



# Hygienic milk handling and transportation

A training guide for milk transporters in Eastern Africa



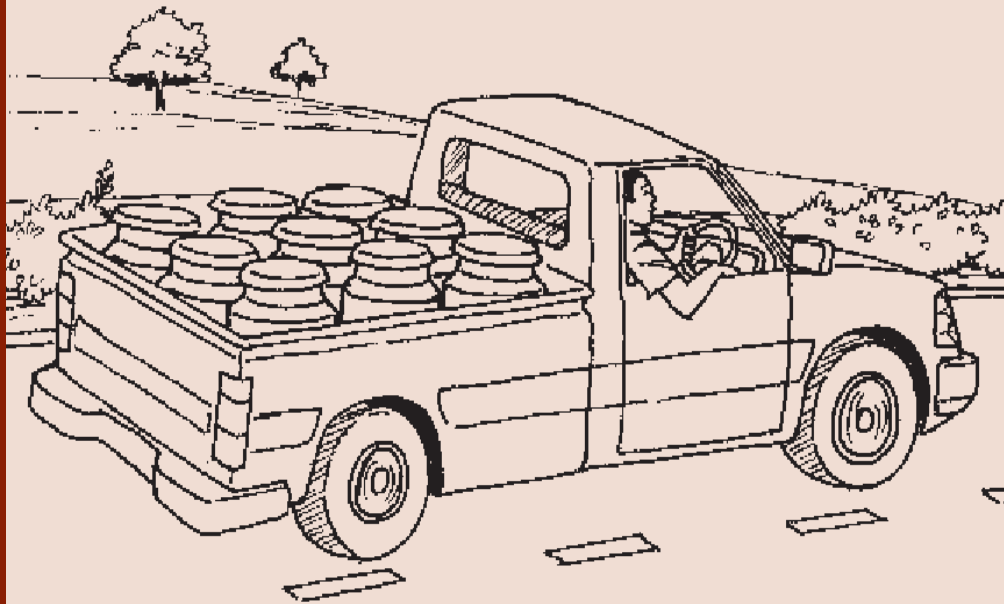
**TDB**  
Tanzania Dairy Board



A Programme of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)



**ILRI**  
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE



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MODULE 3

# Hygienic milk handling and transportation

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It is our desire and hope that the use of this guide in training programmes will contribute to the improvement of milk quality along the marketing chain and provide income generation opportunities for those involved. We look forward to continued collaboration with the above institutions as we strive to strengthen the dairy industry and cross-border trade in the region.





## Foreword

As a milk transporter, you know very well how raw milk can get spoilt very easily if it is not handled and stored properly or transported quickly. Thus, it is important for you to have adequate knowledge and skills that will enable you to practise good hygiene whenever you handle milk and transport it for sale to your customers. This will help to avoid unnecessary losses due to milk spoilage and allow you to increase your profits.

It is with this in mind that this training guide was developed through collaboration between dairy regulatory authorities in Kenya, Rwanda, Tanzania and Uganda; the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) through its Programme for Agricultural Policy Analysis (ECAPAPA) and the International Livestock Research Institute (ILRI). This document will help you become competent in basic hygienic milk handling and transportation. The aim of this guide, therefore, is to help you acquire basic knowledge and skills in the following areas:

- Hygienic milk production
- Hygienic milk handling
- Milk quality control and testing
- Hygienic milk storage, preservation and transportation
- Maintenance of milk handling and cooling equipment

The guide is designed to be used during on-site training (2-3 hours per day) at a suitable location. After the training, you will undergo a theory and practical test to evaluate your level of competence in hygienic milk handling. Upon passing the test, you will be awarded a **certificate in basic hygienic milk handling and transportation**. You will need to obtain this certificate before you can be licensed by your national dairy board or authority to operate a milk transport business.



There are similar training modules for farm level workers, milk collection centre operators, small-scale traders and milk processors that cover the minimum competencies for hygienic milk handling and processing. A module on basic marketing and dairy business management is not mandatory for licensing of small-scale dairy operatives but is optional for those who desire basic training in this area.

