RQF LEVEL 3

FOPMR303

FOOD PROCESSING

Raw Milk Reception

TRAINEE'S MANUAL

October, 2024

RAW MILK RECEPTION

2024

AUTHOR'S NOTE PAGE (COPYRIGHT)

The competent development body of this manual is Rwanda TVET Board ©, reproduce with permission.

All rights reserved.

- This work has been produced initially with the Rwanda TVET Board with the support from TQUM Project
- This work has copyright, but permission is given to all the Administrative and Academic Staff of the RTB and TVET Schools to make copies by photocopying or other duplicating processes for use at their own workplaces.
- This permission does not extend to making of copies for use outside the immediate environment for which they are made, nor making copies for hire or resale to third parties.
- The views expressed in this version of the work do not necessarily represent the views of RTB. The competent body does not give warranty nor accept any liability.
- RTB owns the copyright to the trainee and trainer's manuals. Training providers may reproduce these training manuals in part or in full for training purposes only. Acknowledgment of RTB copyright must be included on any reproductions. Any other use of the manuals must be referred to the RTB.

© Rwanda TVET Board

Copies available from:

- *HQs: Rwanda TVET Board-RTB*
- *Web: www.rtb.gov.rw*
- **KIGALI-RWANDA**

Original published version: October 2024

ACKNOWLEDGEMENTS

The publisher would like to thank the following for their assistance in the elaboration of this training manual:

Rwanda TVET Board (RTB) extends its appreciation to all parties who contributed to the development of the trainer's and trainee's manuals for the TVET Certificate III in Food Processing, specifically for the module **"FOPMR303: Raw Milk Reception."**

We extend our gratitude to KOICA Rwanda for its contribution to the development of these training manuals and for its ongoing support of the TVET system in Rwanda.

We extend our gratitude to the TQUM Project for its financial and technical support in the development of these training manuals.

We would also like to acknowledge the valuable contributions of all TVET trainers and industry practitioners in the development of this training manual.

The management of Rwanda TVET Board extends its appreciation to both its staff and the staff of the TQUM Project for their efforts in coordinating these activities.

This training manual was developed:

Under Rwanda TVET Board (RTB) guiding policies and directives

Under Financial and Technical support of

COORDINATION TEAM

RWAMASIRABO Aimable
MARIA Bernadette M. Ramos
NTAHONTUYE Felix

Production Team

Authoring and Review

HIRWA Serge

MUKANGWIJE Yvonne

Validation

AYEBARE Honorée

MUKANSONERA Charlotte

NSABUMUREMYI Diogene

Conception, Adaptation and Editorial works

HATEGEKIMANA Olivier

GANZA Jean Francois Regis

HARELIMANA Wilson

NZABIRINDA Aimable

DUKUZIMANA Therese

NIYONKURU Sylvestre

KAMERE Raban

Formatting, Graphics, Illustrations, and infographics

YEONWOO Choe
SUA Lim
SAEM Lee
SOYEON Kim
WONYEONG Jeong
MANISHIMWE Marc

Financial and Technical support

KOICA through TQUM Project

TABLE OF CONTENT

ACRONYMS

%: Percentage

CIP: Cleaning In Place

CMT: California Mastitis Test

COP: Cleaning Out of Place

IC: Indicative content

Ind: Indicator

Ltd: Limited

MCC: Milk Collection Center

OC: Degree Celsius

pH: Hydrogen Potential

PPE: Personal Protective Equipment

RTB: Rwanda TVET Board

SCC: Somatic Cells Count

SNF: Solid Not Fat

TQUM Project: TVET Quality Management Project

INTRODUCTION

This trainee's manual includes all the knowledge and skills required in food processing specifically for the module of "**Raw Milk Reception**". Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies. The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainee's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainee, you will start by addressing questions related to the activities, which are designed to foster critical thinking and guide you towards practical applications in the labour market. The manual also provides essential information, including learning hours, required materials, and key tasks to complete throughout the learning process.

All activities included in this training manual are designed to facilitate both individual and group work. After completing the activities, you will conduct a formative assessment, referred to as the end learning outcome assessment. Ensure that you thoroughly review the key readings and the 'Points to Remember' section.

MODULE CODE AND TITLE: FOPMR303 RAW MILK RECEPTION

Learning Outcome 1: Prepare workplace, tools, material and equipment
Learning Outcome 2: Perform raw milk testing
Learning Outcome 3: Store raw milk

Learning Outcome 1: Prepare Workplace, Tools, Materials and Equipment

Indicative contents

1.1. Selection of Tools, equipment and materials used in raw milk reception
1.2. Cleaning of the work area
1.3. Preparation of testing reagents

Key competencies for learning outcome 1: Prepare Workplace, Tools, Materials and Equipment

Knowledge	Skills	Attitudes
• Description of tools, equipment and materials for raw milk sampling, testing, storage and for cleaning • Explanation of selection criteria for tools, equipment and materials for raw milk reception • Description of cleaning methods and techniques used to clean the work area for raw milk reception	• Selecting tools, equipment and materials • Preparing cleaning products • Cleaning the workplace • Arranging the work area for raw milk reception • Adjusting tools and equipment used in raw milk reception. • Checking the effectiveness of cleaning • Preparing reagents for milk testing	• Being accurate while preparing reagents for milk testing. • Being vigilant while testing raw milk. • Being careful while handling cleaning products. • Being attentive while using tools and equipment. • Being accurate while adjusting tools and equipment for raw milk testing and storage

Duration: 10 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly tools, equipment and materials used in raw milk reception.
2. Explain correctly the selection criteria of tools, equipment and materials used in raw milk reception.
3. Describe clearly cleaning methods and techniques used in cleaning work area for raw milk reception.
4. Select appropriately tools, equipment and materials used for raw milk reception.
5. Adjust properly tools and equipment used in raw milk reception.
6. Clean effectively the workplace for raw milk reception according to standards operating procedures and cleaning methods
7. Arrange appropriately the work area for raw milk reception.
8. Prepare properly reagents for raw milk testing according to testing protocol.

Resources

Equipment	Tools	Materials
• Lactoscan • Incubator • PPE • Weighing scale • Balance • Gerber centrifuge • Cooling tank • Table • Milking can • Pump • Water bath • Refrigerator • Watch • Autoclave • Gas cooker • Pressure cleaner	• Lactometer • Thermometer • PH meter • Alcoholmeter • Alcohol gun • Test tube • Mastitis kits • Antibiotic kits • Brush • Mops • Bucket • Broom • Spoon • Measuring cylinder • Filters • Bunsen burner • Cup	• Raw milk • Raw milk testing reagents • Water • Detergents • Disinfectants • Record forms • Sample labels • Raw milk sampling bottles

	• Waste bin • Micropipette • Beaker • Calculator • Basin • Milk sampler dipper • Broom	

Indicative content 1.1: Selection of Tools, Equipment and Materials Used in Raw Milk Reception

Duration: 3 hrs

Theoretical Activity 1.1.1: Description of tools, equipment and materials used in raw milk reception

Tasks:

1: You are requested to answer the following questions related to description of tools, equipment and materials used in raw milk reception:

i. What do you understand by the following terms?
   a. Raw milk
   b. Milk collection centre

ii. What are the tools and materials used for:?
   a. Raw milk sampling
   b. Raw milk testing
   c. Raw milk storage
   d. Cleaning raw milk reception workplace

2: Write your answers on papers, flip chart, blackboard, or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 1.1.1.

Key readings 1.1.1: Description of tools, equipment and materials used in raw milk reception

- **Definition of key terms:**
  - ✓ **Raw milk**

It is a normal, clean and fresh secretions extracted from the udder of a healthy cow but excluding that obtained during the first seven days after calving and thirty (30) days before next calving.

- ✓ **Milk collection Center**
  - It is a central location where dairy farmers can bring their milk for collection.
  - These centers are typically established by dairy processing companies or cooperatives to collect milk from multiple farmers in a particular region.
  - The milk is then transported to a processing plant for further processing, such as pasteurization, homogenization, and packaging.
- ✓ **Raw milk testing**
  - Refers to the systematic evaluation of raw milk samples to determine their microbial quality and safety.
  - Serves as quality control measure, helping farmers identify issues related to

sanitation, animal health and milking practices.

- **Tools and materials used for raw milk sampling**

When it comes to sampling raw milk, there are several tools and materials that are necessary to ensure the process is done correctly.

The following table contains tools and materials used in raw milk sampling with their uses

Tool/material	Image	Use
Dipper sampler		Used to take a milk sample
Sterilized Milk Sampling Bottles		Designed for collecting milk samples ensuring that the sample remains uncontaminated.
Sterile Sampling Tubes		used to collect small milk samples from the bulk milk tank or individual cows
Milk Sample Cooler		This is a portable cooler that is used to transport milk samples from the farm to the laboratory for testing. It is designed to maintain the temperature of the raw milk sample and prevent spoilage
Milk Sample Labels		These are labels that are attached to each sample bottle or tube Indicating important information such as date, time, farmer's identification number
Micropipette / Dropper		Used to take small amount of milk
Stirrer		For mixing before taking sample

- **Tools, equipment and materials for raw milk testing,**

Tool/material/equipment	Image	Use
Milk can		Hold milk
Thermometer		Used to measure the temperature of raw milk at reception
Lactometer		Used for measuring the density of milk
pH meter:		Used to measure acidity and alkalinity of milk
Lactoscan		Used to measure the milk freezing point of fat (FAT), Solid not fat (SNF), density, proteins, lactose, salts, water content percentage, temperature, freezing point, pH, total solids
Mastitis kit		Used to measure the presence of mastitis in milk
Acidity gun		Used to measure the acidity of milk or colostrum and mastitis
Butyrometer		Used to determine fat content in milk
Bunsen burner		Generate flame when perform clot on boiling test
Gas cooker		Used for heating
Measuring cylinder		Used in measuring milk volume

Practical Activity 1.1.2: Selecting and adjusting tools, equipment and materials for raw milk reception

Task:

Referring to the previous theoretical activity 1.1.1, you are requested to go in milk processing workshop to select and adjust the right tools, material and equipment used in raw milk reception and make an adjustment where is required.

1: Apply safety precautions

2: Select tools, equipment and materials for raw milk reception and make adjustment where is required.

3: Present your work to the trainer and whole class. Ask clarification where necessary.

4: Read the key readings 1.1.2

5: Perform the task provided in application of learning 1.1.

Key readings 1.1.2: Selecting and adjusting tools, equipment and materials for raw milk reception

- **Selection criteria for tools and equipment**

Tools and equipment used in raw milk reception must meet the following criteria to ensure the quality and safety of the milk.

- The tools and equipment used in raw milk reception should be made of food-grade materials that are non-toxic, non-reactive example/ made in stainless steel
- Easy to clean and sanitize.
- Durable
- Corrosion-resistant
- Easy to use
- Able to perform the task
- Minimize the risk of contamination and ensure that the milk is handled gently to avoid damaging its quality.
- Tools and equipment used in raw milk reception should be designed to facilitate rapid cooling, such as by incorporating heat exchangers or other cooling systems.

- **Selection criteria for cleaning agent and reagent**

✓ **Effectiveness:**

- The cleaning agent should be effective in removing all types of contaminants from the equipment.
- It should be able to remove dirt, bacteria, and other microorganisms that can affect the quality of milk products.

✓ **Safety:**

- The cleaning agent t should be safe for use in food processing facilities.

- It should not leave any harmful residues on the equipment that can contaminate milk products.

✓ **Compatibility**:

- The cleaning agent should be compatible with the type of equipment being cleaned.
- It should not damage or corrode the equipment during the cleaning process.

