in page 37 (if you are ready). Request your teacher to evaluate your performance and outputs.

Information sheet-1	Preparing and using required materials, tools and equipment.

1.1. Definition of important terminologies

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.

1.2. Materials, tools and equipment

A dairy farm, even if a small one requires a variety of equipments for production, preservation, distribution of milk, processing and handling of milk products.

Milking materials and equipment:

Milking jar

, pail, milk can, weighing scale, towel, rope, strip cup, milk storage tank, sieve, apron, teat cup, milking machine

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.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define milk preservation (2 points)
2. Mention at least five milking equipment (5 points)
3. List down at least 4 Milk cooling equipment (4points)

Note: Satisfactory rating - 11points Unsatisfactory - below 11 points

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

Answer Sheet

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Information sheet-2	Conducting Milking procedure

2.1. Milking Methods

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. Proper milking is enjoyable to the cow and profitable to the owner.

There are two types of milking methods, namely

1. Manual (hand milking)
2. Mechanical (machine milking)

2.1.1. Hand milking methods.

There are two techniques of hand milking methods.

1. 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

2. 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.

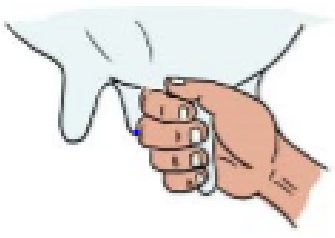


Fig.1 Hand squeeze

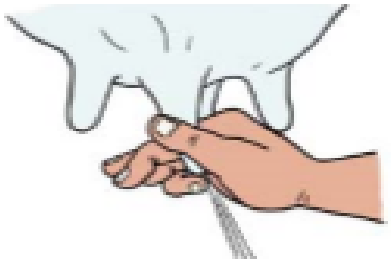


Fig.2 Hand strip

❖ 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

1. First calf heifers free of mastitis
2. Older cows free of mastitis
3. Cows with history of mastitis but not showing the symptoms
4. Cows with quarters producing abnormal milk

2.1.2. Machine milking

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. The milk flow is continuous in this method. 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.

Advantages

1. Clean milk/with less contaminants
2. Fast milking/time saving
3. Less man power
4. Complete milking
5. Important for large scale farm
6. More manageable
7. less injury to teats

8. hygienic method of milk production

Disadvantages

1. Machines are expensive
2. Require skilled man power
3. Require facilities(electricity, road)etc
4. Requires maintenance cost.

2.1.2.1. Types of milking machines/systems

1. Portable milking machines: These are ideal for small herds (upto 20 cows)

Fig.1. portable milking machine for two cows per time

Fig.2. portable milking machine for one cow per time

Fig. 3.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 parlour is present (20-100 cows)

Fig.4. Barn milking systems

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

Fig.5.Milking parlour

2.1.2.2. Selection of appropriate milking machine / system

For milking on the individual farm you need to specify a plant that best meets the requirements on the particular farm.

- 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.

2.1.2.2. 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:

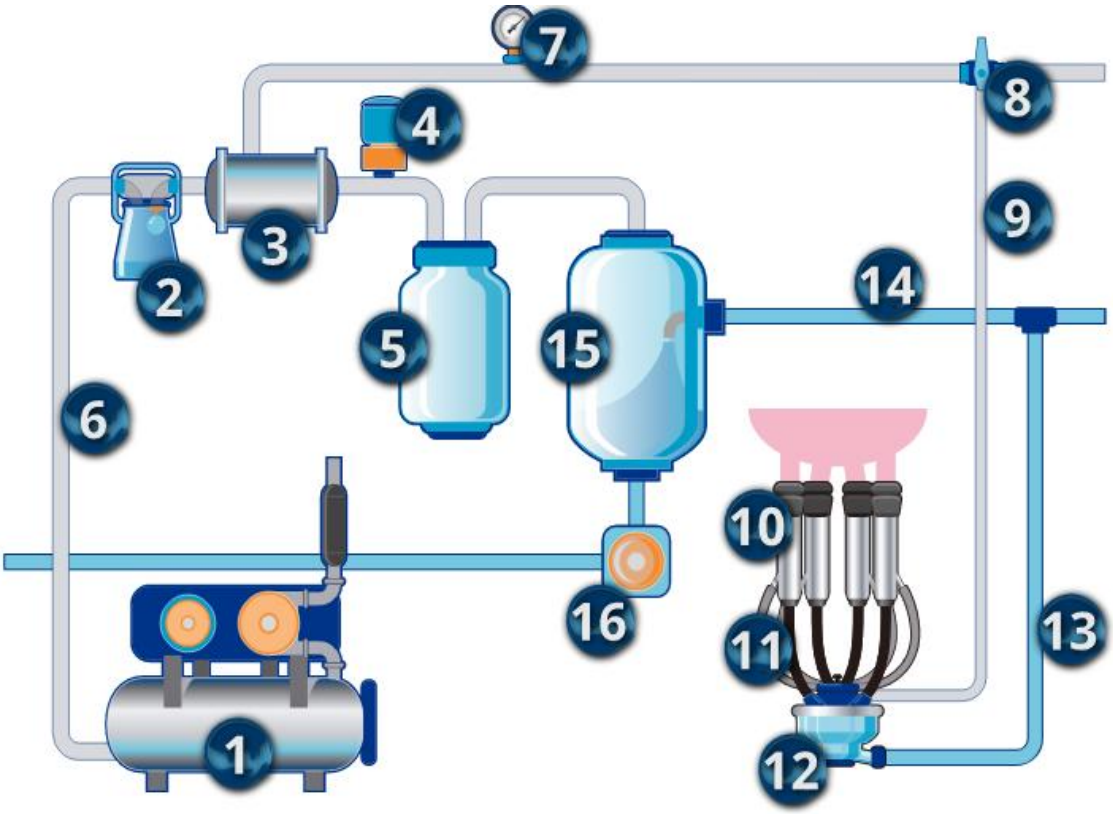


Fig.6. parts of milking machine

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 thank: 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 thank by milk pump

