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SMALLHOLDER DAIRY PROJECT

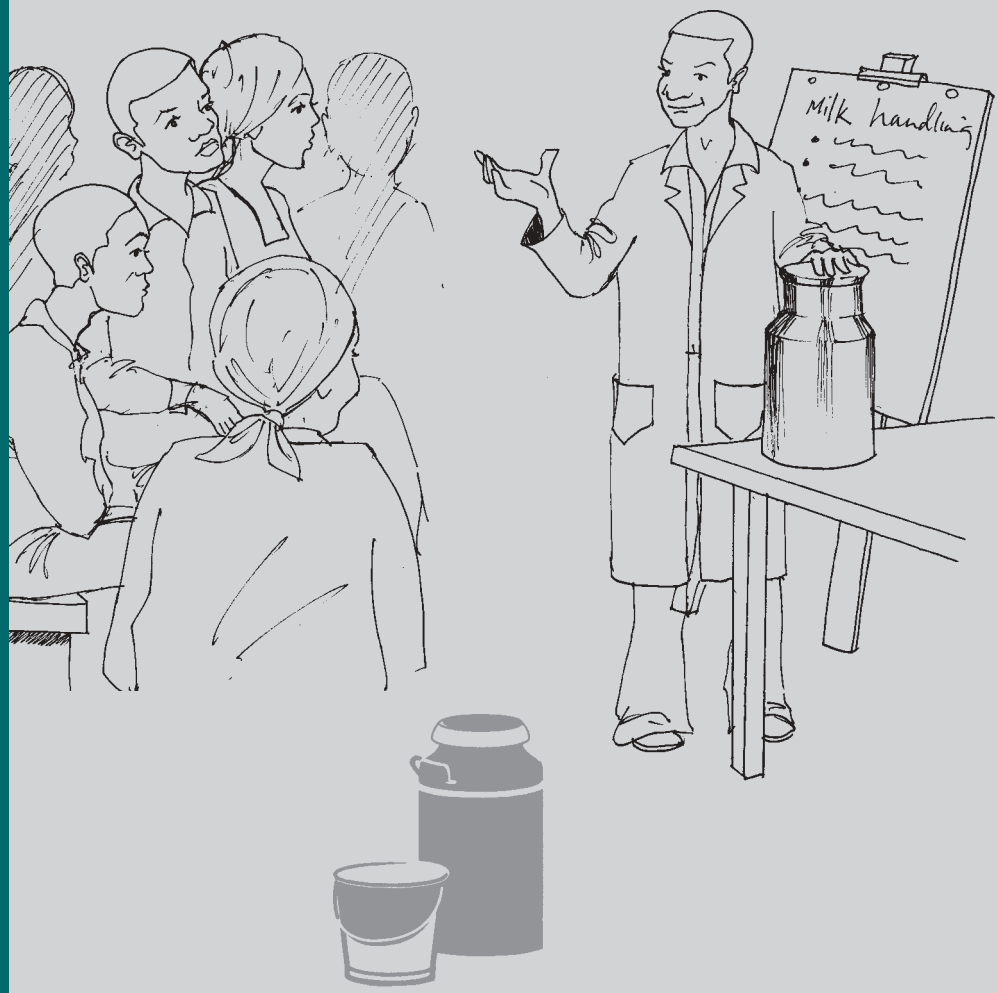
Improve the Quality of Your Milk and Please Your Customers

TRAINING GUIDE FOR TRAINERS OF SMALL-SCALE MILK TRADERS IN KENYA

KENYA DAIRY BOARD

FAO

Land O'Lakes Inc



MAY 2004

KENYA DAIRY BOARD

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IMPROVE THE QUALITY OF YOUR MILK AND PLEASE YOUR CUSTOMERS

TRAINING GUIDE FOR TRAINERS OF SMALL-SCALE MILK TRADERS IN KENYA

MAY 2004

PREFACE

About this guide...

This *Training Guide for Trainers* covers milk quality and testing requirements for small-scale milk traders in Kenya. It has been produced through collaboration between:

- The Kenya Dairy Board (KDB)
- The Food and Agriculture Organization of the United Nations (FAO), Animal Production Service
- The Smallholder Dairy Research and Development Project (SDP) funded by the British Department for International Development and operated by the Ministry of Livestock and Fisheries Development, Kenya Agricultural Research Institute and the International Livestock Research Institute
- Land O'Lakes Inc.

In Kenya, small-scale milk traders currently dominate the marketing of milk. This guide is aimed at filling an important gap in the provision of training materials for improvement of milk quality in the country by addressing the specific needs of small-scale milk businesses.

The *Training Guide for Trainers* outlines the key lessons for trainers to convey during a recommended four-day training course. The guide is designed to be used together with the *Training Guide for Small-scale Milk Traders*. Emphasis is placed on the use of participatory methods during training, examples of which are given. Trainers should already have prior basic knowledge of milk quality control, for example, by attending the certificate-level short courses on Hygienic Milk Handling and Processing, and Milk Testing and Quality Control at

the Naivasha Dairy Training Institute. This guide targets both public (regulatory) and private dairy sector officials who are responsible for training on milk quality and hygiene. The contents are easy to use and practical and can therefore be used by trainers who are milk market agents themselves.

It is recommended that a certificate of attendance be presented to all participants at the end of the course as it is intended that the training will form part of a certification programme to be administered by the Kenya Dairy Board.

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LIST OF ABBREVIATIONS AND ACRONYMS

DFID	Department for International Development
FAO	Food and Agriculture Organization of the United Nations
ILRI	International Livestock Research Institute
KARI	Kenya Agricultural Research Institute
KDB	Kenya Dairy Board
LOL	Land O' Lakes
MoLFD	Ministry of Livestock and Fisheries Development
SDP	Smallholder Dairy Project
SNF	Solids-Not-Fat

PART 1

INTRODUCTION

Knowledge of the basic concepts and practice of milk quality control and hygiene is essential to ensuring good milk quality. The emphasis in the training course in which this guide will be applied is participatory diagnosis of problems related to milk quality and practical sessions in milk quality control. The objectives are to equip participants with knowledge and skills that should enable them to:

a) appreciate the causes of milk spoilage

b) use a limited number of milk quality tests

c) understand the relationship between milk quality and the success of their milk marketing businesses, and

d) train their peers on hygienic milk handling

The recommended duration for conducting this course is four days, with about four hours for indoor sessions (See Table of Contents and Program Timetable)

The trainer should go through the following two checklists for course preparation and delivery beforehand.

CHECKLIST FOR COURSE PREPARATION

- [ ] 1 **Identify and invite participants:** Compile a list of up to 20 participants of similar background in terms of milk trading and knowledge of milk quality.

- [ ] 2 **Prepare venue:** Venue should be within a milk source or sale area. Identify and book a suitable meeting room beforehand. Arrange for food or snacks to be served at an appropriate time.

- [ ] 3 **Get an assistant trainer:** Two trainers (a head trainer and an assistant) are ideal.

- [ ] 4 **Prepare teaching materials:** Ensure the course teaching materials such as Training Guide for Traders, flip charts, felt pens, white or black board, notebooks and overhead projector are ready. Video clips that demonstrate milk quality control can also be used when available.

- [ ] 5 **Prepare materials for practical exercises:** Ensure required materials for practical exercises such as chemicals, testing equipment and milk samples are prepared and made ready for use at least two hours before the practical sessions. Adequate provisions for the Practical Day Out should also be made.

- [ ] 6 **Prepare certificates of participation:** Arrange these beforehand using the prototype in Annex 3.3. On Day 3, while the traders are out in the field, fill in the certificates with the names of the traders who attended training sessions on Day 1 and 2. In addition, identify an official (e.g. from the Kenya Dairy Board) to preside over the closing ceremony.

- [ ] 7 **Make adequate copies of the pre-evaluation and post-evaluation forms provided in Annexes 3.1 and 3.2.**

CHECKLIST FOR COURSE DELIVERY

1 **Conduct participatory introductions:** Start the first session on Day 1 with participatory introductions by participants. Pair up the participants at random. Ask each of them to find out the name and details of their partner such as those illustrated in Box 1 below and to report those details. This helps the participants to relax.

BOX 1: EXAMPLES OF QUESTIONS TO ASK DURING PARTICIPATORY INTRODUCTION

- What is your name?
- When did you start selling milk?
- How much milk do you sell?
- What else do you do: For work? As a hobby?
- Why are you attending this course?
- What do you hope to get from the course?

After five minutes of interviewing each other, ask participants to report about the partner they have interviewed.

2 **Agree on expectations:** Capture the expectations of the participants before explaining the objectives of the training. The facilitators also present their expectations.

- What are the expectations of participants from the course?
- What are the expectations of participants from facilitators?
- What are the expectations of facilitators from participants?

After expectations have been discussed, write these down on a flip chart paper, which can be stuck to the wall during the training. Participants are then able to use the list to monitor whether or not their expectations have been met or have changed.

BOX 2: EXAMPLES OF EXPECTATIONS OF PARTICIPANTS FROM THE COURSE

- Understand the concept of milk testing and skills required
- Learn how to screen and identify adulterated milk
- Learn how to preserve milk to reduce spoilage
- Acquire skills in training other milk traders
- Receive a certificate of participation
- Obtain a licence from KDB after completing the course

BOX 3: EXAMPLES OF EXPECTATIONS OF PARTICIPANTS FROM THE FACILITATORS

- Learn about milk testing
- Acquire new skills in milk handling
- Receive certificates at the end of the course
- Clarity in presentation
- Practical field experience
- Time-conscious team

BOX 4: EXAMPLES OF EXPECTATIONS OF FACILITATORS FROM THE PARTICIPANTS

- Attentiveness
- Free discussions
- Cooperation

3 **Set ground rules with the traders:** For the four-day learning period participants develop their own rules. Ensure that each rule is widely accepted.

BOX 5: EXAMPLES OF RULES SET BY PARTICIPANTS

- All sessions must start with prayer
- Punctuality, after setting time to start
- Active participation by everyone
- Everyone to attend all the sessions
- Respect each other's opinion

4 **Conducting discussions.** As far as possible during instructions and discussions, elicit responses to various questions from the participants and appreciate those responses that are correct[1].

5 **Evaluation at the end of each day.** At the end of each day the trainer should assess the value of the sessions covered by asking the participants to list the things they have learnt.

6 **Ensure active participation in practical exercises.** Groups for practical sessions (Day 2) should be formed randomly and each group should not exceed five participants in order to ensure active participation in the exercises. Where there are illiterate and literate participants ensure that there is somebody who can read and write in each group, where writing is required. Encourage participants to try all milk quality control options during the practical day out (Day 3).

[1] Try to involve participants by asking questions, finding out what they know, different views held and treat all responses with respect.

7 **Review all sessions:** At the start of each day, review all sessions delivered the previous day before starting the day's sessions. In particular, review the Practical Day Out (Day 3) on Day 4 by encouraging participants to discuss what was useful, not useful and difficulties faced. Discuss the resolution of the problems with them.

8 **Conduct the post-evaluation exercise:** This is to help obtain a permanent record, judge whether the course objectives have been achieved and develop and improve your training approach and materials, if need be (see Annex 3.2).

PART 2

TRAINER GUIDELINES

The following part of the training manual comprises the course content and training methodology in the form of the trainer guidelines. The guidelines are segregated by day, by session and activities to be conducted in each session. Trainee participants will have an abridged (smaller) version, which includes some of the text and all of the illustrations to be used during the training program.

DAY ONE

1 MILK SPOILAGE AND MILK QUALITY CONTROL

OBJECTIVE FOR THE DAY

To equip participants with background knowledge on causes of milk spoilage and quality control.

SESSION 1.1: INTRODUCTION TO THE TRAINING PROGRAM (1 hour)

Objectives for this session:

1.1.1 —To create a friendly learning environment through participatory introduction of participants
1.1.2 —To elicit hopes, fears and expectations of participants
1.1.3 —To set the ground rules
1.1.4 —To explain the importance of training for milk traders
1.1.5 —To explain the aims and objectives of the whole course

Activity 1.1.1: Introduction of participants

Specific Objective: To create an open and friendly learning environment in which everyone is encouraged to participate.

Activities	Resources
Ice breaker: participants introduce themselves whilst lighting a match	Match box
Ensure each participant has a name badge so that they can be called by their name of choice	Name badges
Have participants sign the attendance sheet	Attendance sheet list
Issue pens, training manuals and folders	Pens Manuals and folders

Activity 1.1.2: Eliciting hopes, fears and expectations

Specific Objective: To elicit the participants' feelings about the training.

Activities	Resources
Issue each participant with two post-it pads. They are to write their hopes and expectations on one and their fears for the training on the other	A20 sheets, flip charts, marker pens and post-it pads
After which participants stick the sheets on to the A20 sheets on the wall	A20 Hopes and expectations sheet
Have a participant read out everybody's comments. Open the floor for any discussions based on issues raised	A20 Fears sheet

Activity 1.1.3: Setting the ground rules

Specific Objective: To ensure consensus and agreement on the conducting of the training program.

Activities	Resources
Ask participants to suggest rules to govern the training program	A20 sheets, flip charts and marker pens
Present the timetable and agree upon the time taken for each session and breaks	See Table of Contents and program timetable

Activity 1.1.4: The importance of training for milk traders

Specific Objective: To recognize the importance of milk traders and why training on milk quality is relevant to them.