✓ **Ease of use**:

- The cleaning agent or reagent should be easy to use and apply.
- It should not require complicated procedures or specialized equipment to apply.

✓ **Cost-effectiveness:**

- The cleaning agent or reagent should be cost-effective and efficient in its use.
- It should not require excessive amounts to achieve effective cleaning.

✓ **Regulatory compliance:**

- The cleaning agent or reagent should comply with all relevant regulations and standards for food processing facilities. (odourless)

✓ **Reagents and cleaning agents:**

- must be non-toxic,
- non-reactive and not expired.

✓ **Selection procedures for tools and equipment**

- Observe the tools and equipment available in workshop.
- Select tools and equipment based on the activity and set objective.
- Follow the safety guidelines for handling tools and equipment

- **Adjustment of tools and equipment**

Below are the steps involved in the adjustment of tools and equipment for raw milk reception:

Step 1: Wear appropriate personal protective equipment (PPE).

Step 2: Turn off and unplug the equipment

Step 3: Read the manual or guidelines for adjustment specification

Step 4: Inspect the equipment for damage, wear, or contamination and remove any milk residues, dirties, or build up to avoid contamination

Step 5: Make adjustment

Step 6: Test and verify

Points to Remember

- While receiving raw milk, make sure that the tools, materials and equipment for raw milk sampling, testing, and storage are available, cleaned and in good working conditions.
- Before using any tool or equipment, you are recommended to adjust accordingly following instructions from the manufacturer to avoid failure. Remember to wear personal protective equipment while adjusting tools and equipment.

Application of learning 1.1.

Your family member wants to establish a milk collection centre in your district. You are requested to help him/her to select tools, equipment and materials for raw milk sampling, testing and storage and for cleaning workplace.

Indicative content 1.2: Cleaning of The Work Area

Duration: 4 hrs

Theoretical Activity 1.2.1: Description of methods and techniques used for cleaning workplace

Tasks:

1: You are requested to answer the following questions related to methods and techniques used for cleaning workplace.

i. What is cleaning?
ii. What is the importance of cleaning workplace?
iii. What do you think should be taken into consideration in workplace to ensure safety?
iv. Give the factors affecting cleaning.
v. What are the cleaning methods used in raw milk reception?
vi. What are the cleaning techniques used in raw milk reception?

2: Provide the answers to the asked questions by writing them on papers, flip chart, blackboard, or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 1.2.1.

Key readings 1.2.1: Description of methods and techniques used for cleaning workplace

Cleaning: is a process in which complete removal of soil on tools, equipment and surface

- **Purpose of cleaning workplace**
  - Beauty of equipment and space
  - Produce safe products
  - Prevent cross contamination
  - Prevent some accident in work area
  - Facilitate worker movement
  - Good presentation of work area
  - Removing offensive odour
  - Avoiding the spread of dirt and contaminants to oneself and others
- **Hygienic safety precautions**

The following precautions should be taken into consideration to ensure hygienic safety in workplace:

- Wear PPE
- Do not mix cleaning product that contain bleach and ammonia.

- Making sure that workers know which cleaning product must be diluted and what is the correct dilution,
- During dilution, do not add water in cleaning products because some of them release flame. Add cleaning product in water.
- Training workers on the use, storage and emergency spill procedure for cleaning chemicals,
- Provide PPE to the workers using the cleaning product,
- Ensure that all container of cleaning product and chemicals are labelled to identify their contents and hazards,
- Operating ventilation system as needed during cleaning task to allow sufficient air flow and prevent build-up of hazardous vapour,
- Provide washing station for workers after using cleaning products.

- **Factors affecting cleaning:**
  - Types of cleaning product used.
  - Concentration of cleaning products
  - Temperature of water used.
  - Quality of water used during cleaning.
  - Water velocity
  - Contact time.
  - Procedure used during cleaning.
  - Technique used during cleaning.
  - Types of soil or dirt to be removed.
- **Cleaning method**

During cleaning we use two methods depend on type of tool and equipment**.**

✓ **Wet cleaning:**

Is a method of cleaning which use water and detergent solution to clean equipment and work area.

✓ **Dry cleaning:**

Is a method of cleaning equipment without water by using chemicals or other substance to clean equipment safely and efficiently.

- **Cleaning techniques**

✓ **Cleaning-in-place (**CIP**):**

- It is a method of cleaning designed to clean interior surfaces of tanks and pipelines of liquid process equipment without disassembling.
- It allows process plant and pipe work to be cleaned between process runs without the requirement to dismantle or enter the equipment.

✓ **Cleaning out of place (COP):**

- This is the term used for those cleaning operations involving the removal of small sections of piping, valve parts, filler parts, and other small appurtenances that are not normally cleaned in place and placing them into a cleaning vat.

This cleaning occurs outside of the equipment. This cleaning involves removing them from its working station and transfer to cleaning station.

Practical Activity 1.2.2: Cleaning and arrangement of the work area

Task:

Referring to previous theoretical activity 1.2.1, you are requested to go in milk processing workshop to prepare cleaning products, Clean and arrange the work area for raw milk reception.

1: Apply safety precautions

2: Prepare cleaning product, clean and arrange the work area for raw milk reception

3: Present your work to the trainer and whole class. Ask clarification where necessary.

4: Read the key readings 1.2.2

5: Perform the task provided in application of learning 1.2.

Key readings 1.2.2: Cleaning and arrangement of the work area

- **Preparation of cleaning product**

To prepare cleaning products in raw milk reception, it is important to follow strict guidelines to ensure the safety and quality of the milk. To prepare cleaning products for raw milk reception, the following processes are typically involved:

- ✓ **Selection of Cleaning Agents**: Choose appropriate cleaning agents based on the type of dirt and residues present on the equipment surfaces. Common cleaning agents used in dairy processing include alkaline cleaners, acid cleaners, and sanitizers.
- ✓ **Dilution of Cleaning Agents:** Dilute the cleaning agents according to the manufacturer's instructions or recommended concentrations to ensure effectiveness without causing damage to the equipment or compromising safety.
- ✓ **Preparation(mixing) of Cleaning Solutions**: Mix the diluted cleaning agents with water in designated containers or tanks to create the cleaning solutions that will be used during the cleaning process.
- ✓ **Testing of Cleaning Solutions**: Before using the cleaning solutions on equipment surfaces, it is essential to test them in small areas to ensure compatibility and effectiveness.

- **Cleaning procedures**
  - Pre-Cleaning

- Main Cleaning
- Rinse
- Disinfection
- Final Rinse (if necessary)
- Drying

- **Check the effectiveness of cleaning.**

To check the effectiveness of cleaning in raw milk reception, the following checking techniques should be used:

- ✓ **Visual inspection:** This is the most basic method of checking cleaning effectiveness. It involves visually inspecting surfaces to ensure that they are free of dirt, debris, food residue and biological growth.
- ✓ **SWAB test**: This method involves using a sterile swab to collect samples from surfaces. The samples are then tested for the presence of bacteria or other microorganisms.
- ✓ **pH test:** This method involves measuring the pH of final rinsing water. A pH of 7 is neutral, while a pH below 7 is acidic and a pH above 7 is alkaline. Because cleaning agents are basic and acidic. neutral PH indicate that there is no cleaning agent's residue.
- ✓ **Phenolphthalein test:** This method involves spraying a phenolphthalein solution final rinsing water. Phenolphthalein is a chemical indicator that turns pink/purple when it meets alkaline substances. And turns colourless in acidic solution.

- **Arrangement of the work area**

There are steps to consider when arranging tools and materials in workplace:

- ✓ **Categorize Tools and Materials:** Separate tools and materials based on their functions and usage.
- ✓ **Create Designated Storage Areas:** Allocate specific storage areas for different categories of tools and materials. This helps in easy identification and access when needed.
- ✓ **Implement a Labelling System:** Label shelves, cabinets, or containers to indicate the contents stored within. Clear labelling prevents confusion and promotes organization.
- ✓ **Prioritize Accessibility:** Place frequently used tools and materials in easily accessible locations to streamline workflow and reduce time wastage searching for items.
- ✓ **Ensure Proper Ventilation and Lighting**: Adequate ventilation and lighting are crucial for maintaining a safe working environment.
- ✓ **Follow Hygiene Guidelines**: Adhere to strict hygiene practices when arranging tools and materials in a milk processing workshop.

Keep all surfaces clean, sanitize equipment regularly, and store perishable items appropriately.

- ✓ **Consider Workflow Efficiency:** This includes placing items in sequential order to minimize movement during production.
- ✓ **Regular Maintenance Checks:** Conduct regular inspections of the storage areas to ensure that tools and materials are properly arranged, organized, and maintained. Address any issues promptly to prevent disruptions in operations.

Points to Remember

- When you are going to clean work area, you are recommended to prepare cleaning products accordingly. Remember to respect hygienic safety precautions and respect the cleaning procedures.
- While arranging work area, you are recommended to follow guidelines. Remember to prioritize the accessibility and follow hygienic guideline.

Application of learning 1.2.

The rehabilitation activities of your school food processing workshop are ended. You are requested to go in raw milk reception unit to prepare cleaning products used in raw milk reception, Clean the work area, Check the effectiveness of cleaning and arrange work area.

Indicative content 1.3: Preparation of Testing Reagents

Duration: 3 hrs

Practical Activity 1.3.1: Prepare testing reagent

Task:

You are requested to go in milk processing workshop to prepare testing reagent (alcohol) used in testing raw milk.

1: Apply safety precautions.

2: Prepare alcohol used for testing raw milk.

3: Present your work to the trainer and whole class. Ask clarification where necessary.

4: Read the key readings 1.3.1

5: Perform the task provided in application of learning 1.3.

Key readings 1.3.1: Prepare testing reagent

The alcohol test is a critical procedure used to assess the quality of raw milk, particularly to determine its potential for coagulation during thermal processing.

The following steps outline the procedure for conducting the alcohol test:

Step 1: Selecting the Appropriate type of alcohol: It is crucial to use high-purity ethanol (usually 95% or higher) to ensure that no impurities interfere with the test results.

Step 2: Gathering required materials: Before preparing the alcohol solution, gather all necessary materials: High-purity ethanol, distilled water (if dilution is needed) and measuring cylinders or pipettes, clean glass containers or test tubes and Personal protective equipment (gloves, goggles)

Step 3: Preparing dilutions: Calculate the desired concentration using the formula: $C_1V_1=C_2V_2$ where C_1 is the concentration of stock solution, V_1 is the volume of stock solution needed, C_2 is the desired concentration, and V_2 is the final volume.

Note that C_1: Concentration of ethanol before dilution

V_1: Volume of ethanol before dilution

C_2: Concentration of ethanol after dilution

V_2: Volume of ethanol after dilution

Step 4: Mixing thoroughly: Once you have measured out your components (ethanol and distilled water), mix them thoroughly in a clean glass container to ensure homogeneity.

Step 5: Labelling and Storing Solutions Properly: Label all containers clearly with details such as concentration, date prepared, and any safety warnings. Store them in a cool, dark place away from direct sunlight and heat sources to maintain stability.

Points to Remember

- When preparing alcohol to be used in raw milk test, you are recommended to use high purity alcohol and distilled water.
- Be accurate while diluting ethanol.

Application of learning 1.3.

You are requested to go in milk processing workshop to prepare alcohol solution for raw milk testing and prepare the report.

