Dairy Products Processing Level-III

Based on October 2019, Version 2 OS and March 2021, V 2 Curriculum

Module Title: - Carrying out Sampling and testing of Milk at receival

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LG #17	LO #1- Implement and Monitor Personal Hygiene Standards

Instruction sheet

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

- Meeting personal hygiene for food safety program requirements
- Identifying and reporting risks to food safety
- Wearing cloth and footwear
- Complying movement around the milk processing plant

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:

- Meet personal hygiene for food safety program requirements
- Identify and report risks to food safety
- Wear cloth and footwear
- Comply movement around the milk processing plant

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”. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key answers to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, go back to “Operation sheets”.

Information Sheet 1- Meeting personal hygiene for food safety program requirements

1.1. Introduction

The health of milker and personnel handling milk is of considerable importance. The milker should be healthy, clean, have short and clean finger nails and wear clean clothes. The milker should milk the cow paying full attention to the task and not smoke, spit or cough while milking. The cow should be milked as quickly and completely as possible, and preferably always milked by the same person. By calm and gentle handling, touching the cow, talking to her and maintaining routine actions during milking.

1.2 Economic importance of effective food safety Program requirements

- Decreased health care costs;
- Improved worker productivity due to decreased disease burden;
- Increase in availability of palatable, wholesome food;
- Increased consumer confidence in food supply;
- Increased trade opportunities and export premiums;
- Increase in tourism and other related industries.

1.3 Hygiene during milking, collection and transport

Milking must be carried out hygienically, ensuring in particular:

- Before milking starts, the teats, udder and adjacent parts are clean;
- Milk from each animal is checked for abnormalities by the milker;
- Milk from animals showing clinical signs of udder disease is not used for human consumption;

The identification of animals undergoing medical treatment likely to transfer residues to the milk, and that milk obtained from such animals before the end of the prescribed withdrawal period is not used for human consumption;

- Immediately after milking, milk must be held in a clean place designed and equipped to avoid contamination.
- Milk must be cooled immediately to not more than 8°C in the case of daily collection, or not more than 6°C if collection is not daily.
- During transport the cold chain must be maintained and, on arrival at the establishment of destination, the temperature of the milk must not be more than 10°C.

1.4 Meeting personal hygiene for food safety program requirements

Guidelines for personal hygiene for workers employed in dairy processing units:

- All personnel involved in production, handling and distribution of milk and milk products should be medically examined regularly.
- Any employee suffering from vomiting, diarrhea or any notifiable disease should not handle milk but should seek medical treatment immediately.
- Finger nails should be short and clean.
- Employees should wash their hands with soap and water before commencing work and especially after using sanitary conveniences.
- Preferably elbow or leg operated taps be provided at hand-washing facilities.
- Persons performing milking must maintain a high degree of personal cleanliness.
- Suitable facilities must be available near the place of milking to enable persons performing milking and handling raw milk to wash their hands and arms.
- During milking, the milker **should not:**
  - ✓ Have long nails,
  - ✓ Sneeze, spit or cough, during milking,
  - ✓ Smoke, etc.

Don’ts during Milk receiving, testing and handling (Perssonal Hygiene)

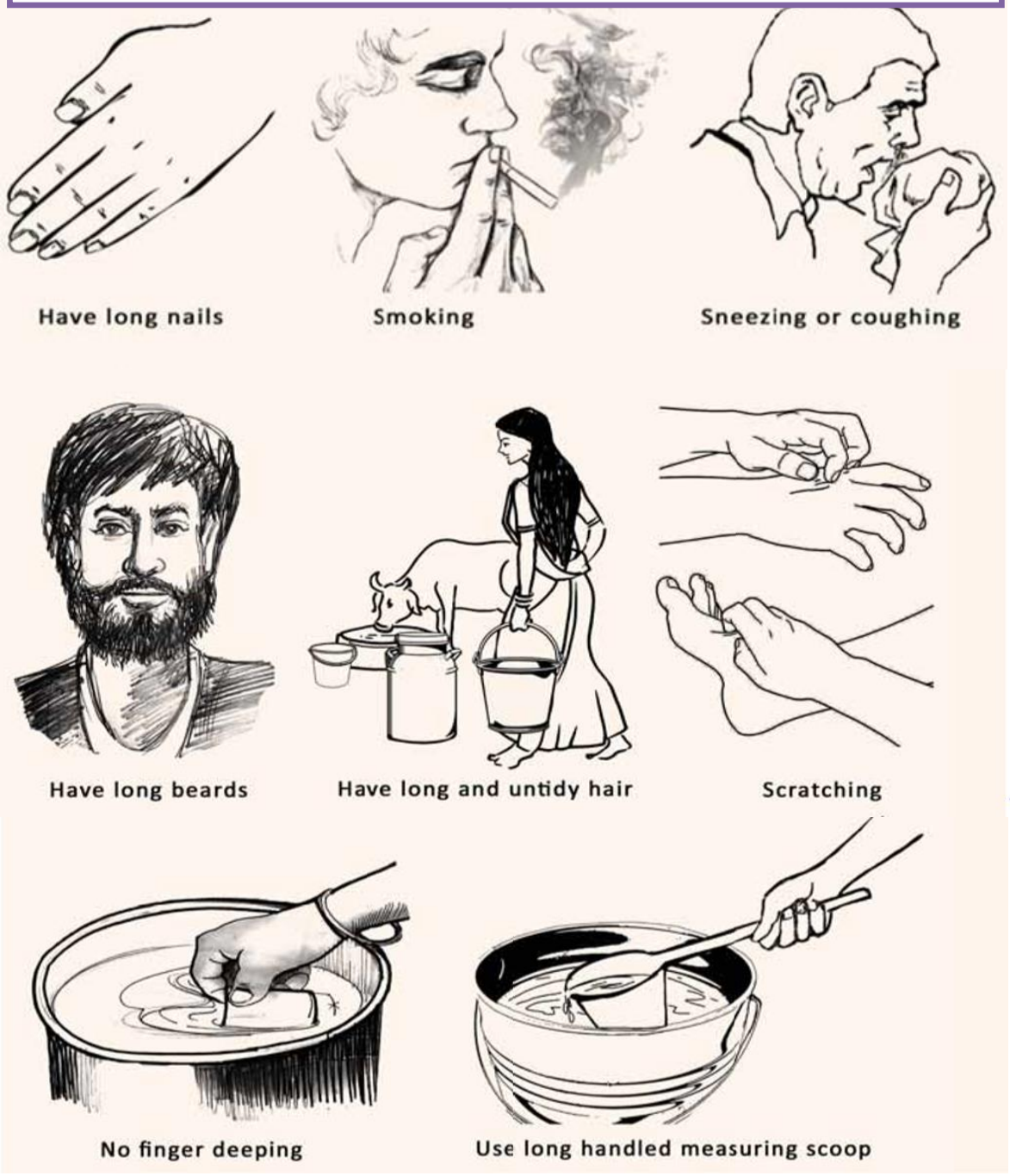

Figure 1 Personal hygiene requirements

1.5 Good personal hygiene tips to prevent food poisoning

Good personal hygiene also makes good business sense and customers like to see food-handling staff that take hygiene seriously and practice safe food handling.

Food handlers should follow tips to prevent poisoning using good personal hygiene;

- Wash and dry hands thoroughly before handling food, and wash and dry them.
- Dry hands with a clean towel, disposable paper towel or under an air dryer.
- Never smoke, chew gum, spit, or eat in a food handling or food storage area.
- Never cough or sneeze over food, or where food is being prepared or stored.
- Wear clean protective clothing.
- Keep personal items away from where food stored and prepared.
- Tie back or cover long hair.
- Keep fingernails short so they are easy to clean, and don't wear nail polish because it can chip into the food.
- Avoid wearing jewelry, or only wear plain-banded rings and sleeper earrings.
- Completely cover all cuts and wounds with a wound strip.
- Wear disposable glove over the top of the wound strip if there is a wound.
- Change disposable gloves regularly.
- Bathe or shower regularly.
- Wash your hands after:
  - ✓ Return back from the toilet
  - ✓ Handling raw food
  - ✓ Blowing your nose
  - ✓ Handling garbage
  - ✓ Touching your ears, nose, mouth or other parts of the body
  - ✓ Every break, etc.

Self- Check _1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (15 points)

1. Write down guidelines for personal hygiene for workers employed in dairy processing units. (5 points)
2. Write at least four economic importance of effective food safety Program requirements. (4 points)
3. Write down tips which food handlers should follow to prevent food poisoning using good personal hygiene. (6 points)

Note: **Satisfactory rating - 15 points** **Unsatisfactory - below 15 points**

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

Score = _____

Rating: _____

Information Sheet 2- Identifying and reporting risks to food

2.1 Identifying food safety hazards

A food safety hazard is something that is dangerous and likely to cause harm to food. Food safety hazards include;

a. Physical hazard

Physical contamination is caused by foreign objects entering food during the food preparation and service process and generally results in an injury rather than an illness. Physical contamination can come from a number of sources and can include items such as:

- Glass fragments from milk handling;
- Dust from poor cleaning ;
- A band-aid falling into food; and
- Pest infestation.

b. Chemical hazard

Chemical food poisoning is caused by the presence of toxic chemicals in food. Examples of chemicals that may contaminate food include;

- Pesticides,
- Insecticides,
- Cleaning agents, or
- Chemicals resulting from a chemical reaction between food and inappropriate Storage Containers, Eg Galvanized Cans.
- Toxins which are a poisonous chemical produced by some microorganisms.

c. Biological hazard

Food handling practices should ensure that food is not exposed to any food safety hazards. Poor handling practices can result in food being contaminated by bacteria. People, animals or pests can all cause bacterial contamination. Examples of how this could occur include:

- Poor personal hygiene such as food handlers coughing or sneezing over food;
- Not washing hands after eating or using the toilet;
- Food not being protected during self-service;
- Self-service such as buffet not being supervised;
- Pest infestations;
- Poor storage practices resulting in food being open to contamination;
- Animals on food premises.

