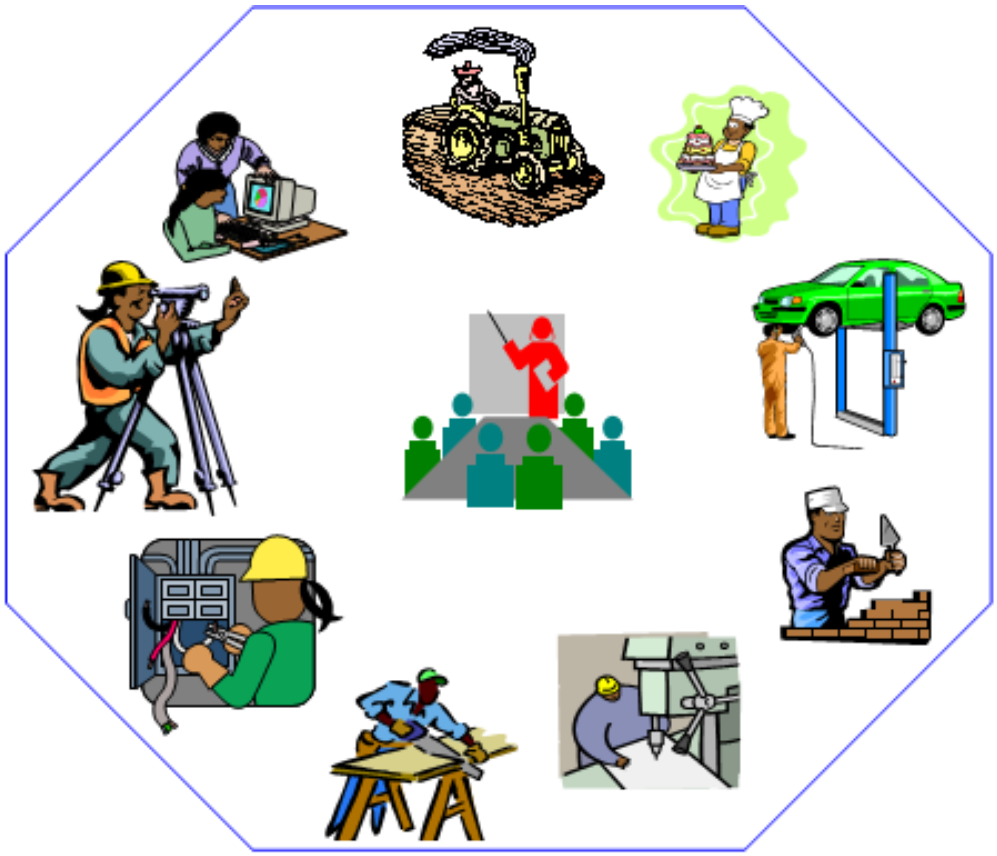
Dairy Products Processing Level-III

Based on October 2019, Version 2 OS and March.2021, V1 Curriculum



Module Title: - Performing Basic Quality Tests

LG Code: IND DPP3 M14LO (1-5) LG (51-55)
TTLM Code: IND DPP3 TTLM 0321v1

March, 2021

United Nations Educational, Scientific and Cultural Organization

With the support of Republic of Korea Funds-in Trust

Contents

LG #51	LO #1- Interpret test requirements

Instruction sheet

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

- Reviewing test request
- Identifying hazards and enterprise controls

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:

- Review test request
- Identify hazards and enterprise controls

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”. Try to understand what are being discussed. 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 to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
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Information Sheet 1- Reviewing test request

1.1 Introduction

Generally an analytical chemist will confront with the problem of selection of proper method and procedures from array of methods and procedures for quantitative analysis. A variety of methods and procedures may be capable of achieving the desired analysis and the decision to select one may depend on a variety of issues

Because of the difference in results obtained by using various methods and procedures in sampling and testing and because of the variations obtained by different operators of the immediate problem was to find out whether the conflicting results were due to faulty equipment and procedures or to inaccuracies in the method. Therefore reviewing the different methods of sampling, preserving and testing milk for its composition according to standardize procedure is very vital.

1.2. Choice of analytical test

There are several factors or criteria or issues which determine the choice of selecting a method from the available number of methods. These are as follows:

- Speed

Time taken by a method to complete the analysis is one of the criteria. It should be less time consuming method.

- Convenience

The method should be convenient to use. It should not be cumbersome i.e. difficult.

- Accuracy/precision

The method of analysis should give accurate results. That means the method should be error free.

- Sensitivity/detection limits of the method

The method should be sensitive enough to estimate even the small traces of component. Higher the sensitivity better will be the results. Therefore, as far as possible the detection limit should be low means the method should be able to detect lower levels of the components in a food.

- Selectivity/non-interference of other compounds present in the sample

The method should selectively estimate the component which we want to estimate. Other components present in the sample should not interfere in the estimation of a particular component in the sample.

- Availability of instruments/specific apparatus

Instrument/ Specific apparatus required in a selected method should be available in the laboratory or a department where work is being carried out.

- Amount of sample

The selected method should be such that only small amounts of sample should be required for analysis.

- Level of analysis/nature the analysis

The method of selection of a particular test will also depend upon the type or nature or level of analysis. For example, the test may be required for qualitative purposes. Generally, separate tests or methods are available for qualitative and quantitative analysis.

In case of quantitative analysis, the selection of a test or method will also depend on whether you want to estimate the given component from a gross composition point of view or a contamination point of view. It may also be required to check the residual level of the component after the processing of a product so as to check the permissible limits of the residual components (e.g. pesticides, antibiotics etc) as per the food laws. For all these purposes different types of methods are required. For example, for the estimation of traces or residual contents, more sensitive methods are required.

Self-check 1	Written test

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

1. Why do you review milk testing? (2pts)
2. What are the factors or criteria or issues which determine the choice of selecting a method? (8pts)

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

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

Information Sheet 2- Identifying hazards and enterprise controls

2.1 Classifications of hazards

The various hazards which give rise to occupational injuries, diseases, disabilities or death through work may be classified as:

- Physical hazards

Physical hazards, which can adversely affect health, include noise, dust , solar radiation vibration, sharps, broken glassware and hand tools, slips, trips and falls, and electric shock

Physical hazard has possible cumulative or immediate effects on the health of employees.

- Mechanical hazards

Mechanical factors include unshielded machinery, unsafe structures at the workplace and dangerous unprotected tools are among the most prevalent hazards

- Chemical hazards

Example cleaning agents, sulphuric acid, fluorides and hydrocarbons, aerosols

- Biological hazards

Many biological agents such as viruses, bacteria, parasites, fungi, moulds and organic dusts have been found to occur in occupational exposures. In the industrialized countries around 15 % of workers may be at risk of viral or bacterial infection, allergies and respiratory diseases. In many developing countries the number one exposure is biological agents.

- Ergonomic hazards

Between 10% and 30% of the workforce in industrial countries and between 50% and 70% in developing countries may be exposed to heavy physical workload or to an ergonomic working conditions such as lifting and moving of heavy items or repetitive manual tasks.

- Psycho social hazards

Up to 50% of all workers in industrial countries judge their work to be “mentally heavy”. Psychological stress caused by time pressure, hectic work, and risk of unemployment has become more prevalent during the past decade. Other factors that may have adverse psychological effects include jobs with heavy responsibility for human or economic concerns, monotonous work or work that requires constant concentration.

Others are shift-work, jobs with the threat of violence, such as police or prison work, and isolated work. Psychological stress and overload have been associated with sleep disturbances, burn-out syndromes, stress, nervousness and depression. There is also epidemiological evidence of an elevated risk of cardiovascular disorders, particularly coronary heart disease and hypertension.

Within the work environment emotional stress may arise from a variety of psychosocial factors, which the worker finds unsatisfactory, frustrating, or demoralizing.

2.2 Techniques of hazard control

Enterprise controls to address hazards:

- Use of MSDS
- Use of signage, barriers and service isolation tags
- Use of PPE
- Use of of biohazard containers, and cabinet, laminar flow cabinets and fume hood
- Recognizing and observing hazard warnings and safety signs
- Labeling of samples, reagents, aliquot samples and hazardous materials
- handling and storage of all hazardous materials and equipment in accordance with labeling, MSDS and manufacturer's instructions, and enterprise procedures and regulations
- cleaning and decontaminating equipment and work areas regularly using recommended procedures
- following established manual handling procedures for tasks involving manual handling

Self-Check – 2	Written test

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

1. List the types of hazards in milk testing laboratory? (6pts)
2. List the enterprise hazard control techniques? (13pts)

Note: Satisfactory rating - 19 points Unsatisfactory - below 19 points

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

LG #52	LO #2- Prepare sample

Instruction sheet

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

- Recording and comparing sample description
- Recording and reporting discrepancies
- Preparing sample

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:

- Record and compare sample description
- Record and report discrepancies
- Prepare sample

Learning Instructions:

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Information Sheet 1- Recording and comparing sample description

1.1 Introduction

A sample refers to a smaller, manageable version of a larger group. It is a subset containing the characteristics of a larger population. Samples are used in statistical testing when population sizes are too large for the test to include all possible members or observations.

Sampling is the process by which inference is made to the whole by examining a part. The purpose of sampling is to provide various types of statistical information of a qualitative or quantitative nature about the whole by examining a few selected units.

1.2. Recording and comparing sample description

Records must allow a test material to be traced back to its arrival and any information that arrive with it. Records should be such that if the need for reanalysis arises, it could be done under the same conditions and in the same way as before. Records must be retained and protected from misuse, loss or deterioration for an agreed time

If all the laboratories, under organization follow the same test protocol(code of practice/procedure), it is expected that the test results should be comparable. To cross check the test results from time to time, all the laboratories should use duplicate samples of the same sample to perform different tests. If all the laboratory shows similar results for each test, it can be considered that all the laboratories are performing well.

Sample description

The description of the sample product, including:

- sample reference,
- sample mass,
- lot size,
- sample origin (e.g. vertical silo, lorry)

The description of the sampling operation, including:

- the location and point of sampling,
- the number of increments per lot,

- the number of laboratory samples per lot,
- the sampling procedure used (equipment, static/flowing, etc.),
- the destination of the sample, e.g. the name and address to which the samples are to be shipped,
- comments if any;

Self-Check – 1	Written test

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

1. Define sample and sampling (2pts)
2. Discuss about sample description of product and the description of sampling operation? (9pts)

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

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

Information Sheet 2- Recording and reporting sample discrepancies

2.1 Introduction

The laboratory report is a condensed version of the data appearing in worksheets and laboratory notebooks. It must contain all the information normally necessary for the organization to utilize the result it contains.