Learning outcome 1 end assessment

Written assessment

1. The following table contains tools and equipment used in raw milk reception (column A) with their uses (column B). Match the two columns by writing the correct answer in the provided place (column C)

Column A	Column B	Column C
1.Filters	i. Used in measuring milk volume	1……..
2.Thermometer	ii. Used to measure the density of milk	2…….
3.Butyrometer	iii. To separate raw milk and impurities	3……
4.Lactodensimeter	iv. Measure fat content in milk	4……
5.Dippers and Plungers	v. Used to measure temperature of milk	5…..
	vi. Generate flame when perform clot on boiling test	
	vii.Used for heating	
	viii. Used to take sample	

2. Circle the letter corresponding to the right answer

A. Which of the following statements is **NOT** a correct criterion to select tools, material and equipment used in raw milk reception?

i. Cause harm to the processor
ii. It should be composed by materials that minimize corrosion / made in stainless steel
iii. Able to perform the task
iv. Easy to use

B. The following are the purposes of work area arrangement **EXCEPT**

a. Good presentation of work area
b. Facilitate effectiveness of process and protective
c. Help you get your work done accurately
d. Help to make unsafe product

C. Choose from the list below, the suitable solution for adjusting the concentration of alcohol of 95% to the appropriate concentration of alcohol to be used in raw milk quality testing at reception point

a. Potable water
b. Distilled water
c. Chlorine

d. None above

3. Fill in the blank with missing information related to cleaning techniques.
   a. ……..allows process plant and pipe work to be cleaned between process runs without the requirement to dismantle or enter the equipment.
   b. ……..operations involving the removal of small sections of piping, valve parts, filler parts, and other small appurtenances that are not normally cleaned in place and placing them into a cleaning vat. This cleaning occurs outside of the equipment.
4. Calculate the concentration of 68% ethanol from 500ml of 96% concentration.
5. The following are steps to follow when arranging workplace. Rearrange them according to their sequence: consider workflow efficiency, create designated storage areas, ensure proper ventilation and lighting, categorize tools and materials, implement a labelling system, follow hygiene guidelines, prioritize accessibility, regular maintenance check.
6. Answer by **True** if the statement is correct and **False** if not.
   a. During dilution of concentrated cleaning product, add water in the product.
   b. Sometimes employers can train workers on the use, storage and emergency spill procedure for cleaning chemicals.
   c. Phenolphthalein is a chemical indicator that turns pink/purple when it meets alkaline substances.

Practical assessment

ABC is a dairy company ltd located in Ngororero District and it is willing to open an MCC. Suppose that you are hired as an assistant technician on the post of milk receptionist.
You are requested to:

1. Select tools and equipment that will be used when receiving raw milk.
2. Clean work area.
3. Prepare testing reagents to be used while testing received raw milk.

END

References

CDC Features: Raw (Unpasteurized) Milk. (n.d.). Retrieved 7 29, 2024, from CDC: https://www.cdc.gov/features/rawmilk/

Chocolate: Types (Unsweetened, Bittersweet, Semisweet, Milk), Selection, and Storage. (n.d.). Retrieved 7 29, 2024, from https://www.bhg.com/recipes/desserts/chocolate/chocolate-types-selection--storage/

Eddison, R. T., Kempthorne, O., Hosking, Z. D., Barkworth, H., Cox, C. P., & Rowlands, A. (1951). 435. Keeping quality and raw-milk grading: II. The effect of storage on the results of keeping quality and dye tests. *Journal of Dairy Research, 18*(01), 43-71. Retrieved 7 29, 2024, from https://cambridge.org/core/journals/journal-of-dairy-research/article/435-keeping-quality-and-rawmilk-grading-ii-the-effect-of-storage-on-the-results-of-keeping-quality-and-dye-tests/5b7bed1db34105d70a1927e426866c2e

Food safety of raw milk. (n.d.). Retrieved 7 29, 2024, from Foodsmart.govt.nz: http://www.foodsmart.govt.nz/food-safety/high-risk-foods/raw-milk/rawmilk.htm

Food Standards and Labeling Policy Book. (2005). United States Department of Agriculture. Retrieved 7 29, 2024, from http://www.fsis.usda.gov/OPPDE/larc/Policies/Labeling_Policy_Book_082005.pdf

Gargouri, A., Hamed, H., & ElFeki, A. (2013). Analysis of Raw Milk Quality at Reception and During Cold Storage: Combined Effects of Somatic Cell Counts and Psychrotrophic Bacteria on Lipolysis. *Journal of Food Science, 78*(9). Retrieved 7 30, 2024, from https://onlinelibrary.wiley.com/doi/abs/10.1111/1750-3841.12188

Gordin, S., Ziv, G., & Gamil, O. (1970). Comparison of three methods for grading the hygienic quality of raw milk. *Journal of Agricultural Research, 20*(3). Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19710401526

Jennings, W. (1960). Automation in cleaning milk processing plant equipment. *California Agriculture, 14*(9), 4-4. Retrieved 7 29, 2024, from http://californiaagriculture.ucanr.org/landingpage.cfm?article=ca.v014n09p4&fulltext=yes

Kandpal, S. D., Srivastava, A. K., & Negi, K. S. (2012). ESTIMATION OF QUALITY OF RAW MILK (OPEN & BRANDED) BY MILK ADULTERATION TESTING KIT. *Indian Journal of Community Health, 24*(3), 188-192. Retrieved 7 29, 2024, from http://iapsmupuk.org/journal/index.php/ijch/article/view/306

Laanen, P. G.-V. (1999). *Safe Home Food Storage*. Retrieved 7 29, 2024, from http://nchfp.uga.edu/how/store/texas_storage.pdf

Marsh, K. (n.d.). Food Packaging—Roles, Materials, and Environmental Issues. *Journal of Food Science, 72*(3), 39–54. Retrieved 7 29, 2024, from http://ift.org/knowledge-center/read-ift-publications/science-reports/scientific-status-

summaries/~/media/Knowledge%20Center/Science%20Reports/Scientific%20Status%20Summaries/FoodPackagingEnviron_0407.pdf

Martin, N., Ranieri, M., Murphy, S., Ralyea, R., Wiedmann, M., & Boor, K. J. (2011). Results from raw milk microbiological tests do not predict the shelf-life performance of commercially pasteurized fluid milk. *Journal of Dairy Science, 94*(3), 1211-1222. Retrieved 7 29, 2024, from https://ncbi.nlm.nih.gov/pubmed/21338787

Nixon, M. C., & Lamb, A. B. (1945). Resazurin Triple Reading Test for Grading the Quality of Raw Milk. *Canadian journal of comparative medicine, 9*(1), 18-23. Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19452701370

Nouws, J., Loeffen, G., Schouten, J., Egmond, H. J., Keukens, H., & Stegeman, H. (1998). Testing of raw milk for tetracycline residues. *Journal of Dairy Science, 81*(9), 2341-2345. Retrieved 7 29, 2024, from https://sciencedirect.com/science/article/pii/s0022030298701249

Pullinger, E. (1946). A method of grading raw milk, with special reference to the grading of milk for South Africa. *Journal of The South African Veterinary Association-tydskrif Van Die Suid-afrikaanse Veterinere Vereniging, 17*(1), 15-41. Retrieved 7 29, 2024, from https://journals.co.za/content/savet/17/1/aja00382809_577

Raw Milk - Food Safety. (n.d.). Retrieved 7 29, 2024, from (US) Centers for Disease Control and Prevention: https://www.cdc.gov/foodsafety/rawmilk/raw-milk-index.html

Rosenman, K. D., Reilly, M. J., Schill, D. P., Valiante, D., Flattery, J., Harrison, R., . . . Filios, M. S. (2003). Cleaning Products and Work-Related Asthma. *Journal of Occupational and Environmental Medicine, 45*(5), 556-563. Retrieved 7 29, 2024, from https://ncbi.nlm.nih.gov/pubmed/12762081

Rowlands, A., & Hosking, Z. D. (1951). 443. Keeping quality and raw-milk grading: III. Comparison of keeping quality tests and dye tests in milk control (results of a field trial). *Journal of Dairy Research, 18*(02), 166-192. Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19512703826

White, C. (2011). *Milking and Handling of Raw Milk | Effect of Storage and Transport on Milk Quality*. Retrieved 7 30, 2024, from https://sciencedirect.com/science/article/pii/b9780123744074003265

Wightman, T. (2009). *Raw Milk Production.* Farm to Consumer Legal Defense Fund.

Indicative Contents

2.1. Raw milk sampling
2.2. Sample Analysis
2.3. Grading of raw milk

Key Competencies for Learning Outcome 2: Perform Raw Milk Testing

Knowledge	Skills	Attitudes
• Description of raw milk • Description of sampling techniques • Description of raw milk tests • Description of raw milk grading parameters	• Sampling raw milk • Handling raw milk sample • Performing raw milk tests and interpreting result • Grading raw milk	• Being accurate while sampling raw milk. • Paying attention while testing raw milk. • Being careful while handling raw milk samples • Being vigilant while grading raw milk. • Being organized while keeping records. •

Duration: 30 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe clearly the characteristics of raw milk required in raw milk reception.
2. Describe properly sampling techniques used for raw milk testing.
3. Explain properly the types of tests applied while receiving raw milk.
4. Test appropriately raw milk as applied in raw milk reception.
5. Interpret correctly the results from raw milk test as required in raw milk reception
6. Explain clearly grading parameters required in raw milk grading.
7. Grade effectively raw milk according to grading parameters.

Resources

Equipment	Tools	Materials
• Lactoscan • Incubator • PPE • Weighing balance • Gerber centrifuge • Cooling tank • Table • Milking can • Pump • Water bath • Refrigerator • Watch • Autoclave • Gas cooker	• Lactometer • Thermometer • PH meter • Alcoholmeter • Alcohol gun • Test tube • Mastitis kits • Antibiotic kits • Spoon • Measuring cylinder • Filters • Bunsen burner • Cup • Waste bin • Micropipette • Beaker • Calculator • Milk sampler dipper	• Raw milk • Raw milk testing reagents • Record forms • Sample labels • Raw milk sampling bottles

Indicative content 2.1: Raw Milk Sampling

Duration: 6 hrs

Theoretical Activity 2.1.1: Description of raw milk and raw milk sampling

Tasks:

1: You are requested to answer the following questions related to description of raw milk and raw milk sampling.

i. What do you understand about:
   a. raw milk?
   b. Milk sample?

ii. Suggest the types of raw milk sampling?

iii. How can you handle milk samples?

2: Write your answers on papers, flip chart, blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 2.1.1

Key readings 2.1.1: Description of raw milk and raw milk sampling

- **Description of Raw milk**

✓ **Definition of Raw milk:**

- Is the normal, clean and fresh secretions extracted from the udder of a healthy cow, but excluding that obtained during the first seven days after calving and thirty (30) days before next calving.
- Is the milk that has not been pasteurized or milk that has not yet undergone any kind of treatment (heat, separation, purification, …)

✓ **Characteristics of Raw milk**

- Be clean and obtained from healthy cow.
- Have white yellowish or creamy-white colour with natural odour and flavour.
- Be clean and free from any foreign matters.
- Not have added or removed substance.

✓ **Specific requirements for raw milk**

S/N	Characteristics	Requirements
1	Milk fat, %min	3.25
2	Protein, % min	3.00
3	Freezing point, ^{O}C	-0.550 to -0.525
4	Alcohol test	Negative

5	Clot-on-boiling test	Negative
6	Ph	6.6-6.8
7	Density at 20° C, g/ml	1.028-1.034
8	Titratable acidity, %, max.	0.17
9	Milk solid non-fat, %, min	8.5
10	Phosphatase test	Positive

- **Description of milk sampling**

- A milk sample refers to a small amount of milk that is collected for analysis or testing purposes.
- Milk sampling is the process of collecting a representative sample of milk from a bulk tank or individual animal for testing purposes.