Activities	Resources
Draw the milk marketing chain flow chart on an A20 sheet and conduct a brainstorming exercise with the question: "Why are milk traders important?"	A20 sheets, flip charts and marker pens
Follow up feedback with a second question: "Why should a training program on milk quality be of importance to you?"	
Facilitator records participants' responses on A20 sheets	

The milk marketing chain:

Relating causes and effects:

- Better quality milk - better shelf life
- Better shelf life - less spoilage
- Less spoilage - greater profit
- Less spoilage - improved consumer confidence
- Improved consumer confidence - increased patronage etc.

Examples of responses from a pilot training exercise

Importance of milk traders	Importance of training on milk quality
● Employment and ability to meet our financial needs ● Make milk accessible to consumers ● Assist poor farmers to market milk	● Milk is 'delicate' - needs hygiene ● Need to know how to keep milk longer ● To prevent farmers from 'baptizing' (adulterating) milk ● Learn best ways of storing milk

Activity 1.1.5: Aims and objectives of the whole course

Specific Objective: To explain the objectives of the 4-day training program.

Activities	Resources
Plenary discussion: Ask participants what they think should be the aims of a milk quality control training program (what would we hope to accomplish?). Record responses on an A20 sheet	A20 sheets, flip charts and marker pens Overhead projector, overhead transparency
Present the producer - trader - consumer - marketing chain again: how can each of these stakeholders benefit?	See Table of Contents and program timetable
Present the aims and objectives of the program on an Overhead transparency	

SESSION 1.2:
FACTORS RELATED TO MILK SPOILAGE (1½ hours)

Objectives for this session:

1.2.1 —To identify stakeholder relationships that affect milk business

1.2.2 —To determine the relative importance of milk spoilage as a marketing constraint

1.2.3 —To appreciate the causes and effects of milk spoilage

Materials

Flip chart, flip chart stand or whiteboard, felt pens, cards made from manila paper, pins, masking tape and a pair of scissors.

Background

There are many constraints or problems that milk traders face in marketing their milk. Many of these constraints or problems cause milk spoilage or are the result of it. These may include the following factors:

- Long distance or time between collection and resale point
- Type of containers used
- How the containers are washed
- Method of preservation
- Low profits
- Lack of training

All these factors relate to milk spoilage. Traders are aware of most of the causes and effects of milk spoilage, and their relationship with various stakeholders. The relationship between the traders and various stakeholders in milk marketing, whether positive (e.g. provision of training) or negative (e.g. arrests) has an influence on

their business and the quality of milk that they sell. In a formal training session, the trainer can discuss more examples of these relationships.

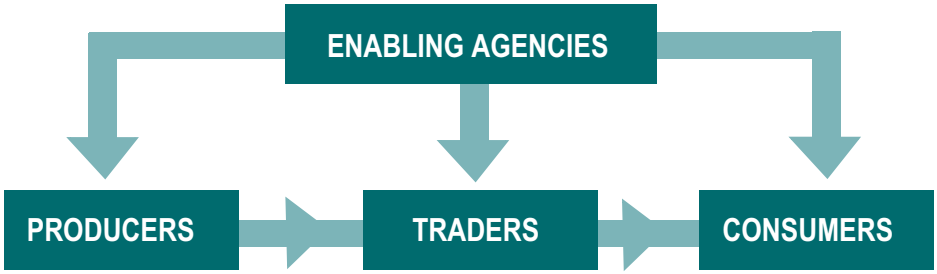
Activities 1.2.1 (Stakeholder analysis) and 1.2.2 (General milk marketing constraints) are optional exercises and require an additional 30 minutes each. If time restricts the training program to the scheduled 4 hours only then it is recommended that the facilitator begin session 2 with activity 1.2.3 (The causes and effects of milk spoilage).

Activity 1.2.1: Stakeholder analysis

Specific Objective: To enable traders to identify the stakeholder relationships that either promote or constrain their milk businesses.

Activities	Resources
Explain the meaning of the term "stakeholder" with the aid of the conventional commodity production/marketing flow diagram	A20 sheets, flip charts and marker pens
Explain that supposedly enabling agencies can also be disabling agencies!!! e.g. police, regulators	
Produce the diagram: analysis of stakeholders within the milk marketing business, on an A20 sheet	
In a plenary group ● Identify the main stakeholders ● Discuss briefly their main role and function ● Ask whether the relationship is friendly (positive) or hostile (negative)	
There is danger of spending too much time on this exercise - remember this is to be only a brief overview	
Use Annex 1.1: (Venn diagramming of stakeholders) if you decide that it is appropriate to spend more time discussing these issues	Annex 1.1

Analysis of stakeholders within the milk marketing business:



Activity 1.2.2: General milk marketing constraints

Specific Objective: To determine the relative importance of milk spoilage as a production and/or marketing constraint.

Activities	Resources
Group work 5 - 6 persons per group Discuss the main constraints faced in marketing your milk	A20 sheets, flip charts and marker pens
List and explain the main constraints Trainer to demonstrate pair-wise ranking (use Annex 1.2 - Identification and ranking of constraints) Groups rank constraints using pair-wise ranking. Elicit reasons for the choices given from each group	Annex 1.2

Activity 1.2.3: The causes and effects of milk spoilage

Specific Objective: To enable the participants to appreciate the inter-relationship between causes and effects when addressing the main issue of milk spoilage.

Activities	Resources
Group work: 5 - 6 persons per group Discuss in groups the main causes and effects of milk spoilage	A20 sheets, flip charts and marker pens
Participants list the main causes and effects of milk spoilage on the A20 sheets provided	Work stations (desks and chairs) for three groups
Groups present their findings with plenary debate	
Discuss other factors (marketing, poor roads, transport, seasonal supply, etc.) that influence milk spoilage	
Reinforce the effects by discussing the human diseases that can be passed through contaminated milk (Annex 1.3 - diseases that can be passed through milk) If possible use the public health officer to address these concerns as they relate to the specific locality	Annex 1.3

SESSION 1.3: WHY YOU NEED TO KNOW ABOUT MILK QUALITY CONTROL (1/2 hour)

Objectives for this session:
1.3.1 —To discuss the constituents of milk
1.3.2 —To demonstrate how multiplication of bacteria in milk causes spoilage
1.3.3 —To explain the factors affecting milk spoilage

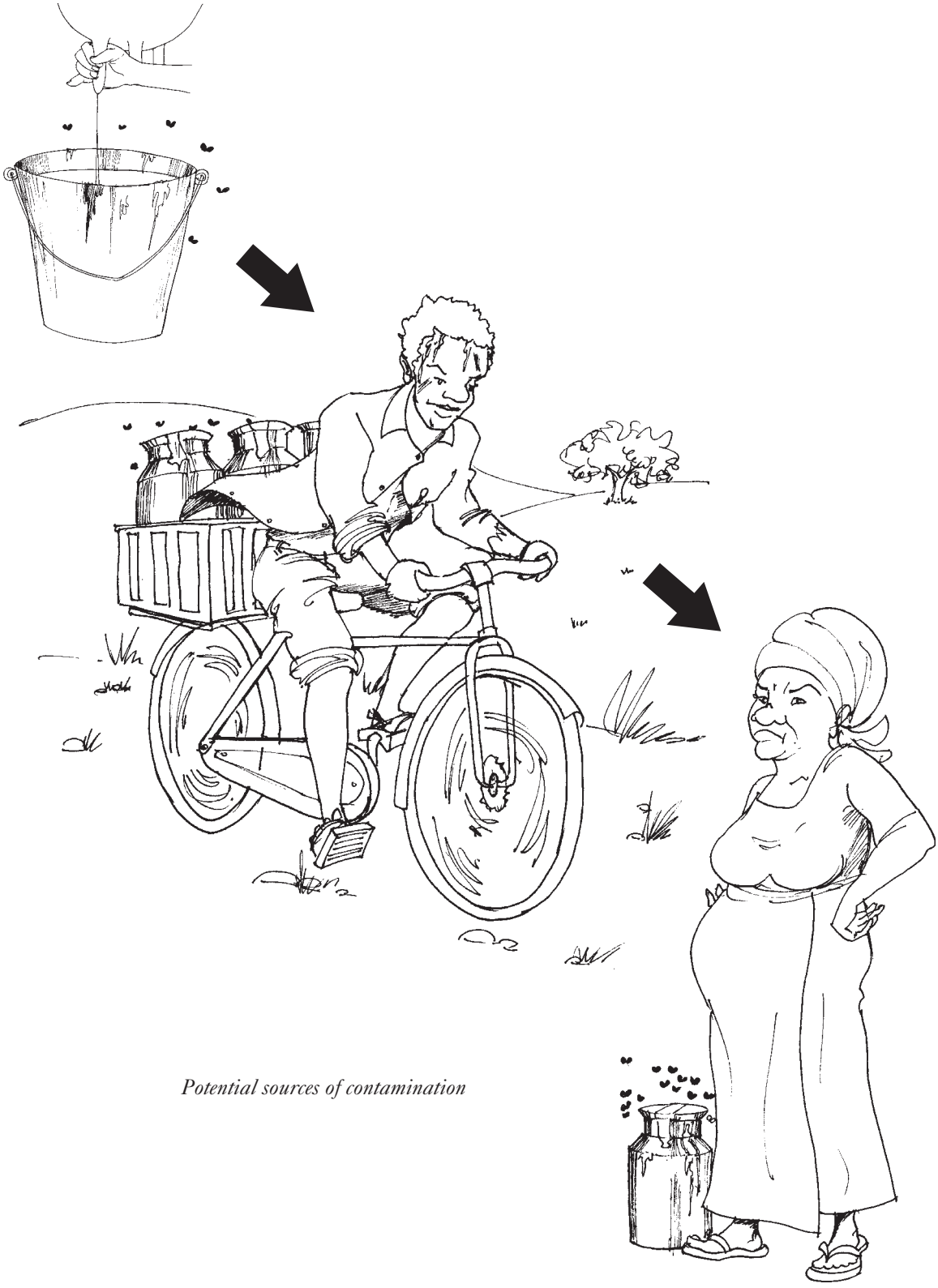
Materials

Flip chart, flip chart stand or whiteboard, felt pens, beans (in 4 packs of 0.5kg each).

Background

Milk has nutrients that make it suitable for the rapid multiplication of bacteria that cause spoilage. Unhygienic production, poor handling and undesirable practices such as addition of water or other substances can introduce the bacteria or germs that cause spoilage[2]. The resulting wastage can make milk traders lose profits that they would have otherwise made. Unhygienic handling may introduce disease-causing bacteria into the milk and this can also adversely affect human health. In addition, regulatory authorities will likely require that traders undergo a training course that covers the contents of this guide before they issue them with a licence to trade in milk. This session is therefore designed to provide the relevant knowledge and skills needed for traders to handle milk hygienically.

[2] Different bacteria require/breakdown different nutrients (i.e. sugar, fat and protein)



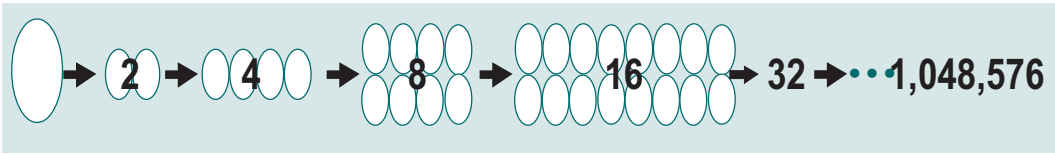
Potential sources of contamination

Activity 1.3.1: The constituents of milk

Specific Objective: To enable participants to understand the constituents of milk that make it susceptible to spoilage by bacteria.

Activities	Resources
Draw a plate and cup on an A20 sheet! Ask participants to describe their preferred Kenyan meal. Draw the items on the A20 sheet as they name them and explain: ● Carbohydrates (ugali and rice) ● Protein (meat and beans) ● Fat (sauce) ● Vitamins and minerals (vegetables) and ● Glass of water!	A20 sheets, flip charts and Marker pens
Open question to participants: "What is milk composed of?" (And later "In what proportions?")	
Record responses Use Overhead projector or poster of figure from Annex 1.4 - Composition of cow's milk	Annex 1.4 Overhead projector
Many participants find graphs and pie charts difficult concepts so try to relate the proportions to milk found in a milk churn	
Draw on A20 sheet an outline of a milk churn with proportions of milk constituents, beginning with the highest percentage i.e. water at the bottom and minerals at the top	See Annex 1.4
Explain that just as human beings eat and grow from their food so milk has all the ingredients that enable bacteria to "eat" and grow	

Bacterial multiplication



Activity 1.3.2: Causes of spoilage

Specific Objective: To demonstrate the contribution of multiplication of bacteria towards spoilage of milk.

Activities	Resources
Open question to participants: "What REALLY causes milk to spoil?" Record responses	A20 sheets, flip charts and marker pens
Explain the importance and nature of bacteria/micro-organisms	
Divide participants into two groups: ● Clean milk group ● Contaminated milk group	Chalk, two big bags of beans, 30 cm rulers
Use Annex 1.5 - *Bacterial multiplication by division* - to explain the group exercise conducted on the ground	Annex 1.5
Summarize what group members learnt from the exercise: the rapid multiplication of bacteria over time especially in contaminated milk	

Activity 1.3.3: Factors affecting milk spoilage

Specific Objective: To enable participants to understand the main factors that enable bacteria to multiply and spoil milk.