2.2. Milk sample discrepancies

Findings indicate that the milk sampling system used has a substantial effect on the fat contents recorded for individual milk samples. Such discrepancy could arise from:

- poor functioning of equipment,
- inadequate mixing of the milk portion from which the sample is obtained, or
- the non proportionality of the sample.

If any laboratory shows significantly diverse result, it can be anticipated that there should be some problem in handling or performing the tests or interpreting the test result in that particular laboratory. In that case, the said laboratory should take necessary measures to correct their mistakes with support of the other laboratories.

Similarly, each laboratory manager can also check the quality of lab test in his/her laboratory by making duplicate samples of the same sample and can assign different identification no. to the duplicate samples. The laboratory technicians should be asked to conduct the test of each duplicate sample without informing him/her about the duplicity. If the results of all the duplicate samples are almost same, it can be interpreted that the laboratory technicians are performing the test properly. If any, signify cant deviation observed among the test results, it can be interpreted that there is some problem in conducting the test. Laboratory manager should explore the reason behind of this deviation and address the problem.

Further, the laboratory manager should randomly conduct some tests using the same protocol to verify the test results. If he/she finds the same results with the laboratory technician it can be interpreted that the laboratory technician has performed the test

well. If any deviation is observed between both the results, both the laboratory manager and laboratory technician should sit together to resolve the issue.

2.2. Reporting format

The format of laboratory report typically include the following

- Name, Address of the Laboratory
- Name, Address of the customer
- Certificate/Report Number
- Page Identification (Page X of Y)
- Sample received details (Dates, Names of deliverable, receiver)
- Unambiguous identification of sample / test material (Description, Laboratory Number etc.)
- Analysis conducted, Methods, Procedures any deviation from standard practices.
- Preparation of test material, taking of test portions
- Results
- Uncertainty of measurements
- Comments on significant of findings (if expected by the customer)
- Date of report
- Authorizing signature

Self-Check – 2	Written test

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

1. List the sources of sample discrepancy?(3pts)
2. What are included in the format of laboratory report? (11pts)

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

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

Information Sheet 3- Preparing sample

3.1. Introduction

Samples from milk, whey or buttermilk are taken with metal or glass pipe (dry, clean and stainless-steel) with diameter at about 10 mm, which is slowly dipped till the bottom of the vessel and its upper end remains open. In this way it is filled with milk simultaneously with its dipping.

Sampling for testing or analysis can be taken from a representative portion from a material or product to test (e.g. by physical measurements, chemical analysis, microbiological examination), typically for the purposes of identification, quality control, or regulatory assessment. The sampling is a significant role in testing activities as it reflects the ultimate test results.

3.2. Classification of samples

Samples may be conveniently classified under two broad divisions:

I. Formal samples – These are samples taken to determine if the food milk complies with national or local laws or regulations and

II. Informal samples – These are samples taken for the purpose of monitoring or as part of survey work. Formal follow-up samples can be taken if informal samples receive adverse laboratory reports. Formal or informal sample are also taken under others such as follow-up to a consumer complaint.

3.3 Preparing sample

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 testing purpose. In the following sections, a standard process has been explained for the laboratory and field staff-.

3.3.1 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 (mainly plastic) with graduation/calibration on the body and polythene zip bag;
- Glass beakers , 100 ml;
- A plunger/ dipper

Fig.:1. Sterile containers in polythene zip bag

Fig.2: Marker

Fig.: 3. Glass beakers

Fig.4: Leak-proof sterile container

Fig.5: A milk sampling plunger

Fig.6. A milk sampling dipper

- A cool box/ thermos flask 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
- A disposal bag for carrying disposable materials like leftover milk, gloves, mask, etc.
- A hand sanitizer to sanitize hands of the sample collector
- A small weighing balance to weigh if milk products (e.g. cheese, curd, etc.) are to be collected;

3.3.2 Information to be collected along with the sample

The following information need to be collected from the household/source at the time of sample collection:

Type of the sample (e.g. milk/curd /cream/others);

Species: Cow/goat;

Type of animal: Exotic/ CB/Non descript;

If milk sample is collected from the cow: Quarter of udder: L (left)/R(right): F(fore)/ R(rear);

If bulk milk is collected: Time of milking;

Weight/ volume of the sample;

- Place of collection;
- Date and time of collection;
- Name and designation of the collector;
- Purpose of collecting the samples;
- Name, address and thumb impression/signature of the person from whom the sample has been taken.
- All samples should be marked with a unique sample number
- The above information shall be recorded against the specic sample number allocated to each sample collected and part of the information shall be supplied with the sample to the lab.

3.3.3 General considerations in sample collection, handling and storage

- The samples should never be touched with bare hands. Gloves and mask should always be used in the process of collection.
- Knife/dippers/plungers, instruments used for cutting, removing and manipulating samples (e.g. cheese, sweets, etc.) should be sterilized with hot water before and after use
- Sample should not be exposed to dirty materials/environment after collection and should not be mixed with other biological samples.
- Temperature and pH shall be recorded at the collection stage and after transporting to the laboratory.
- Disinfect the surface of the work area before opening the samples for measuring, packaging, etc. at the laboratory
- Sample should preferably be measured directly in the sterile container with graduation;
- Gloves, mask and other materials in contact with the sample must be disposed properly.
- The stopper/cover of the container shall be securely fastened to prevent leakage of the contents in transit.

3.3.4 Method of milk sample collection 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 in order to make the contents of a milk container as homogenous as possible for obtaining a representative sample.
- Never agitate too vigorously because air bubbles, if dispersed in milk, will change its physical properties and disturb the analysis.
- Use a plunger or a dipper having a handle long enough for doing this and immediately take the sample of required volume into a sample bottle and close it.

- In order to make sure that a sample will well represent the whole contents of milk 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 the sample carefully again before the sample start to analysis in a laboratory.

3.3.5 Sampling from several containers

If milk needs to be collected from several containers, the following procedure shall be followed.

- Mix the content of each container thoroughly, take equal volume of milk from each container and pour into a small container.
- Take a sample after mixing the combined sample.

3.3.6 Sampling from storage tanks and rail and road milk tankers

If milk needs to be collected from a large tanker, the following procedure shall be followed-

- The method of sampling of milk from storage tanks and rail and road tankers is largely governed by storage/transport conditions
- In all cases, the milk in the tank/tanker shall be thoroughly mixed by a suciently large plunger, a mechanical agitator or by compressed air; the uniformity of the samples being determined, when necessary, by mixing till such time as complete agreement is obtained between samples taken at the manhole and at the outlet cock in respect of fat and total milk solids.

3.3.7 Collecting milk sample directly from cow

To collect milk sample directly from a cow, the following procedure shall be followed-

- Clean the udder and teats of the cow thoroughly with water.

- Put on the clean gloves, face mask, apron, etc. Strip two to three streams of milk from each teat in order to flush the teat canal and thereby to reduce contamination risk.
- Dry teats thoroughly with an individual cloth towel, paying close attention particularly to the teat end.
- While holding the top of the teat steady, wipe the end of the teat well with an alcohol-soaked cotton ball. Use as many cotton balls as necessary until the cotton ball still looks clean after using.
- Open the milk vial and immediately take the sample, making sure not to touch the inside of the tube or bottom part of the lid. Hold the milk vial about 3 inches from the teat end and fill the tube half to three-quarters full of milk. Hold the vial at a 45 degree angle to prevent dirt from falling into the vial.

Fig.:7 cow milk sample with vial

- Close the lid immediately and label the top with the date, cow number, and quarter sampled.
- Put the sample in cool box immediately.

Note: Do not place the teat inside the vial when sampling.

3.3.8 Sample collection, labeling and storing

- About 50-100 ml or gm of milk and milk products should be collected for testing purpose.
- Separate sterile container should be used for each sample.

- Immediately after collection of each sample, it should be properly labeled stating sample no., date of collect, time of collection etc.
- If sample is collected for regulatory purpose (as advised by Food safety Ocer), a paper slip of the size that goes round completely from the bottom to top of the container, bearing the signature of the Designated Ocer and number of the sample, shall be pasted on the wrapper, the signature or thumb impression of the person from whom the sample has been taken, shall be axed in such a manner that the paper slip and the wrapper both carry a part of this signature or the thumb impression. The outer covering of the packet shall also be marked with the same number of the sample.
- The labeled container should immediately be transferred to the cool box/ thermos flask filled with ice packs.
- The collected container shall be properly secured and sealed so that no tempering is possible after collection. To ensure this, signature of the milk producer/trader/sweet maker and a witness should be taken on the sealed pack.
- All samples should be transported to the laboratory by maintaining cold chain in a cool box/thermos ask with gel/ice packs.
- After arriving the sample at the laboratory, a separate code should be assigned to each sample at the reception desk. The sample should be processed in the laboratory and results should be mentioned against that code only.
- No personal details of the owner of the sample should be supplied to the laboratory technicians who conduct the tests to avoid any potential pre-judgment by the lab technicians.
- The sample should be stored at 4°C if milk is tested within a day or two (maximum 96 hours).
- In case of preserving the sample for longer duration, samples need to be stored at (-)20°C

3.3.9 Packaging and dispatching of samples to other laboratories

- For dispatching the samples to other laboratories, sample with their details should be put in a thermo-cool box. Adequate quantity of cool pack/gel pack should be put in the box to keep the sample cool during the time of transportation.

Fig.:8 A cool box

Fig.:9 Gel pack

- The outside of the thermo-cool box should be wrapped up with white paper and address of ‘From’ and ‘To’ should be clearly written on it preferably in all capital letters.
- A certificate should also be enclosed with the box stating the nature of the materials and purpose of sending.
- Packages should be marked clearly to provide information about the contents of package and, nature of the hazard, if any.
- Sample should be sent by the mode of transportation that can deliver the sample at the quickest possible time in the destination. If the transportation time is more, the ice/gel pack may come to normal temperature and the sample may get spoiled. In order to avoid this, adequate no. of ice/ gel pack should be put in the thermos-cool box. There shall not be empty space inside the box as it will allow movement of samples as well as allow the gel/ice pack to get melted early.
- The thermo-cool box should be marked with ‘Handle with care’ and an ‘Arrow mark’ showing upside of the box, in order to guide the handlers during handling and transportation.