✓ **Purpose of sampling**

Raw milk sampling serves several critical purposes in the context of food safety, quality control and public health. Below is a detailed explanation of the main purposes of raw milk sampling:

- To assess quality and safety of the milk before it undergoes processing.
- To identify if the milk is fit for production.
- To ensure that milk and milk products are safe and healthy.
- To meet the standards for chemical composition and purity of milk.
- To meet the standard levels of bacteria and other microorganisms in milk.
- To ensure that milk collectors, processors and marketing agencies follow the correct methods.
- To monitor the quality of the milk during processing.
- The consumer expects to pay a fair price for milk and milk products of acceptable to excellent quality.
- Helps the government and public agencies to protect against nutritional problem.

- **Sampling techniques**

✓ **Aseptic Sampling:**

- Involves using sterile equipment and techniques to collect samples without introducing contaminants.
- This method is essential for maintaining the integrity of the sample and ensuring accurate microbiological testing.

✓ **Representative Sampling**

- It is designed to capture a sample that accurately reflects the entire volume of milk being processed.
- This technique often involves collecting larger volumes over time, typically using a peristaltic pump to ensure that the sample represents the whole batch rather than just a portion.

✓ **Grab Sampling**

- It is a simpler technique where a small volume of milk is collected at a specific moment in time, usually with a sterile syringe or container.
- While this method provides quick results, it does not account for variations within the entire batch and is generally less reliable than representative sampling for raw milk.

✓ **Composite Sampling:**

- It involves taking multiple grab samples from different locations or times and combining them into one sample for analysis.
- This method can help mitigate some of the variability seen in grab samples by averaging out differences across multiple points.

✓ **Inline Sampling**

- It refers to taking samples directly from the processing line during operations.
- This technique allows for real-time monitoring of quality parameters and can be done aseptically to prevent contamination.

✓ **Manual Sampling**

- It involves physically collecting samples from storage tanks or transport vehicles at designated intervals or after specific events (like agitation).
- This method requires careful handling to maintain sterility and representativeness.

✓ **Handling sample**

- Handling a sample refers to the process of manipulating, storing, and transporting sample before analysis.
- It serves many critical purposes that ensure safety, quality and economic viability of dairy products.

✓ **Sampling milk for bacteriological testing**

This test requires a lot of care. Tools used must have been sterilized in an autoclave or pressure cooker for at least 15minutes at 120^0C in order not to contaminate the sample.

Practical Activity 2.1.2: Sampling and handling raw milk samples

Task:

Referring to the previous theoretical activity 2.1.1, you are requested to go in the food processing workshop to take and handle sample of raw milk.

1: Apply safety precautions

2: Take and handle milk sample.

3: Present your work to the trainer and whole class. Ask clarification where necessary.

4: Read the key readings 2.1.2

5: Perform the task provided in application of learning 2.1

Key readings 2.1.2: Sampling and handling raw milk sample

- **Milk sampling Procedure:**

While sampling raw milk pass through the following procedure:

- ✓ Wash and dry hands; to keep hands clean during sampling operation
- ✓ Mix thoroughly the milk with stainless stirrer.
- ✓ With a dipper take the sample (500ml) as soon as possible after mixing.
- ✓ Cover sample with aluminium foil and seal the milk can.
- ✓ Label the sample with the necessary information.
- ✓ Wash equipment used for sampling after use.

- **Handling guidelines**

- ✓ Work on a sample immediately after sampling, if not, the sample must be cooled to near freezing point quickly and be kept cold till the work can begin (temperature of 4^{o}C).
- ✓ If samples are to be taken in the field e.g. at a milk cooling center, ice boxes with ice packs are useful.
- ✓ Labelling and record keeping: samples must be clearly labelled with name of farmer/supplier or code number and records of dates and places included in standard data sheets.

Points to Remember

- To ensure quality and safety of raw milk samples, you are recommended to handle them properly before testing.
- While sampling raw milk, make sure that your hands and sampling tools are cleaned. You are recommended to take the sample as soon as possible after mixing, cover sample and label with the necessary information. Don't forget to keep it cold at 4^{o}C.

Application of learning 2.1.

You are requested to visit a Milk collection centre around your school/ go in food processing workshop and take a sample of raw milk and handle it accordingly.

Indicative content 2.2: Sample Analysis

Duration: 16 hrs

Theoretical Activity 2.2.1: Description of the types of raw milk test

Tasks:

1: You are requested to answer the following questions related to raw milk test.

i. How can you define milk test?

ii. What is the purpose of testing raw milk?

iii. Suggest any three examples of raw milk test.

2: Write the answers on papers, flip chart, blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 2.2.1

Key readings 2.2.1: Description of the types of raw milk test

- **Key definition**

✓ **Milk test** refers to a series of laboratory analyses performed on milk samples to assess various quality and health parameters.

✓ **Quality control** is the use of approved tests to ensure that they meet the standard and regulations concerning milk and milk products.

- **Purpose of raw milk testing**

The tests are designed to ensure that milk products meet accepted standards for chemical composition and purity as well as levels of different micro-organisms. The following are key reasons:

✓ To identify if the milk is fit for production.

✓ To ensure that milk and milk products are safe and healthy

✓ To meet standards for chemical composition and purity of milk

✓ To monitor the quality of milk during processing

✓ The consumers expect to pay fair price for milk

✓ The processor makes sure that the milk received is suitable for further processing.

- **Description of raw milk test types**

There are two main types of raw milk test which are:

✓ **Platform tests:**

- Are rapid tests on which acceptance or rejection of milk can be based.
- Platform tests or milk reception tests are the commonly used names for the tests carried out on the raw milk at collection and/or reception.
- These can be carried out both at the Milk Collection Centre and at the Dairy Plant.

Examples: Organoleptic tests, alcohol test, clot -on-boiling test, …

✓ **Laboratory tests:**

Test based on which milk is graded according to microbial population or composition.

Examples: Gerber test for fat, Resazurin test, bacterial inhibitor test

- **Organoleptic test**

➢ This should always be the first screening of the milk, since it is cheap, quick and does not require any equipment.

➢ The organoleptic tests permit rapid segregation of poor-quality milk at the milk receiving platform; that is why the milk grader must have a good sense of sight, smell, and taste.

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

➢ The clot-on-boiling test measures the degree of acidity of milk and involves boiling a small amount (2–5 ml) of milk in any suitable container.

➢ If clotting (coagulation or precipitation) occurs, this indicates that the milk is bad because it has many acid-producing bacteria.

➢ The clot-on-boiling test is simple, quick and cheap.

- **Materials**

- Test tube or spoon
- Paraffin burner or Bunsen burner
- Boiled water

- **The alcohol test**

➢ The alcohol test is mainly used to detect the degree of acidity of the supplier's milk.

➢ This test is more sensitive than the COB test which only detects milk which is highly acidic (pH<5.3).

➢ The alcohol test detects even medium-acidity milk (pH <6.4). Therefore, milk which passes the COB test may fail the alcohol test. Colostrum and mastitis milk may also fail the alcohol test.

- **Materials**

- Alcohol gunner or syringe
- Beaker or glass
- 68-80% alcohol

Comparison between alcohol test from clot on boiling

Comparison	**Alcohol test**	**Clot on boiling**
Materials used	✓ Test tube ✓ Alcohol gun ✓ Ethanol 68%	✓ Test tube or spoon ✓ Paraffin burner or Bunsen burner
PH	PH<6.4	PH<5.3
Detection of acidity	It detects medium acidity	It detects highly acidic milk
Feasibility	High	Low

Sensitivity	More sensitive than COB	COB only detect high acidic milk
Skills	Need skills for preparation of alcohol	No skills needed

- **The Lactometer Test**

- It is designed to detect the change in density of such adulterated milk based on the specific gravity.
- Milk has a specific gravity when it is adulterated with water, or other materials are added or both misdeeds are committed.
- The density of milk changes from its normal value to abnormal.
- Any buyer of milk should carry out this test to assure him/herself that the milk he/she purchases is wholesome and has not been adulterated.

Sample	**Milk temperature**	**Lactometer reading ^{o}L**	**Correction ^{o}L**	**True lactometer reading ^{o}L**	**True density g/ml**
1	17	30.6	-0.6	30.0	1.030
2	20	30.0	Nil	30.0	1.030
3	23	29.4	+0.6	30.0	1.030

- **Titratable acidity test**

The evaluation of milk acidity at reception is to determine the freshness of milk. Two values are determined: **the pH** and **the acidity.**

- **pH:**
  - **I**s usually carried out with an electronic pH-meter.
  - It depends on the potential difference set up between two electrodes when they are in contact with a test sample.
  - A reference electrode whose potential is independent of the pH of the solution and an electrode whose potential is proportional to the hydronium ion concentration [H+] of the test sample are used.
  - Saturated calomel electrodes are usually used as reference electrodes, and glass electrodes are used to measure the pH.
  - Instruments which measure the current produced by the difference in potential between the glass and calomel electrodes are called pH meters.
- **Milk acidity test**
  - Involves determination of the acid content in milk due to presence of acid-producing bacteria.
  - The normal fresh milk has a pH between **6.6** and **6.8.**

- If the pH < 6.60, the milk is acidic. Further acidity test is needed to make a clear evaluation.
- If the pH > 6.80, the milk contains added water, or it is from a mastitic cow. Further tests (freezing point, CMT) must be carried out to have a clear evaluation.
- The production of acid in milk is normally termed "**souring**" and the sour taste of such milk is due to lactic acid.
- The percentage of acid present in milk at any time is a rough indication of the age of the milk and the way it has been handled.
- Fresh milk has an initial (titratable) acidity due to its buffering capacity and for normal milk, this "natural" acidity varies between 0.13% and 0.17% lactic acid.
- The acidity test measures the lactic acid in the milk. If the acidity is higher than 0.19%, then the milk quality is poor and cannot be processed. If the acidity is lower than normal (e.g. 0.10% lactic acid) then the milk is of poor bacterial quality or sodium hydroxide/bicarbonate might have been added.

❖ **Reagents used:**

- Sodium hydroxide 0.1N
- Distilled water
- Phenolphthalein indicator

○ **Calculations:** N NaOH V NaOH = N Sample V Sample

$$\% \text{ Lactic acid} = \frac{volume\ required\ for\ neutralization\ (used\ ml\ of\ 0.1N\ NaOH) X 0.009}{Weight\ of\ sample} \text{x} 100$$

Weight of sample = Volume of milk x specific gravity

California Mastitis Test (CMT TEST)

- It is a quick, easy and economical test for the detection of subclinical infection of a quarter.
- It provides an indication of the number of somatic cells found in the milk.
- The CMT will only trigger a visible reaction with a concentration of 400,000 cells/ml or more.

Resazurin test

- The resazurin test measure the general bacteriological condition of raw milk.
- Resazurin test is the most widely used test for **hygiene and the potential keeping quality of raw milk**.
- Resazurin is a dye indicator. Under specified conditions Resazurin is dissolved in distilled boiled water.
- The resazurin solution can later be used to test the microbial activity in each milk sample.
- The 10 min resazurin test is useful and rapid, screening test used at the milk platform.

- The 1-hour test and 3-hour tests provide more accurate information about the milk quality, but after a fairy long time. They are usually carried out in the laboratory.