16. Milk pump: releases the milk to bulk thank

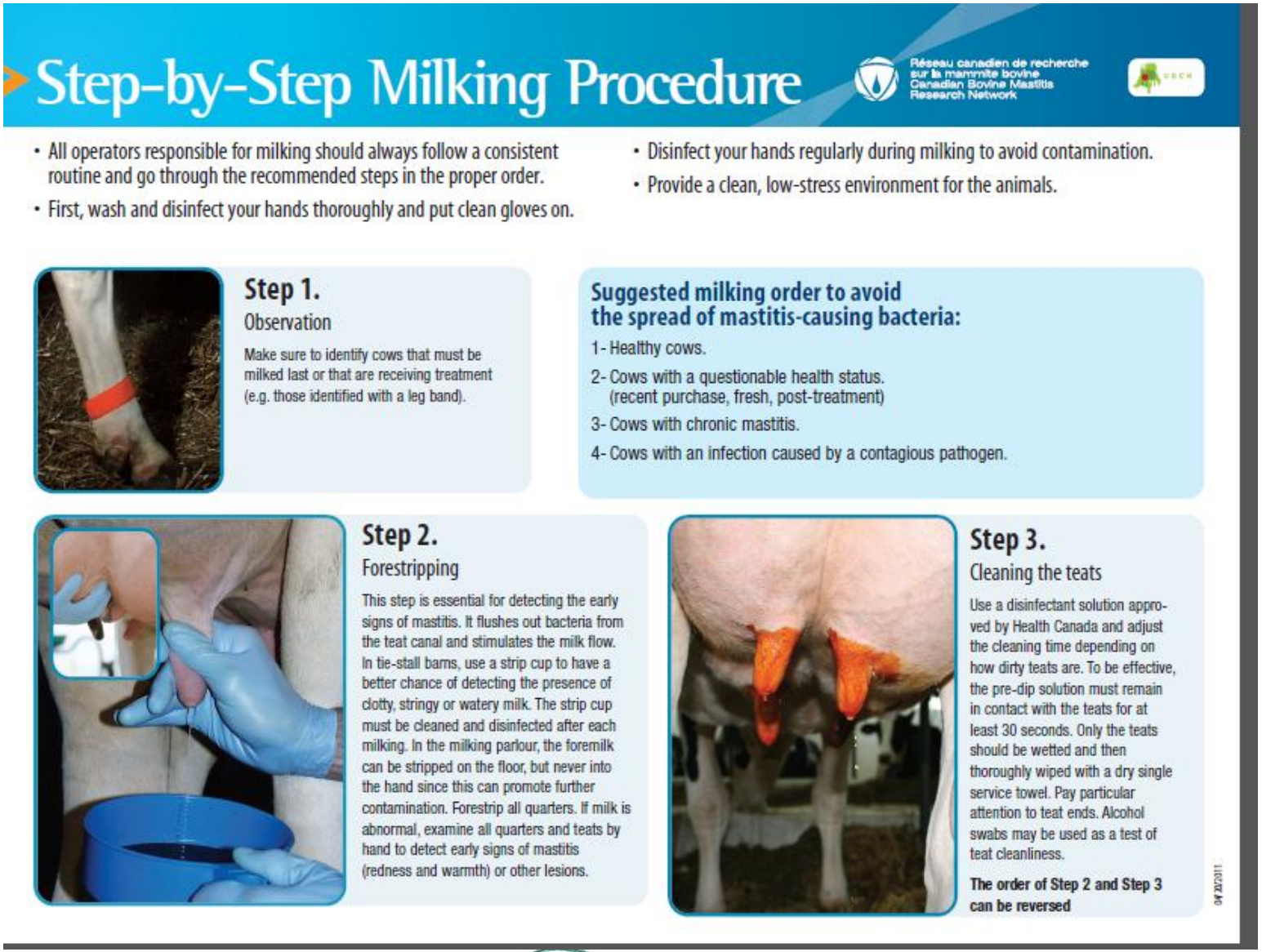
2.1.2.3. Procedure of milking machines

Milking cows is a highly qualified job that will benefit from a persistent use of correct routines.

- Before starting milking 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.
- Always 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 dry cleaning if the udder is clean. If it is so dirty that wet cleaning is required make sure you wipe the teat dry after cleaning. Use disposable cloths for each cow or individual cloths that are cleaned in a washing machine between every milking.
- Premilk by hand in a test cup. Take a few squirts from each teat and check for flocculation or blood.
- In some countries a special pre dip is used to disinfect the outside of the teat. This will eliminate infections to spread from the outside of the teat to the inside of the same or other teats milked with the same unit.
- 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 dip the cows within one minute after takeoff. This will safeguard disinfection and protection of the teat canal while it still is open
- Register the observations you do on the individual cows during milking. In many production systems milking is the only time of the day when you are close to all the individual lactating cows.
- Treated and sick cows shall always be milked separately and after all the healthy cows.

Steps of machine milking with picture



Step-by-Step Milking Procedure

Step 4.

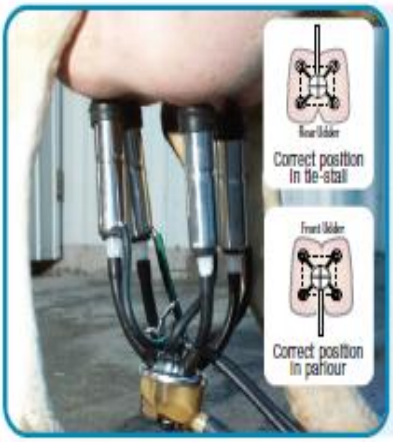
Attaching the milking unit

The milking unit should be attached within 60 to 120 seconds after first stimulation. This time allows the milk letdown reflex to occur and maximizes milking performance.

Step 7.

Milking unit removal

If the claw is removed manually, always shut off the vacuum before attempting to remove the milking unit. When using automatic detachers, make sure that they are properly adjusted.



Step 5.

Adjusting the milking unit

Adjust the milking machine to avoid a twist in the hose and to obtain a square position of the four teat cups under the udder. Teat cups must be aligned vertically. The unit alignment should be such that, the claw outlet points between the cow's legs. The claw outlet should point between the cow's front legs for tie stalls and herringbone parlours and between the back legs for parallel parlours. Quickly correct any slipping teat cup.

Step 8.

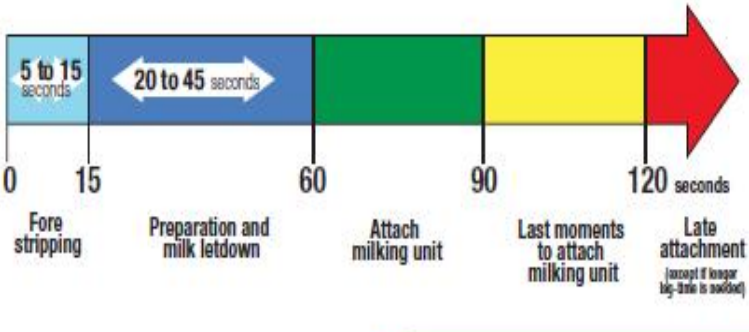
Disinfection

Once milking is completed, dip the teats fully in a disinfectant solution approved by Health Canada. Teat dip cups must be clean. Discard any unused solution, clean the container thoroughly and prepare fresh solution at each milking.

Step 6.

End of milking

Complete milking should take from 4-6 minutes per cow for most cows. Observe the milk flow carefully or use milk flow indicators to determine the ideal moment for shutting off the milking unit. Avoid overmilking.



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Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention the two types milking methods (4 points)
2. Advantage of machine milking (6 points)
3. Mention types of milking machine (3points)
4. List down important points to considered during selections of milking machine (5points)

Note: Satisfactory rating - 10points Unsatisfactory - below 10 points

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

Answer Sheet

Score = _____

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Information sheet-3	Milk composition and constituents

3.1. 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. 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

3.2. 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.

3.2.1. 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.

3.2.2. Stage of lactation

Immediately after calving, a cow produces colostrums during the first five days after which the milk reverts to its normal composition. Colostrums is heavier than normal milk and contains 10 times more whey proteins. Colostrums 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.

3.2.3. 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.

3.2.4. 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).

3.2.5. 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 per cent. A good forage-to-concentrate ratio is important to enable cows produce good quality milk to their potential.

3.2.6. 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.

3.2.7. Effect of heating

Pasteurization kills more than 90 per cent of bacteria and causes minor Denaturation of proteins and loss of some water-soluble vitamins. Heating milk above 90°C causes more than 65 per cent 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.

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention factors that affect the milk composition and constituents (7points)

2. Describe how heating of milk can alter composition of milk (3points)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

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

Answer Sheet

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Rating: _____

Name: _____ Date _____

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Information sheet-4	Undertaking Milk quality test

Milk testing and quality control is an essential component of any milk processing industry whether small, medium or large scale. 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. The quality of raw milk is the primary factor determining the quality of milk products. Good-quality milk products can be produced only from good-quality raw milk. The hygienic quality of milk is of crucial importance in producing milk and milk products that are safe and suitable for their intended uses. To achieve this quality, good hygiene practices should be applied throughout the dairy chain.

4.1. Factors affecting Milk quality

There are many factors that affect quality of milk .some them are listed below

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

The quality of milk a cow gives directly affects how much a farmer is paid for it. That's why farmers go to such great lengths to assure quality of milk. 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. Just like humans, cows can catch illnesses such as a cold or flu. They're also 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.
- **Milk adulteration:** Adulteration of milk by intentional addition of water or other substances (e.g. margarine, coconut milk, cassava fl our) 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 c gravity and increases the freezing point of milk; normal whole milk has specific c gravity range of 1.026 to 1.032 while its freezing point is minus 0.54°C. Hence, milk collection centers and processors routinely determine the specific gravity of raw milk and reject milk suspected of having been adulterated**.**

- **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** – Another factor affecting milk quality is how it's treated once it leaves the cow. 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.

