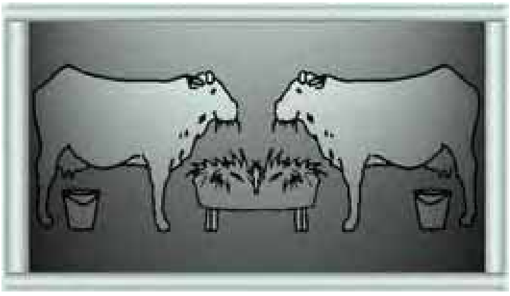

Small-scale

dairy farming manual

Vol. 1

Regional Dairy Development and Training Team
for Asia and Pacific
Chiangmai, Thailand

Regional Office for Asia and the Pacific
Bangkok, Thailand

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1993

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Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 1

Milk Composition - Part 1

Technical Notes

Introduction (5 - 8)

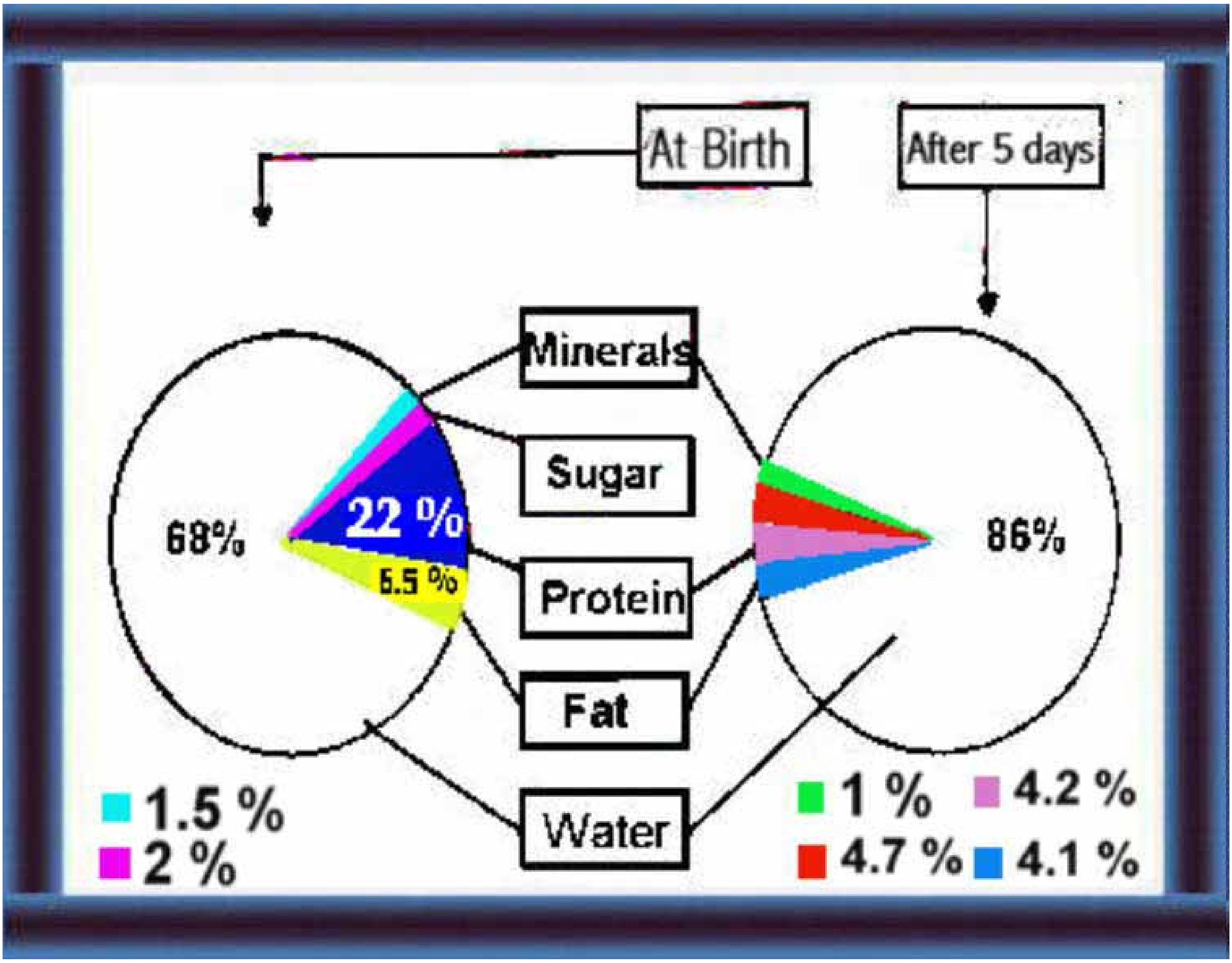
The following notes refer to milk from cows.