Self-Check – 3	Written test

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

1. List the two classes of sample ?(2pts)
2. Explain the sample collection, labeling and storing procedures? (11pts)

Note: Satisfactory rating - 13 points **Unsatisfactory - below 13 points**

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

LG #53	LO #3 Check equipment before use

Instruction sheet

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

- Setting up test equipment
- Performing pre-use and safety checks
- Identifying and reporting faulty equipment
- Checking and reporting calibration status

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:

- Set up test equipment
- Perform pre-use and safety checks
- Identify and reporting faulty equipment
- Check and reporting calibration status of equipment

Learning Instructions:

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Information Sheet 1- Setting up test equipment

1.1 Introduction

Establishing equipment for milk test is fundamental to solve the problem of testing each method. In this content we set up test equipments according to the type of milk test performed in the laboratory.

1.2 Setting up test equipment

- **Alcoholic test**

Apparatus:

- ✓ Test-tubes, 150 mm x 19 mm, preferably with graduation marks at 5 ml and 10 ml.
- ✓ Measure for alcohol, for 5 ml

Reagent: Ethyl Alcohol, minimum 68 % by weight (density 0.8675 g/ml at 27 °C)

- **Clot-on-boiling (COB) test**

Apparatus:

- ✓ Test-tube: 15.6 cm x 1.9 cm, preferably with a mark at 5 ml;
- ✓ Water-bath.

- **Determination of pH**
  - ✓ PM –meter (see fig.10)

Fig .10: PH tester

- ✓ Indicator paper strips or discs are made by soaking strips of absorbent paper in a suitable indicator and drying them

- **Determination of density in milk**

Equipment:

- ✓ Thermo lacto densimeter (TLD)
- ✓ Test tube (250 ml)

- **Determination of titratable acidity**

Apparatus:

- ✓ Incubator
- ✓ Burette; with soda-lime guard tube
- ✓ Porcelain dishes; white hemispherical of approximately 60 ml
- ✓ Stirring rods; of glass, flattened at one end.

Reagents:

- ✓ Standard sodium hydroxide solution
- ✓ Phenolphthalein indicator solution
- ✓ Rosaniline acetate stock solution
- ✓ Bench solution

- **Determination of milk fat**

Gerber Method:

Apparatus: Butyrometer 10% scale (0-10% scale with 0.1% mark) , 10 ml automatic measure for sulphuric acid, 10.75 ml pipette for milk, 1 ml automatic measure for amyl alcohol, Stoppers for butyrometer, Gerber Centrifuge (1400 ± 70 RPM), water bath (65 ± 2 ^{0}C), Butyrometer stand, lock stopper key

Fig .11: Fat testing Gerber centrifuge

- **Determination of total solids**

Gravimetric Method:

Apparatus:

Shallow flat bottomed dishes of aluminum alloy, nickel, stainless steel, porcelain or silica, 7 to 8 cm diameter, about 1.5 cm in height and provided with easily removable lid. Hot air oven maintained at 100 OC, ± 0C Hot water bath, analytical balance.

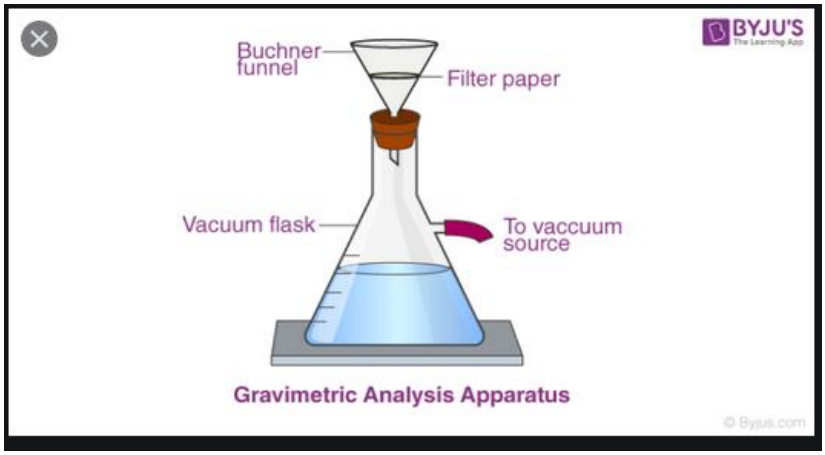

Fig.12: Gravimetric analysis apparatus

- **Phosphatase test**

Apparatus:

All purpose Lovibond comparator

Standard discs-APTW or APTW/7

Two 25 mm. fused glass cells

Water bath at 37 .5 + 0.5 degree centigrade

Pipettes: 1.0 ml /5ml.

Graduated flask: 1000ml

Measuring cylinder: 100ml

Test tubes

- **Determination of ash content in milk**

Apparatus: Crucibles, dessicator, analytical balance, muffle furnace, electrical heater

- **Determination of protein in milk by formal titration (Pyne's Method):**

Apparatus: Pipette – 10 ml, 2 ml and 1 ml graduated, Burette, flask 100 ml.

Reagents: Neutral formalin, saturated potassium oxalate solution, N/10 sodium hydroxide, phenolphthalein indicator

Self-Check – 1	Written test

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

1. List equipment/apparatus used for alcohol test (2pts)
2. List the equipment/apparatus used for determination of fat(10pts)

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

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

Information Sheet 2- Performing pre-use and safety checks

2.1 Introduction

First and foremost, the purpose of a pre-use inspection is to ensure that the equipment is safe to operate. Defective equipment could easily endanger the life of its operator, as well as the lives of laborers' working in the close proximity to it.

If an accident does happen, OSHA or another regulatory agency will ask to see the equipment's safety inspection records. If an inspection hasn't done recently, your firm could face large fines. On a more practical level, a pre-use inspection helps your operators to find small problems before they can become big ones

2.2 Pre-use and safety checks of equipment

Performing a pre-start on laboratory equipment before you start the day is the best way to ensure the job gets done safely and without delay. Undertaking a pre-start check on equipment before you start a day work happens in three stages.

- Visual inspections of important features prior to starting the equipment
- Visual & function tests while the equipment is turned on but stationary
- Testing the equipment's functions during a short drive

Check all the equipment before use.

- Are all the equipment functional and sufficient enough in number?
- Are all free from any contaminants?
- Is there any equipment which needs maintenance?
- Is the equipment function coincides with the given task?

Then check and report to your supervisor the condition of this equipment. After reporting the condition of equipment, your supervisor will guide you what to do if there is insufficient of equipment to perform this particular work.

Self-Check – 2	Written test

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

1. What is the purpose of pre-use check of equipment (2pts)
2. List the three stages pre-start check of machine before start a day work?(3pts)

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

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

Information Sheet 3- Identifying and reporting faulty equipment

3.1. Meaning of faulty equipment

Fault is unplanned occurrence or defect in an item which may result in one or more failures of the item itself or of other associated equipment

3.2 Types faulty equipment

The following are the types of faulty equipment

- Non-damage fault-a fault which does not involve repair or replacement action at the point of the fault
- Damage fault – a fault which involve repair or replacement action at the point of fault
- Incident- an event related to an internal fault which temporarily or permanently disturbs the normal operation of an equipment such as equipment leakage
- Failure- the termination of the ability of any item to perform a required function
- Electrical fault- a partial or disruptive discharge through the insulation
- Partial discharge - a discharge which only partially bridges the insulation between conductors. It may occur inside the insulation or adjacent to a conductor
- Discharge-disruptive- the passage of an arc following the breakdown of the insulation
- Thermal- excessive temperature rise in the insulation

Self-Check – 3	Written test

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

1. Define faulty equipment (2pts)
2. List the types of faulty equipment (8pts)

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

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

Information Sheet 4- Checking and reporting calibration status

4.1. Meaning of calibration

Calibration is the process of comparing a reading on one piece of equipment or system, with another piece of equipment that has been calibrated and referenced to a known set of parameters. The equipment used as a reference should itself be directly traceable to equipment that is calibrated according to ISO/IEC17025, 2018

4.2 Calibration and performance assessment requirements

For accurate test results, lab shall be ensured that the equipments which are suitable for intended purpose and capable of providing valid results, such instruments would be regularly inspected, checked & calibrated accordingly. So laboratory should establish a schedule for the calibration and performance verification of equipments/instruments, which will be direct influence on the test results.

The calibrations to be done by in-house (internal)/external agencies/competent body having traceability to a national / international standard depending upon the type of equipment / instruments

Laboratory management has to first segregate and classify the instrument, require external and internal calibration. The interval / frequency of calibration has to decide by the laboratory considering the equipment/instruments:

- type, uses, experience and need base,
- Previous performance of the equipment etc.

Regarding external calibration laboratory has to collect the information from the calibration agencies / laboratories to ascertain the facility / capability to fulfill the laboratory requirements, status of accreditation, charges etc and based on the same the competent calibration agencies / laboratories can offer for the calibration job. The calibration for the instruments like balance etc is recommended to perform on site and others may be sent to workshop/workplace. The laboratory shall ensure calibration status /performance status of the instruments/equipments goes outside of the laboratory control after return / put into service.

It is the laboratory responsibility to verify the calibration certificate in terms of the lab requirements, traceability to the primary standard, ensure the capability / calibration range, uncertainty, due date of next calibration (if require) etc and laboratory has to evaluate the services. All records are to be maintained.

The sophisticated instruments such as UV-VIS Spectrophotometer etc. are recommended to check the performance verification & operational qualification (OQPV) al least once in a year depending upon criticality of the uses of the instruments through the service providers. It is the responsibility of the laboratory to verify calibrates the instruments to ensure the performance in regular basis before put into use analysis by use reference standards etc.

The equipments like thermometer, pressure gauge, humidity meter, laboratory may calibrate through external calibration agencies with proper traceability in regular intervals / as per the lab protocol and the laboratory may use the same equipments as standards for verification.

Where the certain criteria e.g. temperature, humidity etc has a direct effect in the result of the test, the measuring device should be appropriate in quality to achieve the perfect accuracy and those devices should be calibrated (internally/externally) traceable to national/international standards.

In case of incubators, water baths, ovens, furnace etc. the stability of temperature, uniformity of temperature distribution and time required to achieve the equilibrium are to establish initially by experienced personnel. The documented monitoring system of operating temperature is also be maintained.

Other equipments/instruments like conductivity meter, pH meter, refractometer and other similar devices are to be verified in regular interval and prior to use with reference standard.

Laboratory also ensures that the performance of the lab autoclave is also capable to meet the specified time and temperature, pressure. Devices used for controlling/monitoring of operating cycles are verified as well as calibrated. Laboratory is also ensuring to maintain records of autoclave operation including temperature/pressure

and time for every cycle. In addition to monitoring the effectiveness of the autoclave operation during its cycle also be checked by use of chemical/biological indicator for monitoring sterilization/decontamination purpose when a load has been processed.