4.2. Common milk quality testing methods

There are various ways and methods of monitoring milk quality, with the key ones described briefly below. Many of the methods are relatively inexpensive, with little needed in the way of equipment. Other methods may require more expensive equipment, but are more accurate and quicker. There are four simple milk quality tests that may be carried out routinely both at the farm and milk collection centre:

- Sight-and-smell (organoleptic) test
- Clot-on-boiling test
- Alcohol test
- Lactometer test

These tests ensure that only milk of acceptable quality is received and require only a small amount (sample) of milk from each container. If the sample of milk doesn't pass the test, the milk from that container will be rejected and in most cases, the farmer bears the loss. Thus, it is important that milk is handled in accordance with good hygienic practice particularly at the farm. The procedures of these milk quality tests are described below:

4.2.1. Organoleptic (sense) tests

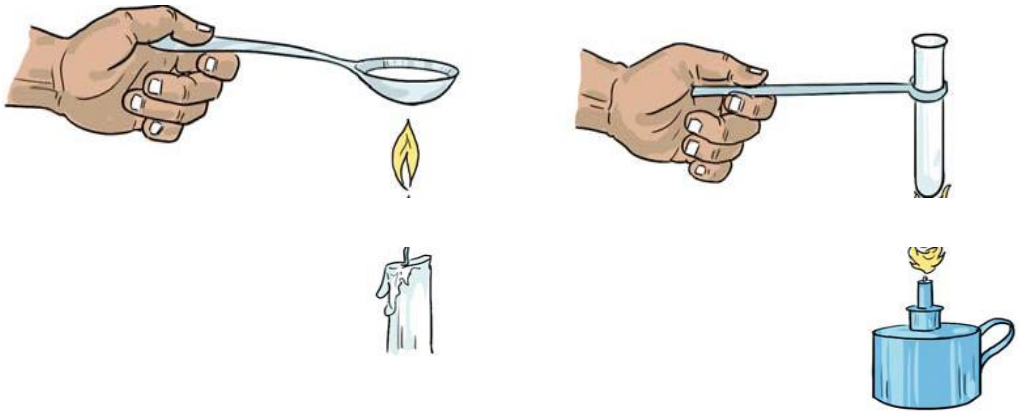
The organoleptic test permits rapid segregation of poor quality milk at the milk receiving platform. No equipment is required, but the milk grader must have good sense of sight, smell and taste. The result of the test is obtained instantly, and the cost of the test is low. Milk which cannot be adequately judged organ must be subjected to other more sensitive and objective tests.

Abnormal appearance and smell that may cause milk to be rejected could be due to:

- Type of feed or atmospheric taint
- Cows in late lactation or in some cows when on heat
- Bacterial taints (from cows with mastitis)
- Chemical taints or discoloring (may be due to equipment not rinsed properly)
- Advanced acidification or souring (milk that is fermenting)
- Marked separation of fat may be caused by:
- Adulteration with other solids (may also show as sediments or particles)
- Boiling, if milk fat is hardened

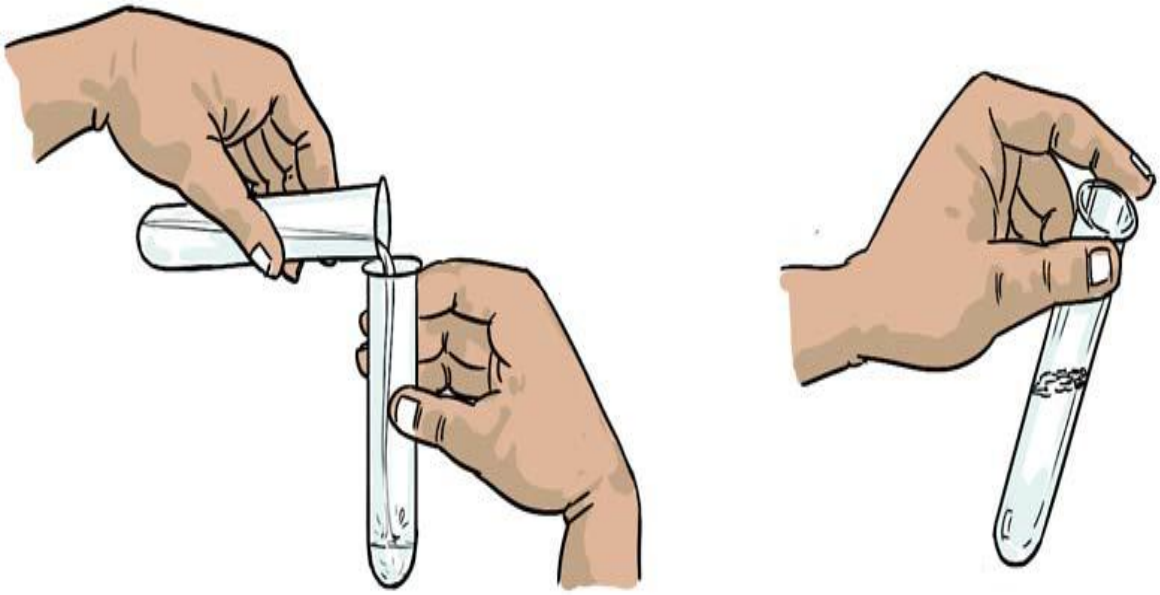
4.2.2. Clot on Boiling (C.O.B) Test

The test is quick and simple. It is one of the old tests for too acid milk (pH<5.8) or abnormal milk (e.g. mastitis milk). If a milk sample fails in the test, the milk must contain many acid or rennet producing microorganisms or the milk has an abnormal high percentage of proteins like colostrums milk. Such milk cannot stand the heat treatment in milk processing and must therefore be rejected.



4.2.3. The 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 (colostrums milk) and salt concentrates (mastitis) results in a positive test.



4.2.4. 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.

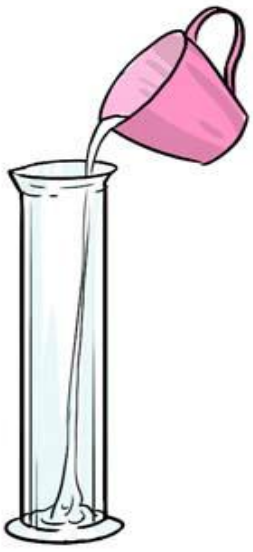
4.2.5. Lactometer or density test

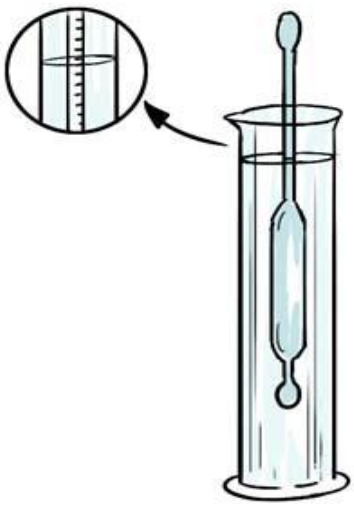
During the organoleptic inspection the milk appears to be too thin and watery and its colour is “blue thin”, it is suspected that the milk contains added water. The lactometer test serves as a quick method to determine adulteration of milk by adding water. The test is based on the fact that the specific gravity of whole milk, skim milk and water differ from each other.

With a lactometer the specific density of milk is measured. At 20 ºC 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 20ºC.

EXAMPLE: Calibration temperature of lactometer 20ºC.

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





Procedure:

- Mix the milk sample and pour it gently into a measuring cylinder.
- Let the Lactometer sink slowly into the milk.
- Read and record the last Lactometer degree (ºL) just above the surface of the milk.
- If the temperature of the milk is different from the calibration temperature (Calibration temperature may be=20 ^{0}C) of the lactometer,
- Calculate the temperature correction. For each ºC above the calibration temperature add 0.2ºL; for each ºC below calibration temperature subtract 0.2 ºL from the recorded lactometer reading.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down common milk quality testing methods (4pts)
2. What are the factors that affect milk quality? (4pts)
3. Write method of milk quality test which **doesn't not** require equipment (2pts)
4. Which method of milk quality testing is used to identify adulteration of milk (2points)

Note: Satisfactory rating – 12 points Unsatisfactory - below 12 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-5	Preservation of milk

5.1. Milk preservation method

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.

5.1.1. Cooling milk

To avoid rapid deterioration of the milk after milking, it should be cooled down to 2-4^{0}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

5.1.2. 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.

5.1.3. 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.

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 10^0C (50^0F).