To prevent food safety hazards, it is important to understand the key risks to food contamination, and the practices that need to be applied at each stage of food production. Food handlers should understand these two basic principles:

- Preventing food being contaminated; and
- Controlling bacteria from growing in food.

2.2 Reporting hygiene hazards to food

It is workers' responsibility to report food hygiene hazards. Food handlers must cultivate hygienic work habit. It is important to work clean and to work tidy. Recognize that food handling at work must not be treated the same as at home. The potential risks are far greater.

Food handlers must report health problems to the manager of the establishment before working with food. If they become ill while working, they must immediately report their condition, and if food or equipment could become contaminated, the food handler must stop working.

There are several instances when a food handler must either be restricted from working with or around food or excluded from working within the establishment. It is important for food handlers to report their health problems to their manager because:

- Their illness could contaminate food;
- Their illness could spread to customers eating the food they prepare;
- Their illness could cause financial loss to the business by hurting its reputation if there was a food poisoning outbreak because of their illness.

Self-Check – 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Define food safety hazard. (2 points)
2. Write down food safety hazards. (5 points)
3. Write down importance of reporting health problems to managers. (3 points)

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

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

Score = _____

Rating: _____

Information Sheet 3- Wearing cloth and footwear

3.1 Wear required personal protective clothes

Food handlers must be aware that they themselves, their actions, their health and their personal habits have a great impact on the wholesomeness of food served to the public.

A food handler's clothing plays an important role in the prevention of food-borne illness. Dirty clothes may harbor pathogens and give customers a bad impression of your establishment. Protective clothing should be kept clean and should not be worn outside the factory.

Food handlers during milk receiving and testing should:

- Wear a clean hat or other hair restraint; a hair restraint will keep hair away from food and keep the food handler from touching it.
- Wear clean clothing daily; the type of clothing chosen should minimize contact with food and equipment, and should reduce the need for adjustments.
- Remove aprons when leaving food-preparation areas; For example, aprons should be removed and properly stored prior to taking out garbage or using the restroom.
- Remove jewelry prior to preparing or serving food or while around testing areas;
  - ✓ Jewelry can harbor microorganisms, often tempts food handlers to touch it, and may pose a safety hazard around equipment.
  - ✓ Remove rings, bracelets, watches, earrings, necklaces, etc.

The personal hygiene rules during wearing personal protective clothes and operating milk testing activity includes:

- No jewelry to be worn on hands and wrists.
- Facial hair must be kept neat and controlled.
- Fingernails must be short, clean and free of polish.
- Clothing must be clean.
- Cuts and sores must always be covered
- Food handlers in the acute state of a common cold must not handle food.
- Food handlers with any communicable disease must not deal with food until they receive a certificate from a doctor stating that they are cleared to work with food.

2.1 Personal protective equipment for milk receiving, testing and handling

There are different types of equipment and supplies to perform different activities in milk handling. 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. Personal protective equipment includes;

- Overalls
- Gloves
- Plastic boots/shoes
- Respiratory musk
- Aprons,
- Hair covers, etc.

Self-Check – 3	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write down personal protective equipment which are used for undertaking milk testing activity. (5 points)
2. Write down personal hygiene rules during wearing personal protective clothes to perform milk testing operation. (5 points)

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

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

Score = _____

Rating: _____

Information Sheet 4- Complying movement around the milk processing plant

4.1 Complying movement around the milk processing plant

Once milk gets to the milk plant, several tests are required to assure food safety and wholesomeness of milk. A test conducted at the facility that is required, but not directly related to milk sensory quality, is drug residue testing. Assessments directly or indirectly related to milk quality.

Compliance with additional hygienic provisions is important, and is considered mandatory in certain circumstances, throughout the milk production process, up to the manufacture of the particular raw milk product. In addition, increased emphasis in certain aspects of the production of milk for raw milk products are specified and are critical to the production of milk that is safe and suitable for the intended purpose.

Milking should be carried out under hygienic conditions, including:

- Good personal hygiene of the milking personnel;
- Clean udders, teats, groins, flanks and abdomens of the animal;
- Clean and disinfected milking vessels/equipment; and
- Avoidance of any damage to the tissue of the teat/udder.

Milking equipment, utensils and storage tanks should be designed, constructed and maintained in such a way that they can be adequately cleaned and do not constitute a significant source of contamination of milk. Milking equipment and storage tanks (and other vessels) should be thoroughly cleaned and disinfected following each milking, and dried when appropriate. Rinsing of equipment and storage tanks following cleaning and disinfection should remove all detergents and disinfectants, except in those circumstances where the manufacturer instructions indicate that rinsing is not required.

4.2 Dairy Plant Operations and Operation requirements

In dairy plant operation, Permissible milk is characterized by:

- All raw milk delivered to a dairy plant must;
  - ✓ Meet the drug residue requirements of Schedule
  - ✓ Have been produced on a dairy farm by a licensed producer, and
  - ✓ Have been transported in a milk transport vehicle.
- Processor must ensure that samples are taken from each milk transport vehicle when milk is delivered to a dairy plant.
- Processor must test the samples for drug residue in accordance with regulation.
- Processor tested milk for drug residues is responsible for the cost of the tests.

An operation requirement in dairy plant operation includes:

- A processor must ensure that all equipment used in the processing of dairy products is designed, constructed, installed and operated to ensure that there is no contamination of dairy products by any other product.
- The surfaces of the materials and equipment that come into contact with dairy products must be;
  - ✓ Made of non-corrosive material,
  - ✓ Smooth and have no crevices or loose parts,
  - ✓ Non-toxic and of a type suitable for cleaning and disinfecting operations,
  - ✓ Free of components or residue that may contaminate dairy products.
- Steam introduced directly into dairy products and processing equipment must be from potable water and be free of harmful substances.
- The materials and equipment that come into contact with dairy products must be cleaned at the end of the dairy plant's daily operations, and must be sanitized immediately before use and every time they are contaminated.
- Non-metallic materials must be used when hand cleaning equipment.

Self-Check – 4	**Written Test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write down Dairy Plant Operations and Operation requirements. (5 points)
2. Write down hygienic conditions to carry out Milking. (5 points)

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

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

Score = _____

Rating: _____

LG #18	LO #2- Carry out Standard Tests to determine the blending and further Processing requirements of Milk

Instruction sheet

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

- Implementing procedures for receiving and handling milk
- Complying requirements and procedures for milk testing
- Carrying out sampling of milk
- Preparing and operating milk testing equipment
- Recording and storing data
- Interpreting results

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**:

- Implement procedures for receiving and handling milk
- Comply requirements and procedures for milk testing
- Carry out sampling of milk
- Prepare and operating milk testing equipment
- Record and store data
- Interpret results

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Information Sheet 1- Implementing procedures for receiving and handling milk

1.1 Milk reception and Handling

The objective of handling the milk as quickly as possible continues even at the milk reception, as the milk is still vulnerable to the spoilage, till it is chilled and taken into milk storage tank, and processed. The crucial stage of milk reception also involves the responsibility of checking the quantity, quality for acceptance, and the time management of handling many vehicles.

When milk is brought from the farm to the dairy for processing the following information on the milk is required:

- **Quality**

Before weighing the milk, its quality should be checked. Taste and smell are good preliminary indicators of milk quality, and visual observation can also be useful. If the person receiving the milk suspects that it is of poor quality, workers can carry out one of the following tests acidity, pH, alcohol and clot-on-boiling. These will determine the quality of the milk. Once the person receiving the milk is satisfied with its quality, it can be weighed and the weight recorded.

- **Quantity**

The quantity of milk received can be estimated either volumetrically or gravimetrically. Milk processors usually base payments for milk on its solids content, and hence it is more appropriate to use weight to estimate the quantity of milk being tendered. In a small-scale processing center a spring balance on a tripod and a stainless-steel bucket can be used to weigh milk. Milk weight must be recorded accurately as losses to either the seller or buyer can be incurred if care is not taken at this stage.

- **Composition of milk**

A dairy whose principal product is butter should base its payments on the butterfat content of the milk. The milk received has to be sampled and analyzed for butterfat content. It is expensive to analyses all individual milk supplies for butterfat content on a daily basis.

- **Adulteration of milk**

There are several ways in which milk may be adulterated, e.g. by adding water to increase the quantity of milk delivered and by adding an alkali to reduce the acidity of the milk with the intention to mislead with regard to its freshness.

A milk supplier may also skim off a portion of the cream layer and retain it for domestic purposes. Sophisticated equipment and techniques are required to precisely determine the degree and type of adulteration but the results of fat, titratable acidity and specific gravity tests may give strong indications of fraudulent behavior by the milk supplier. If a lower than normal fat test is obtained combined with a high (1.035) specific gravity then milk skimming should be suspected. If a lower than normal fat test is obtained combined with a low (1.020) specific gravity then the addition of water should be suspected. A lower than normal titratable acidity, e.g. 0.10% lactic acid suggests the addition of an alkali such as sodium hydroxide or sodium bicarbonate.

1.2 Milk handling equipments

After collecting and testing 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 milk handling and processing;

- Bucket
- Ladle /Spoon
- Sieve/filter
- Milk jars
- Milking can
- Lactometer
- Refrigerator
- Homogenizer
- Pasteurizer, etc.

During handling of milk consider the following important consideration points;

- Aluminum or stainless steel cans should be used for storing milk.
- Do not use plastic containers as they are difficult to clean and increase the risk of contamination after getting exposed to sun heat.
- Always handle milk in clean containers.
- When transferring milk from one container to the other, pour the milk directly from one container into the other instead of scooping it with a cup or bucket. Scooping greatly increases the chance of contamination and spoilage.
- Use long handle measuring litter/ scoop for taking out required volume of milk from milk can.
- Do not allow your fingers/ nails to touch the milk.