As dairy regulators in Eastern Africa, we recommend this guide for training and certification of milk transporters.

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Nairobi, February 2006



# HYGIENIC MILK PRODUCTION

Milk from the udder of a healthy cow contains very few bacteria. Poor hygiene introduces additional bacteria that cause the milk to get spoilt very quickly. To ensure that raw milk remains fresh for a longer time, good hygiene must be observed during milking and when handling the milk afterwards.

## Important factors that influence milk quality

### *Feeding*

A well-fed and watered animal will produce high quantities of milk of good composition. If cows are fed a diet that is low in forages and high in starch, the butterfat content may fall below 2.5%.

Thus, a good balance of forage and concentrates is important. Cows may be given feed supplements but it is important that the proper proportions be observed. Cows should not be fed with silage during milking or shortly before milking, as this will give rise to off-flavours in the milk. It is recommended that silage feed be provided two hours before milking.



*Keep your cows well-fed and healthy*

### *Health of the cow*

An unhealthy cow will feed less and produce less milk of poor quality. Cows should always be kept healthy and clean because sick animals can transmit diseases like tuberculosis and brucellosis to milk consumers. If a cow is suspected to be sick, a qualified veterinary practitioner should be contacted immediately. Milk from a cow that is being treated with antibiotics should not be sold or consumed until after the specified withdrawal period.



## Animal and udder health

### *Zoonoses*

Zoonotic diseases like tuberculosis and brucellosis can be spread to humans through milk. Cows suffering from such diseases should be referred to a qualified veterinary practitioner who will decide on the fate of the animal. Farmers are encouraged to vaccinate their animals against brucellosis. Animals should also be checked periodically for all types of contagious diseases and treated promptly in case of infections.

### *Mastitis*

Mastitis is an inflammation of the mammary glands in the udder caused by infection with disease-causing bacteria. These bacteria can also end up in the milk and result in illness if the milk is consumed. For this reason, milk from cows suffering from mastitis should not be sold or drunk. You can control mastitis by observing general hygiene and proper milking procedures. Hair at the udder should be kept short by trimming. Cows suffering from mastitis should be treated by a qualified veterinary practitioner. Milk from animals that are undergoing antibiotic treatment should not be consumed or sold until the withdrawal period has elapsed because antibiotic residues may cause allergies and drug resistance in consumers.

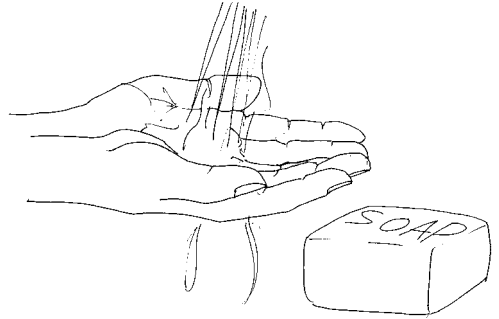
## Hygienic milking

Good hygiene and quality control needs to be observed at all stages of milk production, handling and sale. Thus, hygienic practice must begin at the farm level. Good hygiene will ensure that the milk you handle is clean and has low levels of spoilage bacteria. Below is some advice you can give to the farmers from whom you get milk, in order to ensure good quality:

- Maintain clean and healthy cows.
- Keep a clean milking environment, free of dust and mud.
- Do not milk cows if you are suffering from communicable diseases like diarrhoea or typhoid, but seek medical treatment and resume milking only when you have fully recovered.