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:

1. 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 63^0c (145^0 F) for 30 minutes.

2. High temperature-short time method

This is a continuous process by which milk is rapidly brought to a temperature of 71^0c (161^0 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 1610F and is held there through a holding tube for a period of 15 seconds, after which the milk is returned to the regenerator. The milk is then passed into the cooler and finally to a bottle filling device.

3. The ultra-high temperature (UHT) method

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

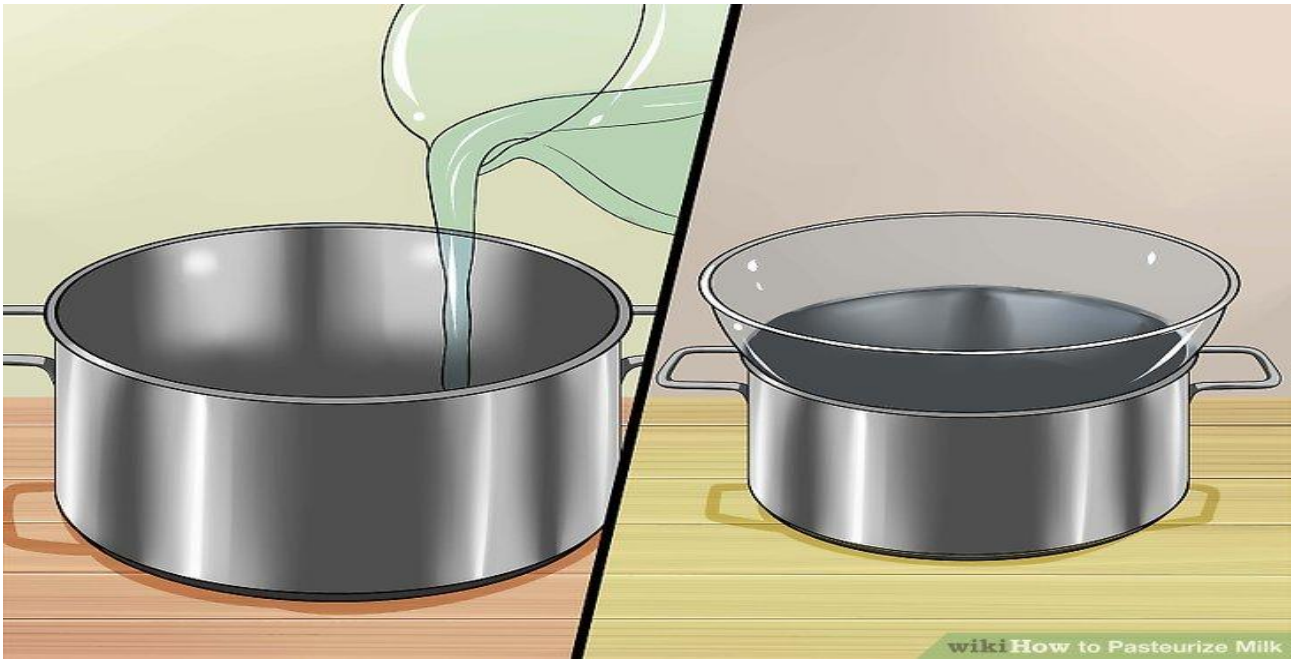
This method has been developed very recently and is used only in a few developed countries because it requires complex equipment and the highest levels of precision and handling.

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

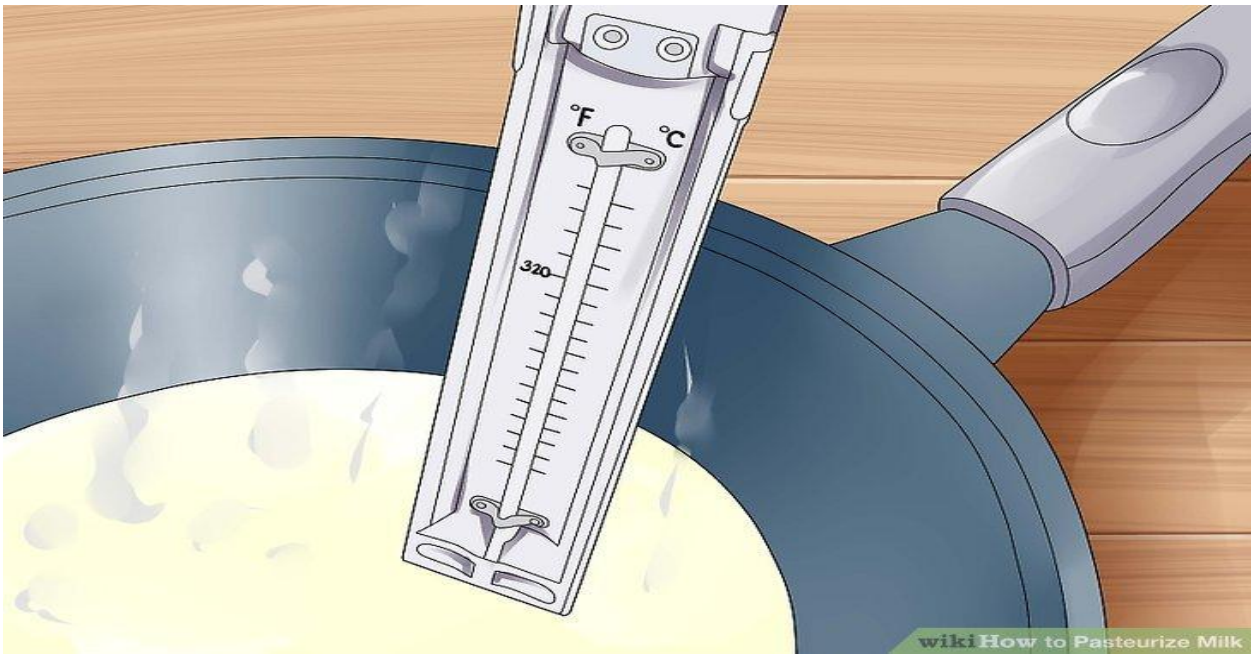
- It can only be effectively done on a commercial basis
- It requires special and expensive equipment and budget
- It requires skilled technicians to operate
- It requires a centralized collection, processing and distribution management center.

Step of pasteurization with picture

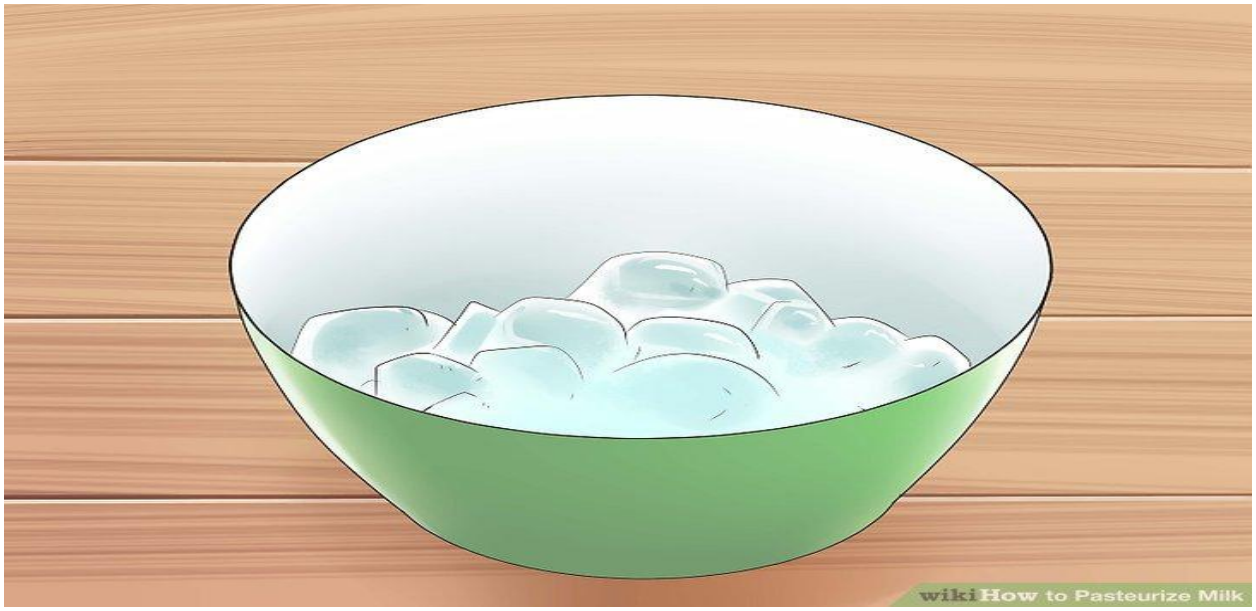
Part 1 setting up



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.