❖ **Materials and reagents**

- Resazurin tablets
- Test tubes with 10 ml mark
- 1ml pipette or dispenser for resazurin solution.
- Water bath thermostatically controlled
- Lovibond comparator with resazurin disc 4/9

❖ **Procedure**

- The solution of resazurin as prepared by adding one tablet to 50 ml of distilled sterile water.
- Resazurin solution must not be exposed to sunlight, and it should not be used for more than eight hours because it losses strength.
- Mix the milk and with a sanitized dipper put 10 ml milk into a sterile test tube.
- Add one ml of resazurin solution, stopper with a sterile stopper,
- Mix gently the dye into the milk and mark the tube before the incubation in a water bath,
- Place the test tube in a Lovibond comparator with resazurin disk and compare it colour diametrically with a test tube containing 10 ml milk of the same sample, but without the dye (Blank).

Observations

Resazurin disc no.	Colour	Grade of milk	Action
6	Blue	excellent	Accept
5	Light blue	v. good	Accept
4	Purple	Good	Accept
3	Purple pink	Fair	Separate
2	Light pink	Poor	Separate
1	Pink	Bad	Reject
0	White	Very bad	Reject

- The Resazurin test is essentially a rapid bacteria estimation.
- Resazurin is a blue dye which gives normal milk a characteristic blue colour.
- The test is based on the ability of bacteria in the milk to reduce the blue dye.
- The quality of the milk is judged by noting the degree of colour change from blue through mauve and purple and pink and finally colourless after a stated period of incubation, or the time required to reduce the dye to a predetermined colour

- **Lactoscan**

- It is a simple machine used to determine different physicochemical parameter at ago in one minute.

➢ **Materials and Equipment:**

- Lactoscan
- Plastic sample holder

➢ **Procedure**

- Take sample in container
- Pour the sample in the plastic sample holder on the lactoscan and follow the instruction and functionality of the machine.

➢ **Judgment:**

The screen displays the first letter of the Parameter and the result

F: Fat……3.25-5%

S: SNF…… 7.8 - 8.5%

D: Density * …… 1.028-1.034 g/cm3

P: Proteins ……. ……2.8% to 4%

L: Lactose …….. ……3.5 to 5 %

W: Water added ……. …….. 0 %

FP: Freezing point …… ……. – 0,550-525o C

PH*…….. ……6.6-6.7

- **Inhibitory test**

Milk collected from producers may contain drugs and/or pesticides residues. These when present in significant amounts in milk may inhibit the growth of lactic acid bacteria used in the manufacture of fermented milk such as cheese and Yoghurt, besides being a health hazard.

➢ **Materials and equipment**

- Test tubes
- Water bath
- Pipette
- Beaker
- Incubator

➢ **Reagents**

- Starter culture
- Milk (Sample)
- Milk (Blank)

➢ **Procedure**

- Three test tubes are filled with l0 ml of sample to be tested and three test tubes filled with normal milk.
- All tubes are heated to 90 ºC by putting them in boiling water for 3 - 5 minutes.
- After cooling to optimum temperature of the starter culture (30, 37, or 42ºC), 1

ml of starter culture is added to each test tube, mixed and incubated for 3 hours.

- **Judgement of results:**
  - If acid production in suspected sample is the same as the normal sample, then the suspect sample does not contain any inhibitory substances.
  - If acid production in the suspect sample is less than in the normal milk sample, then, the suspect sample contains antibiotics or other inhibitory substances.

Gerber test for fat

This test is used to determine the fat content of the milk.

- **Procedure:**
  - Add 10 ml sulphuric acid to the butyrometer followed by 11 ml of well mixed milk. Avoid wetting of the neck of the butyrometer.
  - Next add 1 ml of Amyl alcohol, insert stopper and shake the butyrometer carefully until the curd dissolves and no white particles can be seen.
  - Place the butyrometer in the water bath at 65ºC and keep it there until a set is ready for centrifuging.
  - The butyrometer must be placed in the centrifuge with the stem (scale) pointing towards the center of the centrifuge. Spin for 5 min. at 1100 rpm.
  - Remove the butyrometers from the centrifuge.
  - Put the butyrometers in a water bath maintained at 65ºC for 3 min. before taking the reading.
- **Note**: When transferring the butyrometers from the centrifuge into the water bath make sure that:
  - The butyrometers are all the time held with the neck pointing up.
  - The fat column should be read from the lowest point of the meniscus of the interface of the acid-fat to the 0-mark of the scale and read the butterfat percentage.
  - The butyrometers should then be emptied into a special container for the very corrosive liquid of acid-milk, and the butyrometers should be washed in warm water and dried before the next use.
- **Appearance of the test:**
  - The colour of the fat column should be straw yellow.
  - The ends of the fat column should be clearly and sharply defined.
  - The fat column should be free from specks and sediment.
  - The water just below the fat column should be perfectly clear.
  - The fat should be within the graduation.

Alcohol-Alizarin test

- The procedure for carrying out the test is the same as for alcohol test, but this test is more helpful.
- Alizarin is a colour indicator changing colour according to the acidity of milk.
- The Alcohol-Alizarin solution can be bought readymade or be prepared (0.4 g

alizarin powder) in 1 litter of alcohol (68%).

- **Procedure**

- Mix equal amounts of milk and 68% of ethanol solution in a small test tube. For routine testing 2 ml milk is mixed with 2 ml 68% alcohol.
- Observe the coagulation, clotting or precipitation in milk and change in colour of milk.

- **Observations/Results for alcohol-alizarin test**

Parameter	normal milk	slightly acid Milk	acid milk	alkaline Milk
pH	6.6 – 6.7	6.4 – 6.6	6.3 or lower	6.8 or higher
Colour	red brown	Yellowish brown	Yellowish	Lilac
Appearance of milk	No coagulation no lump	no coagulation	coagulation	no coagulation

- **Methylene blue test**

- It is known as MBRT (Methylene Blue Dye Reduction Test).
- It is a test used as a quick method to assess the microbiological quality of raw and pasteurized milk.
- Increasing the number of bacterial flora will reduce the colour of methylene blue more rapidly due to increasing consumption of oxygen, i.e. the speed of reduction of methylene blue colour is directly proportional to the number of bacteria present in milk sample.
- The shorter the decolouration time, the higher the number of bacterial flora present in milk, and the poor quality of milk.

- **Interpretation**

Decolouration time	**Results**
30 minutes-2 hours/ less than 30minutes	Poor quality
2-6 hours/ 1-2 hours	Fair quality
6-8 hours/3-4hours	Good quality
Over 8hours/5or above	Excellent quality

- **Procedure**

- Take 10ml of milk sample
- Add 1ml of MBRT dye solution (dye concentration 0.005%)
- Put in water bath at 37 plus or minus 1 ºC

- Record this time as the beginning of the incubation period
- Decolouration is considered complete when only a faint blue ring (about 5mm) persists at the top.

The sediment test

- It involves filtering a definite amount of milk through a white cotton pad and observing the character and amount of residue.
- Amount of residue found in milk may serve to help people learn how to improve on milk quality and the test does not lead to milk rejection.

Detection of Maltodextrins

Maltodextrins are produced from starch and usually found as a creamy white hygroscopic powder. They can be cheaply and widely available.

Procedure

- Put 20 ml of milk in a beaker, boil and cool.
- Coagulate the milk using 10% Trichloroacetic acid.
- Filter through Whatman filter paper no. 42 and collect the filtrate.
- Add 2 ml of 2% Barium chloride to the filtrate and mix well.
- Appearance of blue colour indicates the presence of maltodextrins.

Addition of starch / Cereal flour

- Take 3 ml of well mixed sample of milk in a test tube
- Boil the milk over a Bunsen burner
- Cool and add a few drops of 1 percent Iodine solution and observe for colour change.
- Appearance of blue colour indicates the presence of starch.
- So, development of blue colour indicates adulteration of milk with starch / cereal flour.
- Blue colour disappears when the sample is boiled.

Antibiotic residues test

- Performing a rapid antibiotic residues test in raw milk involves the detection of three common classes of antibiotics: **β-lactam, tetracycline,** and **sulphonamide**.
- This test is crucial to ensure the safety and quality of milk products, as the presence of antibiotic residues can have adverse effects on human health.

Procedure for Beta lactams and Tetracyclines test

- Read instructions before experiment.
- Bring the test kit and samples at room temperature.
- Milk samples should be full liquid without any agglomeration and deposition.
- Take the bottles needed from the kit packages, take out required wells and strips and make proper marks.
- Please use the test strips within one hour.
- Seal the cap of the bottles and store the unneeded kit.

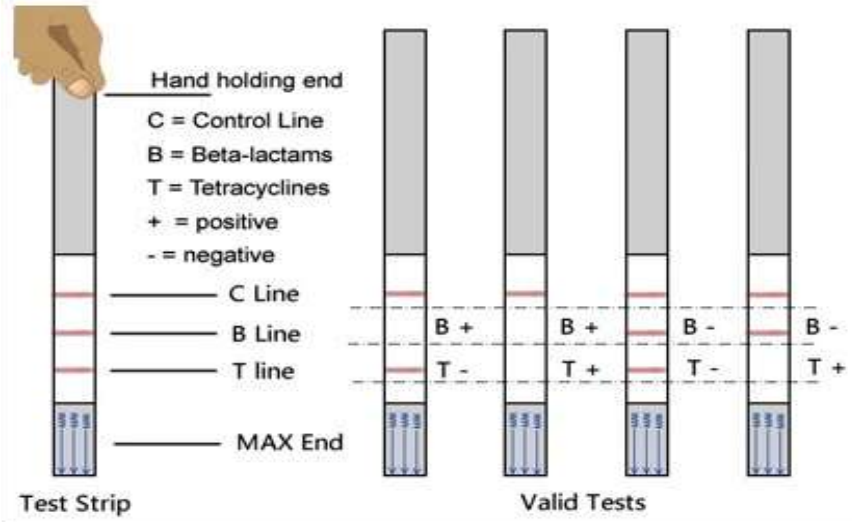
- Take 200µl of the milk sample into the micro well, then repeatedly absorb up and down for 5 times to mix the sample with the reagent in wells completely. The mixture should be pink, and then start the timer.
- Notes: In the case you are sampling with a plastic pipette, please add sample close to the marker line on the wells, which can be watched by the eye quite easily.
- Incubate for **5 minutes at room temperature,** and then insert the test strips into the well with the **MAX** end fully dipped in to the mixed reagent and sample.
- Incubate for **5minute at room temperature** again. Take out the strip; determine the results according to part 4.

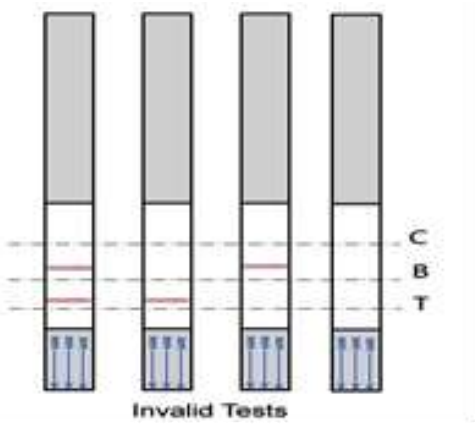
➢ **Result Determination**

There are 3 lines in the strips, **Control line, Beta Lactams line and Tetracycline's line**, which are briefly used as **C, B and T** respectively**.** The test results will depend on the colour of these line.

The following diagram describes the result identification.

- **B+ T negative**: Line C, B and T are red.
- **B+T positive**: Line C is red; line B and T have no color
- **Beta**-lactams positive: Line C is red; line B has no color
- Tetracyclines Positive: Line c is red; Lines T has no color
- Invalid result: Line C has no color





Practical Activity 2.2.2: Testing raw milk and interpreting result

Task:

Referring to the previous theoretical activity 2.2.1, you are requested to go in the food processing workshop to perform raw milk test and interpret the obtained results.

1: Apply safety precautions.