The weight and balance are also to be calibrated traceably at regular interval / as per the lab protocol. The performance of the weighing balance to be checked in regular interval every time before use

The volumetric equipment such as dispenser/diluters, pipettes, volumetric flasks etc. used in lab are to be checked to ensure the performance of the equipment. The equipments shall be checked for the accuracy of the delivered volume against the set volume and the precision of the repeat deliveries also be measured. Laboratory shall obtain the certified specific tolerance supplies from manufacturer/companies and calibrate through external agencies with traceability. The laboratory may also follow internal verification and intermediate checks on accuracy. The lab also ensures to provide a dedicated balance as reference to carry out the in-house calibration verification of glass wares etc.

The status of calibration (internal / external) of all the equipments/instruments including frequency of calibration, date of last calibration, due date of next calibration, plan and procedures shall be maintained by the laboratory

Self-Check – 4	Written test

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

1. Define calibration (2pts)
2. Discuss on internal and external calibrating agencies (4pts)

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

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

LG #54	LO #4 Perform tests on samples

Instruction sheet

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

- Identifying, preparing and weighing sample and standards
- Conducting tests
- Recording data
- Performing calculations on data
- Identifying and reporting out of specification
- Shutting down equipment

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, prepare and weigh sample and standards
- Conduct tests
- Record data
- Perform calculations on data
- Identify and report out of specification
- Shut down equipment

Learning Instructions:

Read the specific objectives of this Learning Guide.

Follow the instructions described below.

Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

Accomplish the “Self-checks” which are placed following all information sheets.

Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

If you earned a satisfactory evaluation proceed to “Operation sheets

Perform “the Learning activity performance test” which is placed following

“Operation sheets” ,

If your performance is satisfactory proceed to the next learning guide,

If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Identifying, preparing and weighing sample and standards

1.1 Introduction

Milk has a variety of products such as skim milk, cream, cheese, yoghourt, etc. Therefore for the purpose this section cream is selected as a sample. You are expected to prepare and weigh sample of cream for fat determination.

1.2 Preparing and weighing cream sample and standards

Prepare cream sample for testing

The preparation of cream for testing is similar to that for milk. Cream samples should be heated in a water bath until the cream has reached a temperature of approximately 37.8 ^{0}C. Temperatures above 37.8 ^{0}C may cause the fat to "oil off. Bottle racks should be used in the water bath to keep the bottles in a fixed, vertical position. The bottles should be kept sealed with a stopper or lid while heating to avoid evaporation and to prevent accidental dilution by water. Mix the sample thoroughly by pouring from one container to another three or four time, and then pipette the sample immediately for weighing.

Weighing the cream

Cream is weighed into the test bottle instead of measured because cream varies in weight according to the fat content. Cream containing a high fat content is lighter in weight than cream containing a lower percent of fat. Additionally, thick cream adheres to the side of the pipette which prevents delivery of the full measured volume into the test bottle, and cream often contains variable amounts of air and other gases which can cause weight variations for a given volume.

While the cream sample is warming, mark the test bottle with the same number given the corresponding sample. If using an electronic scale, tare the scale with the cream test bottle on the scale. Weigh nine grams (9g) of cream. No cream should be allowed to get on the outside of the bottle or on the scale while weighing. If too much cream is added to the test bottle, the excess may be removed with a clean wire or glass rod. Do not touch or remove the bottle from the scales until the weighing is complete.

Self-Check – 1	Written test

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

1. Explain the cream preparation and weighing process?(3)
2. At what temperature cream is heated(1pts)

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

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

Information Sheet 2- Conducting tests

2.1 Introduction

Milk testing is an essential component of any milk processing industry. Milk is prone to adulteration by unscrupulous middle men and unfaithful workers. Moreover, its high nutritional value makes it an ideal medium for the rapid multiplication of bacteria 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 conducted at the various stages of transportation of milk from the producer to processor and finally to the consumer.

2.2. Types of tests

2.2.1 Organoleptic tests

Testing milk for organoleptic characteristics is also called sensory testing and uses the normal senses of sight, smell and taste in order to determine the overall quality. The result of this test is obtained immediately and is of minimum cost. This type of testing can be very reliable if carried out by an experienced person. Testing for organoleptic characteristics is used as a screening test to determine whether to accept the milk or test the milk further.

Appearance

The color of cow milk should be slightly yellowish white; a different color may indicate milk, which is unsuitable for processing. 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 color of the milk, visible dirt and particles, changes in viscosity etc. After emptying the container, inspect the inside of the lid and the container for visible dirt and impurities. Take note of the following appearances:

Visible dirt and impurities can indicate that the milk is produced under unhygienic conditions.

Yellow milk can indicate pus or colostrums.

Reddish milk could indicate that there is blood in the milk.

A **"blue thin"** color and a thin and watery appearance can indicate that the milk contains added water or skimming (fat removal).

Large clots can indicate sour milk or mastitis milk

Small white clots or grains can indicate either mastitis milk or milk adulterated with -flour and / or skim milk powder.

Taste and smell

A bad smell or taste of the milk may be caused by bacteria, chemical re-actions or by other flavours absorbed by the milk. Judging the quality of milk by its taste and smell requires considerable skill, which can only be acquired by practice. The taste of milk is more permanent and easy to define than smell. Taste raw milk only after making sure that it is from healthy animals. Any abnormal smell is noticed by inhalation of air standing above the milk in the upper part of the milk can. Samples for tasting must be spread around in the mouth in order to identify the taste. In addition to these basic tastes, the mouth also allows us to distinguish characteristics such as coolness, warmth, sweetness, etc. The different abnormal flavours are described as follows:

Acid flavours are easily detected by smell and taste. The flavour is caused by the growth of acid-producing bacteria that reduce lactose to lactic acid.

Rancid and bitter flavours: a pure bitter flavour can be detected by taste only. The rancid flavour can be detected by both the senses of smell and taste and is caused by lipolysis (deterioration) of fat.

Feed flavours like garlic, onion, beets, poorly made silage, certain plants and pastures can cause off flavours to milk.

Flat flavours are quite easy to detect. A very slight oxidized flavour suggests -at flavour as well as low solids and/or low-fat milk.

Malty flavours are very suggestive of malt. The flavour is caused by the growth of the bacteria Streptococcus lactis var. maltigenes.

Oxidized flavours are sometimes described in such terms as “oily”, “stale”, “tallowy”, “cardboard” or “sunshine”. The oxidized flavour is characterized by a quick taste reaction

Salty flavours are easy to detect; and often associated with milk from cows in an advanced stage of lactation or mastitis milk. It is caused by an increase in chlorine and decrease in lactose content.

Unclean flavours suggest mustiness, staleness and foul stable air.

Other flavours such as drugs, disinfectants and detergents can also be causes bad smell and -flavour.

2.2.2 Physical tests:

- **Lactometer test for water addition**
  - ✓ Use: test for payment or screening; determine added water, level of solids or removal of fat.
  - ✓ Advantages: quick, cheap.
  - ✓ Disadvantages: can be inaccurate, influenced by temperature and fat.
  - ✓ Alternatives: freezing point test.

Principle

With a lactometer (also called hydrometer, **see Figure 13**), the specific density (also called gravity) of milk is measured. The specific gravity of the milk varies according to the proportions of fat, SNF and water. At 15 °C, the normal density of the milk ranges from 1.028 to 1.034 g/ml, whereas water has a density of 1.0 g/ml.

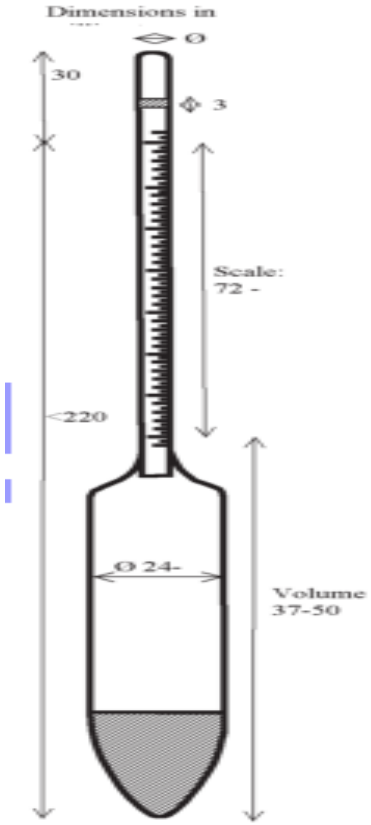

Figure 13: wide-range lactometer dimensions

Interpretation

Readings between 1.028 and 1.033 are considered normal and are some-times recorded as degrees using the last two figures, i.e. 28 and 33. It is best to combine the lactometer reading with a fat test (see 3.4.2, page 17): if the results of the fat test are low and the density is 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. 1.027), then water might have been added to the milk. You can use the lactometer reading together with the fat con-tent to estimate the SNF content of the milk . Make sure you adjust readings according to the temperature as indicated in table 3. Please take note that at high altitude milk boils at a lower temperature

Table 1: Temperature adjustments for lactometer readings

Temp (°C)	17	18	19	20	21	22	23	24
Correction:	-0.007	-0.005	-0.003	0.000	+0.003	+0.005	+0.008	+0.011

At other temperatures the correction is approximately + 0.0024 for each degree Celsius above 24 0C.

- **Clot-on-boiling**
  - ✓ Use: test for screening, rapid testing of increased acidity.
  - ✓ Advantages: simple, quick, cheap, definitive result (milk either coagulates or not).
  - ✓ Disadvantages: slightly sour milk is not detected
  - ✓ Alternatives: alcohol test , acidity test , other hygiene tests

Principle

The heating of milk in an advanced state of souring (acidity of more than 0.20%) or abnormal milk (colostrum or mastitis milk) will result in clotting.

Interpretation

The acidity of milk that gives a positive test is generally above 0.22% (as lactic acid) or has an abnormally high percentage of protein like colostrum milk. Such milk cannot stand the heat treatment in processing and is therefore not suitable for distributing as liquid milk or for processing. Such milk must therefore be rejected. Please take note that at high altitude milk boils at a lower temperature. This test is not very sensitive to slightly sour milk.

- **Alcohol test**
  - ✓ Use: test for screening, rapid assessment of acidity.
  - ✓ Advantages: quick, cheap.
  - ✓ Alternatives: Clot on boiling test, Acidity test .
  - ✓ Principle:

Proteins in milk that has become sour (i.e. because of lactic acid formation) will coagulate when mixed with alcohol.