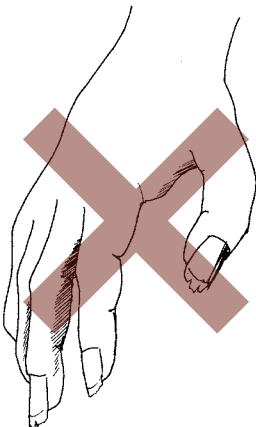


- Do not mix colostrum (the milk produced for the first seven days after calving) with normal milk.
- Wash your hands with soap and clean water before milking.
- Wash the udder with a clean cloth and warm water.
- Dry the udder with a clean dry cloth.
- Make the first draw into a strip cup to check for mastitis and throw away from the milking area even if the milk 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 veterinary practitioner.
- After every milking, dip the teats into an “antiseptic dip”.
- During milking, the milker should **not**: (a) have long nails, (b) sneeze, spit or cough, (c) smoke.



*Wash hands with soap and clean water*

*During milking, do NOT...*



*...have long nails*



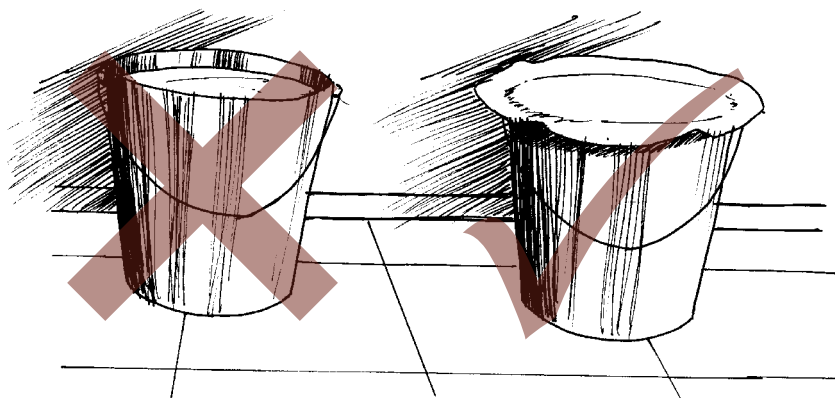
*...smoke*



*...sneeze or cough*



- Release the cow from the milking area as soon as milking is finished.
- After milking, sieve the milk through a strainer or muslin cloth to remove solid particles that may have fallen in during milking.
- Cover the milk to avoid contamination.
- Move the milk to a clean and cool area.



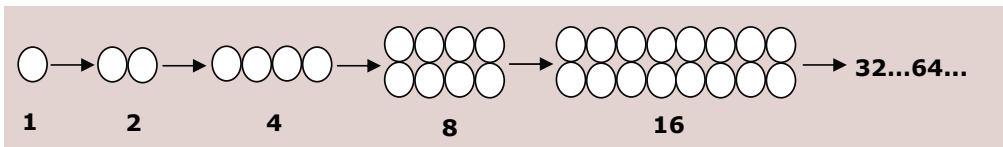
*Cover the milk to avoid contamination*



# HYGIENIC MILK HANDLING

## What causes milk spoilage?

It is important for you to know some of the things that can cause milk spoilage so that you can avoid unnecessary losses. Milk is very rich in nutrients. Because of this, the bacteria that cause spoilage can grow very quickly in milk. Bacteria cells grow by dividing into two. If milk is stored at high temperatures for a long time then the bacteria will grow and divide very fast and soon the milk will have a very high number of bacteria and thus get spoilt quickly. Also, if the milk had a high number of bacteria to begin with then it will get spoilt in a very short time.



*Bacteria cells grow by dividing into two*

Here are some guidelines to follow in order to avoid milk spoilage:

- Always handle milk in clean metal containers.
- When transferring milk between containers, pour the milk instead of scooping. Scooping may introduce spoilage bacteria.
- Do not store milk at high temperatures.
- Avoid keeping milk for a long time before it is delivered to the milk collection point or processing factory.
- Do not handle milk if you are sick. Seek medical treatment and resume your work only when the doctor says you are fit to do so.