2: Test raw milk and interpret the results.

3: Present your work to the trainer and whole class. Ask clarification where necessary.

4: Read the key readings 2.2.2.

5: Perform the task provided in application of learning 2.2

Key readings 2.2.2: Perform raw milk testing and result interpretation

The following is a series of tests performed for raw milk.

- **Organoleptic test**

✓ **Procedure**

- Open a container of milk
- Immediately smell the milk
- Observe the appearance of the milk
- If still unable to make a clear judgement of the milk, taste the milk, but do not swallow it!
- Look at the can lid and the milk can to check for cleanliness
- Touch the milk container to assess whether it is warm or cold. This will allow you to know whether the milk has been cooled since this will also affect the lactometer reading.

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

✓ **Procedure**

- Boil about 5 ml of milk in a test tube or spoon or any other suitable container over a Bunsen burner.
- **Results observation**

- If there is clotting, coagulation or precipitation, the milk is sour (acidic), the milk has failed the test and should be rejected.
- If no coagulation occurs the milk can stand heating operations at the time of testing.

- **The alcohol test**

✓ **Procedure**

- Put equal volumes of milk and 68-80% alcohol in a test tube (e.g. 2 ml of milk in 2 ml of 68-80% alcohol).
- Invert the test tube several times; keep your thumb pressed tightly over the open end of the tube.
- Examine the tube to see whether the milk has coagulated.
- If it has, fine particles of curd will be visible.
- **Results observation**

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

- **The Lactometer Test**

✓ **Procedure**

- First, read the temperature of the milk
- Mix the milk sample gently and pour about 200 ml it into a measuring cylinder.
- Slowly dip the lactometer into the milk and leave it. It will sink slowly into the milk and then stop.
- Take the lactometer reading just above the surface of the milk
- Proceed to the reading of the lactometer
- **Results observation**

- At 15°C the normal specific gravity of milk ranges from 1.026 to 1.032. Below the value (1.026) indicate the possible addition of water to the milk. While above the value (1.032) indicate adulteration with solid like flour, starch.
- At 20^{o}C the normal specific gravity of milk ranges from 1.028 to 1.034. Below the value (1.028) indicate the possible addition of water to the milk. While above the value (1.034) indicate adulteration with solid like flour, starch.
- The specific gravity of milk is calculated by the following formula.

- Specific Gravity of milk is = 1 + CLR / 1000; Where CLR = Corrected lactometer reading.

- **Titratable acidity test**

✓ **Procedure:**

- Fill the burette with N/10 NaOH and make sure there are no air bubbles trapped in the lower part.
- Adjust the level of NaOH in the burette to the top mark – the lowest reading being at the upper end.
- Place 10ml (for example) of milk in the cup
- Add 3 to 5 drops of phenolphthalein to the sample in the cup.
- Note the reading of the NaOH in the burette at the lowest point of the meniscus.
- Allow the NaOH to flow slowly into the cup containing the sample and stir continuously. When a faint but definite pink colour persists, the endpoint has been reached.
- Take the reading of the burette at the lowest point of the meniscus. Subtract the first reading from the second to determine the number of milliliters of alkali (NaOH) required to neutralize the acid in the sample.

Calculations: N NaOH V NaOH = N Sample V Sample

% Lactic Acid = $\frac{volume\ required\ for\ neatralization\ (used\ ml\ of\ 0.1N\ NaOH)X\ 0.009}{Weight\ of\ sample}\ x\ 100$

Weight of sample = Volume of milk x specific gravity

- **California Mastitis Test**

✓ **Procedures:**

- Take about 1 teaspoon (2 cc) milk from each quarter. This is the amount of milk that would be left in the cups if the CMT Paddle were held nearly vertical.
- Add an equal amount of CMT solution to each cup in the paddle.
- Rotate the CMT Paddle in a circular motion to thoroughly mix the contents. Do not mix more than 10 seconds.
- Read the test quickly. Visible reaction disintegrates after about 20 seconds. The reaction is scored visually. The more gel formation, the higher the score.

- **Resazurin test**

✓ **Procedure**

- The solution of resazurin as prepared by adding one tablet to 50 ml of distilled sterile water. resazurin solution must not be exposed to sunlight, and it should not be used for more than eight hours because it losses strength.
- Mix the milk and with a sanitized dipper put 10 ml milk into a sterile test tube.
- Add one ml of resazurin solution, stopper with a sterile stopper,
- Mix gently the dye into the milk and mark the tube before the incubation in a water bath,

Resazurin disc no.	Colour	Grade of milk	Action
6	Blue	excellent	Accept
5	Light blue	v. good	Accept
4	Purple	Good	Accept
3	Purple pink	Fair	Separate
2	Light pink	Poor	Separate
1	Pink	Bad	Reject
0	White	Very bad	Reject

- Place the test tube in a Lovibond comparator with resazurin disk and compare it colour diametrically with a test tube containing 10 ml milk of the same sample, but without the dye (Blank).

Observations

Points to Remember

- While performing raw milk test follow the procedures required for each test to obtai n accurate results.

Application of learning 2.2.

You are requested to go in food processing workshop and perform raw milk test using organoleptic test, clot on boil test, alcohol, lactometer test and interpret obtained results.

Indicative content 2.3: Grading of Raw Milk

Duration: 8 hrs

Theoretical Activity 2.3.1: Description of raw milk grading parameters

Tasks:

1: You are requested to answer the following questions related to description of raw milk grading.

i. What do you understand about raw milk grading?
ii. Based on your understanding, what should be the purpose of raw milk grading?
iii. State any three grading parameters?

2: Provide the answers to asked questions by writing them on papers, flip chart, blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 2.3.1.

Key readings 2.3.1: Description of raw milk grading parameters

- **Grading** is a systematic process used to evaluate and classify raw milk based on its quality, safety and suitability for consumption or processing.
- **Purpose of grading**

The primary purpose of grading raw milk is to safeguard public health by ensuring that the milk produced and sold is safe for consumption. The following are the main purposes of raw milk grading:

- To separate milk into similar classes such as bacterial count, somatic cell counts and presence of drug residues so that the consumer may select milk for purposes according to his desires and pocketbook.
- Select milk products that may be consumed and rejected unfit food products
- To separate the available supply of potable milk into classes differing in superiority

- **Grading parameters**

✓ **Grade milk according to fat content**

The normal bovine milk has a fat content of 2.5 to 5.5%. The higher the fat content the better the grade.

✓ **Categories of milk based on fat content**

Milk is processed based on the maximum content of fat and solid non-fat possess:

- **Regular or whole milk**

➢ This is natural milk with nothing added or removed.
➢ It called whole milk because all the milk fat found them.

- It is also called **full cream milk** and **full of flavour**.
- This type of milk is usually consumed by children, teenagers and body.
- Whole milk must contain at least **3.25%** milk fat and **8.25%** milk solid by weight which means it derives about 50% of its calories from fat.

Reduced fat milk

- This type of milk contains 2% milk fat.
- It is called reduced because there is some amount of fat that is removed; such milk derives 35% of its calories from fat.

Low fat milk

- This milk contains 1% of milk fat.
- It has lower energy content and slightly lower levels of vitamins A and E, but higher calcium content.

Skimmed milk

- It is also called non-fat milk because it has much of fat removed as possible.
- It may not contain more than 0.5% milk fat by weight.
- It has about half the calories of whole milk.
- It is the best choice for adults and is the only type of milk that should be consumed by people on strict low-fat diets.

Toned milk

- It also called the single toned milk obtained by adding skimmed milk powder and water to whole milk.
- It contains about 3.0% fat.
- It restricts the body from absorbing cholesterol from the milk to the minimum.
- It contains the same nutrition as whole milk minus the fat-soluble vitamins.

Double toned milk

- It is obtained by adding skimmed milk powder to whole milk and has about 1.5% fat content.
- It is ideal for those trying to maintain weight as it keeps the calorie intake under check and aids weight loss.

Summary of milk grade /types based on fat content

Milk grade/type	Fat content(%)
Low fat milk	1-1.5
Fat free milk(skim milk)	Less than 1
Reduced fat milk	2
High fat milk /whole fat milk	3.5

✓ **Factors affecting fat content**

The different factors that affect the fat content are:

Dietary

Feeding strategy/patterns or Nutritional

- Genetics
- Age of lactation
- Season
- Ambient temperature
- Heat stress
- Breed
- Unsaturated fat
- Sampling strategy/Analytical methods
- Milk protein concentration
- Animal physiology

✓ **Grade milk by total bacteria count**

Received milk is graded according to its microbial total count. This helps in determining the product to be processed from that milk. Normally acceptable raw milk contains up to 500,000/ml bacteria count.

- Acceptable range of bacteria in raw milk content:
  - Total bacteria are 30,000cfu/mL
  - Somatic cell count should not exceed750,000cfu/mL
  - No positive test on drug residue detection

✓ **Grade milk by density**

At reception milk can also be graded according to density. For normal bovine milk the density varies from 1.028 to 1.034 at 20^{o}C.

- **Effect of density on milk product quality Effects of density on milk products quality**:
  - Low density means low SNF content in milk which results in end products with low nutrients.
  - High density means high SNF given that milk has not been adulterated with solids such as starch.
  - Loss of milk quality
  - No further processing
- **Factors affecting density of milk**
  - Breed
  - Feed
  - Fat content
  - Solids-not-fat
  - Milk adulteration (addition of water, removal of fat)
  - Water
  - Temperature

✓ **Grade milk according to microbial contamination (Resazurin test)**

- The Resazurin test is essentially a rapid bacteria estimation.
- Resazurin is a blue dye which gives normal milk a characteristic blue colour.

- The test is based on the ability of bacteria in the milk to reduce the blue dye.
- The quality of the milk is judged by noting the degree of colour change from blue through mauve and purple and pink and finally colourless after a stated period of incubation, or the time required to reduce the dye to a predetermined colour.

Observations

Resazurin disc no.	Colour	Grade of milk	Action
6	Blue	excellent	Accept
5	Light blue	v. good	Accept
4	Purple	Good	Accept
3	Purple pink	Fair	Separate
2	Light pink	Poor	Separate
1	Pink	Bad	Reject
0	White	Very bad	Reject

Practical Activity 2.3.2: Grading raw milk

Task:

Referring to the previous theoretical activity 2.3.1, you are requested to go in the milk processing workshop and perform raw milk grading.

1: Apply safety precautions

2: Grade raw milk.

3: Present your work to the trainer and whole class. Ask clarification where necessary.

4: Read the key readings 2.3.2

5: Perform the task provided in application of learning 2.3

Key readings 2.3.2

- **Raw Milk Grading Process**

✓ **Collection of Samples:** Collect samples of raw milk and ensure that sampling is done in a sterile manner to avoid contamination.

✓ **Initial Inspection:** Conduct a visual inspection of the milk for any abnormalities such as off-color, unusual odor, or visible contaminants and check the temperature of the milk.

✓ **Laboratory Testing:** Send samples to a certified laboratory for microbiological testing

✓ **Final Grading Decision:** Based on laboratory results and compliance with grading standards, assign a grade to the raw milk

Points to Remember

- While grading raw milk, you are recommended to follow carefully grading parameters as required.

Application of learning 2.3.

You are requested to visit an MCC in your Sector and perform raw milk grading coming from different farmers.