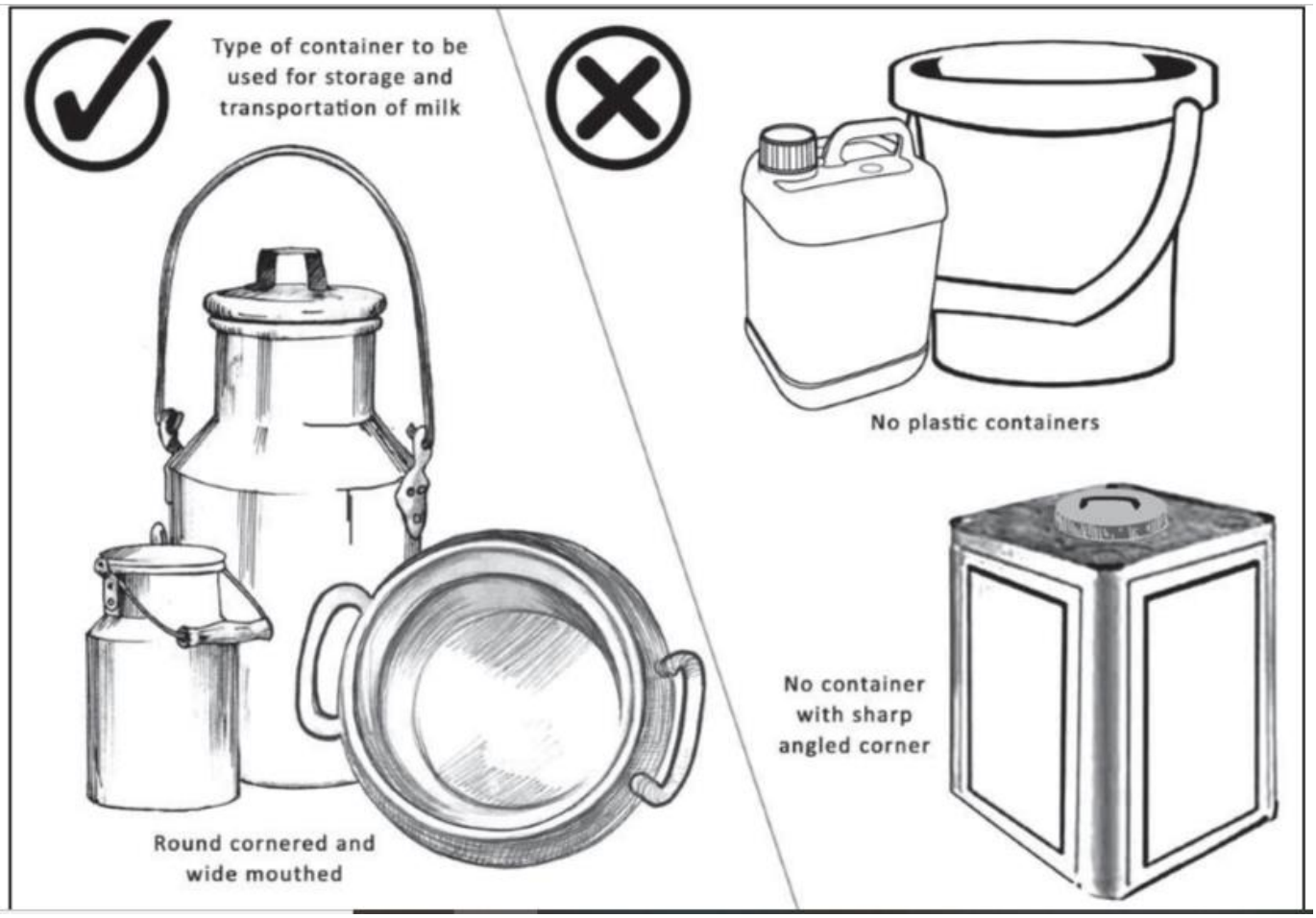


Figure 2; Milk handling equipment

1.4 Records of product quality during milk receiving

It is the objective of every milk-processing enterprise to operate an efficient and profitable unit. Apart from milk payment and processing records it is also necessary to keep records of the quality and amount of products sold. Records of sales and payment for these sales must be kept. An appropriate record sheet for each particular product will assist in identifying trends in product movement to enable processing strategies (the amount and type of product) to be drawn up.

Suggested formats for records of receiving, payment and utilization;

Table 1; Milk received, kg (table a & b)

a. Month ---------- Year ----------

Supplier No.	01	02	03	04	05	Etc
Date						
1						
2						
3						
etc						

b. Supplier No. ---------- Month ---------- Year ----------

Date	Milk received, kg	Fat %	Total Solid %
1			
2			
3			
4			
etc	Total	Average	Average

The fat and total solids determinations need not be carried out daily. Instead the milk supply is sampled daily to make a composite sample which is tested once or twice in the month.

Table 2; Milk payments record (table a & b)

(a) Month ---------- Year ----------

Supplier No.	Milk deliver, kg	Fat, %	Fat/kg	Price/kg	Total
Date					
01					
02					
03					
etc					

(b) Month ---------- Year ----------

Supplier No.	Milk deliver, litter	Price/litter	Total
Date			
01			
02			
03			
etc			

Table 3; Record of total milk supplies

Month ---------- Year ----------

Date	Milk receiving, kg	Fat %	Fat, kg	Total Solid, %	Total solids, kg
1					
2					
3					
etc	Total	Average	Total	Average	Total

Figure 3; Milk delivery at Dairy processing unit

Generally, during receiving, Good milk has the following manifestations: ·

- High fat and protein ·
- Low number of bacteria per ml. ·
- No dirt ·
- No antibiotics residues ·
- No adulterations ·
- Low number of somatic cells per ml. ·
- Produced by healthy cows ·
- Handled by healthy people.

Self-Check – 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Choose the correct answer (6 points).

1. What type of information will required when milk is brought to processing plant?
   A. Quality B. Quantity C. Composition of milk D. All
2. Which type of record can be required during milk receiving?
   A. Payment record B. Supply record C. Utilization record D. All
3. Good milk has the following manifestations except;
   A. High fat and protein C. High number of somatic cells per ml
   B. Low number of bacteria per ml. D. No antibiotics residues

Part II. Short Answer Questions (9 points)

4. Write down important consideration points during handling of milk. (5 points)
5. List at least six equipment used for milk handling and processing. (4 points)

Note: **Satisfactory rating – 15 points** **Unsatisfactory - below 15 points**

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

Score = _____

Rating: _____

Information Sheet 2- Complying requirements and procedures for milk testing

2.1 Introduction

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. Moreover, its high nutritive value makes it an ideal medium for the rapid multiplication of bacteria, particularly under unhygienic production and storage at ambient temperatures. We know that, in order for any processor to make good dairy products, good quality raw materials are essential. A milk processor or handler will only be assured of the quality of raw milk if certain basic quality tests are carried out at various stages of transportation of milk from the producer to the processor and finally to the consumer.

2.2 Milk quality testing procedures and requirements

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.

Make arrangement of all necessary materials before going to milk testing. 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.

The sight and smell test should be carried out immediately after opening the lid of the m ilk can/ container by following means:

- Observe the colour, appearance, and cleanliness of milk,
- Smell the milk just above the milk surface immediately after removal of the lid.
- Taste of milk is more permanent and easy to define than smell.
- Before tasting the milk,ensure that the raw milk is from healthy dairy animal.

Factors affecting Milk quality

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

Generally, milk test requirement and procedures includes;

- Arrangement of required sample and test materials and equipment
- Preparation of essential personal protective equipment
- Receiving raw milk
- Taking milk sample
- Test collected sample
- Determine sample quality.

Self-Check – 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. What are the factors that affect milk quality? (5 points)
2. Write down milk test procedures and requirements. (5 points)

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

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

Score = _____

Rating: _____

Information Sheet 3- Carrying out sampling of milk

3.1 Introduction

Sample is portion of a material collected according to a defined sampling procedure. The size of any sample should be sufficient to allow all anticipated test procedures to be carried out, including all repetitions and retention samples. If the quantity of material available is not sufficient for the intended analyses and for the retention samples, the inspector should record that the sampled material is the available sample and the evaluation of the results should take account of the limitations that arise from the insufficient sample size.

The first step of lab operation is collection, transportation, handling and storage of milk samples following a standard process in order to maintain the quality of milk samples that is fit for the testing purpose.

Accurate sampling is the first pre-requisite for a fair and just quality control system. Liquid milk in cans and bulk tanks should be thoroughly mixed to disperse the milk fat before sampling.

3.2 Equipment for sampling

General requirement for sample collection

Make arrangement of all necessary materials before going to sample collection. Please take the following items for collection of milk samples.

- Clean, dry, leak-proof, sterile container with graduation on the body and polythene zip bag;
- Glass Beakers , 100 ml;
- A plunger/ dipper;
- A cool box/ thermos fl ask to carry the sample;

- Required ice/gel packs in cool box to keep the sample cool during transportation;
- Personal protective clothing like apron, gloves, mask, etc.;
- Sticker tags, marker, note pad, mask, sanitizers and biohazard bag;
- Disposal bag for carrying disposable materials like leftover milk, gloves, mask;
- A hand sanitizer to sanitize hands of the sample collector, etc.

Equipment/devices used in milk sampling include;

a. Plunger or Stirrer (Agitator)

It is equipment used in sampling milk from milk cans and to mix the milk or cream to make it uniform in composition throughout the container or can in which in which the product is kept. It is made up of stainless steel or aluminum or any metal which will not adversely react with the milk or any other dairy product. A long handle is fixed to it at the center which helps in its to and fro movement in the milk or dairy product.

Figure 4; Milk sampling plunger

b. Tube Samplers

The tube samplers are advantageous in that representative sample can be obtained regardless of how long the milk has stood before sampling, and a column of milk which represents the milk from top to bottom of the container is collected as sample.

c. Stirrer/Planter

This equipment is useful for attaining consistency in the milk/cream for a representative sampling of these dairy products. It is made of stainless steel, aluminum or any other metal that does not adversely affect the milk. It consists of a perforated disk with a long handle fixed at its center to help in moving the equipment to effective mixing.

d. Dipper/Scoop

It used in sampling milk from milk cans and consists of a small cup fixed to one end of a long handle. It is mainly used to collect sample from the container.