Interpretation

Milk containing more than 0.21% acid and milk that is abnormal (e.g. colostrum or mastitis milk) will not pass the test. This milk is not fit for further processing.

- **Titratable acidity test**
  - ✓ Use: test for screening, determine suitability for processing.

- ✓ Advantages: more precise than alcohol and clot on boiling tests.
- ✓ Disadvantages: variation exists between cattle breeds.
- ✓ Alternatives: Clot on boiling test, alcohol test.

Principle

A dye, which changes color at a specific pH, is added to the milk, and titrated with a base (added little by little) until the color changes. By recording the volume of base required and the volume of the milk sample, the amount of lactic acid can be calculated. In this book, we express lactic acid as a percentage but it can also be expressed in other ways according to the test, e.g. Soxhlet Henkel degrees, Thorner degrees or Dornic degrees.

Interpretation

The more sodium hydroxide added, the more acid the milk.

Normal milk acidity ranges from 0.10 to 0.20% lactic acid. Any value in excess of 0.20 % can safely be reckoned as developed lactic acid. Due to the opacity of milk, the end-point of titration is not sharp, so care has to be taken to adjust the conditions to reach the same end-point.

Freezing point test for water

- ✓ Use: test for payment or screening; determine water content, confirmation of density test.
- ✓ Advantages: more accurate than lactometer test.
- ✓ Disadvantages: equipment needed.
- ✓ Alternatives: lactometer test, rapid AMA

Principle

Milk and water have different freezing points; therefore added water in milk can be detected by measuring the freezing point of the sample. Water has a freezing point of 0 °C, whereas 'normal' milk has a freezing point of around -0.540 °C, due to dissolved components (mainly lactose and salts). If milk has failed the lactometer test, a freezing point test can confirm the findings.

Interpretation

The difference between the two samples is called the Freezing Point Depression (FPD). At a measured freezing point of less than -0.530 °C, there is an indication that water has been added to the milk. There may be considerable variation in freezing points due to variations between animals. In practice, the freezing-point depression of quantities of 900 liters or more is unlikely to be less than -0.540 °C while milk from a single animal is un-likely to have a freezing- point depression of less than -0.530 °C.

The addition of sugar, salt or milk powder to mask addition of water will not be detected by the freezing point test. The development of acidity in a sample of milk causes an increase in the freezing-point depression, which might mask, partially or completely, the contrary effect of added water. A statement of the titratable acidity of the sample, should therefore accompany the freezing-point test at the time of testing.

Sediment test

- ✓ Use: screening or grading test to judge cleanliness of milk.
- ✓ Advantages: cheap.
- ✓ Disadvantages: does not indicate bacteriological quality, uses a lot of milk.
- ✓ Alternatives: organoleptic tests.

Principle

The amount of dirt in milk may be an indicator of the hygienic conditions during milk production and handling. By filtering milk through a white disc, these dirt particles become visible. The presence of sediment how-ever, does not necessarily indicate the bacteriological quality of the milk.

Interpretation

For the purpose of comparison, it is convenient to use about five prepared standard discs to classify the milk. Milk can be then classified according to the five discs grades: excellent, good, fair, poor and very bad. Any hair, files, pieces of hay or straw, or any large particles of dirt shall be reported separately. Be aware that the lack of sediment is not always indicative of ideal conditions, because the milk might have been strained at the farm.

Temperature test

Use: test for screening or grading system.

Advantages: simple, cheap.

Alternative: rapid AMA.

Principle and procedure

Most bacteria prefer to grow in the temperature region of 20 ºC to 45 ºC. It is therefore important to cool the milk as quickly as possible after milking. Usually refrigerated milk is kept at a temperature of 4 ºC. Bulk raw milk, when received from a chilling station in the factory should have a temperature below 7 - 8 ºC. The temperature of milk can be determined with a dairy thermometer; it is important to mix the milk well.

pH test

Use: test for screening.

Advantages: simple, cheap.

Disadvantages: regular calibration.

Alternative: rapid AMA tests

Principle and procedure using indicator paper strips

A rough estimate of pH may be obtained using paper strips impregnated with an indicator. Paper strips treated with bromocresol purple and bromothymol blue can be used as screening tests for milk. Bromocresol purple indicator strips change from yellow to purple between pH 5.2 and 6.0, while bromothymol blue indicator papers change from straw yellow to blue-green between pH 6.0 and 6.9.

Principle and procedure using pH meter

A pH meter depends on the potential difference between two electrodes when they are in contact with a test sample. One electrode called a reference electrode (a glass electrode) independent of the pH of the milk is connected to an electrode whose potential is proportional to the pH of the milk (a calomel electrode). The pH of the milk depends on the hydrogen ion concentration in the milk. A pH meter measures the current produced by the difference in potential between the two electrodes.

Interpretation

Always follow the manufacturer's instruction for the particular instrument for interpreting the pH reading. Normal cow's milk has a pH of 6.5 to 6.8.

2.2.3. Chemical tests

Gerber test for fat

Use: test for grading or payment system.

Advantages: relatively simple to use.

Disadvantages: equipment needed.

Alternatives: Babcock test, rapid automatic milk analyzer (AMA).

Principle

The test is a volumetric method in which fat is separated from milk by centrifugal force. Sulphuric acid is used to dissolve the protein that forms the membrane around the fat (fat globules) and amyl alcohol is added to improve the separation of fat from other solids.

Interpretation

Note down the upper and lower scale readings corresponding to the lowest point of fat meniscus and surface of separation of fat and acid. The difference between the two readings gives the percentage by mass of fat in milk. The reading has to be done quickly before the milk cools. The butyrometers should be emptied into a special container for the very corrosive acid-milk liquid, and the butyrometers should be washed in warm water and dried before the next use. Fat testing is often carried out on composite or random samples in order to reduce time and costs involved in testing.

Solids test

The Totals Solids (TS) content in milk is the mass percentage of substances in the milk, comprising fat, protein, lactose, minerals and vitamins. The TS content of milk can either be measured by using estimation from the lactometer reading, by drying the milk and weighing the solids or by using rapid AMAs. Solids-not-fat (SNF) in milk comprises protein, lactose, minerals and vitamins. Here only the calculation method is described.

- ✓ Use: test for payment.
- ✓ Advantages: quick, cheap.
- ✓ Alternatives: rapid AMA

Protein test

- ✓ Use: test for payment, suitability for cheese making.
- ✓ Advantages: relatively quick.
- ✓ Disadvantages: not very accurate.
- ✓ Alternatives: rapid AMAs.

Principle

When formaldehyde is added to milk, the free amino groups of the protein react with the carbonyl groups of formaldehyde causing the milk to become acidic. The acidity developed is related to the amount of protein present, which may be measured by titrating with sodium hydroxide (NaOH) using phenolphthalein as an indicator.

Determination of Total Solids (Gravimetric method)

In this procedure, a known quantity of milk is dried on a boiling water bath. Subsequently sample is dried in hot air oven at 102 ±2°C and from the weight of the residue, the total solids content in milk is determined.

Determination of Lactose by Colorimetric Method

This method is useful in distinguishing milk sweets prepared from khoa and paneer or Channa. The above method is based upon the reaction of lactose with methylamine in hot alkaline solution to form a red complex which absorbs at 540 nm. The method is useful for differentiating Khoa based and channa based sweets.

biological/environmental tests:

Total bacterial count test

- ✓ Use: test for screening or grading; determine total number of bacterial colonies.
- ✓ Advantages: guide to general good hygiene.
- ✓ Disadvantages: delay in reading/interpretation of results (3 days), needs expensive equipment and skilled staff, test needs to be carried out immediately after sampling.

- ✓ Alternatives: Methylene blue test , resazurin test.

Principle

The Total Bacterial Count (TBC) is also referred to as the Standard Plate Count, Total Viable Count or Colony Count. This method involves growing bacteria into colonies on an agar gel, which contains nutrients to support microbial growth. Milk is diluted and added to the agar in a sterile container, the petridish is then incubated at 37-38 °C for two days. The colonies are counted after the three days.

Interpretation

Count the colonies, with the aid of magnification under uniform and properly controlled, artificial illumination. Use the colony counter, equipped with a guide plate, ruled in centimeter squares. Record the total numbers of colonies, avoid mistaking particles of un-dissolved medium or precipitated matter in plates for pinpoint colonies. To distinguish colonies from dirt, specks and other foreign matter, examine doubtful objects carefully. After counting the colonies, calculate the plate count per milliliter / gram: the numerical estimate of colonies per plate is multiplied by the proper dilution factor and the result recorded as 'Plate Count' per milliliter (PC/ml)' or 'Plate Count per gram (PC/g)'.

Resazurin test

Use: test for screening or payment system, indicator for hygienic quality.

Advantages: simple, quick, cheap.

Disadvantages: some equipment needed.

Alternatives: Methylene blue reduction test, total bacterial count.

Principle

When bacteria grow in milk they use up the oxygen present. Certain chemical dyes such as Resazurin change colour according to the amount of oxygen present. These two facts are used in dye-reduction tests. Under standard conditions, the time taken to change or reduce the colour of the dye provides a good indication of the bacteriological quality of milk. The Resazurin test is thus an indicator of the hygienic quality of milk. Resazurin first colors the milk blue, then changes to pink and finally to white during the reduction process. The change in colour depends on the number of bacteria present in the milk and their colour reducing proper-ties, as well as the number of leucocytes. The Resazurin test can be carried out as a 10-minute, 1-hour or 3-hour test. The 10-minute Resazurin test is a rapid screening test used at the milk platform. The 1-hour test and 3-hour test are more accurate, but in this book, only the 10-minute test is described.

Interpretation

Note the number of the color, when the color falls between two disc numbers, it shall be recorded as the half value, for example, a reading between 3 and 4 shall be recorded as 3.5. Tubes giving a reading between 0 and 1 - streaky pink or very pale pinks - are recorded as 0.5. Table 4 gives an indication of the color numbers linked to a hygienic grade of milk, which can be used in a payment system.

Table 2: Reading and results (10 minute Resazurin test)

Disc No.	Colour	Grade of milk
6	Blue	Excellent
5	Light blue	very good
4	Purple	Good
3	Purple pink	Fair
2	Light pink	Poor
1	Pink	Bad
0	White	Very bad

Methylene Blue test

Use: test for screening and payment system, indicator for hygienic quality/ bacterial content.

Advantages: relatively simple and cheap.

Disadvantages: some equipment needed, longer than Resazurin test.

Alternatives: Resazurin test, total bacterial count.