Activities	Resources
Discuss the main factors that cause bacteria to multiply and spoil milk ● Time (for bacteria to multiply) ● Temperature ● Moisture ● Milk constituents	A20 sheets, flip charts and marker pens
Use Annex 1.6 (Milk preservation) and show the graph as an overhead transparency to emphasize the effect of temperature on bacteria growth and hence the role of cooling in extending the shelf life of milk (Milk preservation will be discussed in more detail on day 2)	Annex 1.6 Overhead projector and overhead transparency - effect of temperature on growth of bacteria

SESSION 1.4:
WHAT IS MILK QUALITY CONTROL? (1/2 hour)

Objective for this session:
To introduce the concept of good quality milk in preparation for Day 2.

Materials

Flip chart, flip chart stand or whiteboard, felt pens.

Background

Milk quality control is the practice of specified hygienic methods and use of approved tests to ensure good milk quality. The good hygienic practices and tests are designed to help reduce milk spoilage (See Day 2 for details on these methods and tests). Milk traders will need to practise the tests with a trainer to ensure that they are able to use them properly.

Activity 1.4.1: The basics of milk quality control

Activities	Resources
Brainstorming exercise to prepare for Day 2: ● What do we mean by good quality milk? (Wholesome; safe; clean - looks and smells good - without foreign bodies, etc.) ● How do we make sure that milk is of good quality? (Proper hygiene and testing etc) These are the topics to be considered on Day 2	A20 sheets, flip charts and marker pens

SESSION 1.5:
DAY 1 SUMMARY AND MINI EVALUATION (1/4 hour)

Objective for this session:
To recap the main learning points from Day 1 and to get participants feedback on the training so far.

Activities	Resources
a) Use a playful game (eg. with a ball) to involve all participants in recapping the main learning points from Day 1 All stand - one facilitator passes the ball in turn to participants who state what they have learnt during the day whilst the other trainer records the learning points on the A20 sheet	A20 sheets, flip charts, marker pens and a ball
b) Each participant is then given a post-it sheet to write a comment about day 1 and stick it on the prepared A20 sheet: ● In the "happy" section if they are pleased ● In the "neutral" section if they are indifferent and ● In the "sad" section if they are disgruntled	A20 sheet with "happy"; "neutral" and "sad" faces, post it pads
Participants depart and trainers remain to conduct their own debriefing and assess the participants' evaluation comments	

SESSION 1.6:
PRE-EVALUATION ON KNOWLEDGE OF MILK QUALITY CONTROL (1/4 hour)

Objective for this session:
To obtain background information about the participants for record purposes including assessment of the impact of the training at a later date.

Activities	Resources
Ask participants to complete the pre-evaluation questionnaire before the start of Day 2	40 copies of pre-evaluation questionnaire - Annex 3.1
Many participants find completing this kind of questionnaire difficult and therefore it may be deemed unnecessary, in which case omit this session	

Don't forget milk samples for use on Day 2, Session 3. These need to be prepared at the end of Day 1.

“Happy”; “neutral” and “sad” faces, post-it pads.

Daily evaluation

DAY TWO

2 HOW TO ENSURE GOOD QUALITY MILK

OBJECTIVE FOR THE DAY

To educate participants on hygienic milk handling practices and quality control.

Materials

Flip chart, felt pens, cards, fresh whole milk (5 litres for preparing samples), sour milk, milk adulterated with water, liquid detergent, hand brush, scrubbing material (e.g. Super-brite), water, three big troughs, dirty containers, ten 500ml sample jars, spirit lamp/candle, kerosene/methylated spirit, spoons (1 per group), 5ml disposable syringes (2 per group), 70% ethanol alcohol (500ml per group), small plastic/glass cups (1 per group), thermometer (1 per group), lactometer (1 per group), 100 ml measuring cylinder (1 per group), onions, tissue/ paper towels, tray.

Background

Milk from the udder of a healthy cow contains very few bacteria. Poor hygiene introduces additional bacteria that make the milk spoil quickly. To ensure that the milk remains fresh for a longer time it is necessary to practice good hygiene. Good hygiene needs to be observed at all stages of milk production, handling and marketing. Therefore farmers should be advised on hygienic milk production and handling after milking.

SESSION 2.1:
INTRODUCTION TO ACTIVITIES OF DAY 2 (1/4 hour)

Objective for this session:
To get all participants focused and livened up for Day 2.

Activities	Resources
Feedback from Day 1 and any comments/changes necessary from the Day 1 evaluations	A20 sheets, flip charts and marker pens.
If time did not permit on Day 1 then summarize the main learning points from Day 1 at this stage Try an ice breaker: for example, a song to commence Day 2 Explain the day's program.	

SESSION 2.2:
ADVICE TO GIVE TO FARMERS (1/2 hour)

Objectives for this session:
2.2.1 —To learn about sources of milk contamination at the farm
2.2.2 —To learn about advice to give to farmers on avoiding contamination

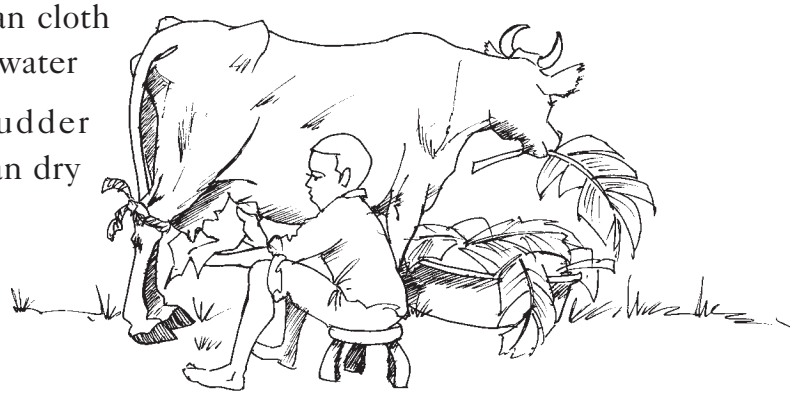
Activity 2.2.1: Sources of milk contamination at the farm

Specific Objective: To enable the participants acquire background knowledge on sources of milk contamination at the farm.

Quality control must begin at the farm[3]. That way, the milk that the traders collect will have fewer bacteria that cause spoilage. Below is some advice that milk traders can give to the farmers who supply them with milk, in order to ensure good quality.

- Maintain clean and healthy cows
- Keep a clean milking environment
- Wash hands with soap and clean water before milking
- Wash the udder with a clean cloth and warm water
- Dry the udder with a clean dry cloth

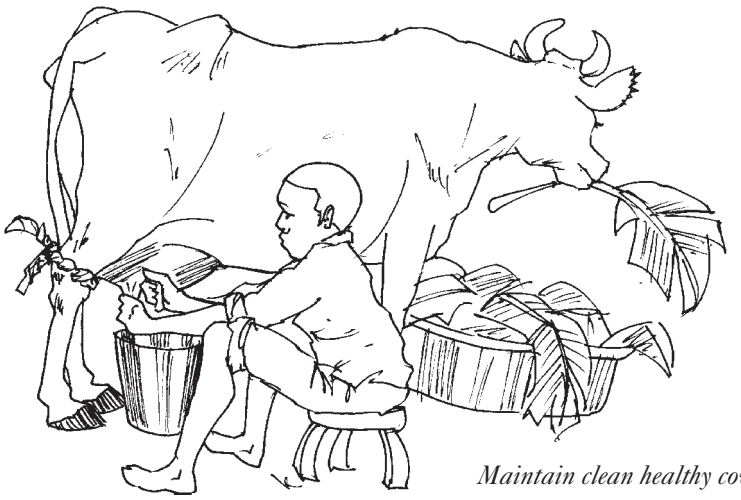
Wash hands with soap


Wash the udder with a clean cloth

[3] See Annex 2.1 for sources of contamination.

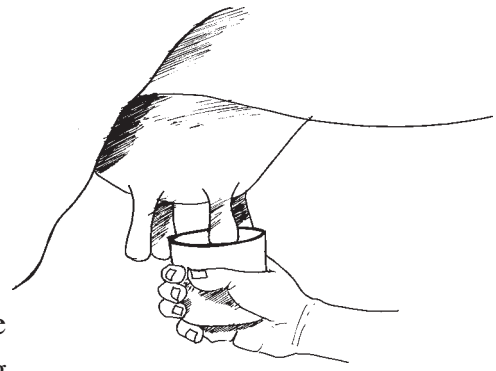
Make the first draw into a strip cup and throw away

- Make the first draw into a strip cup to check for mastitis and throw away from the milking area even if it appears clean
- Use clean containers for milking
- Cows with mastitis should be milked last and their milk discarded
- Milk from cows under antibiotic treatment should not be sold until 3 days after last treatment or as advised by the veterinarian



Maintain clean healthy cows

- After every milking, dip the teats into an "antiseptic dip"
- During milking, the milker should not:
  a) have long nails
  b) sneeze or cough
  c) smoke
- Release the cow from the milking area as soon as milking is finished



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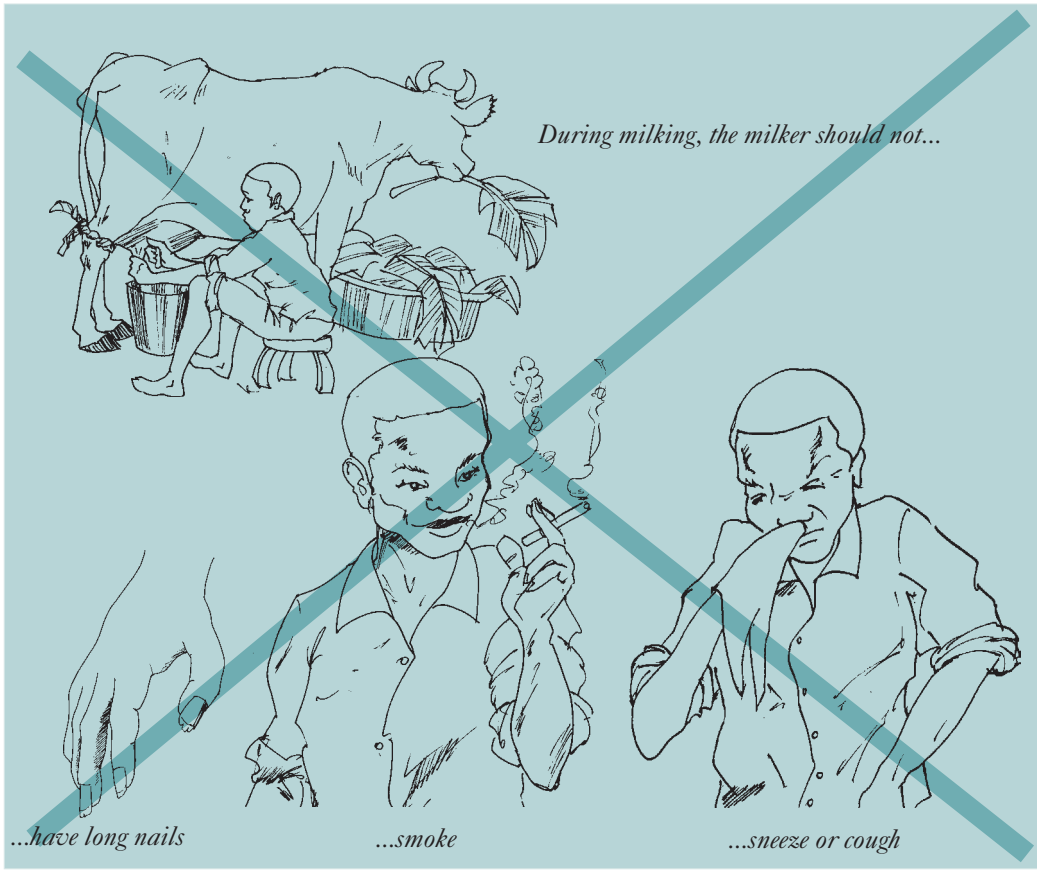
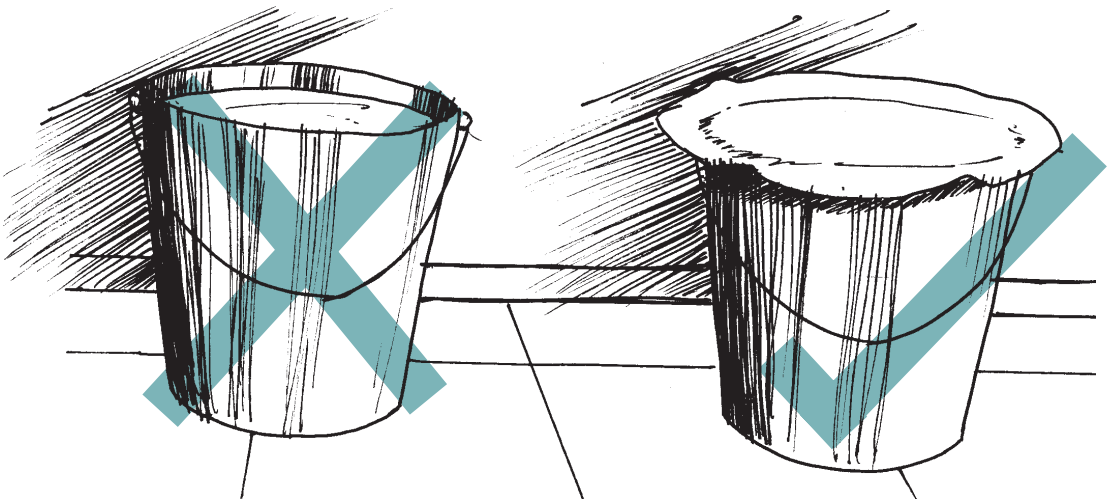


- After milking, cover the milk to avoid contamination
- Move the milk to a clean and cool area



After milking, cover the milk to avoid contamination

Activity 2.2.2: Advice to give to farmers on avoiding contamination

Specific Objective: To enable participants acquire practical knowledge on hygienic milk handling on the farm and pass the same knowledge to farmers who supply them with milk.