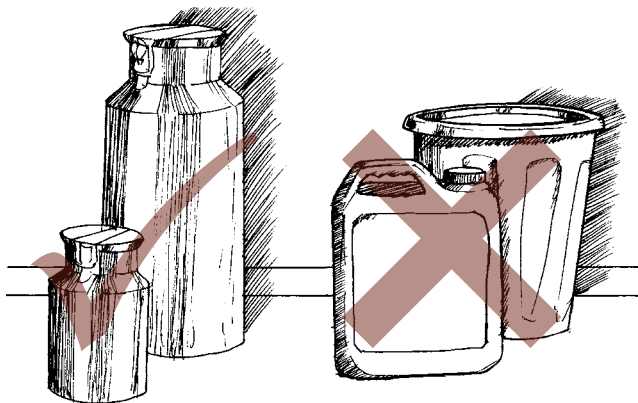
*Scooping may introduce spoilage bacteria*



*Transfer milk between containers by pouring*

## Equipment for milk handling and storage

- Always use certified foodgrade containers, e.g. aluminium, stainless steel or foodgrade plastic jerry cans designed for single use only. Metal containers are preferable because they are easy to clean and sterilize.
- Do not store milk in plastic jerry cans that previously contained paint, herbicides and other chemicals because traces of these substances can taint your milk.



*Store milk in metal containers, NOT plastic jerry cans*





## Safe use of cleaning and sanitation detergents

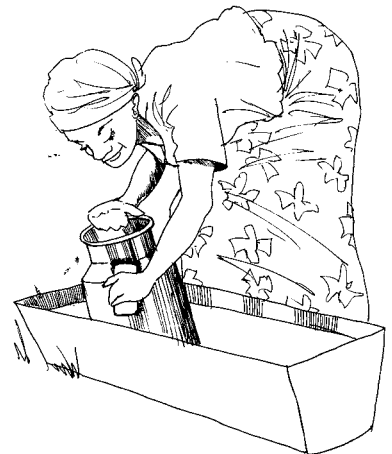
There are various types of cleaning and sanitation agents that have been specially designed to clean and disinfect milk-handling equipment. You may also use food-grade liquid soap, which is a good cleaning agent that also destroys bacteria. Always rinse your equipment properly after cleaning to prevent detergent residues from contaminating the milk.

Cleaning agents should be stored properly and handled with care because some of them may be corrosive to the skin. Always follow the manufacturer's instructions for proper use of detergents.

## Procedure for cleaning of milk containers

Before re-using the milk container:

- Pre-rinse the container soon after use.
- Thoroughly scrub the container with warm water and detergent or soap (using a stiff bristled hand brush or scouring pad).
- Rinse the container in clean running water.
- Dip-rinse the container in boiling water for at least one minute to kill germs. You may also rinse the container by pouring hot water into it.
- Air-dry the container in inverted position on a clean rack in the open.



*Scrub container with warm water and soap*

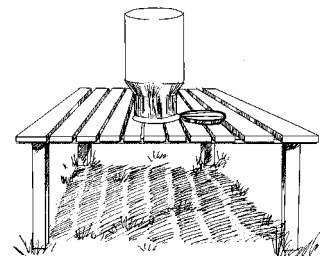


*Dip-rinse the container in boiling water for at least one minute to kill germs*

OR



*Rinse by pouring hot water into container*



*Air-dry the container in inverted position on a clean rack*



## BASIC MILK QUALITY TESTS

You can check whether the milk you collect is of good quality by carrying out one or more of the following four tests:

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

Usually during testing, only a small amount (sample) of milk from each container is assessed. If the sample doesn't pass the test, the milk from that container should not be accepted. Thus, you should advise the farmer to always handle milk in accordance with good hygienic practice.

### Organoleptic test

This test is performed first and involves using the senses to assess the milk with regard to its smell, appearance and colour. This test is quick and cheap to carry out, allowing for segregation of poor quality milk. No equipment is required, but you should have a good sense of sight and smell. Milk that cannot be adequately judged in this way is subjected to tests that are more objective.

#### *Procedure*

- Open a can of milk
- Immediately smell the milk and establish the nature and intensity of smell, if any. Do not accept the milk if it smells slightly sour or has foreign odours like paint or paraffin.
- Observe the colour of milk. Deviation from the normal yellowish-white colour indicates damage to the udder (reddish—blood, or yellow—pus).