**Milk is an excellent food for human beings because it contains essential
nutrients which are easily digestible. Milk provides both energy and
essential body-building compounds.**

**Milk is an all-round food stuff and helps give a balanced diet.
as milk supplies protein, calcium and phosphorus rather than energy,
it is a good supplement to food-stuffs with high energy and low protein,
calcium and phosphorus content.**

(Numbers in brackets refer to illustrations in the Extension materials of the Manual)

MILK COMPOSITION



Extension Material

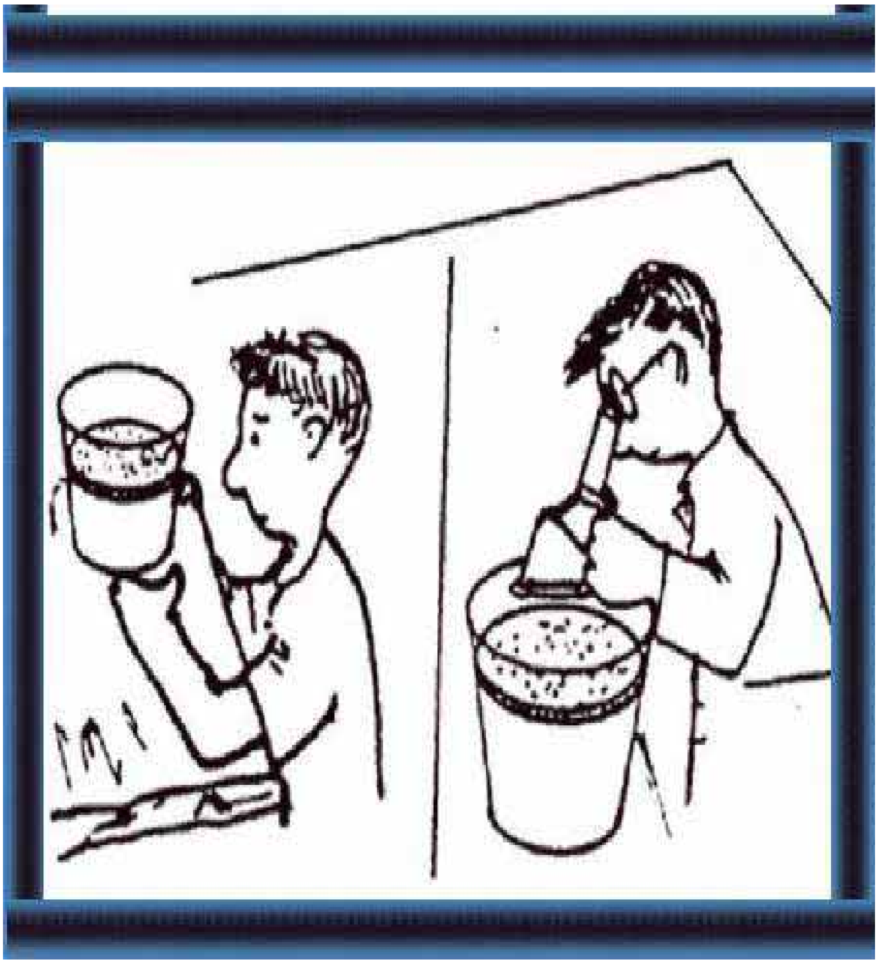
What should you know about Milk Composition?