Principle

As for the Resazurin test, the activity of reducing bacteria determines the time it takes to decolorize Methylene Blue from blue to white.

Interpretation

Interpret the results according to the table below.

Table 3: Interpretation of MBR test results

Time take to decolourize	milk grade
<30 minutes	very bad
30 minutes to 1 hour	bad
1 to 2 hours	fair
2 to 4 ½ hours	good
> 4 ½ hours	excellent

Automatic milk analyzers (AMAs)

- Use: test for payment and most milk parameters.
- Advantages: quick, results immediately.
- Disadvantages: relatively expensive, equipment needs calibration.
- Alternatives: see other compositional and physical quality tests.

Principle

Rapid AMAs use infrared, ultrasonic or digital measurements that are uniquely representative of each milk component analysed. AMAs are relatively new and powerful tools for facilitating clean milk production, milk screening and milk payment systems, especially when linked to electronic weighing units. They are also powerful tools for im-proving and maintaining milk quality, e.g. with 12-volt adaptors they can be used by milk collectors and pro-vide instant results, with instant printouts to show to producers.

Calibration

Depending on the accuracy of analysis required, these instruments have to be calibrated regularly (e.g. every week) using reference methods e.g. the Gerber test. Analyse regularly one or more control samples to make sure the results remain within accepted tolerances. You will have to use good quality milk and store the sample with a

suitable preservative at 4°C. Because calibration methods vary with each instrument, you will need to refer to the manufacturer for the appropriate calibration method.

Rapid screening of milk

The newer AMAs can test for all the compositional and physical parameters of raw milk important to milk producer groups, such as:

- temperature
- fat
- SNF and hence TS
- density
- pH
- freezing point.

Some AMAs, including the lower-cost models, can also test for additional parameters such as protein and added water, important for cheese making and milk producer screening:

- protein percentage
- lactose percentage
- minerals (ash) percentage
- added water percentage.

However, except for measuring pH, AMAs do not perform the rapid hygienic screening tests for measuring the suitability of milk for subsequent processing such as:

- Clot on Boiling Test
- Alcohol Test
- Titratable Acidity Test.

The following is a partial list of instruments that can be used:

- Auto Zero (Rajasthan Electronic & Instruments, India): www.reiljp.com
- Dairy lab (USA): www.dairylab.com
- Lactoscan (Milktronic, Bulgaria): www.lactoscan.com
- Lactoscope (Delta Instruments, USA): www.deltainstruments.com
- Milkoscan (Foss Electric, Denmark): www.foss.dk

- Milk tester (Milk tester, Bulgaria): www.milkotester.com
- Multispec (Multispec, UK): www.claro.co.uk

Fig.14: Milk analyzer lactoscan

Self-Check – 2	Written test

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

1. Discuss organoleptic test of milk (10pts)
2. Discuss the different types of physical test of milk (10pts)
3. Discuss the different types of biological test of milk (10pts)

Note: Satisfactory rating - 30 points **Unsatisfactory - below 30 points**

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

Information Sheet 3- Recording data

3.1 Meaning of data

UNESCO defines data as 'facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing by human or automatic means'.

3.2 Types of data

There are different categories of data types; here is listed two of the data types.

- Data with reference to nature of quantitative values: These are categorized into the following two classes:
  - ✓ Determinable data – Data on a quantity, which can be assumed to take a definite value under a given condition, are known as determinable data. Time-dependent data are usually determinable data, if the given condition is understood to include the specification of time.
  - ✓ Stochastic data – Data relating to a quantity, which take fluctuating values from one sample to another, from one measurement to another, under a given condition are referred to as stochastic.
- Data with reference to terms of expression: The categorization in this case yields three classes of data:
  - ✓ Quantitative data – These are measures of quantities expressed interms of well-defined units, changing the magnitude of a quality to a numerical value. Most data in physical sciences are quantitative data.
  - ✓ Semi-quantitative data – These data consist of affirmative or negative answers to posed questions concerning different characteristics of the objects involved, e.g., in biology, classification of organisms is based upon a set of 'Yes' and 'No' responses to questions concerning morphological, biochemical and other characteristics of species. Such data are regarded as semi-quantitative. 'Yes' and 'No' can be coded as '1' and '0' (zero) for obtaining numerical data.

- ✓ Qualitative data – The data expressed in terms of definitive statements concerning scientific objects are qualitative in nature. Qualitative data in this sense are almost equivalent to established knowledge.

Categories of data analysis

Statistics measure certain attributes about data. These attributes can be divided in the following categories:

- Measure of center : mean, mode and median
- Measure of position: Percentile

Self-Check – 3	Written test

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

1. Define data(2pts)
2. Explain the types of data(4pts)

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

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

Information Sheet 4- Performing calculations on data

4.1 Introduction

In this content it is included some calculations to determine mathematically the components of in composition of milk to deduce the answer.

4.2. Titratable acidity of milk

You can calculate the titratable acidity (as lactic acid per 100 ml of milk) as follows:

$$lactic\text{-}acid(\%) = \frac{9.V_1.N}{V_2}$$

V1 = volume in ml of the standard sodium hydroxide required for titration;

N = normality of the standard sodium hydroxide solution, and

V2 = volume in ml of milk taken for the test

4.3 Total solid of milk

Calculation of solids based on density

Total Solids can be estimated from the corrected lactometer reading and the fat content of the milk, using the following formula:

TS (%) = 0.25 (L) + 1.22 fat % + 0.72

(L = Lactometer reading in degrees)

Once you have the estimation for Total Solids, you can estimate SNF (solid non fat) as follows:

SNF = TS - fat %

Table below provides some examples of SNF calculations

Table 4.SNF calculated

Producer no.	fat %	density - degree	TS %	SNF %
1	4.2	1.036 = 36	14.84	10.64
2	3.5	1.032 = 32	12.99	9.49
3	2.8	1.028 = 28	11.14	8.34

Self-Check – 4	Written test

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

If the fat content of a cow is 4.3, milk lactometer reading is 37^0c

1. Calculate TS(2pts)
2. Calculate the solid non fat(SNF) of milk(2pts)

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

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

5.1 Introduction

The term out of specification (OOS), is defined as those results of in process or finished product testing, which is falling out of specified limits.

The OOS, may arise due to deviations in product manufacturing process, errors interesting procedure, or due to malfunctioning of analytical equipment. When an OOS has arrived, a root cause analysis has to be performed to investigate the cause for OOS. The reasons for OOS can be classified as assignable and non-assignable. When the limits are not in specified limits, called out of specifications When OOS has occurred, the analyst should inform to quality control (QC) manager. Then the senior manager will ask quality assurance (QA) for issuing OOS form to analyst. The designated personnel will classify the OOS as either assignable cause or non-assignable cause. Each out of specification will be identified with a unique identification number. The OOS investigation involves two phases

- Phase-1: Laboratory investigation
- Phase-2: Review of production and additional laboratory testing investigation

5.2 Laboratory investigation

The purpose of the laboratory investigation is to identify the cause for OOS result. The reason for the OOS may be defect in measurement process or in manufacturing process. Irrespective of the rejection of batches, the OOS results must investigate for their trend. The investigation can be done to only those batches that are resulted in OOS, or also to other batches and even other products associated with OOS. The OOS investigation should be thorough, timely, unbiased, well documented and scientifically sound. The phase I investigation should commence well before the test and standard preparations are discarded. During phase I, the root cause analysis has to be performed to recognize the error that may be arisen due to:

- Dilution error of standard and sample solution.
- Errors in analysis method
- Equipment malfunction
- Errors in calculation

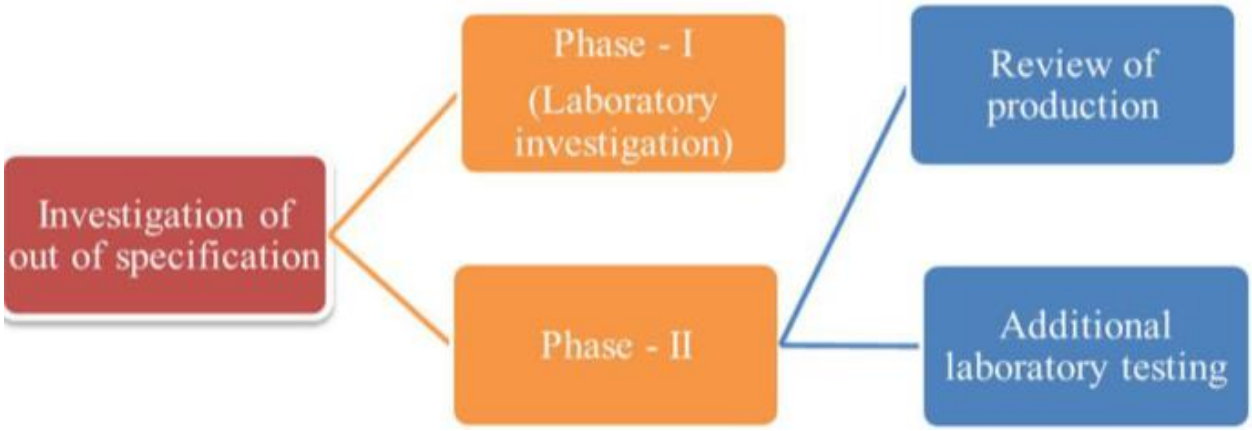

Fig. 15: Investigation of OOS results

5.3 Review of production and additional laboratory testing investigation

When there is no possible outcome has obtained from the phase I investigation, the phase II investigation should be commenced in context to investigate the errors occurred in manufacturing processes, sampling procedures along with other additional laboratory testing.

Production review

A typical production review report should include:

- Review of manufacturing process
- Causes identified resulting in OOS results
- Data of previous batches or products affected
- .A description of corrective actions to prevent thereoccurrence of OOS results.

Additional laboratory testing

The additional laboratory testing at phase II investigation should involve:

- Retesting
- Resampling

Self-Check – 5	Written test

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

1. Define out of specification (2pts)
2. List the two phases to investigate out of specification(2pts)

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

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

Information Sheet 6- Shutting down equipment

6.1 Introduction

Shut down is the act of closing equipment or stopping of equipment from operation.

Refer to your standard operating procedures for the correct way to operate each type of equipment in your workplace. The standard operating procedures for each type of equipment must be adhered to when shutting down equipment.