Activities	Resources
Divide into groups of 5 - 6 persons: Question to discuss (1): "How does milk become contaminated on the farm?" Question to discuss (2): "What advice would you give to farmers from whom you procure your milk?" Groups present their discussions concerning the two questions Group presentations: use Annex 2.1 (*Sources of milk contamination)* to cover any major points not covered by participants	A20 sheets, flip charts and marker pens Annex 2.1
Facilitator illustrates their points using the following graphics: • Maintain clean healthy cows • Wash hands with soap • Wash udder with a clean cloth • Make the first draw into a strip cup and throw away • After every milking, dip teats into 'antiseptic dip' • During milking the milker should not ... have long nails....smoke .....sneeze or cough • After milking, cover the milk to avoid contamination	Overhead projector and transparencies of the main illustrations in the trainees and trainers training manual (Day 2 Session 2)

SESSION 2.3:
HYGIENIC MILK HANDLING (1/2 hour)

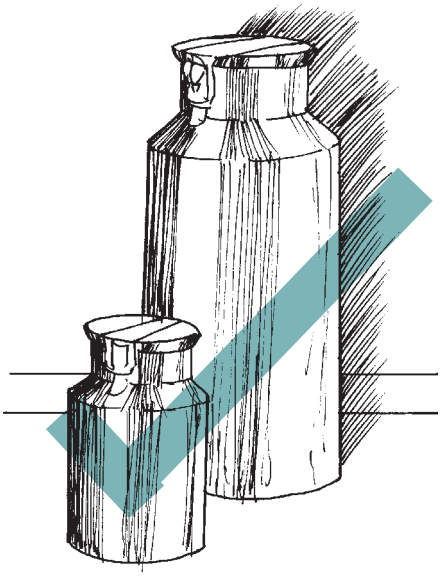
Objectives for this session:
2.3.1 —To acquire knowledge on reducing milk spoilage
2.3.2 —To learn about hygienic milk handling practices

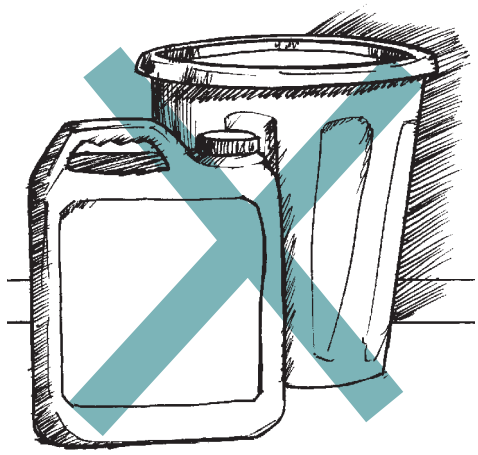
Activity 2.3.1 – Practices to reduce milk spoilage

Specific Objective: How to reduce milk spoilage through hygienic milk handling after purchase

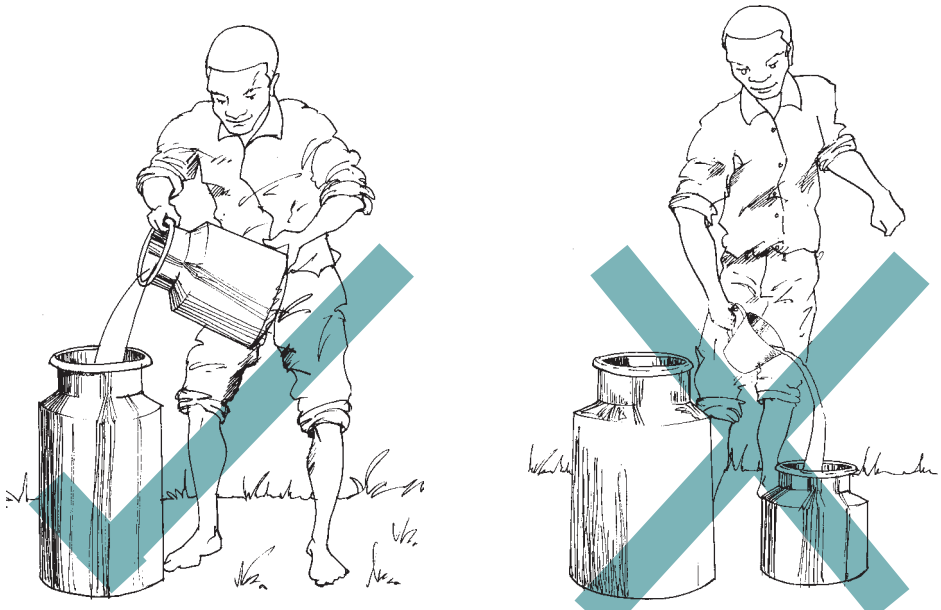
Below are some practical guidelines that the milk traders should follow in order to ensure good milk hygiene.

Always use metal (e.g. aluminium) containers and not plastic containers.





When transferring milk between containers, pour, do not scoop. Scooping may introduce spoilage bacteria.[4]



When transferring milk between containers, pour, do not scoop

Before re-using the milk container,

- Pre-rinse the container soon after use

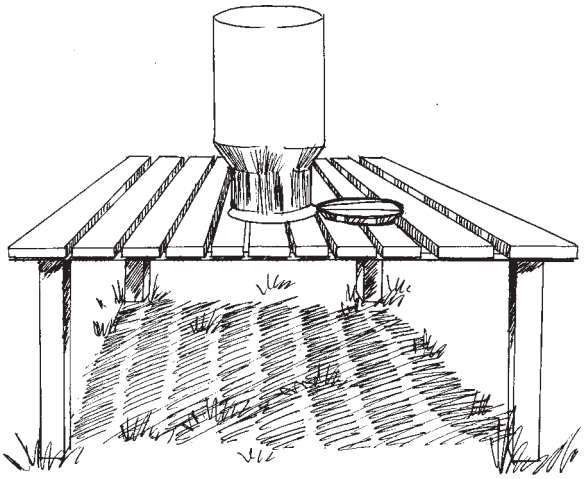
Rinse milk container in running water

[4] Discuss how repeated dipping of scoop into milk by scooping can introduce contamination if, for example, the scoop is kept on a table before being re-used

- Thoroughly scrub the container with warm water and detergent or soap (using a stiff bristled hand brush or scouring pad e.g. "*Super-brite*")
- Rinse the container in running water
- Dip-rinse the container in boiling water for at least one minute
- Air-dry the milk container in the open in inverted position

Thoroughly scrub the milk container with warm water and detergent or soap (using something like a stiff bristled hand brush or scouring pad)

Dip rinse container in boiling water for at least one minute



Air-dry milk container in the open in inverted position.

Activity 2.3.2: Hygienic milk handling practices by traders

Specific Objective: To emphasize practical skills on hygienic milk handling.

Activities	Resources
Open question for discussion in groups: "What can traders do to improve the hygienic handling of milk?"	A20 sheets, flip charts and marker pens
Group presentations. Facilitator uses the illustrations in the section on hygienic milk handling to emphasize the main points made by the groups' presenters: ● Metal vs. plastic containers ● Pouring vs. scooping ● Thoroughly scrub the milk container ● Rinse the milk container in running water ● Dip-rinse container in boiling water ● Air-dry the milk container If time permits: ● Use Annex 2.2 (Evaluating the characteristics of a good milk container) to initiate a discussion about the merits and demerits of using metal and plastic containers ● Conduct a direct ranking exercise comparing the metal and plastic container	Overhead projector and transparency of the main illustrations in the trainees training manual (Day 2 Session 2) Annex 2.2

SESSION 2.4: MILK TESTING (1½ hour)

Objectives for this session:
2.4.1 —To introduce basic milk quality control methods
2.4.2 —To practice organoleptic (sight and smell) test
2.4.3 —To practice other basic milk tests
(clot on boiling, alcohol and lactometer tests)
2.4.4 —To introduce advanced milk tests

Activity 2.4.1: Milk quality control methods

Specific Objective: To equip participants with knowledge and skills on milk quality control methods including testing and preserving.

Basic milk tests

During testing only a small amount (sample) of the milk is used. For the result of the test to give a true picture of the state of the milk, it is important to mix milk before obtaining the sample for testing.

Milk traders can ensure that the milk they receive from the farmer is of good quality by carrying out one or more of the following four basic tests.

i) Organoleptic Test (Using the senses of sight and smell)

This test should be performed first. It simply requires the use of the senses of sight and smell to test the milk. It is easy and straightforward, allowing one to segregate poor quality milk before receiving it. Milk that cannot be adequately judged this way should be subjected to other more sensitive and objective tests. No equipment is required, but the milk tester must have good sense of sight and smell.

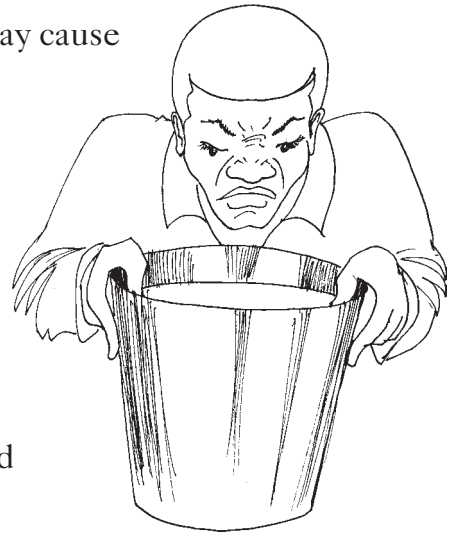
smell the milk

Procedure:

- Open a can of milk
- Immediately smell the milk and establish the nature and intensity of smell, if any. The milk may smell non-fresh or foreign odours may be detected
- Observe the appearance of the milk. Look at the colour of milk, any marked separation of fat, colour and physical state of the fat, foreign bodies or physical dirt
- Touch the milk container to feel whether it is warm or cold. This may indicate to you how long milk has taken since milking (if not chilled thereafter) and will influence the lactometer test for adulteration (see below)

Judgment:

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



- Type of feed or atmospheric taint
- Cows in late lactation
- Chemical taints or discolouring
- Advanced acidification or souring

Marked separation of fat may be caused by:

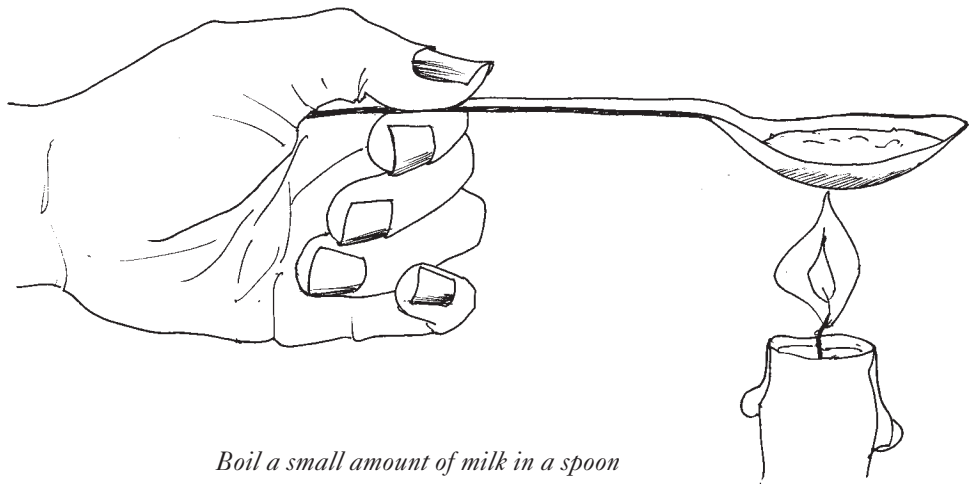
- Milk previously chilled and subjected to disturbance during transportation
- Adulteration with other solids (may also show as sediments or particles)
- Boiling, if milk fat is hardened

ii) Clot on Boiling Test

This test is quick and simple. It allows one to detect milk that has been kept for too long without cooling and has developed high acidity[5], or colostral milk that has a very high percentage of protein. Such milk does not withstand heat treatment, hence clot on boiling test could be positive at a much lower acidity.

Procedure and judgment:

Boil a small amount of milk in a spoon or other suitable container. If there is clotting, coagulation or precipitation, the milk has failed the test and should be rejected.