Figure 5; Milk sampling Dipper

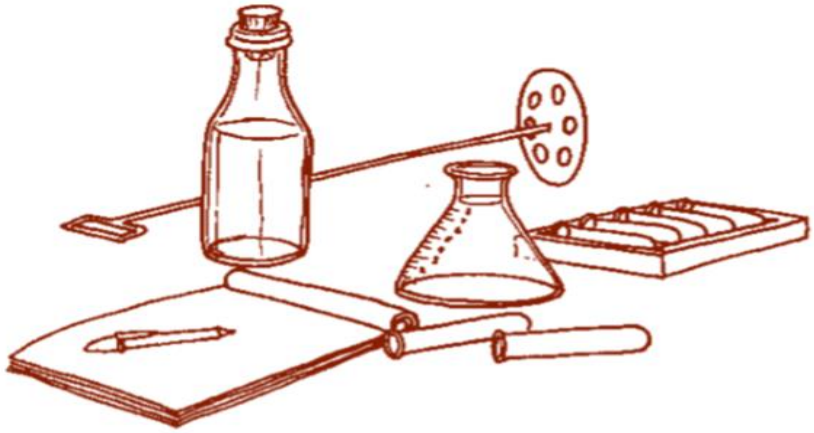


Figure 6; some equipment used for taking milk samples

3.3 Sampling milk

Sampling is necessary because it is practically impossible to test the whole batch and it requires obtaining an accurate and representative sample of milk for subsequent chemical and bacteriological examination. Strict precautions regarding sterility of the stirrer, sampler, container etc. are required for obtaining a bacteriological sample.

There are different types of samples;

a. Sampling from a single container

At the dairy processing plant, we will e receiving milk in single batches, either from individual farmers or from bulking stations. We will need to obtain samples from these single containers.

Figure 7; Collecting sample from single container

b. Composite sample from several containers

Composite sample (mixture of two or more individual lots of milk) is the quantity of milk obtained y mixing proportional parts of different milks. A sample is then picked from the composite sample to represent the whole lot.

Figure 8; collecting sample from several containers

c. Sampling from milk container

In order to collect milk sample for testing purpose, following methods should be followed;

- Agitate the liquid milk thoroughly before sample is taken to obtain a sample.
- Never agitate too vigorously because air bubbles, if dispersed in milk, will change its physical properties and disturb the analysis.
- Use a plunger having a handle long enough for doing this and immediately take the sample of required volume into a sample bottle and close it.
- To represent the whole contents of milk, samples can take the half of the required sample from the lower portion and another half from upper part of the milk can.
- To take sample from a smaller milk container, turn the container upside down few times before sampling ensuring the container is closed well.
- Agitate sample carefully again before the sample start to analysis in a laboratory.

Figure 9; Collecting sample from storage tankers

Important point to observe when sampling milk

- Sampling of milk and milk products should done by an experienced person who is familiar with the techniques.
- The whole body of the milk from which a sample is drawn should be uniform throughout its composition and truly representative one.
- When milk is left for some time in sample bottles, the fat rises to the top by virtue of its specific gravity. Under such conditions, the bottle be immersed in water bath at a temperature of 40°C to keep the fat under molten condition before mixing.
- Mixing of milk sample be ensured by stirring the milk with a long handled plunger if the container is bigger one.
- Exercise extra care when sampling is done from frozen milk because it is not uniform in composition.
- Sampling is required for chemical or bacteriological examination.

- Reach the entire depth of the liquid to ensure a representative sample of the entire batch.
- In small batches, it should be possible to accomplish mixing by pouring the entire quantity of milk from one container to another, three or four times.
- Larger batches of milk be agitated by a hand stirrer or by mechanical means.
- Clotted milk samples pose another problem in sampling due to the developed acidity. Hence, they are treated with a strong solution of caustic soda or ammonia (5-10% to the volume of milk) and a correction factor has to be worked out for the quantity of ammonia or caustic soda added.
- Examine the samples early since physical, chemical and microbiological changes affect the quality of milk.
- Transport of milk over long distance entails its own problem. In such cases, they have to be preserved by adding suitable preservatives.

Self-Check – 3	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Define milk sampling and write its advantage. (3 points)
2. Mention at least four sampling equipment. (4 points)
3. Important point to observe when sampling milk. (3 points)

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

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

Score = _____

Rating: _____

Information Sheet 4- Preparing testing equipment and operating milk test

4.1 Preparing milk testing materials, tools and equipment

Milk testing for quality can be divided into testing for hygiene and for composition. Always it required to balance between the costs and benefits of the tests, because testing regularly can become very expensive. Make sure always clean milk testing equipment thoroughly after use and use boiling water for at least one minute, 70% alcohol, or keep the equipment in a flame.

Milk testing equipment is different for different product and testing method. Testing equipment for common milk testing method includes;

- Equipment and materials used for determination of milk density in lactometer test method includes:
  - ✓ Measuring Cylinder 200 –250
  - ✓ Lactometer Calibrated at 20 ^{o}C (European standard) or 27 ^{o}C (Indian Standard).
  - ✓ Sample milk
  - ✓ Milk temperature instrument/ Thermometer
  - ✓ Lactometer reading, Correction and True reading
  - ✓ For the calculations, use Lactometer degrees, and for the conversion to density write 1.0 in front of the true lactometer reading ,i.e. 1.030 g/ml.
- Equipment and materials used for alcohol test method includes:
  - ✓ Alcohol gunner or syringe
  - ✓ Beaker or glass
  - ✓ 68% alcohol
  - ✓ Milk sample

- Equipment and materials used for COB test method includes:
  - ✓ Milk Sample
  - ✓ A test tube or spoon
  - ✓ Paraffin in burner or Bunsen burner
- Equipment and materials used for Acidity test method includes:
  - ✓ A porcelain dish or small conical flask
  - ✓ 10 ml pipette, graduated
  - ✓ 1 ml pipette
  - ✓ A Burette, 0.1 ml graduations
  - ✓ A glass rod for stirring the milk in the dish
  - ✓ A Phenolphthalein indicator solution, 0.5% in 50% Alcohol
  - ✓ N Sodium hydroxide solution.
- Other materials and equipment used during milk and milk product testing includes:
  - ✓ Strip cup
  - ✓ Lacto scan
  - ✓ Butterometer
  - ✓ Alcohol
  - ✓ Sanitizer
  - ✓ Leak-proof sterile container
  - ✓ Gerber Butyrometer
  - ✓ Milk sampler/ scoops
  - ✓ Milk sampling bottle, etc.

4.2 Operating milk quality test

Common milk quality test methods

a. 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.

Figure 10; Organoleptic test

The sight and smell test should be carried out immediately after opening the lid of the m ilk can/ container by following means;

- Observe the colour, appearance, and cleanliness of milk
- Smell the milk just above the milk surface immediately after removal of the lid.
- Taste of milk is more permanent and easy to define than smell. Before tasting the milk, ensure that the raw milk is from healthy dairy animal.

Table 4: The following are the abnormalities that can be detected by organoleptic testing:

Colour/consistency/ visible dirt	Interpretation
Pink colour	Contaminated with blood
Yellowish creamy colour	Colostrum or late milk
Thin creamy colour	Adulterated by adding water
Large clots or flakes	Sour milk or milk from cow suffering from mastitis
Small white clots or grains	Milk from cow suffering from mastitis or milk
Visible dirt and impurities (fragments of Straw, cow dung, etc.)	Adulterated with flour and skim milk powder. Can

Table 5: Storage of milk together with fruits and fish also causes off-flavours to milk;

Smell and/or taste	Interpretation
Souring	Lactose fermenting, acid producing bacteria
Bitter	Peptonising of milk by Streptococcus liquefaciens
Blue souring	Unpleasant sweet and sour smell, thin and waterish appearance caused by bacterial activity and storage in a closed container without ventilation
Fruit aroma	Pseudomonas producing esters
Slimy milk	Indicates capsule forming bacteria, e.g. Aerobacter aerogenes and Alcaligenes viscosus
Bubbles, coagulation	Fermentation by yeast

b. 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 colostrum milk. Such milk cannot stand the heat treatment in milk processing and must therefore be rejected.

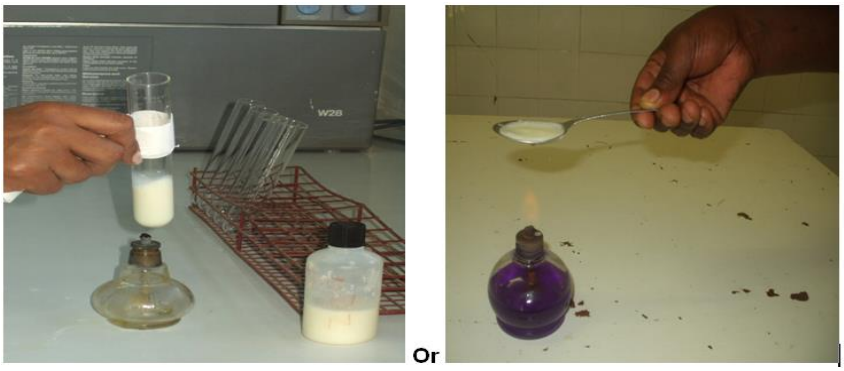


Figure 11; Clot- On- Boiling test

Interpretation of results:

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

c. 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 (colostrum milk) and salt concentrates (mastitis) results in a positive test.

Figure 12; Alcohol test procedures

Interpretation:

- Mix 2 ml of milk with 2 ml of 70% Alcohol
- If the milk Coagulate, it fails the test

d. 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 are higher than this signifies developed acidity due to the action of bacteria in milk sugar.

e. 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.