Learning outcome 2 end assessment

Theoretical assessment

1. Cycle the right letter corresponding to the correct answer

a. Raw milk means:
   i. Pasteurized milk
   ii. Milk obtained during the first seven days after calving and thirty (30) days before next calving.
   iii. Is normal, clean and fresh secretions extracted from the udder of a healthy cow that has not yet undergone any kind of treatment

b. The following are main characteristics of raw milk **EXCEPT**
   i. Be clean with foreign matters.
   ii. Be clean and obtained from healthy cow
   iii. Have white yellowish or creamy-white colour with natural odour and flavour
   iv. Not have added or removed substance

c. From the list of raw milk quality test below, distinguish tests that can be carried out on the platform from those that can be carried out in the laboratory
   i. Organoleptic test
   ii. Resazurin test
   iii. Clot-on boiling test
   iv. Gerber test for fat
   v. Alcohol test

d. The normal color of raw milk is:
   i. Yellow
   ii. White
   iii. White yellowish

e. The correct density for normal raw milk is:
   i. 1.022-1.035
   ii. 1. 028-1.034
   iii. 1.035-1.045

f. The following are reagents to be used in acidity titration test **EXCEPT**
   i. Sodium hydroxide 0.1N
   ii. Boiled water
   iii. Distilled water
   iv. Phenolphthalein indicator

2. The following statements are explaining the results that occur while performing alcohol test. Answer by **True** or **False**

    i. If the milk clots, or coagulates or there are lumps within it means that the milk pass the test

    ii. If there is no coagulation, clots or lumps the milk pass the test

3. The test results displayed from the Lactoscan shows the following information. Referring to the given results take a decision by responding by **Accepted** or **Rejected**.

    i. Water added: 6%

    ii. Density: 1.015

    iii. Protein: 2%

4. Using the judgement for CMT in the column II, choose the right answer for the statement in column I and write it in the answer column.

Answer	**Column I**: Statement indicating the results	**Column II**: Judgement for CMT
i)**….**	i. Distinct thickening of the mixture, but no tendency to form a gel, if CMT paddle is rotated more than 20 seconds, thickening may disappear. 900,000 SCC	A. Strong Positive
ii)**….**	ii. No thickening of the mixture. 100,000 SCC	B. Distinct Positive
iii)**….**	iii. Immediate thickening of the mixture, with a slight gel formation, as mixture is swirled, it moves toward the center of the cup, exposing the bottom of the outer edge. When motion stops, mixture levels out and covers bottom of the cup. 2.7 million SCC	C. Negative
iv)**….**	iv. Gel is formed and surface of the	D. Weak positive

	mixture becomes elevated (like a fried egg). Central peak remains projected even after the CMT paddle rotation is stopped. 8.1 million SCC	

Practical assessment

ABC is cooperative of farmers located in Nyagatare District, Rwimiyaga Sector needs to start a milk processing industry. It needs qualified technician to help in daily activities. As a milk reception assistant technician, you are hired by the Management committee of the cooperative to sample, analyse and grade raw milk from different locations of Nyagatare District.

END

References

CDC Features: Raw (Unpasteurized) Milk. (n.d.). Retrieved 7 29, 2024, from CDC: https://www.cdc.gov/features/rawmilk/

Chocolate: Types (Unsweetened, Bittersweet, Semisweet, Milk), Selection, and Storage. (n.d.). Retrieved 7 29, 2024, from https://www.bhg.com/recipes/desserts/chocolate/chocolate-types-selection--storage/

Eddison, R. T., Kempthorne, O., Hosking, Z. D., Barkworth, H., Cox, C. P., & Rowlands, A. (1951). 435. Keeping quality and raw-milk grading: II. The effect of storage on the results of keeping quality and dye tests. *Journal of Dairy Research, 18*(01), 43-71. Retrieved 7 29, 2024, from https://cambridge.org/core/journals/journal-of-dairy-research/article/435-keeping-quality-and-rawmilk-grading-ii-the-effect-of-storage-on-the-results-of-keeping-quality-and-dye-tests/5b7bed1db34105d70a1927e426866c2e

Food safety of raw milk. (n.d.). Retrieved 7 29, 2024, from Foodsmart.govt.nz: http://www.foodsmart.govt.nz/food-safety/high-risk-foods/raw-milk/rawmilk.htm

Food Standards and Labeling Policy Book. (2005). United States Department of Agriculture. Retrieved 7 29, 2024, from http://www.fsis.usda.gov/OPPDE/larc/Policies/Labeling_Policy_Book_082005.pdf

Gargouri, A., Hamed, H., & ElFeki, A. (2013). Analysis of Raw Milk Quality at Reception and During Cold Storage: Combined Effects of Somatic Cell Counts and Psychrotrophic Bacteria on Lipolysis. *Journal of Food Science, 78*(9). Retrieved 7 30, 2024, from https://onlinelibrary.wiley.com/doi/abs/10.1111/1750-3841.12188

Gordin, S., Ziv, G., & Gamil, O. (1970). Comparison of three methods for grading the hygienic quality of raw milk. *Journal of Agricultural Research, 20*(3). Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19710401526

Jennings, W. (1960). Automation in cleaning milk processing plant equipment. *California Agriculture, 14*(9), 4-4. Retrieved 7 29, 2024, from http://californiaagriculture.ucanr.org/landingpage.cfm?article=ca.v014n09p4&fulltext=yes

Kandpal, S. D., Srivastava, A. K., & Negi, K. S. (2012). ESTIMATION OF QUALITY OF RAW MILK (OPEN & BRANDED) BY MILK ADULTERATION TESTING KIT. *Indian Journal of Community Health, 24*(3), 188-192. Retrieved 7 29, 2024, from http://iapsmupuk.org/journal/index.php/ijch/article/view/306

Laanen, P. G.-V. (1999). *Safe Home Food Storage*. Retrieved 7 29, 2024, from http://nchfp.uga.edu/how/store/texas_storage.pdf

Marsh, K. (n.d.). Food Packaging—Roles, Materials, and Environmental Issues. *Journal of Food Science, 72*(3), 39–54. Retrieved 7 29, 2024, from http://ift.org/knowledge-

center/read-ift-publications/science-reports/scientific-status-summaries/~/media/Knowledge%20Center/Science%20Reports/Scientific%20Status%20Summaries/FoodPackagingEnviron_0407.pdf

Martin, N., Ranieri, M., Murphy, S., Ralyea, R., Wiedmann, M., & Boor, K. J. (2011). Results from raw milk microbiological tests do not predict the shelf-life performance of commercially pasteurized fluid milk. *Journal of Dairy Science, 94*(3), 1211-1222. Retrieved 7 29, 2024, from https://ncbi.nlm.nih.gov/pubmed/21338787

Nixon, M. C., & Lamb, A. B. (1945). Resazurin Triple Reading Test for Grading the Quality of Raw Milk. *Canadian journal of comparative medicine, 9*(1), 18-23. Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19452701370

Nouws, J., Loeffen, G., Schouten, J., Egmond, H. J., Keukens, H., & Stegeman, H. (1998). Testing of raw milk for tetracycline residues. *Journal of Dairy Science, 81*(9), 2341-2345. Retrieved 7 29, 2024, from https://sciencedirect.com/science/article/pii/s0022030298701249

Pullinger, E. (1946). A method of grading raw milk, with special reference to the grading of milk for South Africa. *Journal of The South African Veterinary Association-tydskrif Van Die Suid-afrikaanse Veterinere Vereniging, 17*(1), 15-41. Retrieved 7 29, 2024, from https://journals.co.za/content/savet/17/1/aja00382809_577

Raw Milk - Food Safety. (n.d.). Retrieved 7 29, 2024, from (US) Centers for Disease Control and Prevention: https://www.cdc.gov/foodsafety/rawmilk/raw-milk-index.html

Rosenman, K. D., Reilly, M. J., Schill, D. P., Valiante, D., Flattery, J., Harrison, R., . . . Filios, M. S. (2003). Cleaning Products and Work-Related Asthma. *Journal of Occupational and Environmental Medicine, 45*(5), 556-563. Retrieved 7 29, 2024, from https://ncbi.nlm.nih.gov/pubmed/12762081

Rowlands, A., & Hosking, Z. D. (1951). 443. Keeping quality and raw-milk grading: III. Comparison of keeping quality tests and dye tests in milk control (results of a field trial). *Journal of Dairy Research, 18*(02), 166-192. Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19512703826

White, C. (2011). *Milking and Handling of Raw Milk | Effect of Storage and Transport on Milk Quality*. Retrieved 7 30, 2024, from https://sciencedirect.com/science/article/pii/b9780123744074003265

Wightman, T. (2009). *Raw Milk Production.* Farm to Consumer Legal Defense Fund.

Indicative Contents
3.1 Filtration of raw milk **3.2 Storing of raw milk** **3.3 Record keeping**

Key Competencies for Learning Outcome 3: Store Raw Milk

Knowledge	Skills	Attitudes
• Identification of types of raw milk filters • Description of measuring techniques • Explanation of storage conditions for raw milk	• Filtering raw milk • Measuring the quantity of raw milk • Storing raw milk • Keeping record	• Being accurate while measuring raw milk • Being attentive while filtrating raw milk • Being careful while storing raw milk. • Paying attention while keeping record for raw milk.

Duration: 10 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly the types of filters used in filtration of raw milk.
2. Describe clearly the filtration methods used in raw milk reception.
3. Filtrate properly raw milk as applied in raw milk reception
4. Measure accurately the quantity of raw milk as applied in raw milk reception
5. Store properly the raw milk according to storage parameters.
6. Identify correctly the list of data recorded in raw milk reception
7. Keep appropriately the records of raw milk received as required in raw milk reception

Resources

Equipment	Tools	Materials
• Cooling tank • Refrigerator • Milk can • Cold room	• Milk can • Filter • Record template • Measuring cylinder • Graduated bucket • Balance	• Raw milk • Book • Pen • Computer

Indicative content 3.1: Filtration of Raw Milk

Duration: 3 hrs

Theoretical Activity 3.1.1: Description filtration and measuring of raw milk

Tasks:

1: You are requested to answer the following questions related to description of filtration and measuring of raw milk.

i. What do you think should be the purpose of filtration?
ii. Suggest any types of filters for raw milk.
iii. Which techniques should be used for raw milk filtration?
iv. What should be the procedure for the raw milk measuring?

2: Write your answers on papers, flip chart, blackboard or white board.

3: Present the findings/answers to the whole class.

4: For more clarification, read the key readings 3.1.1.

Key readings 3.1.1: Description of raw milk filtration and measuring

- **Filtration of raw milk:**

It is a process designed to remove impurities, pathogens, and other unwanted particles from the milk.

- **Purpose of raw milk filtration**

The primary purpose of filtration in raw milk is to eliminate contaminants that can affect the quality and safety of the milk. This includes:

- ✓ Removal of large particles such as dirt, hair, straw, and clots that may be present in raw milk.
- ✓ Effective filtration reduces the microbial load by removing bacteria and spores that could lead to spoilage or health risks.
- ✓ By filtering out impurities, the overall quality of the milk is enhanced, ensuring it meets health standards.

- **Types of filters for raw milk**
  - ✓ **Cloth:** A filter cloth or pad of desired pore size, which can retain the smallest particle.
  - ✓ **Metallic (stainless steel)**: This type consists of a nylon filter bag/pad supported of perforated stainless steel filter element. This filter also called in line filter should be installed before the chiller.

- **Application of filtration technics /method**

✓ **Vacuum filtration**

- It is used primarily to collect a desired solid, for instance, the collection of

crystals in a recrystallization procedure.

- This method separates a solid product from a liquid.
- It uses a Buchner funnel and a side-arm flask and they are usually used when the substances to be filtered is small in volume.
- It is faster because the solvent or solution and air is forced through the filter paper by the application of reduced pressure.
- Do not use vacuum filtration to filter a solid from a liquid if it is the liquid that you want, and if the liquid is low boiling.