Boil a small amount of milk in a spoon

[5] If need arises, you may explain that milk clots on boiling when acidity is 0.26% lactic acid and above

iii) Alcohol Test

The test is quick and simple. The specific type of alcohol used is known as 'ethanol'. It enables detection of bad milk that may have passed the previous two tests because it is more sensitive to lower levels of acidity. It also detects milk that has been kept for long without cooling, colostrum or milk from a cow with mastitis.[6]

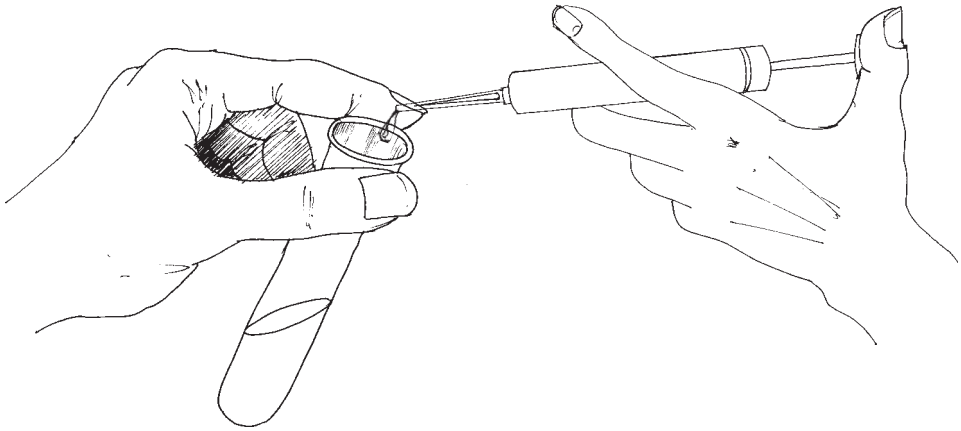
Procedure and judgment:

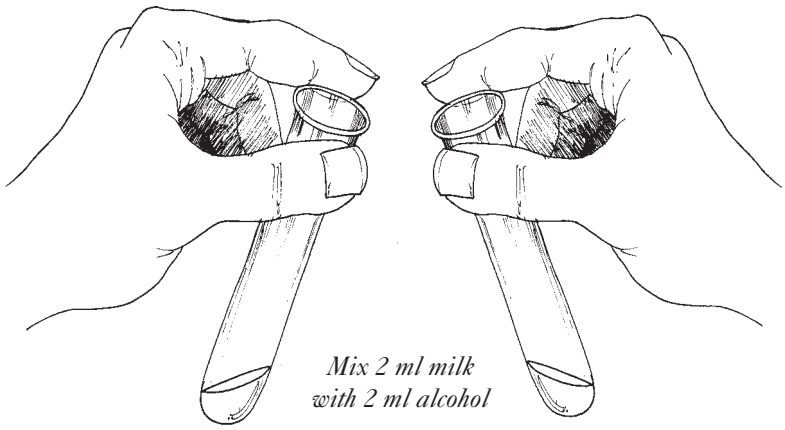
Use a syringe to draw equal amounts of milk and 70% alcohol solution[7] in a small tube or glass cup (such as those used to administer medicine to children). Mix 2 ml milk with 2 ml 70% alcohol.

Use a syringe to draw equal amounts of milk

[6] If the question arises, you may explain that it is possible to distinguish between clots due to acidity/souring and colostrum or mastitis by use of alizarin alcohol, which changes colour if clots are due to acidity. (Alizarin alcohol is prepared by dissolving alizarin dye in 70% ethanol alcohol. The dye changes colour from brown to yellow when mixed with sour milk). Colostrum and mastitis milk will clot on alizarin alcohol but without colour change.

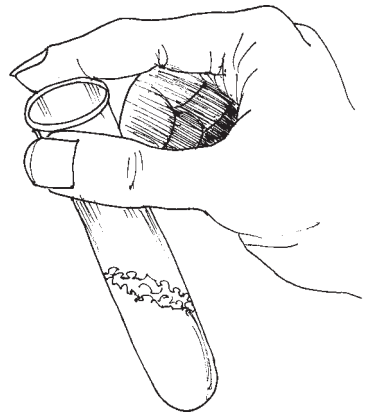
[7] 70% ethanol solution is prepared from 70 ml of 96% or absolute alcohol (can be obtained from a chemist) and 26 ml distilled (or battery) water. You may ask the chemist to pre-dilute the ethanol to 70% for you. Milk will clot on 70% ethanol alcohol test when the acidity is 0.21% lactic acid and above.





Mix 2 ml milk with 2 ml alcohol

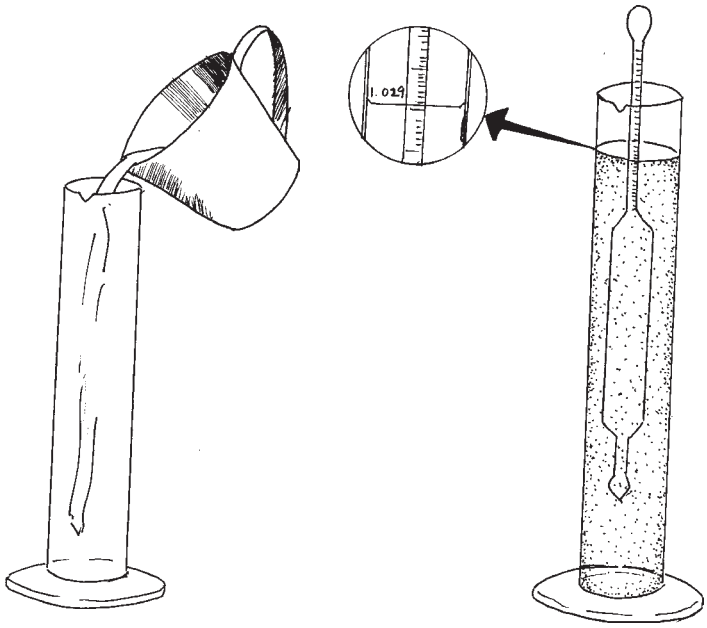
If the tested milk sample coagulates, clots or precipitates, it will have failed the test and the milk should be rejected. Because this test is quite sensitive, milk that passes this test can keep for some hours(at least two hours) before it goes bad.



Sample coagulates, clots - failed the test

iv) Lactometer Test

Some unscrupulous milk suppliers adulterate milk with added water to increase the volume or added solids to make it look thicker. Addition of anything to milk can introduce bacteria that will make it spoil quickly. Adulteration of milk is also illegal. Here is how to test the milk to check whether it has been adulterated. The test is based on the fact that milk has a heavier weight or density (1.026 - 1.032 g/ml) compared to water (1.000 g/ml). When milk is adulterated with water or other solids the density either decreases (if water is added) or increases (if solids are added). If milk fat (cream) is added to milk, the density becomes lower[8]. The equipment used to determine milk density is called a lactometer. Most lactometers are usually marked from "0" (representing density of 1.000g/ml) to "40" (representing density of 1.040 g/ml).



Equipment used for determination of milk density

[8] Milk fat has a lower density than water. When fat is added to milk the milk will have a rich creamy layer unlike adulteration with water.

Procedure:

Ensure that the milk has been left to cool at room temperature for at least 30 minutes[9] and its temperature is about 20°C. Stir the milk sample and pour it gently into a 200ml measuring cylinder (or any container deeper than the length of the lactometer). Let the lactometer sink slowly into the milk. Take the lactometer reading just above the surface of the milk.

If the temperature of the milk is different from the lactometer calibration temperature (20°C), then use this correction factor: For each °C above the calibration temperature add 0.2° lactometer "degrees" (°L) to the observed lactometer reading, and for each °C below calibration temperature subtract 0.2° lactometer "degrees" (°L) from the observed lactometer reading. These calculations are done on the lactometer readings i.e. 29 instead of the true density of 1.029 g/ml.

Example of how to calculate the true lactometer readings when the milk temperature differs from the lactometer calibration temperature of 20°C.

Sample	Milk temperature °C	Observed Lactometer reading °L	Correction °L	True Lactometer reading°L	True density g/ml
No.1	17	30.6	- 0.6	30.0	1.030
No.2	20	30.0	Nil	30.0	1.030
No.3	23	29.4	+ 0.6	30.0	1.030
No.4	20	29.0	Nil	29.0	1.029
No.5	21	29.8	+ 0.2	30.0	1.030
No.6	19	29.2	- 0.2	29.0	1.029

[9] If milk is tested immediately after milking, it will register a lower density because during milking, a lot of air is incorporated and the temperature is higher (>37°C) than the lactometer calibration temperature of 20°C.

Judgment:

Normal milk has a density of 1.026 -1.032 g/ml (or 26 - 32 on the lactometer reading). If water has been added, the lactometer reading will be below 26. If any solid such as flour has been added, the reading will be above 32.

Activity 2.4.2: Activities and resources for organoleptic (sight and smell) test

Specific Objective: To acquire practical knowledge on sensory evaluation of milk quality.

Activities	Resources
Open question for discussion: "How can you ensure that the milk you receive is of good quality? Record responses Use Annex 2.3 (Organoleptic or sensory evaluation of spoilt milk) to guide the trader in using sight and smell as the first step in evaluating milk	A20 sheets, flip charts and marker pens Annex 2.3
Set milk samples around four tables with the necessary equipment: • Conduct the practical exercise in four groups • Tabulate the results on A20 sheets • Review and evaluate the test	Milk samples and cards

Activity 2.4.3: Activities and resources for the other basic milk tests (clot on boiling, alcohol and lactometer tests)

Specific Objective: To acquire practical knowledge on other milk testing procedures.

Activities	Resources
Demonstrate the milk testing methods (use Annex 2.4 Sample preparation and testing of adulteration and spoilage) for technical guidance	A20 sheets, flip charts and marker pens
• Clot on boiling test • Alcohol test • Lactometer test Divide into FOUR groups with four sets of equipment • Tabulate results on A20 sheets for the 3 new tests • Review and evaluate the tests It is important that each group analyses ALL the samples so that the facilitator can lead the follow-up discussion on the merits of each testing procedures. Prepare equipment for tests and Day 3 practical in the field	Pre-prepared samples (Annex 2.4), spoon, candle, disposable syringe, ethanol, lactometer, test tubes and thermometer

Recording sheet for sample milk testing

Sample No	Smell	Sight	Clot on Boiling	Alcohol	Lactometer
1					
2					
3 etc					

Practical equipment for each group

- 2 - 3 samples (these are rotated in time so that each group tests ALL of the prepared samples)
- A20 sheet and marker pens
- Kitchen roll or cloth for cleaning spilt milk
- Basin and water jug
- Spoon
- Candle
- Match box
- Thermometer
- 2 test tubes
- 2 syringes
- Lactometer
- Small 300 ml container that fits the lactometer
- 70% ethanol alcohol

Activity 2.4.4: Introduction to advanced milk tests

Specific Objective: To create awareness on advanced milk quality tests not covered in this guide.

There are other advanced tests that are beyond the scope of this course. Refer anyone interested to the references on page 66.[10] These tests are more sensitive, but they are not practical within the circumstances of most small milk traders. For example;

1. Acidity test: Determines developed acidity in milk (Lactic acid).
2. Resazurin test: Determines the keeping quality (Activity of spoilage bacteria).
3. Butterfat test: Determines fat content in milk.
4. Freezing point determination: Determines deviation due to adulteration or abnormal milk.

[10] For other useful and readily available references see Milk Processing Guide Series Volume 2, FAO/TCP/KEN/6611Project; Training program for Small-scale Dairy Sector and Dairy Training Institute-Naivasha.

SESSION 2.5:
HOW TO PRESERVE MILK TO REDUCE SPOILAGE (1/2 hour)

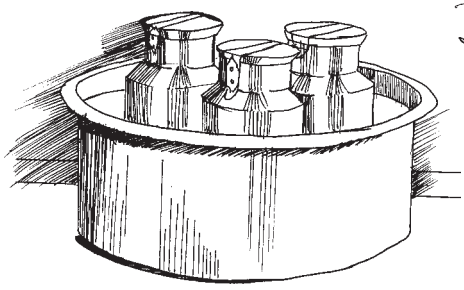
Objectives for this session:
2.5.1 —To appreciate the importance of milk cooling
2.5.2 —To illustrate how cooling helps extend the shelf life of milk

Activity 2.5.1: Importance of milk cooling

Specific Objective: To enable participants learn and appreciate various milk preservation methods.

In order to ensure that traders further increase the shelf life of milk after receiving, it has to be kept in a cool place. Lowering of milk temperature reduces "speed" (rate) of bacterial growth. If there is no refrigerator, the milk may be kept in cold water or in a hole under a shade. [11]

Keep the milk in a hole in a shade



Keep the milk in cold water

[11] You may outline other cooling methods depending on the level of participants

Lastly, ferry your milk quickly to your customers and make them happy. Remember that spoilage bacteria multiply very quickly in warm temperatures. Remind customers to always boil milk before drinking it.

Ferry your milk quickly to your customers

Remind the customer to always boil milk before drinking it

Activity 2.5.2: Extending the shelf life of milk

Specific Objective: To emphasize practical skills in cooling

Activities	Resources
Open question for discussion in groups: "How can you increase the shelf life of your milk?	A20 sheets, flip charts and marker pens
Discussion and feedback	
Use the illustrations on 'How to preserve your milk to reduce spoilage' to emphasize the group presentations: ● Keep the milk in a cool place ● .....in a hole in a shade ● .....in cold water ● Ferry the milk quickly to your customers ● Remind the customer to always boil milk before drinking it	Overhead projector and overhead transparency of the main illustrations in the trainees training manual (Day 2 Session 2.5)
If necessary refer to the graph in Annex 1.6 (Milk preservation) to explain the effect of temperature on the growth of bacteria	

SESSION 2.6:
DAY 2 SUMMARY AND MINI EVALUATION (1/4 hour)

Specific Objective: To recap the main learning points from Day 2 and to get participants' feedback on the training so far.