- Check for any foreign bodies or physical dirt which may indicate that the milking and handling were not done hygienically.
- Touch the milk container to feel whether it is warm or cold. This indicates how long milk has taken since milking (if not chilled thereafter) and will influence the lactometer test for adulteration (see below).

### *Judgement*

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
- Bacterial taints
- Chemical taints or discolouring
- Advanced acidification or souring

Marked separation of fat may be caused by:

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

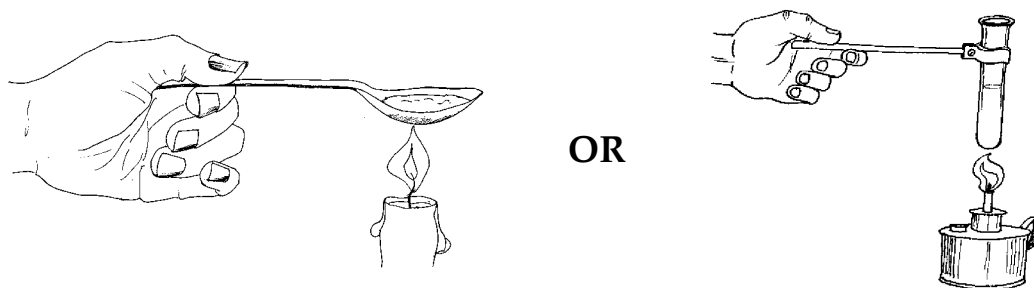
### **Clot-on-boiling test**

This test is quick and simple. It allows for detection of milk that has been kept for too long without cooling and has developed high acidity, or colostrum milk that has a very high percentage of protein. Such milk does not withstand heat treatment hence this test could be positive at a much lower acidity.



### *Procedure and judgement*

- Boil a small amount of milk for a few seconds in a spoon or other suitable container.
- Observe immediately for clotting.
- The milk will be rejected if there is visible clotting, coagulation or precipitation.



*Carrying out the clot-on-boiling test*

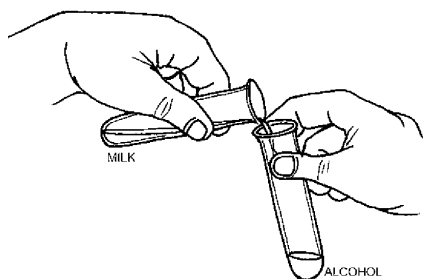
### **Alcohol test**

The test is quick and simple. The specific type of alcohol used is known as “ethanol”. This test is more sensitive to lower levels of acidity and can therefore detect bad milk that may have passed the previous two tests. It also detects milk that has kept for long without cooling, colostrum or milk from a cow with mastitis. Because this test is quite sensitive, milk that passes this test can keep for some hours (at least two hours) before it goes bad.

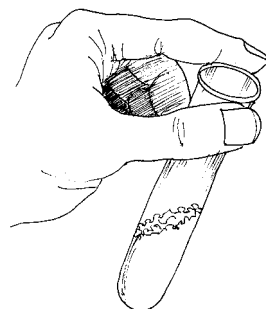
### *Procedure and judgement*

- Use a syringe to draw equal amounts of milk and 70% alcohol solution into a small tube or glass cup (such as those used to administer medicine to children).
- Mix 2 ml milk with 2 ml 70% alcohol and observe for clotting or coagulation.
- If the tested milk sample coagulates, clots or precipitates, the milk will be rejected.