✓ **Membrane filtration**

- It is a technique that permits concentration and separation without the use of heat.
- Particles are separated based on their molecular size and shape with the use of pressure and specially designed semi-permeable membranes.
- It is an effective, accepted technique for testing fluid samples for microbiological contamination.
- It involves less preparation than many traditional methods and is one of a few methods that will allow the isolation and enumeration of microorganisms.
- Membrane filters are used extensively in the laboratory and in the industry to sterilize fluid materials.

➢ **The processes of membrane filtrations**

- **Reverse osmosis**: This process provides the tightest membrane possible in liquid separation. That means that only water can pass through the membrane while all other material (dissolved and suspended) is removed.
- **Nano filtration**: This process removes a range of different minerals from liquid, letting only the liquid and specific monovalent ions to pass through the membrane.
- **Ultrafiltration:** This process separates skim milk (also called the feed) into two different streams, which allows water, salts, lactose, and acids to pass through the membrane in either direction while keeping (and concentrating) protein and fat.
- **Microfiltration:** this process uses the most open kind of membrane. It is used to remove spores, bacteria, and fat globules from the liquid and for fractionation of skim milk.

✓ **Measuring the quantity of raw milk**

- This can be done by measuring the weight or by measuring the volume.
- The weight of received milk is determined using **balance.**
- The quantity of received milk can also be determined by measuring its volume. However, the disadvantage of this method is that **the volume** of milk can vary by temperature change.

Practical Activity 3.1.2: Filtering and measuring raw milk

Task:

Referring to the previous theoretical activity 3.1.1, you are requested to go in the food processing workshop to perform raw milk filtration and measuring.

1: Apply safety precautions

2: Filtrate and measure raw milk.

3: Present your work to the trainer and whole class. Ask clarification where necessary.

5: Read the key readings 3.1.2

6: Perform the task provided in application of learning 3.1

Key readings 3.1.2 Filtering and measuring raw milk

- **Procedures for raw milk filtration**

When performing raw milk filtration, pass through the following steps:

- ✓ Select and clean tools, materials and equipment to be used
- ✓ Pour the raw milk slowly through the filter
- ✓ Allow the milk to pass through the filter naturally
- ✓ Collect the filtered milk in a clean and sanitized container
- ✓ Cool immediately and store the filtered milk at 4°C to prevent growth of microorganism growth

- **Procedure for measuring raw milk**

✓ **The weight of received milk is determined using balance.**

Procedure:

- ➢ The milk in a container is weighed, x kg is obtained.
- ➢ The milk is emptied from the container into a reception tank.
- ➢ The empty container is weighed after emptying the milk, y kg is obtained
- ➢ To get the weight of milk alone: (x-y) kg

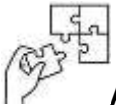
✓ **The quantity of received milk can also be determined by measuring its volume.**

Procedure:

- ➢ The received milk is poured into a graduated container.
- ➢ Read its volume

Points to Remember

- While filtering and measuring raw milk, you are recommended to apply appropriately filtration methods and following measuring procedures to obtain accurate results.



Application of learning 3.1.

The school manager request someone to supply raw milk for trainees. As food processing trainees, you are requested to go in food processing workshop and help the school to filter and measure raw milk supplied. All materials, tools and equipment are available.

Indicative content 3.2: Storing of Raw Milk

Duration: 4 hrs

Practical Activity 3.2.1: Storing of raw milk

Task:

You are requested to go in the milk processing workshop to store raw milk.
1: Apply safety precautions.
2: Store raw milk.
3: Present your work to the trainer and whole class. Ask clarification where necessary.
4: Read the key readings 3.2.1
5: Perform the task provided in application of learning 3.2

Key readings 3.2.2: Storing raw milk

- **Raw milk cooling**

It is the process of rapidly lowering the temperature of raw milk to inhibit bacterial growth and maintain its quality.

- **Purpose of raw milk storage and cooling**
  - To restrict or stop the growth of microorganisms.
  - To extend shelf life of raw milk by slowing down enzymatic reactions and microbial activity that can lead to spoilage.
  - To maintain the quality and safety of raw milk received.
  - Contribute to customers satisfaction.
- **Storage conditions**

Milk should be stored at a temperature that does not exceed four degrees Celsius (4°C)

- **Storing techniques**
  - ✓ **Storing milk by cooling Tank**

At the milk reception centres and in milk plants, the tanks with cooling coils with mixers are used with the capacity of cooling milk from 37°C leaving the cow to 4°C in the milk tank.

- ✓ **Storing milk by cold room**

This is a technique used at the milk collection centres, in the industries and farms with higher milk quantity which consists of using rooms equipped with cooling systems with

ability to cool milk to the desired temperature.

- ✓ **Storing milk with cold water bath**

Milk cans are immersed in water bath containing cold water. It is the cheapest method and applicable to the local farmers.

- ✓ **Storing milk by refrigerator**

This cooling is carried out using a tank equipped with a refrigeration system. The milk should be cooled at 4^{o}C.

Points to Remember

- You are recommended to store properly raw milk to avoid spoilage and extend shelf life. Don't exceed 4^{0}C while storing raw milk.

Application of learning 3.2.

The school manager requested someone to supply milk for trainees. You are requested to g o in milk processing workshop to store raw milk supplied to prevent spoilage.

Indicative content 3.3: Record Keeping

Duration: 3 hrs

Practical Activity 3.3.1: Apply methods of Keeping record

Task:

Referring to the previous practical activities (3.1, 3.2), you are requested to go in the milk processing workshop and keep record.

1: Apply safety precautions.

2: Keep raw milk records.

3: Present your work to the trainer and whole class. Ask clarification where necessary.

4: Read the key readings 3.3.1

5: Perform the task provided in application of learning 3.3

Key readings 3.3.2: Keeping record

- **Purpose of keeping records**

Record keeping is a systematic documentation of various aspects related to the production, processing, and distribution of raw milk. It is essential for the following reasons:

- ✓ To inform the farmers/producers about his production quality
- ✓ Act as resource for new strategies as processor.
- ✓ Helps to find new solutions for business.

- **List of data recorded in raw milk reception**

After raw milk reception, quality tests and the quantity must be recorded.

The following are information to include in the records:

- Milk quality control results
- Quantity received
- Decision taken
- Supplier identification
- Code number
- Records of dates
- Places

- **The techniques used during raw milk recording:**

- ✓ **Quantitative record of milk**

This can be done by measuring the weight or by measuring the volume.

Qualitative record of milk

For all the milk quality tests carried out, records must be kept. For this purpose, a simple

table like the following could be used:

Name of farmer: ……

Location and contact of farmer: ……

Date: ……

Quantity of milk: ……

- ✓ **Milk quality test results**

Quality parameters	Results	Observation
Colour		
Odours		
Temperature		
pH		
Alcohol test		
CMT		
Inhibitor test		
Density		
Fat content		

Conclusion: ……

Name and signature of analyst: ……

- **Method of keeping record**
  - ✓ **Electronic (soft copies**):

It is any information created, used and retained in a form that only a computer can process. With this type of recording all information are recorded in computer.

- ✓ **Hardcopy:**

It is any document, record, report, or data compilation printed on paper. This means all the information are recorded on papers not in computer.

Points to Remember

- While recording raw milk received, both the quantity and quality testes are recorded. Don't forget to mention the main information and take decision accordingly.

Application of learning 3.3.

You are requested to visit the nearest Milk Collection Center from your respective Sector and help the milk receptionist keep record for raw milk received from different locations.

Learning outcome 3 end assessment

Theoretical assessment

1. Read the following statements and answer by **True** if it is correct otherwise **False.**
   A. The weight of received milk is determined using alcohol gun.
   B. The quality of milk can be measured using balance.
   C. Records keeping help to inform the farmers/producers about his production quality.
   D. The main purpose of milk cooling is maximizing bacterial growth.
   E. If you need to measure the volume of raw milk received, you can use a graduated container.
   F. The weight of received milk is determined by adding the weight of milk in container to the wight of container.
2. Circle the letter corresponding to the right answer:
   A. The following is the main objective of raw milk filtration
      i. To ensure that sediment or other extraneous matter is added to the milk.
      ii. To remove hair, stones and other physical contaminants.
      iii. To improve the aesthetic quality of milk by removing invisible foreign matter.
   B. The following are objectives for milk cooling EXCEPT
      i. Maximizing bacterial growth
      ii. Enhancing shelf life
      iii. To ensure safety and quality preservation
      iv. Contribute to customers satisfaction
   C. Which of the following pieces of information are not included on the record form?
      i. Milk quality control results
      ii. Quantity received
      iii. Decision taken
      iv. Supplier identification
      v. Reception tool
      vi. Records of dates,
      vii. Records of cow
2. The following terms are used in filtration of raw milk: diffusion, metallic (stainless steel), strainer, cloth and membrane. Select the correct term to be completed in provided space.

   During raw milk reception, filtration is an essential activity for receiving good quality of raw milk where (a)……is filter that can be used with desired pore size which can retain the smallest particles whereas (b)……..is filter that consists of nylon filter bag which can retain the big particles.

Practical assessment

ABC is a cooperative of farmers located in Nyagatare District, RWIMIYAGA Sector. As a qualified worker in milk reception, you are hired by the management of ABC cooperative to filtrate, store and keep record of raw milk.

END

References

Food safety of raw milk. (n.d.). Retrieved 7 29, 2024, from Foodsmart.govt.nz: http://www.foodsmart.govt.nz/food-safety/high-risk-foods/raw-milk/rawmilk.htm

Gargouri, A., Hamed, H., & ElFeki, A. (2013). Analysis of Raw Milk Quality at Reception and During Cold Storage: Combined Effects of Somatic Cell Counts and Psychrotrophic Bacteria on Lipolysis. *Journal of Food Science, 78*(9). Retrieved 7 30, 2024, from https://onlinelibrary.wiley.com/doi/abs/10.1111/1750-3841.12188

Jennings, W. (1960). Automation in cleaning milk processing plant equipment. *California Agriculture, 14*(9), 4-4. Retrieved 7 29, 2024, from http://californiaagriculture.ucanr.org/landingpage.cfm?article=ca.v014n09p4&fulltext=yes

Kandpal, S. D., Srivastava, A. K., & Negi, K. S. (2012). ESTIMATION OF QUALITY OF RAW MILK (OPEN & BRANDED) BY MILK ADULTERATION TESTING KIT. *Indian Journal of Community Health, 24*(3), 188-192. Retrieved 7 29, 2024, from http://iapsmupuk.org/journal/index.php/ijch/article/view/306

Laanen, P. G.-V. (1999). *Safe Home Food Storage*. Retrieved 7 29, 2024, from http://nchfp.uga.edu/how/store/texas_storage.pdf

Nixon, M. C., & Lamb, A. B. (1945). Resazurin Triple Reading Test for Grading the Quality of Raw Milk. *Canadian journal of comparative medicine, 9*(1), 18-23. Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19452701370

Rowlands, A., & Hosking, Z. D. (1951). 443. Keeping quality and raw-milk grading: III. Comparison of keeping quality tests and dye tests in milk control (results of a field trial). *Journal of Dairy Research, 18*(02), 166-192. Retrieved 7 29, 2024, from https://cabdirect.org/cabdirect/abstract/19512703826

White, C. (2011). *Milking and Handling of Raw Milk | Effect of Storage and Transport on Milk Quality*. Retrieved 7 30, 2024, from https://sciencedirect.com/science/article/pii/b9780123744074003265

Wightman, T. (2009). *Raw Milk Production.* Farm to Consumer Legal Defense Fund.

RTB | RWANDA TVET BOARD

October, 2024