With a lactometer the specific density of milk is measured. At 15 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.

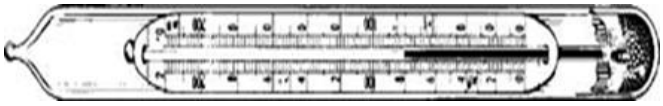


Figure 13; Dairy Thermometer

Figure 14; Lactometer

Figure 15; Lactometer test

Interpretation:

- If the temperature of the milk is different from the calibration temperature of the lactometer(20ºC), then use this correction factor:
- For each ºC above the calibration temperature add 0.2º lactometer reading from the recorded lactometer reading, and for each ºC below calibration temperature subtract 0.2 º lactometer reading.

Self-Check – 4	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Choose the correct answer (4 points).

1. Which one of the following factor ***cannot affect*** milk quality?

   A. Adulteration B. Milk Hygiene C. Temperature D. Disease problem E. None

2. Which type milk testing method is not required equipment?

   A. Organoleptic B. Colt on boiling C. Alcohol test D. Acid test

Part II. Short Answer Questions (11 points)

4. List down common milk quality testing methods (4 pts.)
5. What are the factors that affect milk quality? (4 pts.)
6. Write the method of milk quality test which doesn't not require equipment (3 pts.)

Note: **Satisfactory rating – 15 points** **Unsatisfactory - below 15 points**

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

Score = _____

Rating: _____

Information Sheet 5- Recording and storing data

5.1 Recording and storing data

Accurate records are essential for evaluating your primary processing performance. Operational/ workplace records about products and practices can be helpful to firms. Every workplace is different and requires different types of information to keep it running smoothly, efficiently and profitably. Maintaining proper records of milk processing enables the processor to identify whether the operation is efficient in terms of time, product composition and raw materials used.

5.2 Basic Records for milk

The keeping of good records is particularly important to dairy farmer groups, associations and co-operatives. Records of milk supplies and payment enable the management to know who owes money to the group and how much should be paid to individual members. Also, with good records in place, handing over of assets and liabilities of the group is made easier in the event of a change of leadership.

5.2.1 Milk supply records

Daily milk supply records should indicate the name of supplier, volume of milk supplied, date and time the milk was supplied and the price paid for the milk. Apart from these basic records, it is in the interest of both transporters and suppliers to assess and record the quality of the raw milk transported. The following measurements and basic quality tests may be carried out and the results recorded by the transporter;

- Temperature of milk
- Density of the milk
- Organoleptic test
- Alcohol test

The milk delivery card is a basic record of the quantity of milk supplied by individual farmers. It may also indicate details of the raw milk quality and the grade of milk delivered. Milk delivered refers to milk that was accepted on the basis of passing the alcohol and a lactometer test.

Table 6.1: Sample milk delivery card

Name of farmers' group: Modern Village Milk Producers Group							
Name of member: Mrs Mary Paul							
Membership no. 0023							
Year: 2005				Month: Jan.			
Date:			Milk delivered (kg)				
	a.m.	p.m.	Total (kg)	% fat	Resazurin test	Grade	Farmer's signature
1.							
2.							
3.							
…….							
31							
Total							

The data on the milk delivery card is then entered into a consolidated record of milk deliveries for the entire group.

Table 6.2: Sample consolidated daily milk supply record

Name of farmers' group: Modern Village Milk Producers Group				
Date:				
	Amount delivered (kg)			
Name of supplier	a.m.	p.m.	Total (kg)	Farmer's signature
1.				
2.				
3.				
etc				
Total				

5.2.2 Milk sales/ Delivery record

Upon delivery of milk to the point of sale or processing factory the following should be recorded;

- Name of customer
- Date and time of delivery
- Price of milk delivered
- Temperature of milk
- Density of milk
- Organoleptic quality
- Results of alcohol test

Table 6.3: Sample milk supplier payment record

Name of farmers' group: Modern Village Milk Producers Group					
Milk payment record					
Month: ..... Year:					
Farmer no.	Milk delivered (kg)	Av. grade	Price/kg	Total payment	Signature
001					
002					
003					
....					
Total					

5.2.3 Financial and non-financial records

Financial records for milk traders and transporters include cash books, ledgers, delivery books, invoices and receipts. Other important (non-financial) records include agreements and/or contracts between the milk transporter and farmer groups, individual farmers or milk processors, members' register, time sheet, etc. Farmers are then paid for their milk deliveries on the basis of a milk supplier payment record.

Table 6.4: Example of a simple cash and bank book

Date	Particulars	Ref.	Cash in	Cash out	Balance	Debts	Particulars	Ref.	Bank in	Bank out	Balance

5.3 Importance of record keeping

Records enable small-scale operators of milk businesses to keep track of all transactions carried out by the business. These include the amount of milk supplied, payments made, suppliers, creditors, debtors, and so on. Dairy farmers' records help them keep track of the costs of inputs used in milk production (animal feeds, drugs, veterinary services, labor, milk cans, etc.) and how much income they are getting from the sales of milk, heifers, cull cows, bulls, etc.

It is important to keep records of all milk that is collected. The goal of these records is to keep track of the quality and quantity of milk that is produced and delivered by the individual members of the or DPU. This information is needed to determine the amount of money each farmer will receive. As a matter of accuracy these records should be kept in a book and not on loose papers.

. Records should be kept of: ·

- The quantity of the milk delivered by each producer;
- The quality of the milk; ·
- The temperature of the milk ·
- The hygienic status of the milk and the containers; ·
- The composition of the milk (results of milk testing); ·
- The added water or skim milk to the milk.

All efforts made to milk hygiene and quality production destination is to get wholesome product thereby satisfying consumer needs.

Self-Check – 5	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Choose the correct answer (4 points)

1. Which one of the following measurement and basic quality test may be carried out?
   A. Temperature of milk B. Density of the milk C. Organoleptic test D. All
2. At delivery of milk to the point of sale or processing factory, which type of information should be recorded?

   A. Name of customer C. Date and time of delivery

   B. Temperature of milk D. Price of milk delivered

Part II. Short Answer Questions

3. Write down importance of record keeping. (6 points)

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

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

Score = _____

Rating: _____

Information Sheet 6- Interpreting results

6.1 Milk testing and Interpreting results

Proper interpretation of the recorded data is extremely important and the accumulation of large amounts of data does not indicate an efficient manufacturing operation. The following common tests applied during milk collection and reception will has the following interpreting result;

6.1.1 Organoleptic tests

Milk quality is judged by the use of a person's senses view, smell, and taste. The organoleptic tests are always used for the first screening of the incoming raw milk. In order to judge the appearance of the milk, remove the lid of the milk container and note the appearance of the surface of the milk and the lid, note any abnormal colour of the milk, visible dirt and particles, changes in viscosity etc.

6.1.2 Lactometer or density test

The lactometer test is used to determine if the milk has been adulterated with added water or solids. Addition of anything to milk can introduce bacteria that will make it spoil quickly. 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 and the lactometer test is based on the fact that milk has a heavier weight or density (1.026–1.032 g/ml) compared to water (1.000 g/ml). When milk is adulterated with water or other solids are added, the density either decreases (if water is added) or increases (if solids are added).

Most lactometers are usually marked from "0" (representing density of 1.000 g/ml) to "40" (representing density of 1.040 g/ml).

Procedure:

- Leave the milk to cool at room T^{o} for at least 30 minutes and ensure it's T^{o} is 20°C.
- Stir the milk sample and pour it gently into a 200 ml measuring cylinder or any container deeper than the length of the lactometer.
- Let the lactometer sink slowly into the milk.
- Ensure lactometer is floating and it is not touches the side of cylinder or its bottom.
- When lactometer becomes fixed, take scale reading.
- Note down the temperature, if the temperature is according to standard (20°C),;
- If the temperature of the milk is different from the lactometer calibration temperature (20°C), then use the following correction factor:
  - ✓ For each °C above the calibration T^{o}, *add 0.2* lactometer "degrees" (°L) to the observed lactometer reading.
  - ✓ For each °C below calibration T^{o}, *subtract 0.2* lactometer "degrees" (°L) from the observed lactometer reading.
- Note: These calculations are done on the lactometer readings.

Interpretation:

- If the milk is normal, its lactometer reading will be between 26 and 32.
- If the lactometer reading is below 26 or above 32, the milk will be rejected because it means that it has been adulterated with added water or solids.

Figure 16; Lactometer test

6.1.3 Clot-On-Boiling test

This test is performed simply by heating a small amount (5 ml) of milk in a test tube over a flame or by immersing it in boiling water for four minutes. The result can be seen immediately. If the milk is sour or if the milk is abnormal (colostrum or mastitis milk) the milk will clot and not pass this test.

Interpretations:

- If the milk is sour or if the milk is abnormal (colostrum or mastitis milk), the milk will clot and not pass this test. The milk is rejected if any curd forms.

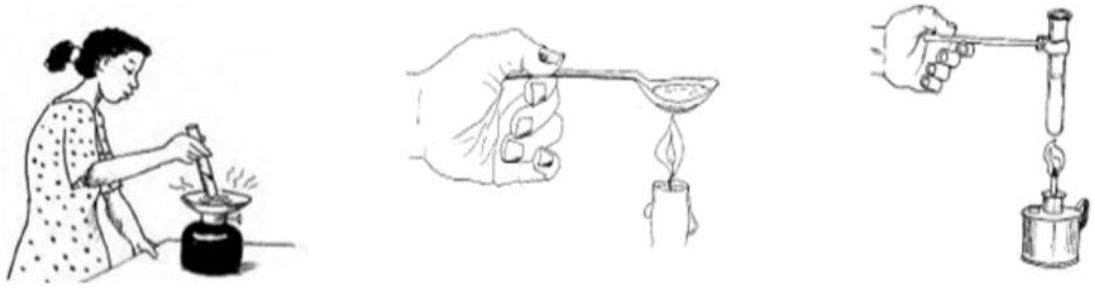


Figure 17; Different methods of clot-on-boiling tests

6.1.4 Alcohol test

The alcohol test is used for rapid determination of an elevated acidity of milk. The test is carried out by mixing equal quantities (2 ml) of milk and of a 68% or 70% ethanol solution in a test tube. If the milk contains more than 0.21% acid, this result in coagulation of the milk proteins and the milk is sour.