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.

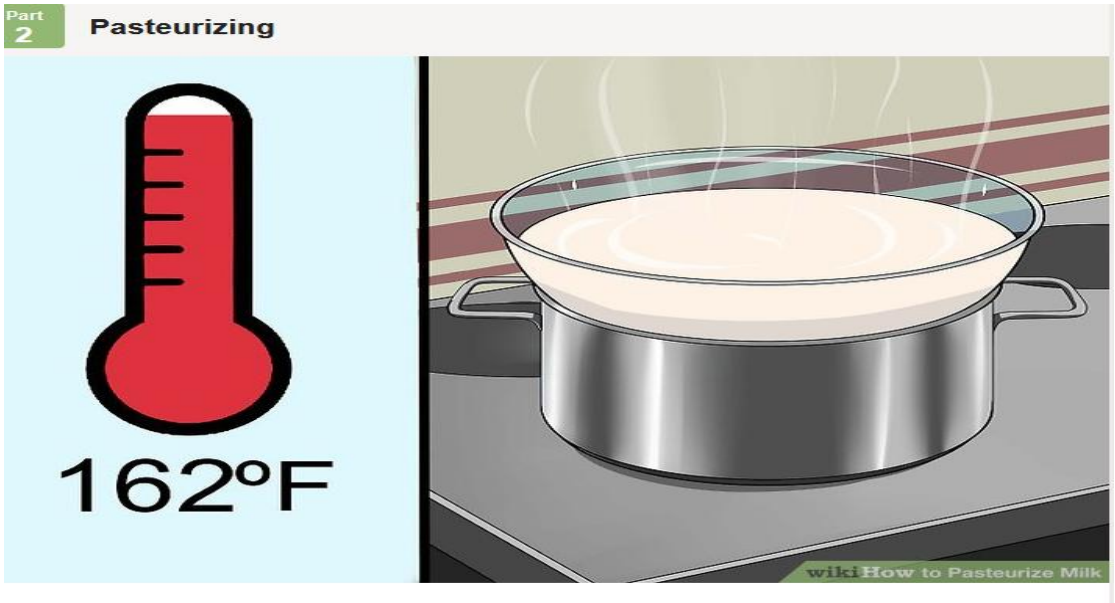


3. Prepare an ice bath. The faster you cool your milk after pasteurization, the safer and tastier it will be. Fill a sink or large tub with cold water and ice so you'll be ready to go.

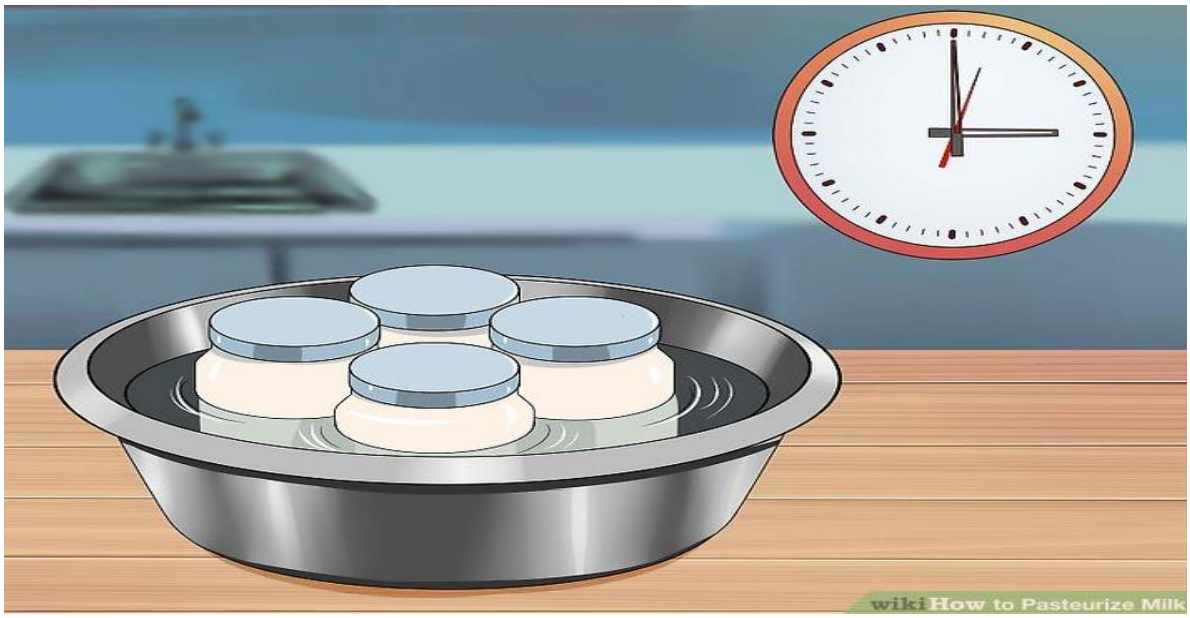
Part 2 .Pasteurizing

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.

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



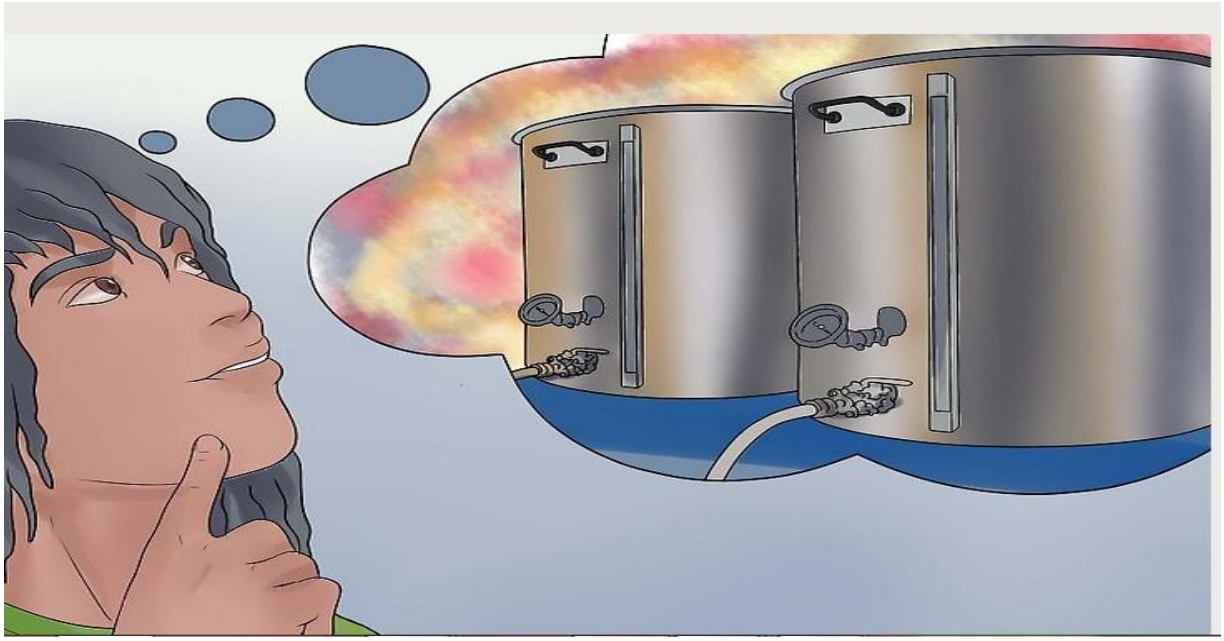
3. Watch the temperature closely. Make sure the thermometer probe is not touching the sides or base of the pot, or the measurement will be off. As the milk approaches the temperature listed below, stir constantly and draw milk from the bottom of the pan to eliminate hot and cold spots



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 40ºF (4.4ºC). This can take as long as forty minutes in an ice bath, or twenty minutes in an ice cream machine.