Why should you drink milk ?
(5 - 8)

1. You should know about the **nutrients** in milk.

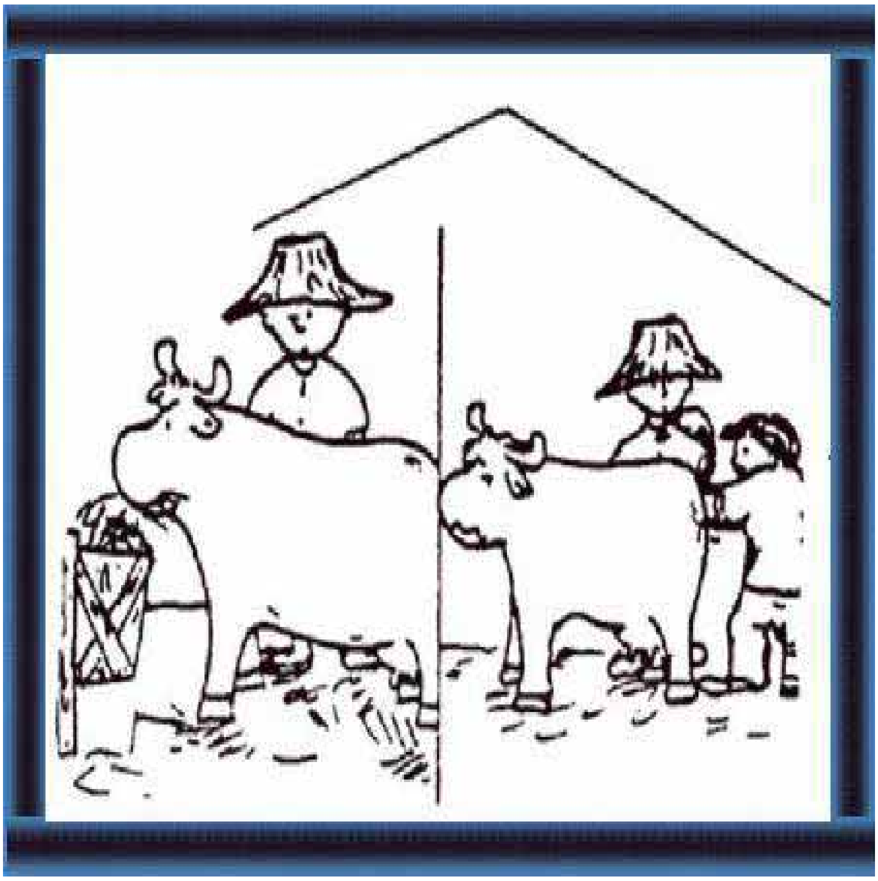
What is milk like ?
(9 - 12)

2. You should know what good quality milk:
looks like
smells like
tastes like.



What does milk contain ? (13 - 46)