*The alcohol test*

Mix 2 ml of milk with 2 ml of 70% alcohol



If the milk coagulates, it fails the test

## Lactometer test

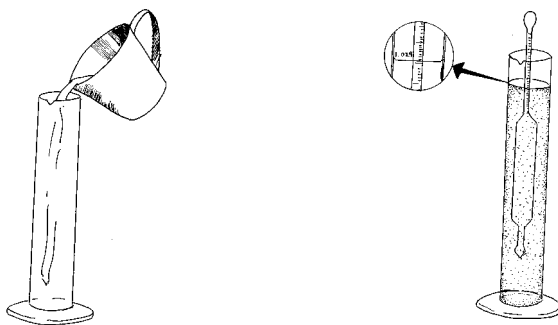
Some unscrupulous milk suppliers adulterate milk with added water to increase the volume or added solids to make it look thicker. Addition of anything to milk can introduce bacteria that will make it spoil quickly. Adulteration of milk is cheating from the buyer of that milk and is therefore illegal. The lactometer test is used to determine if the milk has been adulterated with added water or solids.

This test is based on the fact that milk has a heavier weight or density (1.026–1.032 g/ml) compared to water (1.000 g/ml). When milk is adulterated with water or other solids are added, the density either decreases (if water is added) or increases (if solids are added). If milk fat (cream) is added to milk, the density decreases. The equipment used to measure milk density is called a lactometer. Most lactometers are usually marked from “0” (representing density of 1.000 g/ml) to “40” (representing density of 1.040 g/ml).

### Procedure

- Leave the milk to cool at room temperature for at least 30 minutes and ensure its temperature is about 20°C.
- Stir the milk sample and pour it gently into a 200 ml measuring cylinder or any container deeper than the length of the lactometer.
- Let the lactometer sink slowly into the milk.
- Take the lactometer reading just above the surface of the milk.





*Equipment used for determining the milk density*

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.
- For each °C below calibration temperature, subtract 0.2 lactometer “degrees” (°L) from the observed lactometer reading.
- Note: These calculations are done on the lactometer readings (e.g. 29 instead of the true density of 1.029 g/ml).

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

Milk temperature °C	Observed lactometer reading °L	Correction °L	True lactometer reading °L	True density g/ml
17	30.6	- 0.6	30.0	1.030
20	30.0	nil	30.0	1.030
23	29.4	+ 0.6	30.0	1.030

### *Judgement*

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



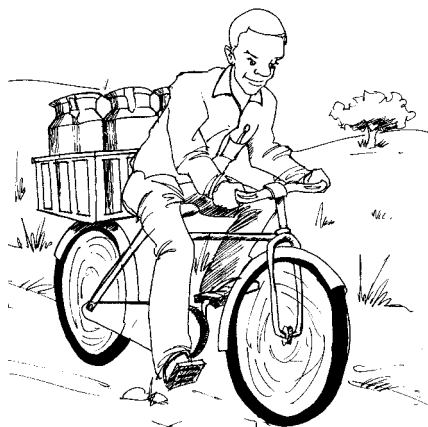
# HYGIENIC MILK STORAGE, PRESERVATION AND TRANSPORTATION

## Appropriate milk storage vessels

Here are some points you should follow in order to ensure that you maintain the good quality of your milk during storage and transportation and avoid losses due to spoilage:

- All containers used for storing milk should be clean and made of food-grade material like stainless steel or aluminium. These are also easy to clean and disinfect.
- The premises used for storing milk should be clean, pest-free, well ventilated with adequate lighting, and protected from dust, rain and direct sunlight.
- Milk should not be stored in the same room with agricultural produce (e.g. onions) or chemicals like paint or paraffin, which can taint the milk with off-odours.
- Transport milk as quickly as possible.
- Delays in transporting milk to a cooling centre or processing factory can cause even good quality milk to spoil. Milk should reach a milk cooling centre or processing factory within three hours after milking.