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 170ºF / 77ºC) for 30 to 60 seconds.

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.



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.

3.4. 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 (100^0c or 212^0 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 -5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention way of cooling milk to prevent milk deterioration (3points)

2. Write 4 limitations of milk pasteurization in developing countries like Ethiopia (4pts)

3. List down 3 milk preservation methods. (2pts)

Note: Satisfactory rating – 9 points Unsatisfactory - below 9 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date** _____

1

- _____
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2

- _____
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Operation sheet-1	**perfume machine milking**

Procedure

1. 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.
2. Handle animals with care and in a calm manner. No yelling or beating if you want them to give you all their milk.
3. 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.
4. Premilk by hand in a test cup. Take a few squirts from each teat and check for flocculation or blood.
5. Put on the milking unit within one minute after preparation.
6. Monitor the milking and adjust the unit if it starts squeaking or if the cow appears uncomfortable.
7. 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.
8. Teat dips the cows within one minute after takeoff.
9. Register the observations you do on the individual cows during milking

N.B. Treated and sick cows should be milked separately after all the healthy cows.

Operation sheet-2	Milk quality test

a. Alcohol test

Apparatus

Test tubes, e.g. 150 mm long and 16 mm diameter

Test-tube racks or blocks of wood with holes bored to hold the test tubes.

Reagents

75% alcohol solution this is usually prepared from 95% alcohol by mixing with distilled water in the proportion of 79 parts of 95% alcohol to 21 parts of distilled water.

Procedure

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

b. Lactometer test/density test

Procedure:

1. Mix the milk sample and pour it gently into a measuring cylinder.
2. Let the Lactometer sink slowly into the milk.
3. Read and record the last Lactometer degree (ºL) just above the surface of the milk.
4. Calculate the temperature correction.

5.For each ºC above the calibration temperature add 0.2ºL; for each ºC below calibration temperature subtract 0.2 ºL from the recorded lactometer reading.

Operation sheet-3	Milk pasteurization

Steps of Pasteurization

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

LAP test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 6 hours.

Task 1. Perform hand milking

Task 2. Milk quality testing

a. Alcohol test

b. lactometer test

Task.3.milk pasteurization

References

Hopster, H., et al., (2002), "Stress Responses during Milking; Comparing Conventional and Automatic Milking in Primiparous Dairy Cows", *Journal of Dairy Science* Vol. 85, pp. 3206–3216

Lund, B.M., Gould, G.W. & Rampling, A.M. (2002) Pasteurization of milk and the heat resistance of Mycobacterium avium subsp. paratuberculosis: a critical review of the data. International Journalof Food Microbiology, **77**, 135–145.

Marshall, R.T. (1992) Standard Methods for the determination of Dairy Products. 16th ed. Publ. American Public Health Association.

Richardson, G.H. (1985) Standard Methods for the examination Dairy Products 15th edition, American Public Health Association, Washington

Dairy production

Level -III

Learning Guide 61

Unit of Competence: Handle and Process Milk

Module Title: Handling and Processing of Milk

LG Code: AGR DRP3 M16 L02 LG61

TTLM Code: AGR DRP3 TTLM 1219v1

LO2. Process milk into different products

Instruction sheet	Learning guide 61

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

- Determining types of milk products
- Preparing milk processing equipment and materials
- Preparing whole milk and other ingredients
- Processing milk into different types of products
- Identifying any OHS hazards and taking appropriate action
- Using PPE
- Observing sanitary procedure

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Determine types of milk products
- Prepare the processing equipment and materials
- Prepare whole milk and other ingredients
- Process milk into different types of products
- Identifying any OHS hazards and taking appropriate action
- Using PPE
- Observing sanitary procedure

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 1 to 7.
3. Read the information written in the “Information Sheet (**1, 2, 3,4,5,6 and 7**) in page **3, 7,9,11, 18, 20 and 25** respectively
4. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
5. Accomplish the **“Self-check (1, 2,3,4,5, 6and 7** in page **(6, 8, 10, 17, 19, 21 and 27**)respectively.

6. If you earned a satisfactory evaluation proceed to “Operation Sheet 1-2 in page 24 and 3 in page 25 respectively.

7. Do the “LAP test” in page 26 (if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work.

Information sheet-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 sometime 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.

Fig.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.

Fig.2. fresh 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.

Fig.3. Ghee

- **Ice cream:** This is cream made by mixing milk products with other ingredients and them freezing them into a semi solid state. The principal ingredient of the cream is usually milk or cream flavoring and coloring materials, etc.

Fig.4.ice cream

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down common milk products that are made locally or commercially produced (6pts)

Note: Satisfactory rating – 6 points Unsatisfactory - below 6 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-2	preparing milk processing equipment and materials

There are many dairy equipments are used for processing of milk in to different types of dairy products such as cream, butter, cheese and some others. These dairy equipments help to boost the production, decrease time for packaging and labor charge as well. These equipments perform well-known dairy activities such as manufacturing, milk processing, storing, pasteurizing, transporting and packaging. Dairy plants use equipment such as plate heat up exchangers, tubular heat exchangers, ultra higher temperature equipment, cream churner milk container, butter churns, storage milk tanks and mixers. 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 equipments must be cleaned and disinfected properly. The following are materials and equipment used for the processing of milk.

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 caseous 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.

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 tanks: The milk tanks are the main part of the dairy plants used for storing or receiving raw milk, skimmed milk and cream.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down the five materials, tools and equipment used in milk processing (5pts)

2. Mention importance of milk homogenizer (2points)

Note: Satisfactory rating – 7 points Unsatisfactory - below 7 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-3	Preparing whole milk and other ingredients for processing

3.1. 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 and 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

3.2. 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 “Beso bila” etc

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down the common milk ingredients (6pts)

2. Mention importance of milk ingredients (3points)

Note: Satisfactory rating – 9 points Unsatisfactory - below 9 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet 4.	Processing milk into different type of product

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.

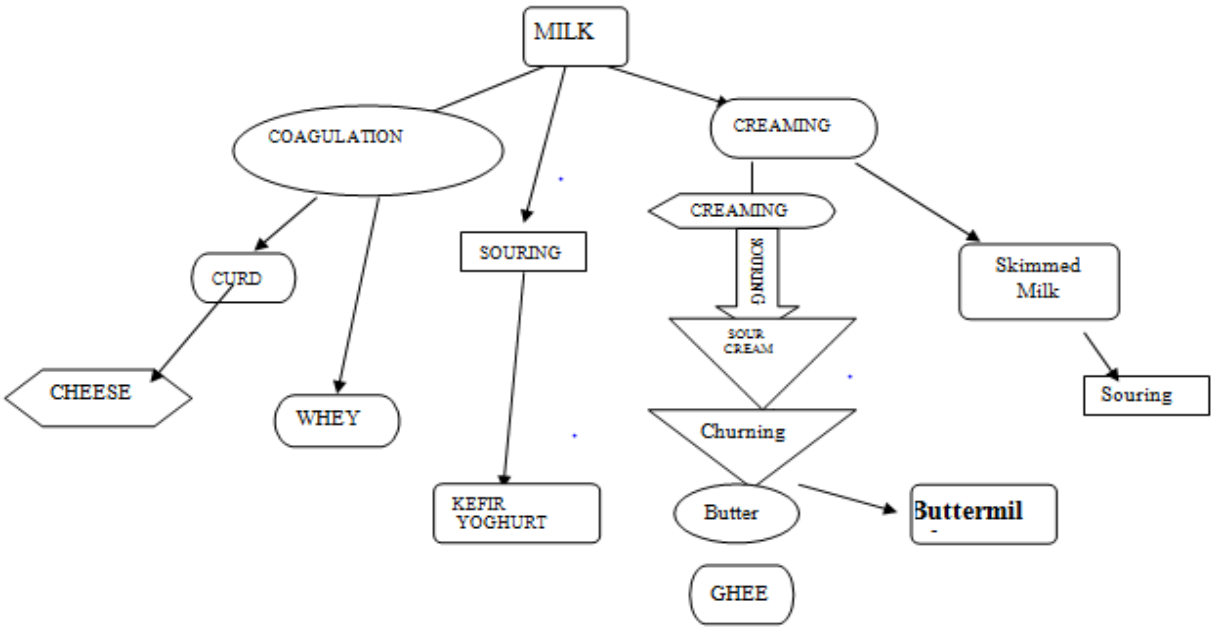

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Diagram. 1. Different products of milk

3.1.Cream separation

3.1.1.cream separation method

1. **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.