Activities	Resources
Use a playful game (e.g. with a ball to involve all participants in recapping the main learning points from day 2	A20 sheets, flip charts, marker pens and ball
All stand - one facilitator passes the ball to participants who state something they have learnt during the day whilst the other trainer records the learning points on the A20 sheet	
Each participant is given a post-it sheet to write a comment about day 2 and stick it on the prepared A20 sheet ● In the "happy" section if they are pleased ● In the "neutral" section if they are indifferent and ● In the "sad" section if they are disgruntled	A20 sheet with "happy" "neutral","sad" face and post it pads

REMEMBER

- Proper hygiene practice in milk production and handling is key to the longer shelf life of milk
- Cooling of milk will slow down the multiplication of bacteria and prolong shelf life.
- But milk that already has many bacteria in it will not keep as long even when cooled
- Better milk quality increases marketing profits

SESSION 2.7: PREPARATION FOR PRACTICAL EXERCISES ON DAY 3 (1/4 hour)

Specific Objective: To prepare the equipment and tasks to be undertaken on Day 3

Activities	Resources
Distribution of equipment - ensure that equipment is signed for (for details see "materials" section under day 3)	A20 sheets, flip charts and marker pens
Explanation of tasks for day 3	

Daily evaluation

DAY THREE

3 PRACTICAL DAY OUT IN THE FIELD

To enable participants to practise the quality control and hygiene tests under normal milk marketing conditions and determine those that are viable in their businesses.

Participants will be working in the field on Day 3 so go through the details of what needs to be done before they leave at the end of day 2 since they will reconvene on Day 4. Brief them on what they are expected to do. Give them a chance to ask questions on what is not clear especially if anyone has difficulty in carrying out milk tests covered in the previous session, in which case attend to him/her individually.

Ensure that each participant has a pack or bag with the relevant milk testing items/tools and a copy of the training guide for milk traders.

Materials

Each participant should have 70% ethanol alcohol (150 ml), two disposable syringes , a lactometer, a thermometer, a candle, a training guide for small-scale milk market traders, a jug, a small notebook and a container for all the items.

SESSION 3.1:
PRACTICAL EXERCISES IN THE FIELD (Whole Day)

Specific Objective: To practice (in the field) the lessons learnt during day 1 and 2 of the training program.

Activities	Resources
Activity 3.1 - advice to farmers	Participants need access to their own manuals (Training Guide for Milk Traders)
Activity 3.2 - hygienic milk handling	
Activity 3.3 - Milk testing methods (1 - 4) used We found that Day 3 is best covered over a 4 - 5 day period after which we reconvene on Day 4.	See Session 2.4 70% ethanol alcohol (150 ml), two disposable syringes, a lactometer, a thermometer, a candle, a jug, a small notebook and a container for all the items

DAY FOUR

4 REVIEW AND EVALUATION OF THE COURSE (3 hours)

1. To get feedback from the practical day out (Day 3) and review lessons on practical skills in milk quality control and testing, and ensure correct interpretation of results.
2. To evaluate effectiveness of the training course
3. To present certificates of attendance to the participants.

Materials

Flip chart, flipchart stand and felt pens, certificates.

SESSION 4.1: INTRODUCTION TO DAY 4 AND FEEDBACK FROM DAY 3 (1-2 hours)

Objectives for this session:
4.1.1 —To introduce Day 4
4.1.2 —To review and obtain feedback from Day 3

Activity 4.1.1: Introduction to Day 4

Specific Objective: To get all participants focused and livened up for Day 4.

Activities	Resources
Ice breaker and introductory exercise	A20 sheets, flip charts and marker pens
Recalling lessons learnt	
Each participant states a learning point that they can recollect from days 1 to 3, and a co-facilitator notes the points on an A20 sheet	

Activity 4.1.2: Review and feedback from Day 3

Specific Objective: To assess the progress made by traders during the practical field exercise.

Activities	Resources
Trainers obtain feedback and discussion with the group on the following tasks from day 3:	A20 sheets, flip charts and marker pens
Activity 3.1 - Advice to farmers Provide feedback on advice given to farmers.	
Activity 3.2 - Hygienic milk handling Provide feedback on hygienic handling practices.	
Activity 3.3 - Milk testing Provide feedback on the milk testing methods used	
Participants are divided into three or four groups to discuss the above three topics (30 minutes). The most effective results are obtained when participants are asked to assess what was: ● Positive (worked well) and ● Negative (did not work well)	
Under each of the three headings, groups present their results on A20 sheets and with discussion guided by the facilitator. (15 minutes per group)	

SESSION 4.2:
EVALUATION OF THE TRAINING PROGRAM (½ hour)

Activity 4.2.1: Course evaluation exercise

Specific Objective: To obtain an overall evaluation of the course from the participants.

Activities	Resources
Group evaluation: Write the points raised on A20 sheets under these headings: • What did you like about the course? • What did you dislike about the course? • What is the most important thing you have learnt? What can be done to improve the course?	A20 sheets, flip charts and marker pens Evaluation forms- Annex 3.2
Individual evaluation: if time and level of education of the participants permit then they should also complete the individual evaluation sheets in Annex 3.2	

SESSION 4.3: CLOSING CEREMONY AND PRESENTATION OF CERTIFICATES (1/2 hour)

Activity 4.3.1: Presentation of certificates

Specific Objective: To ensure that the course gets formal recognition from official authorities and that participants are recognized for their efforts.

Activities	Resources
Formal closing speech by government or KDB official Presentation of course certificates	Course certificates Annex 3.3

Daily Evaluation

OTHER SOURCES OF INFORMATION

1. Milk Processing Guide Series Volume 2, FAO/TCP/KEN/6611Project; Training Program for Small Scale Dairy Sector. Dairy Training Institute, Naivasha.

2. Code of Hygienic Practice for Production, Handling and Distribution of Milk and Milk Products. Kenya Bureau of Standards, Nairobi.

3. Rural Dairy Technology, ILRI Manual No. 1. International Livestock Research Institute, Nairobi.

4. Milk Producer Group Resource Book - a practical guide for establishing milk producer groups. FAO, 2002.

5. Milk Payment Resource Book - a practical guide for using incentives to improve milk quality. FAO, 2004.

PART 3

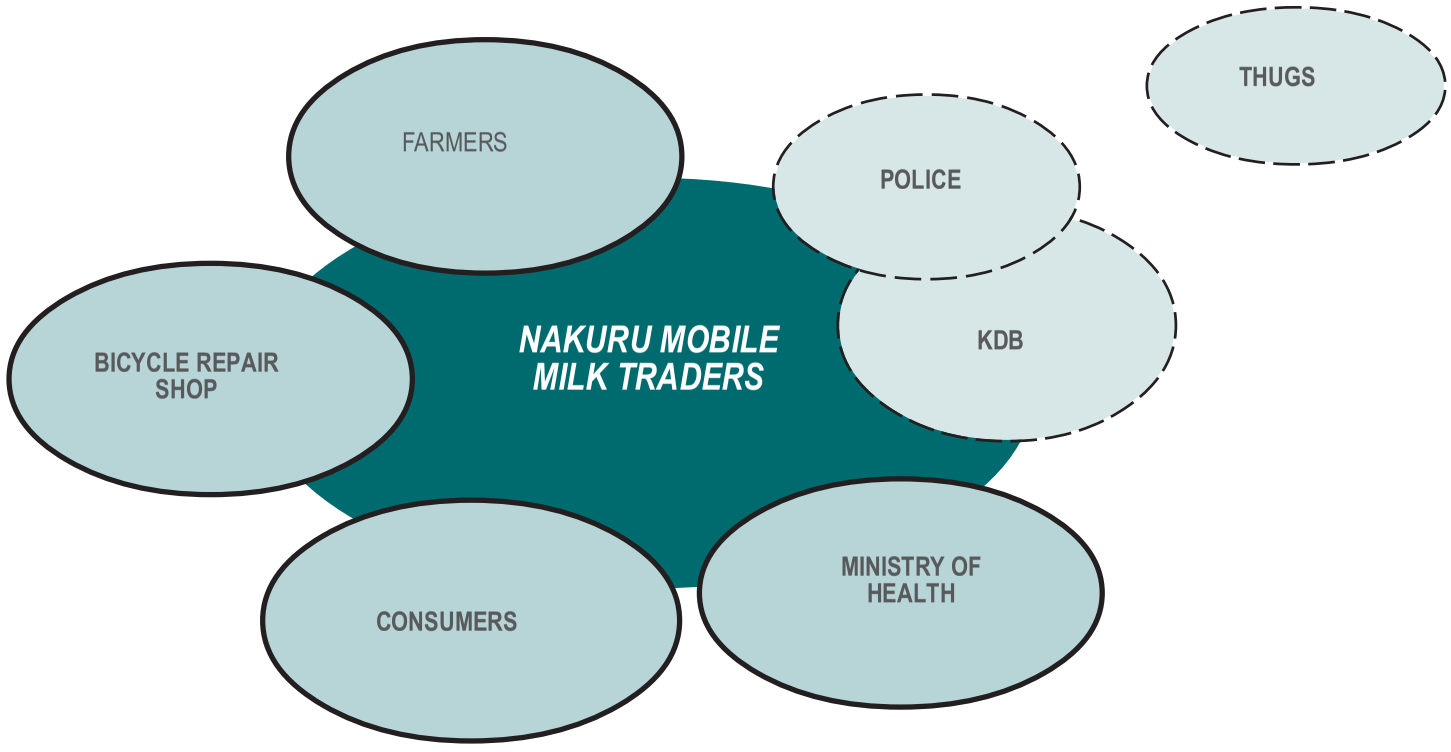
ANNEXES

Annex 1.1: Venn diagramming of stakeholders

Procedure

1. Explain the meaning of the term "stakeholder" to the participants i.e. anybody who is involved in some way with their trade, whether positively or negatively.
2. Ask the participants to identify and list the stakeholders.
3. The trainer may want to prompt participants where he/she think there are stakeholders that have been missed out, but ONLY after the participants have exhausted their suggestions.
4. Determine the type of relationship between each stakeholder and the traders (friendly/not friendly, helpful/unhelpful, etc.).
5. Describe the process of Venn diagramming: Each stakeholder is allocated a circle on a sheet of paper with the size of the circle related to the importance of the relationship. Large circles mean an important stakeholder with the main stakeholder being allocated the largest circle. These circles will then overlap depending on the degree of contact/association to the main stakeholder (i.e. friendly or unfriendly). See example on page A4.
6. Divide participants into groups of 5-10 to produce Venn diagrams of stakeholders.
7. Ask the groups to exhibit and explain their Venn diagrams.
8. Use the Venn diagrams to show the milk traders which stakeholders can give them assistance and information relevant to their trade. Discuss the relative interests of different stakeholders.

Venn Diagram illustration of stakeholder relationships by small scale mobile milk traders in Nakuru in 2001 (circles for stakeholders considered unfriendly by traders are dotted).



A4

IMPROVE THE QUALITY OF YOUR MILK AND PLEASE YOUR CUSTOMERS

Annex 1.2: Identification and ranking of constraints

Identification of constraints

1. Ask traders what constraints they face during sale of their milk. Avoid leading questions like "Is official harassment a constraint?" Ask them to write on separate cards or draw pictures representing the constraints.
2. Constraints that the trainer thinks may have been missed out can be discussed later when the suggestions from participants have been exhausted.
3. These cards or list of constraints can be used in either or both of the following exercises in Ranking of Constraints (see below).

Ranking of Constraints

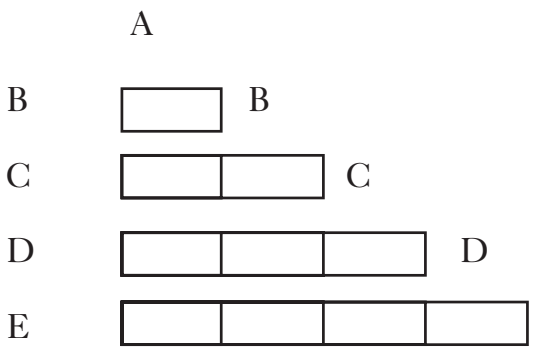
- Explain to participants how to draw a recording matrix as in example on how to do pair-wise ranking on page A7 (Pair-wise ranking is a structured method of ranking a list of items in order of specified priority. It helps to determine the relative importance of items in a list. It can also help in making consensus-based decisions
- Divide the participants into groups of about 10 and suggest that each group nominate a chairman to coordinate the discussion and a secretary to record important points from the discussion
- Summarise the constraints on a flip chart
- Ask each group to draw up a recording matrix on a flip chart as in the example on page A7
- Use the summary list of constraints to ask questions on pair-wise comparisons. For each pair, ask what he/she considers most pressing and record in the matrix

- The groups should then be encouraged to discuss exhaustively why they made the choice (positive or negative aspects of the constraint). For example, ask questions like: "What about the other item?" Disagreements should be noted for discussion in the main session
- Ask the secretaries to record all the reasons that the group gave about why the choices were made
- The groups should continue this process for all possible combinations
- To keep the group interested, suggest that they pick different pairs each time. For example rather than comparing A and B, A against C and then against D and so on, suggest that they compare A and B, then C and D, then E and F and so on
- Show the groups how to complete a ranked list from the most pressing to the least. For this the frequency of occurrence of each item indicates the rank, i.e. highest frequency for most pressing constraint
- Ask each group to present their matrix, the ranks and the reasons for ranking. The chairman, secretary or any willing member may present on behalf of the group
- Discuss the outputs. If there were differences between the two groups, discuss why. Jointly reflect on the results: What questions were asked during group discussions? Does the position of the problem in the tree indicate its importance? Is it the problem that needs to be addressed first?
- Use their current knowledge as the starting point for further explanations. One of the constraints is likely to be milk spoilage. If this was not listed as a constraint the trainer may want to raise it or point out that some constraints are problems because they cause spoilage

- Ask what they know about milk spoilage and identify its causes e.g., unhygienic handling, inappropriate containers, method of washing containers, lack of proper preservation etc.
- Together, identify all other constraints that may be related to milk spoilage e.g., long distances over which milk is transported and/or time to resale
- Write the causes of spoilage that were not identified in the previous exercise on extra cards

How to do pair-wise ranking:

1. Construct a pair-wise matrix: each box represents the pairing of two items.
   For instance, if your list has five items (A, B, C, D and E), the matrix would look like this with the top box representing the pairing of A and B.