6.2 Types of shut down equipment

The types of shut downs used for equipment are:

- Scheduled shut down
- Maintenance shutdown
- Emergency shutdown

I. Scheduled shutdown

A scheduled shutdown is initiated by the operator during normal operation of the unit when, maintenance is required. The shutdown procedure will depend on the type of equipment and the process to be done. Some steps taken in a unit/process shut down may include:

- Shutting off the button to stop processes and heat generation particularly if processes are produce heat
- Shutting off heating or cooling to the unit/ processing operation
- Removing or flushing waste materials from the processing workplace

II. Maintenance shut down

The shutdown should be a scheduled or planned shut down as per standard operating procedures where equipment is:

- Isolated (process, mechanical and electrical)
- Cooled and depressurized

- Cleaned
- Electric tested on a continuous basis prior to and during entry.
- A planned unit/plant shutdown will prevent:
  - ✓ plugging of lines or equipment
  - ✓ possible damage to equipment
  - ✓ Possible injury.

III. Emergency shutdown

An emergency shutdown is initiated in the event of a fire, instrument failure, power failure, unexpected hazard or total loss of the processes.Emergency shutdown procedures must be followed during a shutdown sequence.

Self-Check – 6	Written test

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

1. What is mean equipment shut down.(2pts)
2. List the types of equipment shout down(3pts)

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

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

Operation Sheet 1– Clot on boiling test

Objectives: to determine the increased acidity of milk

List of equipment and materials needed

- Test tubes (15.0 x 1.0 cm, preferably with a mark at 5 ml).
- Source of heating, e.g. a boiling water bath or a flame.

Procedure:

Step 1: Put test tubes with about 5 ml of milk in heating source for up to 4 minutes.

Step 2: Rotate the tubes in an almost horizontal position and examine the film of milk or side of the test tube for any precipitated particles..

Operation Sheet 2– Resazurin test

Objectives: to assess the hygienic quality of milk.

List of equipment and materials needed

- Water bath at 37-38 °C.
- Sterile test tubes (150 x 16 mm, internal diameter 13.5 mm, accurately marked at 10 ml).
- Straight-sided, blow-out delivery 1 ml pipettes.
- Sterile 10-ml pipettes - straight-sided, blow-out type.
- Sterile rubber stoppers for closing tubes.
- A Lovibond comparator with a Resazurin disc.
- A standard solution of Resazurin (0.005%) - prepared by dissolving one standard Resazurin tablet in 50 ml. distilled water. The solution should be stored in a tightly stoppered dark-coloured bottle in a refrigerator and, preferably, prepared fresh after every 8 hours.
- Clock or watch.

Procedure:

Step 1: Fill two test tubes with 10 ml milk.

Step 2: Pipette 1 ml of Resazurin solution to the first tube and stopper..

Step 3: Mix by inverting the tube twice in 4 seconds.

Step 4: Place the tube in the water bath and record the time.

Step 5: Take the tube out after 10 minutes and immediately transfer to the Lovibond comparator.

Step 6: Place the second tube (without Resazurin) in the comparator disc, then revolve the disc until the colour which indicates the quality of the milk is matched by one of the standards

Operation Sheet 3– Gerber test for fat

Objectives: to determine the fat content a milk

List of equipment and materials needed

- Sulphuric acid (density 1.807 - 1.812 g/ml at 27 ^{0}C, colorless).
- Amyl alcohol.
- Butyrometers: 6%, 8% and 10% scales depending on fat content.
- Stoppers and shaker stands for butyrometers made from a suitable grade of rubber or plastics.
- 10 ml pipette for sulphuric acid (with rubber suction device).
- 10.75 ml pipette for milk.
- 1 ml pipette for amyl alcohol.
- Centrifuge, electric or hand driven.
- Water bath at 65 + 2 ^{0}C.

Procedure:

Step 1: Use the 10 ml pipette to transfer 10 ml of sulphuric acid into the butyrometer.

Step 2: Fill the 10.75 ml pipette with milk and deliver the sample into butyrometer. Step

Step.3: Add 1 ml of amyl alcohol using the 1 ml pipette and close. Shake the butyrometer in the shaker stand until no white particles are seen and invert it a few times.

Step 4: Put the butyrometer in the water bath for 5 min.

Step 5: Take it out and dry with a cloth, put it in the centrifuge, placing two butyrometers diametrically opposite, centrifuge at maximum speed for 4 minutes..

Step 6: Transfer the butyrometers, stoppers downwards into water bath for 3-10 minutes.

Step 7: Bring lower end of fat column on to a main graduation mark by slightly withdrawing stopper..

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 **5** hour. The project is expected from each student to do it.

Task

- determine the increased acidity of milk
- assess the hygienic quality of milk.
- determine the fat content a milk

LG #55	LO #5- Maintain a safe work environment

Instruction sheet

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

- Establishing safe work practices and using personal protective equipment
- Minimizing generation of wastes and environmental impacts
- Ensuring safe disposal of laboratory and hazardous wastes
- Cleaning and storing equipment and reagents

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:

- Establish safe work practices and using personal protective equipment
- Minimize generation of wastes and environmental impacts
- Ensure safe disposal of laboratory and hazardous wastes
- Clean and store equipment and reagents

Learning Instructions:

Read the specific objectives of this Learning Guide.

Follow the instructions described below.

Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

Accomplish the “Self-checks” which are placed following all information sheets.

Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

If you earned a satisfactory evaluation proceed to “Operation sheets

Perform “the Learning activity performance test” which is placed following “Operation sheets” ,

If your performance is satisfactory proceed to the next learning guide,

If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Establishing safe work practices and using personal protective equipment

1.1 Introduction

Safe work practices are generally written methods outlining how to perfom a task with minimum risk to equipment, people,materials,enviroment, and processes.

Personal protective equipment (PPE) is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses.these injuries and illnesses may result from contact with chemical,physical, mechanical or other workplace hazards

1.2 Safe work practices

Benefits of safe work practices

Getting work safety right can deliver many benefits to people and to organisations. This includes:

- improved health and wellbeing
- greater productivity
- higher performance
- increased job satisfaction
- greater work participation and increased social inclusion
- increased individual, team and organisational resilience
- lower absenteeism rates
- less workplace injury and workers' compensation claims
- faster return to work
- lower workers' compensation premiums.

The 10 most important laboratory safety rules

The 10 most important laboratory safety rules are listed below(fig.X)

1. Follow the instructions!

Whether it's listening to your instructor or laboratory supervisor or following a procedure in a book, it's critical to listen, pay attention, and be familiar with all the steps, from start to finish, before you begin.

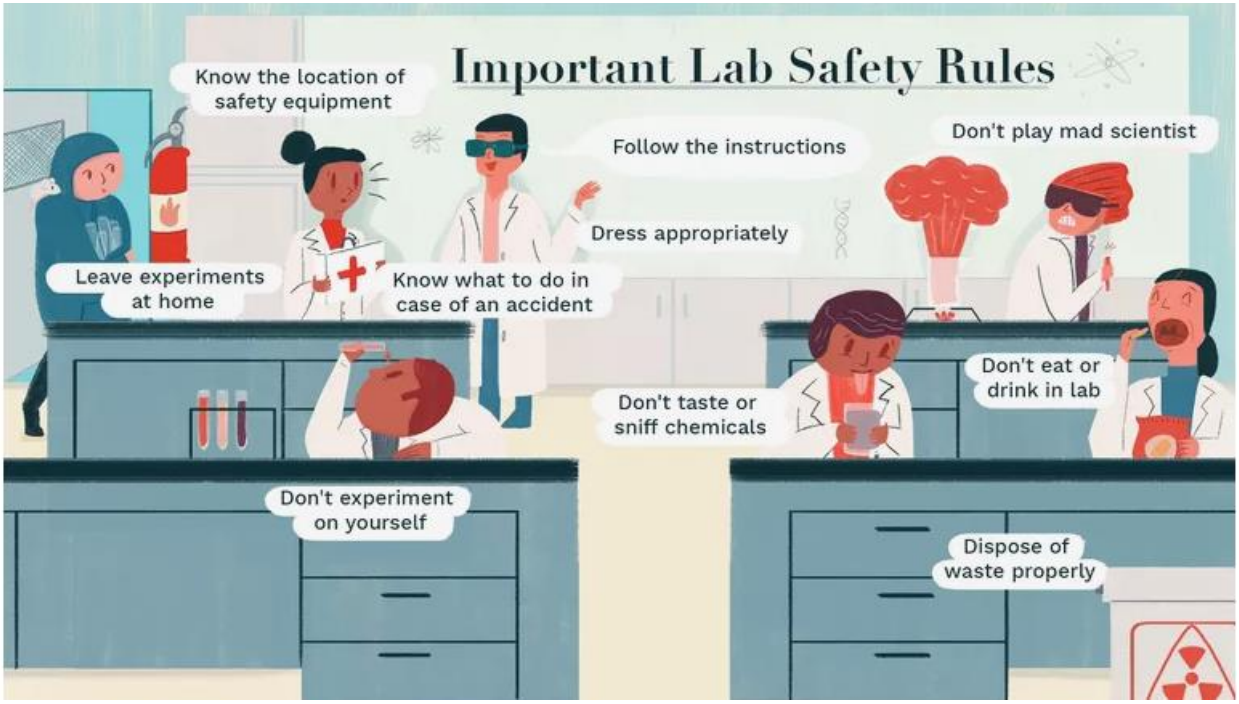

Fig.: Laboratory safety rules

II. Know the location of safety equipment

In the event something goes wrong, it's important to know the location of the safety equipment and how to use it. It's a good idea to periodically check equipment to make sure it is in working order. For example, does water actually come out of the safety shower? Does the water in the eye wash look clean?

Not sure where safety equipment is located? Review laboratory safety signs and look for them before starting an experiment (fig.xx)

III. Dress for the lab

This is a safety rule because your clothing is one of your best forms of protection against an accident. For any science lab, wear covered shoes, long pants, and keep your hair up so it can't fall into your experiment or a flame.

Make sure you wear protective gear, as needed. Basics include a lab coat and safety goggles. You may also need gloves, hearing protection, and other items, depending on the nature of the experiment.

IV. Don't eat or drink in the laboratory

Save your snacking for the office, not the lab. Don't eat or drink in the science laboratory. Don't store your food or beverages in the same refrigerator that contains experiments, chemicals, or cultures.

There is too much risk of contaminating your food. You could touch it with a hand that is coated with chemicals or pathogens or set it down on a lab bench that has residue from past experiments.

Having drinks in the lab risks your experiment, too. You could spill a drink on your research or lab notebook.

Eating and drinking in the lab is a form of distraction. If you are eating, you aren't concentrating on your work.

If you're used to drinking liquids in the lab, you might accidentally reach for and drink the wrong liquid. This is especially true if you did not label your glassware or used lab glassware as dishes.