3. You should know milk contains: some things you can see; some you can not.

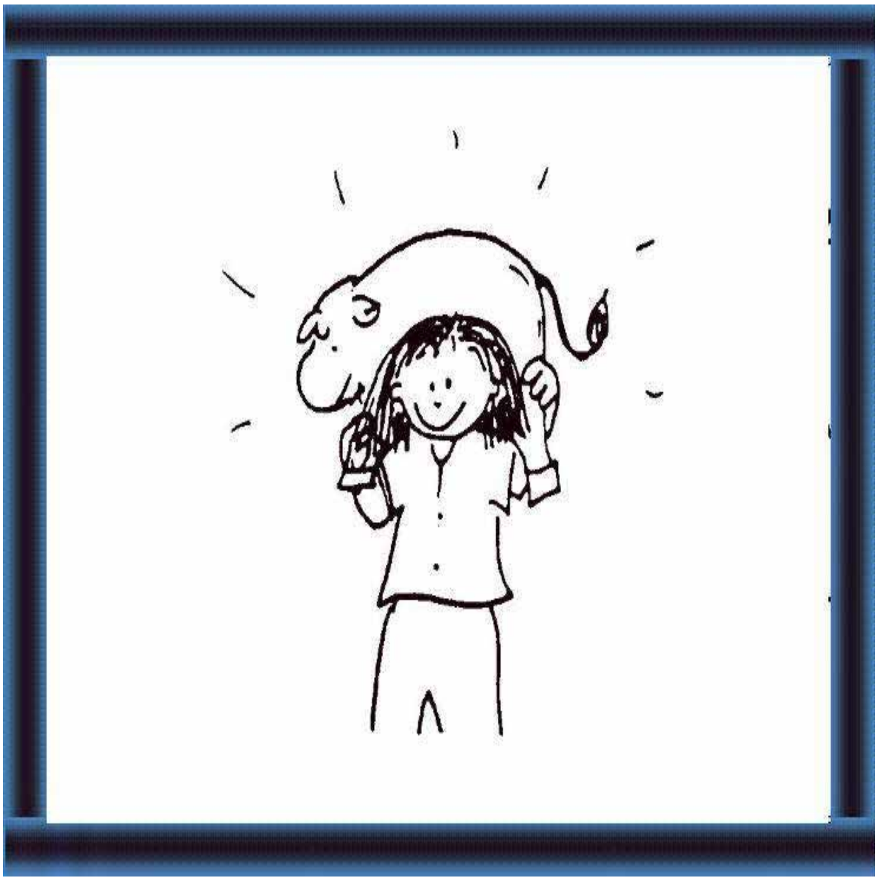


What affects milk composition ? (47 - 58)

4 You should know: environment breeding affect milk production. things you cannot see (without microscope)

Note: pages 2-15 use cow's milk as an example.

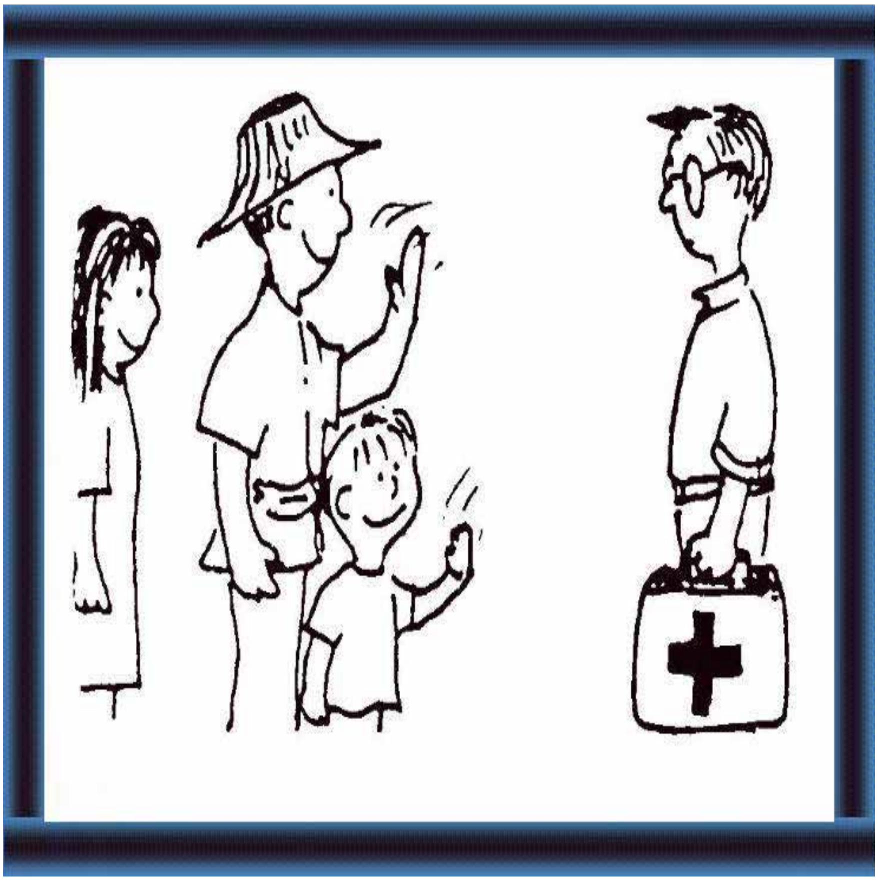
Why should you drink milk ?