2. Rank each pair of items: Pairing is done using consensus-based group discussions (e.g. “which is better? A or B?”) For each pair, write the number of the chosen item in the box. Repeat the pairing process till the matrix is filled.

In the example, A and B are compared; B is better. A and C are compared; A is better. C and D are compared; C is better.

	A			
B	B	B		
C	A	B	C	
D	A	B	C	D
E	E	E	E	D

3. Count the number of times each item appears in the matrix.
4. Rank all items by the number of times they appear in the matrix. To break a tie (where two items appear the same number of times), look at the box comparing the two items. The item appearing in that box receives the higher ranking.

Item	A	B	C	D	E
Count	2	3	1	1	3
Rank	3rd	2nd	4th	5th	1st

There is a tie between B and E; both appear three times. Which one should be ranked 1st and which 2nd? Look at the box comparing B and E. In this box, E appears so it gets the higher ranking (1st) and B is ranked 2nd.

A is ranked 3rd because it appears twice.

There is another tie between C and D; both appear once. Which one should be ranked 4th and which 5th? Look at the box comparing C and D. In this box, C appears so it is ranked 4th and D is ranked 5th.

Example of simple ranking of constraints faced by mobile milk traders in Nakuru in 2001

CONSTRAINT	RANK
Official harassment by authorities	1
Milk spoilage	3
Insecurity (thugs)	2
Lack of trading licence (requirements for fixed premises unaffordable)	4
Non-durable containers (cannot invest in more costly durable containers due to risk of confiscation)	5
Unreliable consumers who may not pay	8
Bicycle riding is tiresome	11
Lack of market to sell more milk	7
Poor roads that damage bicycles frequently	6
Continuity of supply	12
Lack of investment capital to upgrade business	9
Seasonal fluctuation in milk supply	10

Example of pair-wise matrix ranking of above constraints

CONSTRAINT	CODE
Official harassment by authorities	A
Non-durable containers	B
Poor roads that damage bicycles frequently	C
Unreliable consumers who may not pay	D
Lack of trading licence	E
Insecurity	F
Milk spoilage	G
Lack of market to sell more milk	H
Lack of investment capital to upgrade business	I
Seasonal fluctuation in milk supply	J
Bicycle riding is tiresome	K
Continuity of supply	L

Example of how to read the ranking table:

The arrows indicate that when participants compared constraint D to F, they chose F as the more important constraint. Constraint F has 9 scores hence, 9 being the second highest score, constraint F is ranked second (2).

Annex 1.3: Diseases that can be passed through milk

a) Some bacteria (lactic acid bacteria) are useful in milk processing, causing milk to sour naturally, and leading to fermented milk products such as *maziwa lala*, yoghurt and cheese.

b) Other bacteria can cause spoilage of the milk resulting in losses because the taste and smell becomes unpleasant and consumers reject it. These bacteria are always present, but spoilage is prevented by handling milk in such a way as to prevent growth e.g. by cooling.

c) Other bacteria can cause disease Depending on the understanding or capacity of participants you may just wish to list the diseases). These bacteria are not always there, but it is very difficult to know without expensive tests.

d) Milk can transmit diseases if contaminated with harmful bacteria, for example:

i) *Milk can transmit pathogens from one person to another*. (Pathogens are microorganisms that cause disease.)

The following are examples of diseases from infected workers that can be transmitted to consumers of milk:

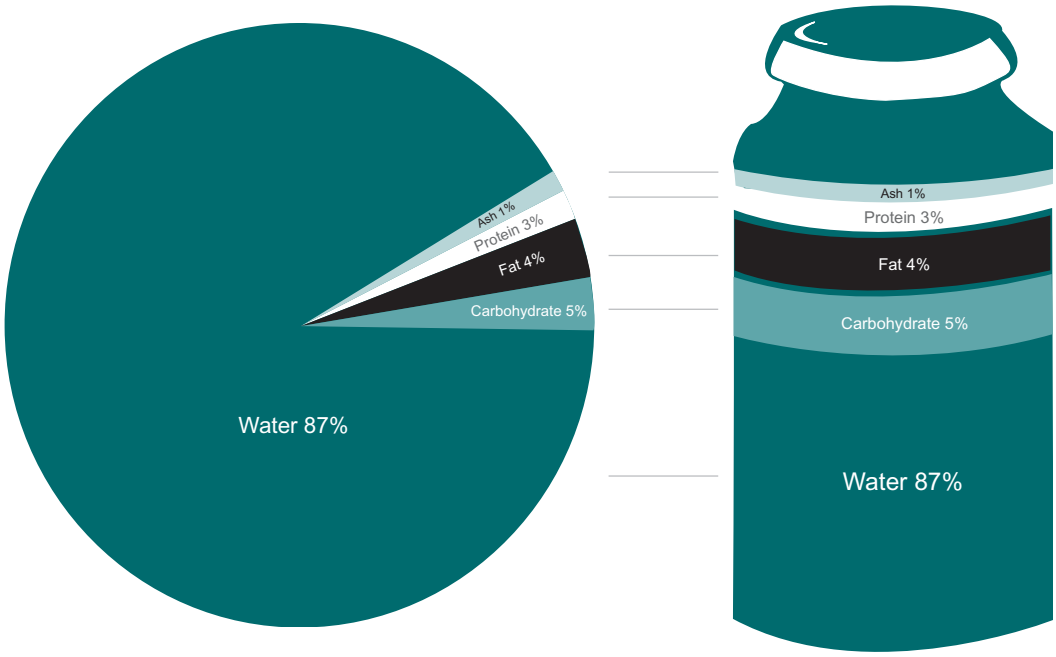
- Typhoid and paratyphoid fever
- Scarlet fever
- Cholera
- Dysentery
- Diphtheria

ii) Milk can transmit diseases from cows to humans (zoonoses)

The following are examples of diseases from infected cows that can be transmitted to humans through milk, especially if the milk is not boiled:

- Brucellosis or undulant fever. Malaria-like disease caused by *Brucella* species
- Tuberculosis, caused by *Mycobacterium tuberculosis*

Annex 1.4: Composition of milk



Milk is composed of water, carbohydrate/milk sugar (lactose), fat, protein and ash(vitamins and minerals). Milk composition is affected by a number of factors including:

a) Breed and individuality of the cow

Both milk yield and composition vary considerably among breeds of dairy cattle. Milk from Jersey and Guernsey breeds has about 5% fat while the milk of Shorthorns and Friesians contains about 3.5% fat. Zebu cows can give milk containing up to 7% fat. Milk of individual cows within a breed varies over a wide range both in yield and content of the various constituents.

b) Interval between milking

The fat content of milk varies considerably between the morning and evening milking because there is usually a much shorter interval between morning and evening milking than between evening and morning milking.

If cows were milked at 12-hour intervals the variation in fat content between milking would be negligible, but this is not practicable on most farms. Normally, the solids-not-fat (SNF) content does not vary with the length of time between milking.

c) Stage of lactation

The fat, lactose and protein contents of milk vary according to stage of lactation. SNF content is usually highest during the first two to three weeks, after which it decreases slightly. Fat content is high immediately after calving but soon begins to fall, and continues to do so for 10 to 12 weeks, after which it tends to rise again until the end of the lactation. The high protein content of early lactation milk is due mainly to the high globulin content found in colostrum (globulins are proteins that protect the new-born calf from infection).

d) Age and health

As cows grow older the fat content of their milk decreases by about 0.02 percentage units per lactation while the fall in SNF content is about 0.04 percentage units. Both fat and SNF contents can decrease because of disease, particularly mastitis.

e) Feeding regime

Underfeeding reduces both the fat and SNF contents of milk, although SNF content is more sensitive to feeding level. Fat content and composition are influenced more by roughage (fibre) intake.

The SNF content may decrease if the cow is fed on a low-energy diet, but is not greatly influenced by protein deficiency, unless the deficiency is acute.

f) Completeness of milking

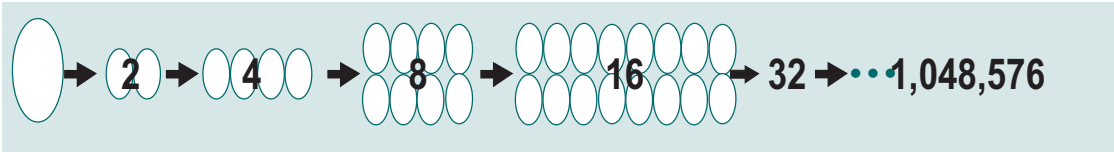
The first milk drawn from the udder contains about 1.4% fat while the last milk (or stripping) contains about 8.7% fat. Thus, it is essential to milk the cow completely and thoroughly mix all the milk removed before taking a sample for analysis. The fat left in the udder at the end of one milking usually ends up in the subsequent milking, so there is no net loss of fat.

Annex 1.5: Bacterial multiplication by division

Procedure

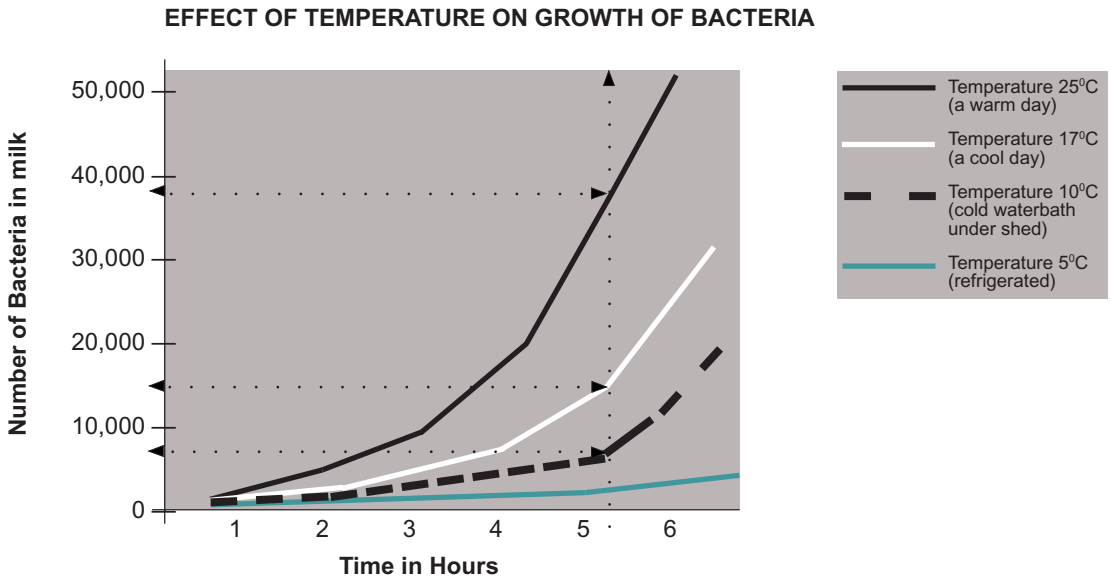
1. Discuss how milk is a suitable medium for bacterial growth and illustrate multiplication of bacteria in milk by division.
2. Divide the participants into two groups:
   - clean milk group
   - contaminated milk group
3. Give a pack of beans and a piece of chalk to each group and ask them to get space on the floor ready for counting.
4. Ask them to draw a straight line of 10 feet (approx. 3 meters) length on the floor and put a mark after every one foot (approx. 30 cm) to represent 0.5hrs i.e., 0 hour followed by 0.5, 1.0, 1.5, and so on until 5.0 hours.
5. Starting with one bean at 0 hour for the clean milk group and 20 beans for the contaminated group, ask them to count double the number of beans and place them at the next mark, and so on until they get to the last mark (5.0 hour mark).
6. It is likely they will soon get tired or run out of beans as the numbers get large. The exercise then can be stopped and used to explain how bacteria cells can multiply fast.
7. Explain that fresh milk from a healthy cow contains few bacteria, but contamination during handling can rapidly increase bacterial numbers within a short time.