Interpretations: The milk will coagulate; it fails the test and is not fit for any process.

Figure 18; Alcohol test **procedures**

Self-Check – 6	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write down milk test results or judgments for Lactometer test method. (5 points)
2. Write down milk test results or judgments for Clot- On- Boiling test method. (5 points)
3. Write down milk test results or judgments for Alcohol test method. (5 points)

Note: **Satisfactory rating – 15 points** **Unsatisfactory - below 15 points**

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

Score = _____

Rating: _____

Operation Sheet 1– Carrying out Milk sampling from milk container

Objectives:

- To determine milk quality.
- To determine composition of milk.

Materials, tools and equipment needed to undertake Milk sampling

- Clean, dry, leak-proof, sterile container with graduation
- Glass Beakers
- A plunger/ dipper;
- A cool box/ thermos flask to carry the sample;
- Required ice packs in cool box to keep the sample cool during transportation;
- Personal protective clothing like apron, gloves, mask, boots, etc.;
- Sticker tags, marker, note pad, mask, sanitizers, etc.;
- Disposal bag for carrying disposable materials like leftover milk, gloves, mask;

Milk sampling from milk container Procedures;

Following the steps outlined below help ensure quality and successful milk sampling.

Step 1: Prepare Personal Protective Equipment.

Step 2: Prepare tools, equipment and machineries for sampling milk.

Step 3: Agitate the liquid milk thoroughly before sample is taken to obtain a sample.

Step 4: Never agitate too vigorously because air bubbles, if dispersed in milk, will change its physical properties and disturb the analysis.

Step 5: Use a plunger having a handle long enough for doing this and immediately take the sample of required volume into a sample bottle and close it.

Step 6: Take samples from the half of the required sample from the lower portion and another half from upper part of the can to represent the whole contents of milk.

Step 7: Turn the container upside down few times before sampling to take sample from a smaller milk container,

Step 8: Agitate sample carefully again before the sample start to analysis in a laboratory.

Step 9: Take sample and perform laboratory analysis for physical, chemical, and biological properties of sampled milk.

Figure 19; Collecting sample from storage tankers

Operation sheet-2 Perform Organoleptic (Sense) Milk tests

Objectives:

- To determine milk quality by the presence of adulteration.
- To observe cleanliness, sediment, and other contaminations.

Organoleptic (Sense) Milk tests Procedures;

Following the steps outlined below help ensure test milk quality with sense organs.

Step 1: Prepare Personal Protective Equipment.

Step 2: Open a can of milk.

Step 3: Immediately smell the milk.

Step 4: Observe the appearance of the milk.

Step 5: If still unable to make a clear judgment, taste the milk, but do not swallow it.

Step 6: Spit the milk sample into a bucket provided for that purpose or into a drain basin, flush with water.

Step 7: Look at the can lid and the milk can to check cleanliness.

Judgment:

- The milk is rejected if any abnormal smell and taste is observed.
- Abnormal smell and taste may be caused by:
- Atmospheric taint (e.g. barny/cowy odour).
- Physiological taints (hormonal imbalance, cows in late lactation- spontaneous rancidity).
- Bacterial taints.
- Chemical taints or discoloring.
- Advanced acidification (pH < 6.4).

Operation Sheet-3 Perform Clot- On- Boiling Milk test

Objectives:

- To determine milk quality.

Materials, tools and equipment needed to perform Clot- On- Boiling milk test;

- One boiling water bath
- Test tubes
- Timer (a watch or clock).
- Spoon

Clot- On- Boiling Test Milk test Procedures;

Following the steps outlined below help ensure test milk quality with Clot- On- Boiling.

Step 1: Prepare Personal Protective Equipment.

Step 2: Prepare tools, equipment and machineries for sampling milk.

Step 3: Place about 5 ml of milk in a test tube (the exact amount is not critical) and place the test tube in boiling water for 5 minutes.

Step 4: Carefully remove the test tube and examine for precipitate.

Judgment:

- If the milk is sour or if the milk is abnormal (colostrum or mastitis milk), the milk will clot and not pass this test.
- The milk is rejected if any curd forms.

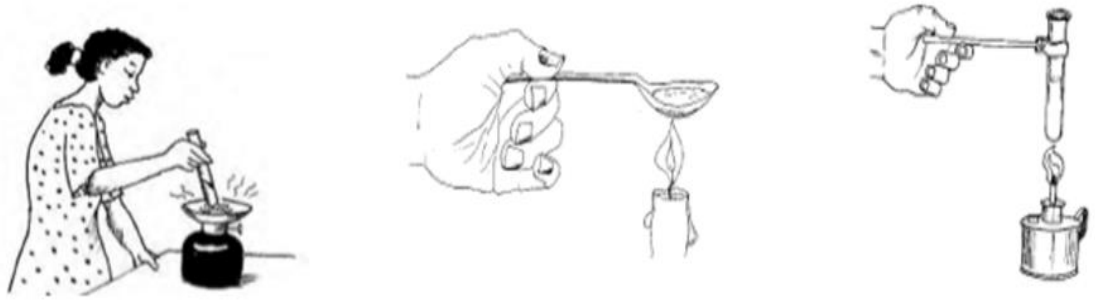


Figure 20; Different methods of clot-on-boiling tests

Operation sheet- 4 Perform Alcohol Milk Test

Objectives:

- To determine milk quality.

List of Materials, tools and equipment needed to perform Alcohol milk test;

- Test tubes, e.g. 150 mm long and 16 mm diameter
- Test-tube blocks of wood with holes bored to hold the test tubes.
- Reagents: 75% Alcohol solution or 68% or 70% Ethanol solution.

Alcohol Test Milk test Procedures;

Following the steps outlined below help ensure test milk quality with Alcohol.

Step 1: Prepare Personal Protective Equipment.

Step 2: Prepare tools, equipment and machineries for sampling milk.

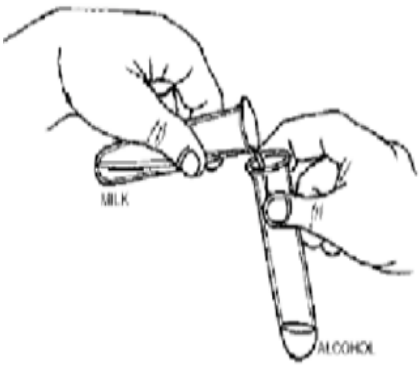
Step 3: Put equal volumes of milk and 75% alcohol in a test tube.

Step 4: Invert the test tube several times with the thumb held tightly over the open end of the tube.

Step 5: Examine the tube to determine whether the milk has coagulated.

Judgment:

- If there is fine particles of curd will be visible, the milk is rejected.



Mix 2 ml of milk with 2 ml of 70% Alcohol *If the milk Coagulate, it fails the test*

Figure 21; Alcohol test procedures

LAP Test	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 **6** hour. The project is expected from each student to do it.

Task 1. Carrying out Milk sampling from milk container.

Task 2. Perform Organoleptic (Sense) Milk test.

Task 3. Perform Clot- On- Boiling Milk test.

Task 4. Perform Alcohol Milk Test.

LG #19	LO #3- Respond to issues of Contamination or other forms of Non-conformance in the receival of fresh Milk

Instruction sheet

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

- Identifying procedures for taking corrective action
- Implementing corrective and preventative measures
- Revising procedures to support control measures
- Identifying and taking corrective action breach of procedures
- Introducing and controlling process changes

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**:

- Identify procedures for taking corrective action
- Implement corrective and preventative measures
- R**e**vise procedures to support control measures
- Identify and take corrective action breach of procedures
- Introduce and control process changes

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”. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key answers to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1- Identifying procedures for taking corrective action

1.1 Introduction

Nonconformity is the failure to meet one or more of the existing requirements in International Standard Organization (ISO 9901). When an organization finds itself outside of regulatory boundaries, it must get the problem under control before continuing business

ISO 9001 is the international standard that underlines the requirements for a quality management system (QMS). It ensures that an organization continues to offer quality products and operates correctly under its regulatory measures. If an organization isn't operating up to standard, it's called non-conformance.

Nonconformity can be found at any level of an organization's operations from quality control and manufacturing to personnel procedures. If Non-conformance persists, it can lead to the company's overall demise, as these standards are in place to ensure everyone is playing by the same rules. The goal of the ISO 9001 standards is to ensure quality and safety for employees and the customer. By entering the realm of non-conformance, a company risks the health of their employees and possibly of their customer base. That is why it is important to recognize nonconformities early.

Non-conformance should first be recognized by coworkers or supervisors before the issue reaches the audit stage. If an auditor notices nonconformity to the standards, it is the job of the audited organization to fix this issue promptly before it affects the greater goal of the company.

Therefore, nonconformity to these standards may result in unhappy customers. Another main goal is to keep employee morale high, and these standards also help to do just that. Without these standards, organizations would not be held accountable for their actions and business practices.

1.2 Non- conformance in milk

Non-conformance in milk can be rise from microorganism development, adulteration or totally quality defect. Factors affecting growth of micro-organisms in milk include;

- Food supply (water, energy, Carbon, Nitrogen, Vitamins and minerals)
- Moisture
- Oxygen supply (Obligate aerobes, Facultative, Micoaerophillic,Obligate anaerobes)
- Acidity and pH (Acidophillic)
- Preservatives
- Light (Phototrophic)
- Concentration (Osmophillic)
- Temperature (Psychotrophs 20-30; Mesophiles 30-40, Thermophiles 55- 65 ^{0}C)
- Antimicrobial constituents

1.3 Corrective action procedures for non-conformances

a. Means of destruction of micro-organisms from equipment

- Heat-pasteurization, sterilization
- Ionizing radiations e.g. UV, gamma rays
- Electricity-by heat generated
- Pressure-600 x> atmospheric pressure
- Chemicals acids, alkalis, halogens H2O2

b. Equipment Calibration

There should be demonstration of all equipment used to inspect, measure or test the product is reading accurately so that the results of these readings can be relied upon. Some equipment, such as thermometers and scales must be calibrated against a national or international standard, or a reference standard of known accuracy.