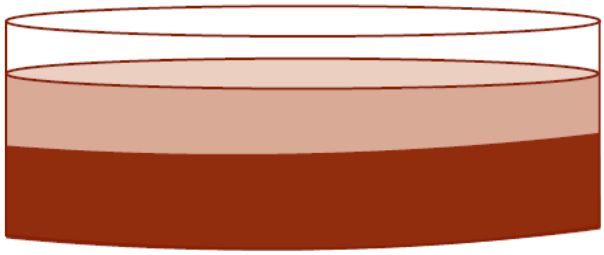

Fig.5 Shallow pan

➢ **Deep setting methods –** 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.

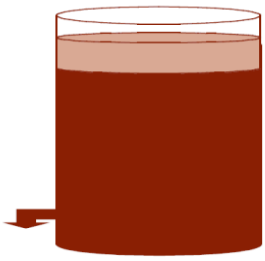

Fig.6. Deep setting pan

2. 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.

Fig.7.cream separator

Factors affecting efficiency of cream separation:

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

3.2. 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 forma network with the air bubbles that are generated by the churning; this traps the liquid and 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.

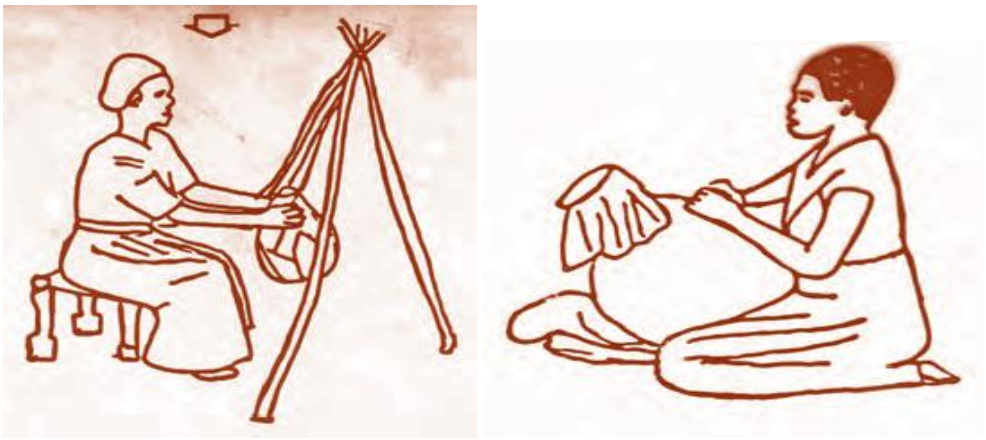

Fig.8. Traditional butter churning in a gourd (left), clay pot (right)

Fig.9.Simple hand driven butter churns

Fig.10 Modern electric churner

Factors affecting butter churning

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

3.3. Cheese

Cheese is one of the most highly concentrated and nutritious dairy products. 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 per cent or more)
- Semi-hard (57–69 per cent)
- Hard (49–56 per cent)
- Extra hard (less than 49 per cent).

Classification based on fat content of the dry matter:

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

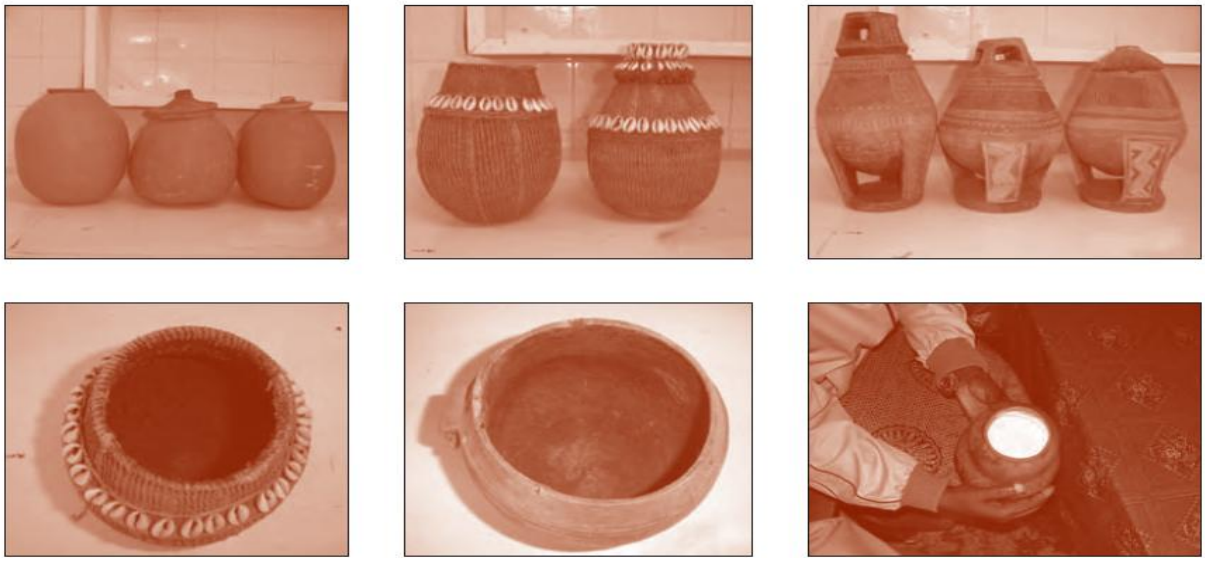

Fig.11: Some traditional milk fermentation vessels from Ethiopia

General Cheese Processing Steps

1. 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
2. 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.
3. 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).
4. 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.
5. 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.
6. 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.
7. Drain whey: The whey is drained from the vat and the curd forms a mat.
8. 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.
9. 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.
10. Form Cheese into Blocks: The salted curd pieces are placed in cheese hoops and pressed into blocks to form the cheese.
11. 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.
12. Package: Cheese may be cut and packaged into blocks or it may be waxed.

Self-Check - 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention factors that affecting efficiency of cream separation (4points)
2. Define churning? (3 points)
3. What are the factors that affect churning? (5points)
4. List down types of cheese based on moisture content of the fat-free solids (3points)

Note: Satisfactory rating – 14 points Unsatisfactory - below 14 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-5	Identifying any OHS hazards and taking appropriate action

According to the International Labor Organization (ILO) OHS Hazard can be categorized into physical, chemical or biological nature. Proper management is needed to avoid accidents and to keep the staff motivated.

5.1. Types of hazards

Physical

- Exposure to high levels of noise.
- Injuries of teats, udder
- Long-time exposure to heat and cold.
- Skeletal problems resulting from lifting and moving of animals, feed bins (bags)

Chemical

- Respiratory problems resulting from exposure to dust, which is composed of feathers, dander, micro-organisms, etc.
- Respiratory, skin, and eye diseases due to exposure to gaseous
- Exposure to disinfectants, detergents, formaldehyde and pesticides.

Biological

- Zoonotic infections. These diseases are transmitted between animals and humans & they also are transmitted from animals to humans

5.2. OHS requirements

Work task is provided according to Occupational Health and Safety (OHS) requirements. This may include:

- Using of relevant protective clothing and equipment,
- Use of tooling and equipment,
- Creating conducive working environment and safety handling of material,
- Using First aid kit to provide aid services
- Hazard control and hazardous materials and substances.etc,
- Following Occupational health and safety procedure designated for the task

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down the types of physical hazards (3pts)
2. Write the Occupational Health and Safety (OHS) requirements in work place. (7pts)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-6	Using personal protective equipment (PPE)

Select suitable personal protective equipment.