Bacterial multiplication



Annex 1.6: Milk preservation

How temperature and time affect bacterial multiplication in milk



Example of readings from the graph

The dotted arrows in the graph above show that after five hours:

1. Milk stored at 25°C had the number of bacteria multiplying from very few to 38,000.
2. Milk stored at 17°C had the number of bacteria multiplying from very few to 15,000.
3. Milk stored at 10°C had the number of bacteria multiplying from very few to 8,000.
4. Milk stored at 5°C (refrigerated) had very minimal bacterial growth.

Annex 2.1: Sources of milk contamination

a) The cow

i) **The exterior of the udder** can be a major source of milk contamination. Cleaning and removal of soil, bedding material and manure from the udder and flanks of the cow before milking is necessary to prevent the entry of many types of bacteria into the milk. Special care must be given to the cloths used for cleaning the udder. The re-use of cloths for cleaning and sanitizing may result in re-contamination of the udder. It is therefore recommended that separate cloths be used for cleaning and sanitizing and, if possible, each cloth should be used for one cow only. Clipping and grooming the udder and flanks makes cleaning and sanitizing more effective.

In addition to the exterior of the udder, the cow's coat may also serve as a vehicle of contamination by adding bacteria directly to the milk during milking. The coat may carry bacteria from stagnant pools of water and muddy grazing areas.

ii) **The interior of the udder.** The number of bacteria in hygienically-drawn milk varies from animal to animal and even from different quarters of the same udder. On average, clean milk drawn from a healthy udder contains between 500 and 1000 bacteria per millilitre. An infected udder usually yields milk with very high numbers of bacteria.

The fore milk contains many bacteria but numbers decrease during milking. This decrease is due to mechanical dislodgement of the bacteria particularly in the teat canal.

b) The milker

The health and personal hygiene of the milker are of considerable importance. Milkers should be in good health and their hands free from any infections. Hands with infected wounds can transfer disease-causing bacteria to milk. Wet-hand milking is also discouraged because the drips from wet hands will introduce more bacteria into milk.

Go through the rules of personal hygiene:

RULES OF PERSONAL HYGIENE

To prevent milk contamination and the spread of infection, milkers have to take reasonable care of their health and safety. The following rules of personal hygiene must be obeyed to prevent milk contamination:

1. Wash your hands frequently and clean your fingernails, particularly after using the toilet and before handling milk. This is essential to prevent the spread of infection. Finger nails should be kept short.
2. Have due regard to personal cleanliness. Bathe or shower regularly.
3. Hair should be covered during milk handling to prevent it from entering the milk.
4. All cuts and sores on the hands or fingers must be covered with waterproof dressing.
5. Personal clothing and overalls must be kept clean. Do not wipe your hands on your clothing.
6. Do not cough or sneeze over milk or milk container.
7. Do not smoke when handling milk.
8. When ill, report to hospital where you will be told of any other special precautions to take.
9. Keep your hands away from your mouth, nose, arms and any other source of contamination while handling milk.

c) The environment

Microorganisms occur in the air and in dust particles originating from manure, soil and feed. Conditions that increase the dust content in the air around the milking area will increase the microbial population and lead to increased bacterial contamination of the milk particularly where hand milking is practiced.

To reduce the dust content of the air the following practices should be avoided:

- Sweeping the milking area before milking
- Handling hay and feeds before and during milking
- Brushing the cow immediately before milking

Accumulation of dirt and dust on the walls, ceiling and bedding should also be avoided. The milking area must be kept clean, and the floors and walls should be constructed of smooth material to facilitate cleaning. Adequate lighting is needed to carry out milking and cleaning operations satisfactorily. Proper ventilation is required in the milk house to avoid moist conditions that favour growth of microorganisms. Flies, insects and rodents must be kept out of the milking house since they can transfer harmful bacteria into the milk.

d) The milking equipment

Equipment and utensils used for milking, storage and transportation of milk may act as major sources of contamination if not well cleaned. The number of utensils used to handle milk between milking and sale to the consumer should be kept at the bare minimum because the more the handling equipment used, the greater the risk of contamination.

Increased mechanization of milking, handling and storage has contributed significantly to the production of clean milk.

However, it has been shown that where milking equipment is improperly cleaned and maintained, the hygienic quality of the milk is worse than that obtained through hygienic milking and handling. It is therefore important that all utensils used for handling milk are properly cleaned and maintained.

e) *Water*

The water used in handwashing, cleaning of containers and washing the udder before milking must be potable and clean. Dirty water can be a source of contamination with disease-causing microorganisms.

Annex 2.2: Evaluating the characteristics of a good milk container

Procedure

1. Elicit from participants what they consider as characteristics of a good milk container. In order to score and rank the characteristics, ask them to list these on a flip chart, board, or on the ground. (See example below).
2. Ask them to compare plastic and metal milk containers and list down the advantages and disadvantages of each. Also ask them to outline the positive and negative effects of each type of container on milk quality.
3. Divide the participants into groups of 5 - 10 and ask them to score the characteristics using a scale of 1 to 4, with 1 representing "worst" and 4 representing "best".
4. Sum the scores for each container. The one with the highest score will be the better container.

Below is an example of a list of advantages of newly fabricated 5 and 10 litre metal cans as given by mobile milk traders in Nakuru in 2002:

1. Handy, neat and attractive (Customers are happy).
2. Easy to clean since it has a wide mouth (Their wives, who normally wash the cans, are happy).
3. Light to carry and fits well in the bread basket.
4. Milk spoilage has reduced.
5. Leak-proof (losses due to spillage reduced).
6. More durable than plastic hence handy for bicycle transport (the cans don't burst when they fall).

EXAMPLE OF DIRECT MATRIX RANKING

Question to ask: "If you were asked to pick/use only one type of container, which one would you choose? Metal or plastic?"

Characteristic	Containers	
	Metal	Plastic
Durable	4	2
Easy to clean	4	1
Fit in bread basket	4	4
Reduce milk spoilage	4	1
Light to carry	3	4
Leak proof	4	3
Neat and attractive	4	2
Wide mouth	4	1
TOTAL SCORE	31	18
	GOOD	BAD

Scale: 1 = worst
2 = bad
3 = good
4 = best

Annex 2.3: Organoleptic or sensory (sight and smell) evaluation of milk

- Prepare samples of fresh whole milk, sour milk, milk adulterated with water, milk with a foreign smell (add a small amount of kerosene or onion). See sample preparation in Annex 2.4
- Label the samples with codes and lay them on a table at random
- Ask traders to look at and smell the samples and record their observations on cards
- If there are illiterate participants ask them to try and remember their observations
- Collect the cards, shuffle them and redistribute them among the participants
- Ask each one to read the card in his/her possession
- Those who did not write should at this stage report their observations
- Write the tabulated observations on a flip chart
- Discuss the observations
- Reveal the identity of the samples
- Ask the participants to reconfirm their observations against the identified samples

Annex 2.4: Sample preparation and testing of adulteration and spoilage

Prepare milk samples at least one hour before the session and code them as described below.

Code	Example of sample preparations (500ml of each milk sample)
01	Milk adulterated with water and blended with sour milk so as to clot on both addition of alcohol and boiling, and fail the lactometer test
02	Whole milk blended with sour milk so as to clot only on addition of alcohol but not boiling
03	Whole milk blended with sour milk so as to clot both on addition of alcohol and boiling
04	Milk adulterated with salt and blended with sour milk so as to clot on both addition of alcohol and boiling and fail the lactometer test
05	Milk boiled and adulterated with water (with a burnt smell and will fail the lactometer test)
06	Fresh whole milk (un-adulterated/unaltered)
07	Milk adulterated with water, flour and blended with sour milk so as to clot on both on addition of alcohol and boiling, and pass the lactometer test
08	Fresh whole milk with some grass
09	Whole milk with a drop of kerosene (kerosene smell)
10	Milk blended with sour milk and vegetable oil so as to clot on both addition of alcohol and boiling, and pass the lactometer test

- Explain to the participants the risk/danger of tasting raw milk (one can get infected with milk-borne diseases)
- Demonstrate each test one by one (as described in Day 2 Session 2.4)
- Divide the participants into groups of 3 - 5 (Balance the literate and illiterate participants among the groups, for the purpose of recording). Ask each group to choose one person to record the observations
- Show them how to draw up a table for recording their observations as in the example below
- Give the set of samples prepared as above to each group for them to carry out the clot-on-boiling, alcohol and lactometer tests. Ask the person recording to write down their observations as in the example below.
- Discuss the observations and reveal how the samples were prepared. Compare the visual observations with the other test results. Ask if there were samples identified as good that did not pass the adulteration and spoilage tests. Explain the likely causes of the differences e.g. the alcohol test is usually more sensitive than clot on boiling test

Examples of results of some samples tested by milk traders during a training session in Murang'a District in 2002

a) Using Sight and Smell (Organoleptic) Test alone

Sample Code	Sight and Smell (Organoleptic) Test		Comment
	Smell	Sight	
01	Sour	Watery	Reject
02	Good	Good	Accept
03	Sour	White particles	Reject
04	Sour	White particles	Reject
05	Burnt	Watery	Reject
06	Good	Good	Accept
07	Sour	Flour	Reject
08	Good	Grass present	Accept
09	Kerosene	Particles	Reject
10	Sour	Oily	Reject

b) Using combination of tests

Sample Code	Organoleptic Test		Clot on Boiling Test	Alcohol Test	Lactometer Test (Density)	Comment
	Smell	Sight				
01	Sour	Watery	Clots	Clots	1.020 (water)	Reject
02	Good	Good	No clot	Clots	1.030(Good)	Reject
03	Sour	White particles	Clots	Clots	1.030 (Good)	Reject
04	Sour	White particles	Clots	Clots	>1.040(adulterated)	Reject
05	Burnt	Watery	No clot	No clot	1.021 (water)	Reject
06	Good	Good	No clot	No clot	1.030 (Good)	Accept
07	Sour	Flour	Clots	Clots	1.030 (Good	Reject
08	Good	Physical dirt	No clot	No clot	1.029(Good)	Accept
09	Kerosene	Particles	Clots	Clots	1.028 (Good	Reject
10	Sour	Oily	Clots	Clots	1.031 (Good)	Reject

Annex 3.1: Pre-evaluation questionnaire

Dear participant,

Welcome to the course on HYGIENIC MILK HANDLING. Let me first congratulate you for having spared time from your regular activities to attend this course. In order to serve you better we would like to get some background information about you. This is necessary to enable us fine-tune our training to meet your needs and those of the group as a whole. Please take a few minutes to answer the questions spelt out on this form. The purpose of this questionnaire is to learn more about your experiences, skills and interests in the dairy enterprise activities. All information given in the questionnaire will be kept confidential.

Name:_____

Name of organization
/Business or firm: _____

Type of business (circle or tick the appropriate answer)

❑ Own ❑ family enterprise ❑ private firm ❑ self-help group

❑ other
If "other" please specify:
_____

Your present position in the business:
employee/own business_____

Number of years worked with the
business/organisation/firm: _____

Your present duties:_____

Quantity of milk sold per day _____

Source _____. Sales area _____

1. How important is training to your job/business?

❑ Critical ❑ Very important ❑ Important

❑ Marginal ❑ Not at all

2. Have you previously participated in other programmes designed to improve your skills as a milk trader? ❑ Yes ❑ No

If yes, give the title of the course(s) and duration(s):

i). _____

ii). _____

iii). _____

a) What did you find useful in these courses:

_____

_____

_____

_____

b) What skills from the course have you used in your job?

_____

_____

_____

_____

c) What did you dislike about these courses?

_____

_____

_____

d) What skills from these courses have you not used in your job?

_____

_____

_____

3. What do you feel are the most important elements in successful training? *(not more than five)*.

_____

_____

_____

_____

_____

4. What do you know about milk hygiene?

_____

_____

_____

_____

5. Do you test the quality of milk at your place of work?

_____

_____

6. How do you preserve the milk?

_____

_____

7. What do you expect to learn or gain during this training?

_____

_____

8. Give reasons why you think milk testing is important in the dairy business.

_____

_____

_____

_____

_____

_____

_____

_____

Annex 3.2: Post-evaluation questionnaire

Each participant should anonymously complete the evaluation sheet below.

Participants should give a score for each aspect in the table below.

Scores should be between 1 and 5:
(1 = very poor, 2 = poor, 3 = average, 4 = good
and 5 = excellent).

Criteria for evaluation	Score
Achievement of the course objectives	
Relevance of the course content	
Relevance of the group exercises	
Relevance of the day 3 practical exercises	
Time given for training sessions	
Time given to participants' questions	
Usefulness of the training manual	
Role of the trainers	
General organization of the training	
Usefulness of the training to your business	

Below please add any other comments you would like to make:

Annex 3.3:
Sample of certificate of attendance

KENYA DAIRY BOARD

KENYA DAIRY BOARD, SOCIAL SECURITY HOUSE, BLOC
P.O. Box 30400, NAIROBI
TELEPHONE: 31650/330057/244064
CABLES: "DAIRY BOARD" – NAIROBI

(or logo of organization offering training)

Certificate Of Participation

This is to certify that

A.N. Nonymous

Participated in the HYGIENIC MILK HANDLING COURSE held at _____, *Kenya based on the Training Guidelines for Small-scale Milk Traders (dd/mm/yy) from* ___ ___ *20*___ *to* ___ ___ *20*___.

Name of Certified Trainer

Signature

Dated 15th May 2004

Notes

Notes