V. Don't taste or sniff chemicals

Not only should you not bring in food or drinks, but you shouldn't taste or smell chemicals or biological cultures already in the lab. Tasting or smelling some chemicals can be dangerous or even deadly. The best way to know what's in a container is to label it, so get in the habit of making a label for glassware before adding the chemical.

VI. Don't play mad scientist in the laboratory

Another important safety rule is to act responsibly in the lab — don't play mad scientist, randomly mixing chemicals to see what happens. The result could be an explosion, fire, or release of toxic gases

Similarly, the laboratory is not the place for horseplay. You could break glassware, annoy others, and potentially cause an accident.

VII. Dispose of lab waste properly

One important laboratory safely rule is to know what to do with your experiment when it's over. Before you start an experiment, you should know what to do at the end. Don't leave your mess for the next person to clean up.

Are the chemicals safe to dump down the drain? If not, what do you do with them?

If you have biological cultures, is it safe to clean up with soap and water or do you need an autoclave to kill dangerous organisms?

Do you have broken glass or needles? Know the protocol for disposing of "sharps".

VIII. Know what to do with lab accidents

Accidents happen, but you can do your best to prevent them and have a plan to follow when they occur. Most laboratories have a plan to follow in the event of an accident.

One particularly important safety rule is to tell a supervisor if and when an accident occurs. Don't lie about it or try to cover it up. If you get cut, exposed to a chemical, or spill something there could be consequences, and the danger isn't necessarily only to you. If you don't get care, sometimes you could expose others to a toxin or pathogen. Also, if you don't admit to an accident, you could get your lab in a lot of trouble.

Leave experiments at the lab

It's important, for your safety and the safety of others, to leave your experiment at the lab. Don't take it home with you. You could have a spill or lose a specimen or have an accident. This is how science fiction movies start. In real life, you can hurt someone, cause a fire, or lose your lab privileges.

While you should leave lab experiments at the lab, if you want to do science at home, there are many safe science experiments you can try.

Don't experiment on yourself

The premise of many a science fiction movie starts with a scientist conducting an experiment on him or herself. However, you won't gain superpowers or discover the secret to eternal youth. More than likely, whatever you accomplish will be at great personal risk.

Science means using scientific methods.You need data on multiple subjects to draw conclusions, but using yourself as a subject and self experimenting is dangerous, not to mention bad science.

Self-Check – 1	**Written test**

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

1. Define safe work place and personal protective equipments?(2)
2. List the benefits of safe workplace practices(10pts)

3. Explain the 10 most important laboratory safety rules(10pts)

Note: **Satisfactory rating - 22 points** **Unsatisfactory - below 22 points**

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

Information Sheet 2- Minimizing generation of wastes and environmental impacts

1.1 Introduction

Laboratory waste is waste that is generated from laboratories in industry.

Reducing laboratory waste will have a number of benefits, saving money and reducing disposal costs while also encouraging safety in the laboratory.

1.2 Category of wastes

All activities performed in laboratory resulting in the following waste category:

- Hazardous
- Non hazardous

How to reduce laboratory waste

- Look at purchasing procedures. Buy only what is needed, reducing wastage due to expiry.
- Find a reliable supplier who will deliver small amounts of chemicals at short notice. Ask if they will take back unused chemicals.
- A centralised purchasing programme should be considered. This means that all orders are placed with a delegated person who may be able to take advantage of bulk pricing.
- All chemicals and wastes in the lab should be labelled. A waste chemical has no use. This labelling system should be standardised.
- Separate waste into the following streams for treatment, reuse or disposal: Sharps including scalpels and syringes; Glassware; Biological samples; General lab waste such as wipes, gloves, tissue; Chemicals.

How to reuse laboratory waste

Reusing an item is often the best way of reducing waste.

Try to incorporate recovery activities during the experiment.

- A chemical swap might be possible with other institutions in your area.
- All wastes should be segregated based on chemical incompatibilities e.g. hazardous and non-hazardous wastes should not be mixed together. The same is true of organic and inorganic waste.
- Waste consisting of the same material type can be segregated.
- Waste streams that are capable of being recycled should be stored separately i.e. recoverable metals or solvents.

How to recycle laboratory waste

- Some material generated in the laboratory will be non-hazardous waste such as paper and packaging waste that can be recycled. To promote and encourage recycling of this material place recycling bins in the laboratory.
- Make sure the recycling bin is labelled clearly by placing a label on the bin stating paper only, ensuring that hazardous wastes such as chemicals are not placed in the bin.
- Bins for the collection of hazardous materials should be placed in the lab. These should be emptied regularly and looked after by lab personnel/technicians.
- All waste from the lab should be collected by a waste collector with a valid waste collection license, who is specialized in hazardous waste collection and who is licensed to treat and dispose of the waste.

Self-Check – 2	**Written test**

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

1. Define laboratory waste ?(2)
2. List the categories of waste(2pts)

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

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

Information Sheet 3- Ensuring safe disposal of laboratory and hazardous wastes

3.1 Introduction

The best methods of safe disposal are segregation and composting. After segregating the waste and separating materials for reuse and recycling, the waste material should be disposed of. Simply defined, a hazardous waste is a waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment. Hazardous waste is defined as any substance or material that can have harmful effects on the health of people and the environment.

3.2 Techniques of waste disposal

Here is a list of four common waste disposal techniques:

Recycling

Recycling is one of the best methods of disposal simply because it goes a long way to preserve the environment. There are so many materials you can recycle starting from metals, PVC(propylene vinyl chroride), PP(Polypropylene), LDPE(low density propylene tripallet ethylene), etc.

Biological reprocessing

This is one of the best methods for dealing with Different kinds of organic waste . Things like shredded paper, onion peels, fruit rind, etc. are a great source of compost or mulch for any garden. The only materials you can treat via biological reprocessing are paper, food, and plant products.

There are various techniques for composting waste. The method used to digest food or paper waste depends on the end use; whether you want compost for industrial materials or household heaps. Other than creating compost or mulch, you can also get waste gas for electricity production via biological reprocessing.

Incineration

This type of waste disposal involves the dumping off method where you eliminate waste materials via combustion. The other name for this disposal method is thermal treatment. You can conduct incineration at an industrial or individual scale and dispose of many kinds of waste matter.

Most countries that have scarce land prefer the incineration method. You can use the energy created by burning waste materials to generate heat, electricity, or steam.

Landfill

It is one of the most common waste disposal methods worldwide. It involves collecting, transporting, dumping, and burying waste in a designated land. Many cities plan for deserted and vacant spaces to handle rubbish.

3.3 Classification of hazardous waste

Hazardous wastes are classified on the basis of their :

- biological,
- chemical, and
- physical properties.

These properties generate materials that are either toxic, reactive, ignitable, corrosive, infectious, or radioactive. Toxic wastes are poisons, even in very small or trace amounts.

Self-Check – 3	**Written test**

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

1. List the techniques of wate disposal (4pts)
2. List the classification of hazardous wastes(3pts)

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

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

Information Sheet 4- Cleaning, caring for and storing equipment and reagents

4.1 Introductions

Cleaning refers to the removal of dirt and impurities, including germs, from surfaces. Cleaning alone does not kill germs. But by removing the germs, it decreases their number and therefore any risk of spreading infection. Cleaning is achieved with soap and water. • Disinfecting works by using chemicals, for example EPA-registered disinfectants, to kill germs on surfaces. This process does not necessarily clean dirty surfaces or remove germs. But killing germs remaining on a surface after cleaning further reduces any risk of spreading infection.

4.2. Cleaning, caring for and storing equipment and reagents

The 4 tips for cleaning, taking care and storage of laboratory equipment are listed below.

I. Cleanliness

One of the easiest ways to keep your lab equipment maintained is to keep everything clean and sanitary. Surprisingly, many labs overlook this important task. To keep your equipment and your lab in great shape, it is important to wipe down the exterior of all equipment each day and do a thorough, detailed cleaning at least once a week. Some types of equipment will need to be cleaned using a specific cleaning process. Be sure to consult each lab equipment's manual to ensure they are cleaned properly.

Procedures for cleaning equipments:

- Prepare fresh cleaning solutions on a daily basis.
- Put on protective clothing, mask and gloves.
- Clean equipment according to individual equipment SOPs.
- Remove all materials from work surfaces that hinder thorough cleaning.

II. Calibration

Another tip for maintaining equipment is to ensure they stay calibrated. Failure to do this regularly can corrupt your data and lead to inaccuracies in your experiments. Calibration can range from basic preventive maintenance to advanced accuracy verification procedures. When you keep up with the calibration of your equipment on a regular basis, you will hardly ever need more than quick preventive maintenance to get back up and running.

Pipetting errors due to uncalibrated pipettes can harm your scientific data. Make sure you calibrate all measuring equipment as prescribed by the manufacturer. A typical re-calibration period for manual pipettes is 1 year.

III. Repairing

If any of your equipment is not working properly or providing accurate results during your experiments, it is important to have that piece repaired or replaced in a timely manner. Many types of lab equipment can be salvaged by replacing simple parts or

repairing necessary components. The earlier you fix an issue with your equipment, the less likely you will need to fully replace it.

Refurbishing

For many labs, the refurbishment of equipment is an ideal option for some pieces of equipment that aren't running quite as smoothly as they used to. The process will involve taking a part each piece and fully cleaning the components. Once they are clean, they can be re-lubricated and put back together. During the process, you can identify any parts that are showing signs of wear and that may need to be replaced before reassembling the equipment. When this process is done, some equipment will work just as good as when it was brand new.

Safe handling and storage of chemicals and reagents

When you handle and store chemicals and reagents , you must follow the following procedures: :

Storage and handling of the chemicals and reagents shall be according to physiochemical properties of the substance and and hazardous behavior-(refer MSDS)

All reagent and solution shall be properly identified with a label

Material safety data sheet (msds) must be available to staff before testing is carried out

Self-Check – 4	**Written test**

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

1. Define cleaning (2pts)
2. List the 4 tips for cleaning, caring for and storing equipments(4pts)

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

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

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AKNOWLEDGEMENT

We would like to express our appreciation to the TVET instructors and experts of regional TVET bureau, TVET College, and Federal Technical and Vocational Education and Training Agency (FTVETA) who made the development of this learning module with required standards and quality possible.

We wish thanks and appreciation to the representatives of BEAR II UNESCO PROJECT who covers the financial expenses, scarifying their time and commitments to develop this learning module.

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With the support of
UNESCO
United Nations Educational, Scientific and Cultural Organization
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