Milk contains substances which:

5 -give energy

6 - build your body



7 - keep you healthy

8 Milk does not contain much:

-iron;
-vitamin C and D.

You need to give food which contains these substances especially for infants and young children.

Properties of Milk

State and Colour (9-10)

Milk is yellowish -white liquid which is secreted from mammals to feed
the new-born.

Freezing Point (11)

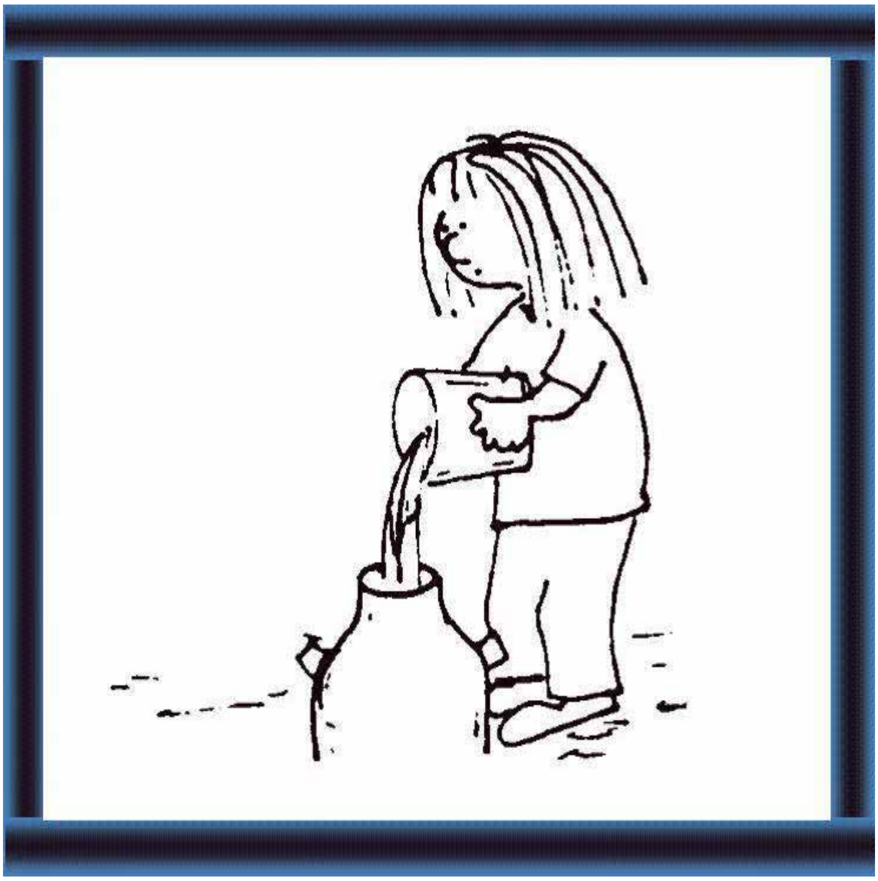
The freezing point of milk is not dependent on fat and protein content. Salt is the decisive factor together with lactose. These substances are completely dissolved. As the quantity of salt and lactose in the milk is almost constant, the freezing point will be constant too (between -0.53 and --0.55 C). Deviation from this show that the composition of the milk is abnormal and that probably been adulterated.