## Appropriate milk transportation equipment



*You should use approved food-grade containers to transport your milk*

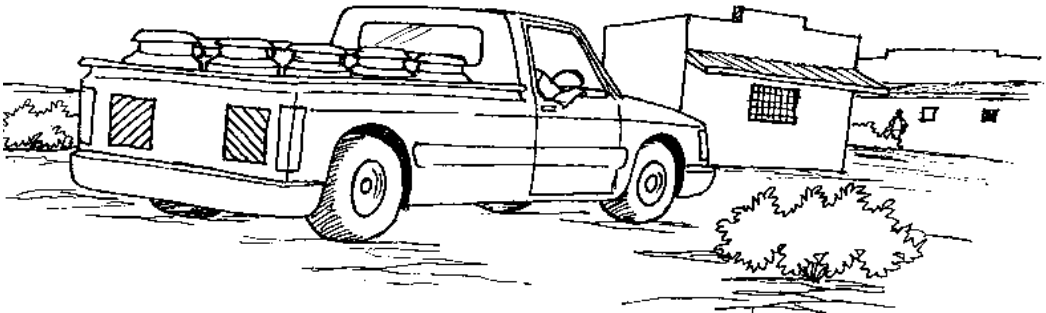
For small quantities of milk, the ideal milk transportation equipment would be metal milk containers made from stainless steel or aluminium. Such containers are made from approved food-grade material and are also durable, easy to clean and sanitise. The milk container should have a lockable lid to prevent spillage.



Transport of larger quantities of milk requires insulated bulk tankers. These are more expensive and require special additional equipment like pumps which should also be thoroughly cleaned by the “cleaning-in-place” (CIP) method.

## Cleaning and sanitation of milk transportation equipment

- Milk transportation equipment should be properly cleaned and sanitized because milk provides an ideal medium for growth of bacteria.
- Select detergents and sanitizers that will not corrode the material from which the equipment is made.
- Cleaning and sanitizing are complementary processes; either of them alone will not achieve the desired result, which is to leave the surfaces of the equipment as free as possible from milk residues.
- For details of how to properly clean milk transportation equipment, refer to “*Procedure for cleaning of milk containers*” in an earlier section of this guide.





# MAINTENANCE OF MILK HANDLING AND COOLING EQUIPMENT

## Maintenance of milk coolers

For best use of milk cooling equipment, it is important to adhere to the following:

- Avoid opening the milk cooler unnecessarily to prevent warm air from entering it.
- Ensure that the evaporator is well ventilated so that the cooler functions properly.
- Ensure that the cooler always has enough refrigerant in the system.
- Connect the cooler to a voltage stabiliser to provide for a constant supply of electricity.
- Set up schedules for cleaning and preventive maintenance and ensure that they are followed. Any mechanical repairs should be carried out by a trained technician.
- Have a standby generator in case of power failure.

## Characteristics and maintenance of milk cans and bulk tanks

Milk cans should be maintained by proper handling and adherence to regular cleaning and sanitation schedules. Cleaning, sanitizing and rinsing of bulk tankers and accessories like pumps should be done immediately after emptying the milk. The valves, hose connections and lid of the tanker should be covered to prevent the milk from being contaminated with dirt.

## Importance of carrier maintenance

Milk transport vehicles often get dented during loading and offloading. Milk cans are designed with rims at the bottom to resist deformation during rough handling. To



protect the carrier vehicle during loading, you can use a set of loading conveyors. It is also advisable to partition pick-up trucks with double deckers for greater stability of the loaded vehicle. The carrier vehicle should be serviced regularly and undergo preventive maintenance.

## Legal requirements for milk transportation vessels and carriers

The legal requirements for milk transportation are likely to vary from country to country. However, you can contact your national dairy regulatory agency to find out the specific licences, certificates and permits that you will need. Documents must be valid and are likely to include:

- Certificate of registration with the national dairy board or dairy authority
- Certificate from the national transport licensing board
- Public health certificate
- Driving licence
- Road licence
- Motor vehicle insurance certificate

You should also follow the code of hygienic practice and any other laws that relate to milk hygiene, e.g. approved milk containers, use of chemical preservatives, medical examinations for milk handlers, environmental management and waste disposal, etc.

## Tips on maintaining milk quality during transportation

In order to ensure that good milk quality is maintained during transportation, here are some points you need to follow:

- All personnel involved in milk transport (drivers, turn boys and porters) should observe good personal hygiene and wear clean protective clothing whenever they handle milk.