Employers have duties concerning the provision and use of personal protective equipment (PPE) at work. PPE is equipment that will protect the user against health or safety risks at work. It can include items such as safety helmets, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses. There are different types of materials, tools and equipments and supplies to perform different activities in milk handling. Therefore, identifying, selecting, using and preparing facilities, supplies according to the working activity are very important aspect in work.

Personal protective equipment include

- **Gloves**

  Gloves protect and comfort hands against cold or heat, damage by friction, abrasion or chemicals, and disease; or in turn to provide a guard for what a bare hand should not touch. Disposable gloves are often worn by health care professionals as hygiene and contamination protection measures

Fig.12.disposibe gloves

Fig.13. Rubber glove

- **Safety boots/shoes**

  Boots or shoe that has a protective reinforcement in the toe which protects the foot from falling objects or compression, usually combined with a mid sole plate to protect against punctures from below.

Fig.14.boots

- **Overall**

  The primary purpose of work wear overalls is to protect the user from harsh elements or substances that are part and parcel of the job. Whether your workers are dealing with harsh chemicals or they're out at sea; it is of the utmost importance that their skin is kept dry and comfortable.

Fig.15. overall

- **Eye protection**

Goggles, or safety glasses, are forms of protective eyewear that usually enclose or protect the area surrounding the eye in order to prevent particulates, water or chemicals from striking the eyes. They are used in chemistry laboratories and in woodworking.

Fig.16.safet goggle

- **Respiratory musk**

Respirators serve to protect the user from breathing in contaminants in the air, thus preserving the health of one's respiratory tract. here are two main types of respirators. One type of respirator functions by filtering out chemicals and gases, or airborne particles, from the air breathed by the user.[3] The filtration may be either passive or active (powered). Gas masks and particulate respirators are examples of this type of respirator. A second type of respirator protects users by providing clean, respirable air from another source

Fig.17.respiratory mask

- **Hearing protection**

Ear protection device worn in or over the ears while exposed to hazardous noise, to help prevent noise-induced hearing and reduce (not eliminate) the level of the noise entering the ear.

Fig.18.hearing protection

Protective clothing should be selected to prevent skin contact with contaminated materials or environments. Consideration should be given to the type of work being performed by the worker when selecting personal protective clothing.

Self-Check -6	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down PPE used in processing of milk (6pts)

2. Importance of using suitable PPE

Note: Satisfactory rating – 6 points Unsatisfactory - below 6 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-7	Observing Sanitary procedure

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.

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 to dry.

7.1. 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.

7.2. 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.

7.3. 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.

Self-Check -7	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write importance of cleaning milking handling and processing equipment (3points)

2. List down the general guide used in cleaning of milk equipment (5pts)

Note: **Satisfactory rating – 8 points** **Unsatisfactory - below 8points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

1. _____
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Operation sheet -1	**Cream separation**

Procedure

1. prepare all necessary materials and equipment
2. Set bow, fit the skim milk spout and the cream spout.
3. Fit the regulating chamber on top of the bowl.
4. Put the float in the regulating chamber.
5. Put the supply can in position, making sure that the tap is directly above and at the centre of the float.
6. Pour warm (body temperature) water into the supply can.
7. Turn the crank handle, increasing speed slowly until the operating speed is reached.
8. Open the tap and allow warm water to flow into the bowl.
9. Pour warm milk (37--40°C) into the supply can. Repeat steps 6 and 7 above and collect the skim milk and cream separately.
10. 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.
11. Continue turning the crank handle and flush the separator with warm water.

Operation sheet -2	Butter making

Procedure

1. Clarify or filtrates the milk as soon as it is milked & cool it.
2. Wash & dry the charner.
3. 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.
4. Churn the cream in cool temperature (morning or evening).
5. When the butter grains appear, it may be necessary to add water ($2c^0$ below the churning temperature) to maintain butter grain butter grain of required size.
6. Churning should cease when the butter grains & are the size of small wheat grains.
7. 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.
8. 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.
9. Roll out the 8 to 10 times or ridge with spatulas to remove excessive moisture.
10. Take weight & pack it in container.

Operation sheet -3	Cheese making

Procedure

1. Prepare all necessary materials tools and equipments
2. Standardized the milk
3. Heat to 83 ^{0}cfor 20 minutes
4. Acid is added example Lemon juice or Lactic acids Acetic acid or Acid whey
5. Stirring for 2minutes
6. Coagulation to casein in denatured serum proteins, fat is incorporated
7. Precipitation to settle the curd 15min
8. Filtering
9. Adding of salt 3-10g/l used milk
10. Cooling
11. Filling packs/ moulds & pressing
12. packaging

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5 hours.

Task 1. Cream separation

Task 2. Butter making

Task 3. Cheese making

References

Marshall, R.T. (1992) Standard Methods for the determination of Dairy Products. 16th ed. Publ. American Public Health Association.

Richardson, G.H. (1985) Standard Methods for the examination Dairy Products 15th edition, American Public Health Association, Washington

Smith, P. W. 1981. “Milk Pasteurization” *Fact Sheet Number 57*, U.S. Department of Agriculture Research Service, Washington, D.C.

Dairy production

Level –III

Learning Guide 62

Unit of Competence: Handle and Process Milk

Module Title: Handling and Processing of Milk

LG Code: AGR DRP3 M16 L03 LG62

TTLM Code: AGR DRP 3 TTLM 1219v1

LO3. Clean up on completion of milk

Instruction Sheet	Learning Guide 62

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

- Storing the processed milk and milk by products properly
- Returning materials to the store
- Cleaning, maintaining and storing tools and equipment
- Reporting work outcomes

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to –

- Store the processed milk and milk by products properly
- Return materials
- Clean, maintain and store tools and equipment
- Report Work outcomes

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 1 to 7.
3. Read the information written in the “Information Sheet (**1, 2, 3, and 4**) in page **2, 4, 6 and 9** respectively
4. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
5. Accomplish the **“Self-check 1, 2, 3 and 4** in page**, 3, 5, 8 and 10** respectively.
6. If you earned a satisfactory evaluation proceed to “Operation Sheet 1 in page 11.
7. Do the “LAP test” in page 12 (if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work.

Information sheet-1	Storing the 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 or dairy products be placed on refrigerator shelves and 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: 1 Recommended dairy product storage guidelines

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

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down Important points to be considered in storing of milk and processed milk product (5pts)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

1. _____
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Information sheet-2	Returning/Disposing of materials

2.1. Waste materials produced during work

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.

2.2. 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

2.3. 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.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the waste materials produced during handling and processing of milk.(5pts)
2. list down importance of waste management (5points)

Note: **Satisfactory rating – 10 points** **Unsatisfactory - below 10 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-3	Cleaning, maintaining and storing tools and equipment

3.1. 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 becomes 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. 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.

3.2.1. 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.

3.2.2. 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.

3.2.3. 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.

3.2.4. 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 though
- 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

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the advantages of cleaning and maintaining materials, tools and equipment. (4pts)
2. Mention the objectives of maintaining materials, tools and equipment.(4pts)

Note: **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

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Information sheet-4	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	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention 4 points that are reported to the supervisor (4pts)

Note: **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date _____

1. _____
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- _____
- _____
- _____

Operation sheet-1	Cleaning equipment

Procedure

- 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;

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1 hour.

Task 1. Cleaning milk handling and processing equipment

References

Dairy Practices Council. 1995. DPC #4 Guidelines for installation, cleaning, and sanitizing of large parlor milking systems, Keyport, NJ.

Missouri Department of Agriculture. (2008). Cleaning and Disinfection: Standard Operating

Guide No. 004. In Missouri Department of Agricultural Emergency Response Actions: Livestock Disease Emergency. Retrieved from http://agriculture.mo.gov/animals/pdf/animalag_guide4.pdf.

Slaghuis, B.A., G.M.V.H Wolters, H.J. Soede and J.A.M. Boerekamp, 1994. Effect of different rinsing steps on cleaning of milking equipment. Proc. Fouling and cleaning in Food Processing, Cambridge, March 1994

Wolters G.M.V.H. and J.A.M. Boerekamp, 1996. Comparison of different cleaning systems for milking equipment. Proc. IDF-symp. Bacteriological Quality of raw milk, Wolfpassing, Austria.

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