Specific Gravity (Density) (12)

The specific gravity of milk measured at 15ºC or 20ºC is normally 1.028 - 1,033 kg/litre. The specific gravity depends on the protein and fat content. The specific gravity of fat is 0.93, solids-non-fat, 1.6 and water 1.0 kg/litre.

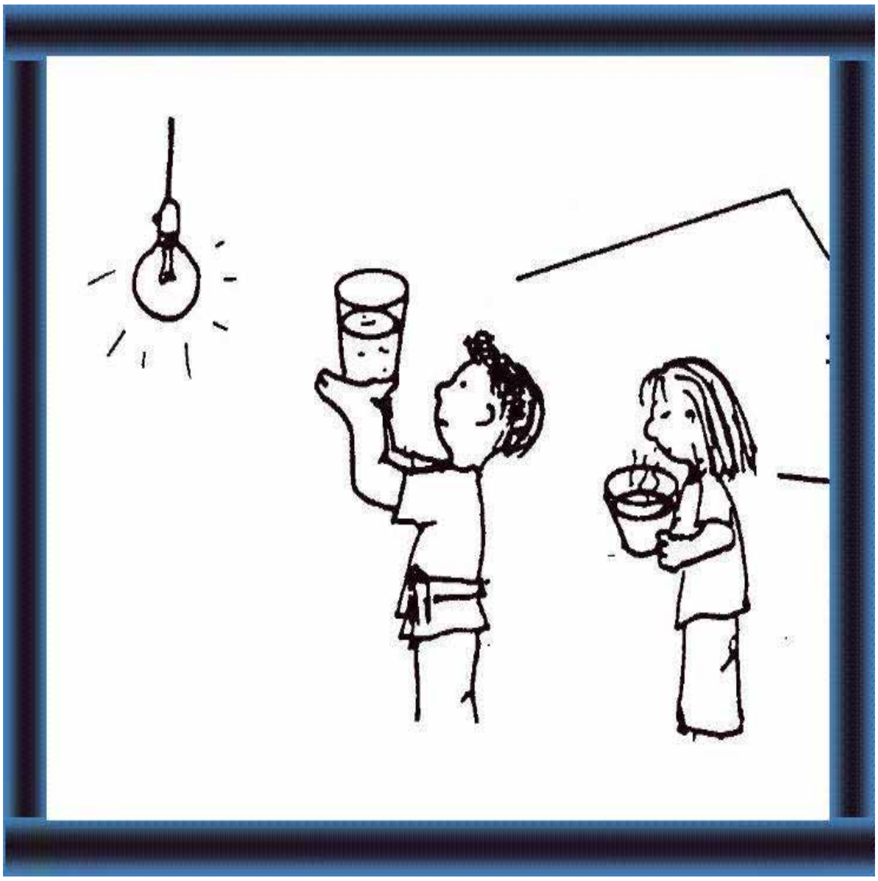
If the milk is mixed with air, by pumping for example, the specific gravity will be lower. The specific gravity of the milk collected by a tanker is usually between 1.015 and 1.020 kg/litre. If the specific gravity is lower than 1.01 kg/litre, this may indicate extraneous water (water content higher that normal).

What is milk like ?



9 Fresh milk is

a liquid.