- Use only approved foodgrade containers—preferably metal—to ferry the milk.
- Keep the milk containers and transport vehicle clean at all times.
- Keep milk out of direct sunlight and avoid storing it for long periods at high temperatures.
- Ensure the transport vehicle is well covered to protect milk containers from rain and dust.
- Deliver milk to the cooling centre or processing plant as quickly as possible, ideally within three hours after milking.
- If using a bulk tanker, maintain the temperature of the milk at less than 10 degrees Centigrade.
- Avoid excessive shaking of the milk during transport. You can achieve this if you minimize the head space when filling the containers.
- Avoid formation of foam (air) when filling the milk containers because air can cause milk spoilage due to oxidation.
- Do not carry animals and passengers on the transport vehicle while it is being used to ferry milk.
- Always keep the milk transport vehicle clean and well maintained.



## **REMEMBER!**

- ➔ **Good hygiene practice in milk handling and transportation is the key to milk quality and safety.**
- ➔ **Cooling milk will slow down the growth of spoilage bacteria and prolong the milk's shelf life.**
- ➔ **Milk should be transported as quickly as possible to the milk cooling centre or processing factory to avoid spoilage.**
- ➔ **But milk that already has many bacteria in it will not keep for long, even when cooled.**
- ➔ **Good milk quality means good prices for your business.**



# APPENDIX

## Curriculum and minimum competencies for milk transporters

Target Group	Course Title	Type of course & location	Course units (sessions)				
Milk transporters	Hygienic milk production, handling and transportation	On-site	Milk production				
Subunits	Objectives (Competency sought)	Course content	Duration		Training method/ materials	Evaluation	Award
			Theory	Practical			
1. Hygienic milk production	Milk transporters knowledgeable and on factors influencing quality of milk at farm level	Factors influencing milk quality - Feeding - Animal health - Milking practices	1 hour		Lectures Discussions Questions & answers Participatory adult learning techniques	End of course theoretical written or oral test  End of course practical test	Pass or fail
		Animal and udder health - zoonoses - mastitis	45 min				
		Hygienic milking	45 min	2 hours			
2. Hygienic milk handling	Milk transporters knowledgeable and skilled in hygienic milk handling	Factors contributing to milk spoilage	½ hour		Lectures Discussions Questions & answers Participatory adult learning techniques		
		Types of milk handling & storage equipment	½ hour				
		Cleaning and sanitation agents	½ hour				
		Cleaning & sanitation of equipment	½ hour	1 hour			
3. Milk quality control and testing	Milk transporters knowledgeable and skilled in milk quality control and testing	- Sight and smell (organoleptic) - Alcohol - Clot on boiling - Lactometer	1 hour	3 hours	Lecture Discussion Demonstration Hands-on testing		
4. Hygienic milk storage, preservation and transportation	Milk transporters knowledgeable on various hygienic milk storage, preservation and transportation methods	Appropriate milk storage vessels	½ hour		Lecture Discussion Demonstration Overhead projector Flip chart Chalkboard Felt pens		
		Appropriate milk transportation equipment	½ hour				
		Cleaning and sanitation of milk transportation equipment	½ hour	2 hours			
		Appropriate milk preservation methods	½ hour	2 hours			
5. Maintenance of milk handling and cooling equipment	Milk transporters knowledgeable on maintenance of milk coolers, milk handling equipment and transportation carriers	Maintenance of milk coolers	½ hour		Lecture Discussion Demonstration Overhead projector Flip chart Chalkboard Felt pens		
		Characteristics and maintenance of milk cans and bulk tanks	½ hour				
		Importance of carrier maintenance	½ hour				
		Legal requirements for milk transportation vessels and carriers	½ hour				
			9.5 hr	10 hr	End of course theoretical (½ hr) and practical (1 hr) test	Certificate in basic hygienic milk handling and transportation	

On-site training involves training sessions of 2–3 hours per day at a trader's premises/community centre over a period of 1–2 weeks to cover the 40-hour module.