Thermometers can be calibrated against boiling water and ice-water if these approximate the temperatures the thermometer is required to measure when in use.

Developing a procedure to address products produced between the time equipment "out of calibration" is discovered and the last calibration check. A calibration schedule must include the following;

- Uniquely and permanently identify all equipment that requires calibration
- Frequency of calibration.
- Method of calibration
- A method of identifying equipment that is out of calibration
- Corrective action necessary for product produced whereas equipment was out of calibration
- responsible person for undertaking calibration, recording the results of all calibrations, labeling equipment to indicate when it was last calibrated.

Self-Check – 1	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions s (10 points)

1. Define Nonconformity in food safety according to ISO requirements. (3 points)
2. Write factors which contribute to Non- conformance in milk. (4 points)
3. Mention corrective actions for non- conformance in food safety. (3 points)

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

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

Score = _____

Rating: _____

Information Sheet 2- Implementing corrective and preventative measures

2.1 Correct Non- conformity

A preventive maintenance programme is a system you have in place to ensure that there is a planned and documented approach to the ongoing maintenance of premises and equipment. This preventative approach reduces the likelihood of equipment failure during manufacturing operations and also minimizes contamination of product from faulty or deteriorating structures or equipment.

The maintenance programme should include the following information:

- The maintenance procedures for premises and equipment
- Records to indicate that maintenance procedures have been followed
- Corrective actions to be taken if maintenance procedures have not been followed
- Date maintenance issue was identified
- Description of maintenance issue
- Date maintenance issue was or will be rectified.

The measures must be documented in the food safety program under a health and hygiene programme or policy. Food handlers can be a direct source of contamination if good hygienic practices are not followed.

Contamination could occur from foreign objects, microorganisms or chemicals that are transferred through direct contact with milk or dairy products or as a result of contaminating surfaces that come into contact with the product. This could include, for example:

- A hand washing policy
- Rules regarding clothing , hair and jewelry
- Where on the premises eating/smoking is or is not permitted
- Avoiding unnecessary contact with the product
- Requirements for covering cuts and wounds.

2.2 Non- Conformance Report

If nonconformity has been identified, a non-conformance report (NCR) can be filled out by supervising personnel. NCR's help keep the problem under control and are the first step toward fixing the infraction. A non-conformance report should notify the violator of the ISO 9001 requirement that is being violated, detail the infraction, and outline a plan of action for fixing the violation.

NCR's should be constructive rather than reprimanding. They should be thorough so that the violator knows exactly what went wrong and how to fix the problem. This will ensure that the nonconformity does not happen again. Information to include when filing an non-conformance report;

- ISO 9001 requirement that is being violated
- Circumstances surrounding the violation (what went wrong)
- Plan of action to correct the problem
- Details on how to prevent the problem in the future;
- The first step in correcting nonconformity is identifying what went wrong in the first place.
- The second step will show the violator exactly what went wrong on their part. This way there is no question of how the requirement is violated.
- The third step is to create a plan of action. This is arguably the most important step and doing it correctly will hopefully fix the violation so that minor problems don't become major nonconformities.

A well-written on-conformance report foresees that this problem can happen again and takes measures to inform and ensure that the same mistake is not made twice. A good supervisory team will make note of violations to ISO 9001 and how they overcame them, rather than hiding their mistakes for them to grow larger.

Self-Check – 2	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write down the maintenance programme information to correct Nonconformity. (5 points)
2. Write down information should be recorded in Non-conformance report. (5 points)

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

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

Score = _____

Rating: _____

Information Sheet 3 - Revising procedures to support control measures

3.1 Recording and revising procedures to support control measures

Corrective actions must be recorded and communicated to the appropriate person in the milk collecting and sampling. The record should include details of the food safety breach (e.g. what critical limit was exceeded at what critical control point), details about the corrective action that was taken and why it was taken.

Recording corrective actions makes it possible to identify recurring problems and trends that could be putting customers at risk and sending operational costs through the roof. For example, if there is a very high number of immediate corrective actions related to spoiled and contaminated milk, it could mean that there are underlying issues related to;

- Ineffective inventory management (e.g. Ordering too much)
- Poor stock control (e.g. Not practicing first in, first out)
- Gaps in employee food safety knowledge or skills (e.g. Poor understanding of food safety risks and how to prevent food safety hazards).

Corrective actions are principle five of the seven principles of HACCP (Hazard Analysis and Critical Control Points), a food safety and risk assessment system that forms the basis of Food Safety Plans worldwide. To protect the public from food poisoning, food allergens and other health risks, food businesses are required to:

- Develop a food safety plan based on HACCP principles
- Ensure that all food handlers in the business have undergone food safety training and have the knowledge and skills required to handle food safely

3.2 Control of non-conforming product/corrective actions

It is necessary to have a procedure to control non-conforming goods and services to prevent out of specification raw materials and ingredients from entering the production process, and out of specification products from entering the distribution chain. Corrective action procedure must be in addition to the corrective action requirements. The purpose of Corrective action is to identify the root cause of problems and system faults as they occur and to prevent recurrence. Corrective Action must be recorded.

Non-conforming product includes raw materials, work in process and finished product that does not meet specification. It also includes equipment that has been found to be non-conforming. There must be document how label and identify products and equipment that are rejected or quarantined pending the results of inspection. The procedures or practices adopted could include some, or all of, the following:-

- The designation of an area for the storage of non-conforming stock.
- Using stickers or signs that identify the status of the product.
- Records of disposition of any affected product.
- Retain records of customer complaints and their investigation.

Self-Check – 3	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write down food businesses requirements to protect the public from food poisoning, food allergens and other health risks. (5 points)
2. Mention the procedures or practices adopted to control Non-conforming product/corrective actions. (5 points).

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

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

Score = _____

Rating: _____

Information Sheet 4- Identifying and taking corrective action breach of procedures

4.1 Corrective action breach of procedures

Breaches which cause milk testing and sampling procedures problem rises from contaminated milk samples with bacteria from the hands of the sample collector, the environment, and the teat skin or teat canal. It is important that proper sample collection techniques are used in order to avoid contamination of the milk sample. Isolation of contagious organisms such as;

- Staphylococcus aureus,
- Streptococcus agalactiae, or Mycoplasma sp. is indication of true infection of the udder;
- Environmental organisms such as Streptococcus spp.,
- Coliforms,
- Staphylococcus spp., (Coagulase negative Staph.),
- Pseudomonas sp.,
- Corynebacterium sp.,
- Yeast, and
- Fungi may be contaminants or true infections

Corrective actions are the actions that must be taken if a critical limit is exceeded at any step of food production in a food business (e.g. delivery, storage, preparation). Critical limits mark the minimum or maximum acceptable level of an identified food safety hazard at each critical control point (CCP).

There are two types of corrective action;

a. Immediate corrective actions

Immediate corrective actions are reactive and actions fix an existing problem or deviation from a critical limit. They stop a food safety breach that is happening now.

Some examples of immediate corrective actions are:

- Throwing out food items that show signs of spoilage (e.g. Bad smell, slimy skin)
- Rejecting a food delivery with bite marks on the packaging (or other signs of pest infestation).
- Transferring unrefrigerated perishable food items into cold storage (5°c or below).
- Disposing of food items that have been in the temperature danger zone for more than four hours.
- Sending an employee home if they are experiencing symptoms of food-borne illness (e.g. Fever, nausea, diarrhea).

b. Preventative corrective actions

Preventative corrective actions are proactive and they prevent a potential problem from happening. They stop a breach from occurring in the future.

Some examples of preventative corrective actions are:

- Repairing broken, cracked or chipped equipment, dishware or glassware
- Replacing sample preparation surfaces with cracks or deep scratches changing work procedures to improve food safety or quality
- Appointing a food safety supervisor to manage food safety risks in the business
- Ensuring that all staff receive comprehensive food safety training

Self-Check – 4	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Define immediate corrective actions and give three examples. (5 points).
2. Define Preventative corrective actions and give three examples. (5 points).

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

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

Score = _____

Rating: _____

Information Sheet 5- Introducing and controlling process changes

5.1 Introducing and controlling process changes

Corrective action can include changes made to the performance standards—setting them higher or lower or identifying new or additional standards. Performance standards are often stated in monetary terms such as revenue, costs, or profits but may also be stated in other terms, such as units produced, number of defective products, or levels of quality or customer service.

The measurement of performance can be done in several ways, depending on the performance standards, including financial statements, sales reports, production results, customer satisfaction, and formal performance appraisals. Managers at all levels engage in the managerial function of controlling to some degree.

Effective controlling requires the existence of plans, since planning provides the necessary performance standards or objectives. Controlling also requires a clear understanding of where responsibility for deviations from standards lies. Two traditional control techniques are budget and performance audits. An audit involves an examination and verification of records and supporting documents. A budget audit provides information about where the organization is with respect to what was planned or budgeted for, whereas a performance audit might try to determine whether the figures reported are a reflection of actual performance. Although controlling is often thought of in terms of financial criteria, managers must also control production and operations processes, procedures for delivery of services, compliance with company policies, and many other activities within the organization. Controls also come at a cost. It is useful to know that there are trade-offs between having and not having organizational controls. Let’s look at some of the costs and benefits of organizational controls.