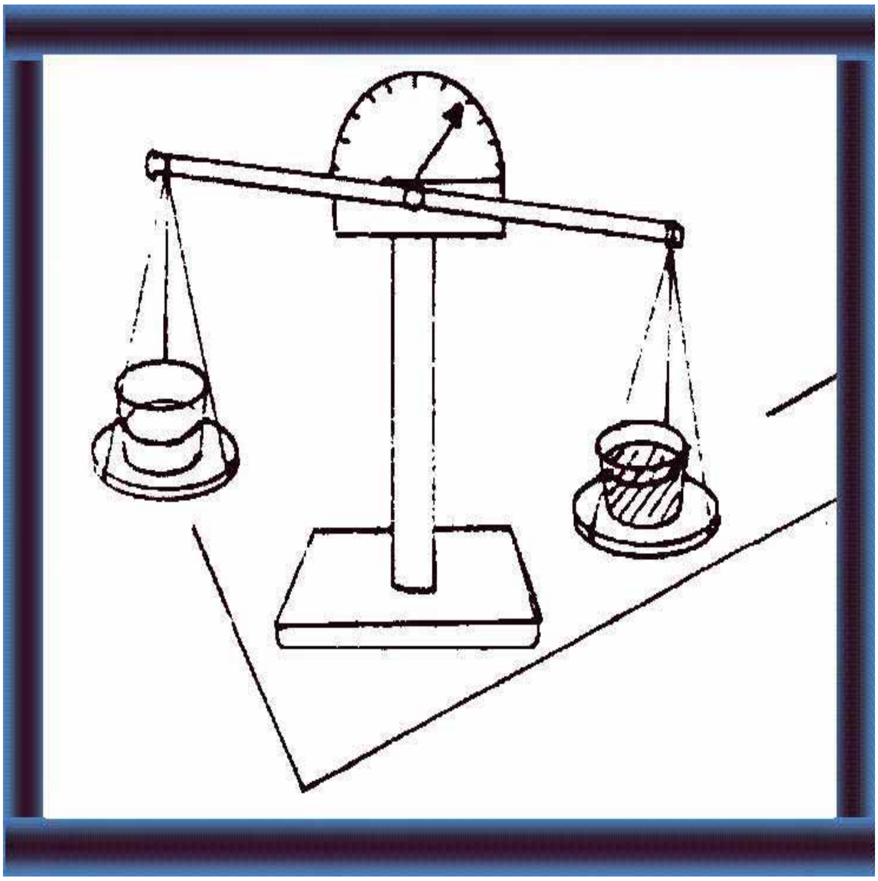
10 It has a:
yellowish-
white
colour and

pleasant,
sweetish
smell.

11 If you
make milk
cold, it will
freeze

at a slightly
lower
temperature

than water.



12 Milk is

slightly
heavier
than water.

Constituents of Milk (13)

In general, milk consists of water, fat, protein, lactose, minerals, vitamins and enzymes. The composition of milk depends on the kind of mammal, feeding (type and quantity of fodder), cycle of lactation and number of lactations.