Controlling involves ensuring that performance does not deviate from standards. Controlling consists of five steps:

i. Set standards,
ii. Measure performance,
iii. Compare performance to standards,
iv. Determine the reasons for deviations and then
v. Take corrective action as needed

The managerial function of controlling should not be confused with control in the behavioral or manipulative sense. This function does not imply that managers should attempt to control or to manipulate the personalities, values, attitudes, or emotions of their subordinates. Instead, this function of management concerns the manager's role in taking necessary actions to ensure that the work-related activities of subordinates are consistent with and contributing toward the accomplishment of organizational and departmental objectives.

Self-Check – 5	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (5 points)

1. Write down five steps of controlling process changes. (5 points)

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

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

Score = _____

Rating: _____

LG #20	LO #4- Review sampling, Handling and Testing procedures for Fresh Milk

Instruction sheet

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

- Identifying product sampling procedures
- Identifying post collection procedures
- Reviewing and responding test results

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:

- Identify product sampling procedures
- Identify post collection procedures
- Review and responding test results

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”. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key answers to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation sheets.
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”.
8. If your performance is satisfactory proceed to the next learning guide.
9. If your performance is unsatisfactory, go back to “Operation sheets”.

Information Sheet 1- Identifying product sampling procedures

1.1 Milk product Samplings

After the milk has left the farm where it is produced, the first control takes place when it arrives at the milk collection center or at the Dairy Processing Unit (DPU). Information is required about the quantity, quality, hygiene, composition, water content, etc. This is needed to determine the payment that the producers will receive for their milk. There is no need to test the whole quantity of milk; we can test only a small sample, to check the quality. Liquid milk in cans and bulk tanks should be thoroughly mixed to disperse the milk fat. Then, a sample for testing is taken from the can, using a plunger or a dipper.

In the case of packed products, representative samples must be taken to make sure that the samples actually reflect the whole batch. Bulk tank milk cultures are a great way to monitor milk quality. They can determine the presence or absence of a bacterial group and identify predominant bacterial groups in bulk tank milk. Guidelines to collecting good bulk tank milk samples:

- Agitate the milk in the bulk tank for 5 minutes before sampling.
- Always collect the sample from the top of the bulk tank.
- Use a clean sanitized dipper or sterile syringe to collect the sample.
- Fill the sample tube half full, as milk expands when frozen.
- Immediately place samples on ice or in the refrigerator.

Steps to aseptically collecting milk samples:

1. Wash your hands and put on new disposable gloves.
2. Using a permanent marker, label a new sample tube with the date, cow ID, and the quarter that the milk collected from.
3. Keep the sample tube closed until the sample will be collected.
4. Make sure that the udder and teats are clean and dry.

5. Pre-dip the teats with an effective germicidal teat dip and leave the dip on for 30 seconds.
6. Wipe each teat dry with a single-use paper or cloth towel;.
7. Discard 3 to 4 streams of milk to minimize risk of contamination of the sample with bacteria in the teat canal.
8. Scrub teat ends with a cotton ball or gauze pad soaked in alcohol.
9. Open the sample tube immediately before the sample is taken.
10. Immediately put the sample tube in the refrigerator.

Additional Tips during milk product sampling;

- Plastic tubes with Snap-On lids work best for collecting milk samples..
- To avoid contamination, handle sample tubes properly to ensure sterility at all times.
- Check that sample tubes are no more than half full and that lids are completely closed.
- Collect samples directly from teats since bucket samples carry over bacteria.
- Label the sample tube with a permanent marker before sample collection.
- For composite milk samples, try to collect the same volume of milk from each quarter.
- Minimize contamination by collecting samples in a clean area, such as the parlor..
- Make sure samples are cold or frozen until they are delivered to the lab to avoid excessive growth of bacteria, which can lead to misleading results.

Figure 22; Collecting sample of liquid milk for quality assessment

Self- Check _1	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write at least four Guidelines to collecting good bulk tank milk samples: (5 points)
2. Write down Steps to aseptically collecting milk samples. (5 points)

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

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

Score = _____

Rating: _____

Information Sheet 2- Identifying post collection procedures

2.1 Care and Preservation of milk samples

If a milk sample cannot be analyzed immediately after sampling, it must be cooled quickly to near freezing point and maintained at that temperature until it is transported to the laboratory. If samples are to be taken in the field (e.g. at a milk cooling center) they can be preserved in ice boxes with ice packs. Milk samples that have been cooled in a refrigerator or ice-box must first be warmed in a 40°C water bath then cooled to 20°C and mixed well before analysis.

Milk samples for butterfat testing may be preserved with potassium dichromate one tablet or 0.5 ml of a 4% solution in a 0.25 liter sample bottle is adequate. Other chemical preservatives include 0.08% sodium azide and 0.02% Bronopol (2-bromo2-nitro-1, 3-propanediol). Because raw milk is highly perishable, traders and transporters must take care during handling to avoid spoilage of milk which would result in it being rejected at processing factories or by consumers.

2.2 Labeling and record keeping

Samples must be clearly labeled with the name or code number of farmer, date of sampling and the place where the sample was collected. This information should also be included in standard data sheets. Records must be kept neat and stored in a dry place. Milk producers should be present at the time of sampling and the records should be availed to them if they so require.

Generally, in order for a milk transport business to be profitable, losses due to spoilage, spillage or wastage must be kept below five percent of the total volume of milk handled. It is important for milk traders and transporters to acquire the knowledge and skills needed to carry out these tests accurately.

To maintain the quality of milk during transportation, the milk sample requires care to be free from any contamination during receiving according to Standard Operation procedures /SOPs/ includes;

- Ensure that milk containers and the transport vehicle are kept clean.
- Do not use milk containers for storage of other goods.
- Do not transport milk with other goods. The code of hygiene requires that vessels and carriers used for milk transport should be used only for that purpose and be labeled “Milk only”.
- Keep the milk as cool as possible and avoid exposing it to high temperatures.
- Keep the milk covered at all times to protect it from light and dust.
- Transport the milk to the processing factory in the shortest time possible.
- Do not smoke; handle other materials with strong odour when handling milk.
- Avoid excessive agitation of the milk cans.
- Label the sample properly;
- During transportation, sample should not be exposed to sunlight, or not to be exposed to near volatile odours as milk picks them up immediately.
- Use an air tight container, it should have 100 – 250 ml. capacity and should be rubber stopper.
- Keep the sample in a cool place at 45 – 60^0F.
- In composite milk sample each time when milk is added, the sample must be mixed thoroughly.

Self-Check – 2	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write down at least five guidelines to maintain the quality of milk during receiving, transportation, and handling according to SOPs. (5 points)
2. Write down post sample collection activities which may be practiced. (5 points)

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

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

Score = _____

Rating: _____

Information Sheet 3- Reviewing and responding test results

3.3 Reviewing and Responding testing results

There are different tests need to perform on raw milk and finished products. Testing raw milk ensures we are receiving a high-quality product. Testing finished product protects consumers from health problems. In order to have safe and high-quality products, dairies must start with high-quality raw milk and cream. Tests must be selected and run on each batch/tanker before we decide whether or not to accept the load.

Test 1. Sensory/Organoleptic characteristics allow for the identification of significant raw milk issues. Receivers should lift the lid on the dome of a tanker the first time and quickly evaluate the odor of the milk. An option other than tasting raw milk is to lab pasteurize and quickly chill for tasting.

At a minimum, Sensory/Organoleptic characteristics should be completed on all dairy products. For fluid milk, the suggested frequency of testing includes freshly bottled off the line, 24 hours after bottling, at end of code and a shelf-life check at 14 days following storage at 45 ^{0}F.

Test 2. Added water is considered adulteration. Cryscope testing helps identify when water was added to raw milk. This test helps to prevent additional concerns that may come with water, such as chemical and biological hazards. This is a useful test for fluid milk finished product, as well as, to ensure additional water was not added during manufacturing.

Test 3. Milk composition tests should be conducted throughout the process to ensure control on fat, as well as to meet standards of identity. Butterfat, total solids and protein are the big three. Chemical tests are very accurate, but they take time. Electronic equipment enables facilities to obtain fast and accurate results.

Test 4. The lactometer test is used to determine if the milk has been adulterated with added water or solids. Addition of anything to milk can introduce bacteria that will make it spoil quickly. 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 and the lactometer test is based on the fact that milk has a heavier weight or density (1.026–1.032 g/ml) compared to water (1.000 g/ml). When milk is adulterated with water or other solids are added, the density either decreases (if water is added) or increases (if solids are added).

As a responding action, when there is unacceptable result during milk and milk product testing, that portion of milk should be rejected and not recommended for further processing in the dairy processing unit.

Self-Check – 3	Written Test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I. Short Answer Questions (10 points)

1. Write down at least four test results. (5 points)
2. What type of response you will provide if there is unacceptable test result during milk reception? (5 points)

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

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

Score = _____

Rating: _____

Reference Materials

Book:

1. Hygienic and Quality Milk Production Training Package for Dairy Extension workers;
2. Marshall, R.T. (1992) Standard Methods for the determination of Dairy Products. 16th ed. Publ. American Public Health Association.
3. Richardson, G.H. (1985) Standard Methods for the examination Dairy Products 15th edition, American Public Health Association, Washington
4. ILCA Manual No.4, Rural Dairy Technology. Experiences from Ethiopia.
5. IDF Doc. No.9002, Handbook on Milk collection in Warm Developing Countries. International Dairy Federation, Brussels, Belgium.
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7. Dairy Industry Regulation; Alberta Regulation 139/1999
8. Dairy Products Quality And Safety;
9. Training Manual for Smallholder Dairy Producers
10. Prepared under the Assam Agribusiness & Rural Transformation Project (APART) ARIAS Society, Khanapara, Guwahati-22.
11. Guidelines for Raw Milk Quality Tests
12. Milk testing lab protocol manual

WEB ADDRESSES

1. http://www.scribd.com/doc/22893163/Microbiology-of-Milk
2. http://milkquality.wisc.edu/using-on-farm-culturing-to-improve-mastitis-treatment/
3. http://www.vdl.umn.edu/services-and-fees/udder-health-mastitis/collecting-milksamples/index.htm
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