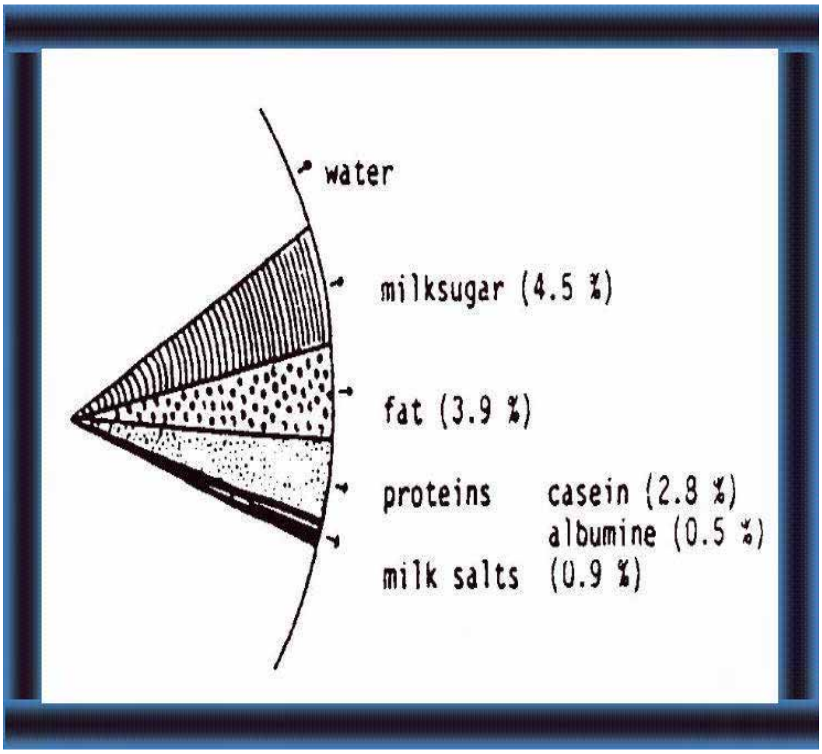


Figure 1: Composition of Milk

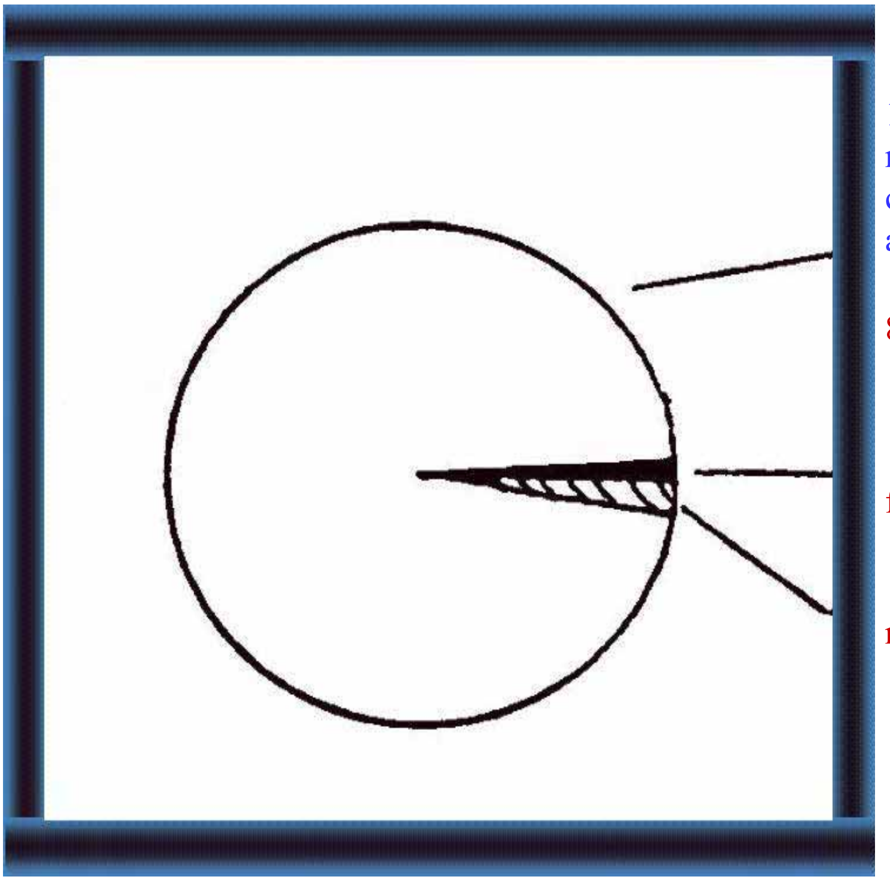
Milk fat (14 - 16)

Milk fat is present in milk in the form of very small globules. The globules are dispersed in the plasma. they vary from 0.1 to 15.0 um. but differ markedly between species and breeds of milch animals. Ranking the milk of the four important species of domestic livestock by average size of globule gives: buffalo milk, cow milk, goat milk and ewe milk. Comparing breeds, milks with high fat content will usually contain larger globules than milks with a low fat content. The globules at the beginning of lactation are comparatively large. Towards the end of the lactation, there is a tendency for the animal to produce small globules.

Percentages of milk fat are:

cream (3.5 - 5%)
skim milk (95 - 96.5%).

What does milk contain ?

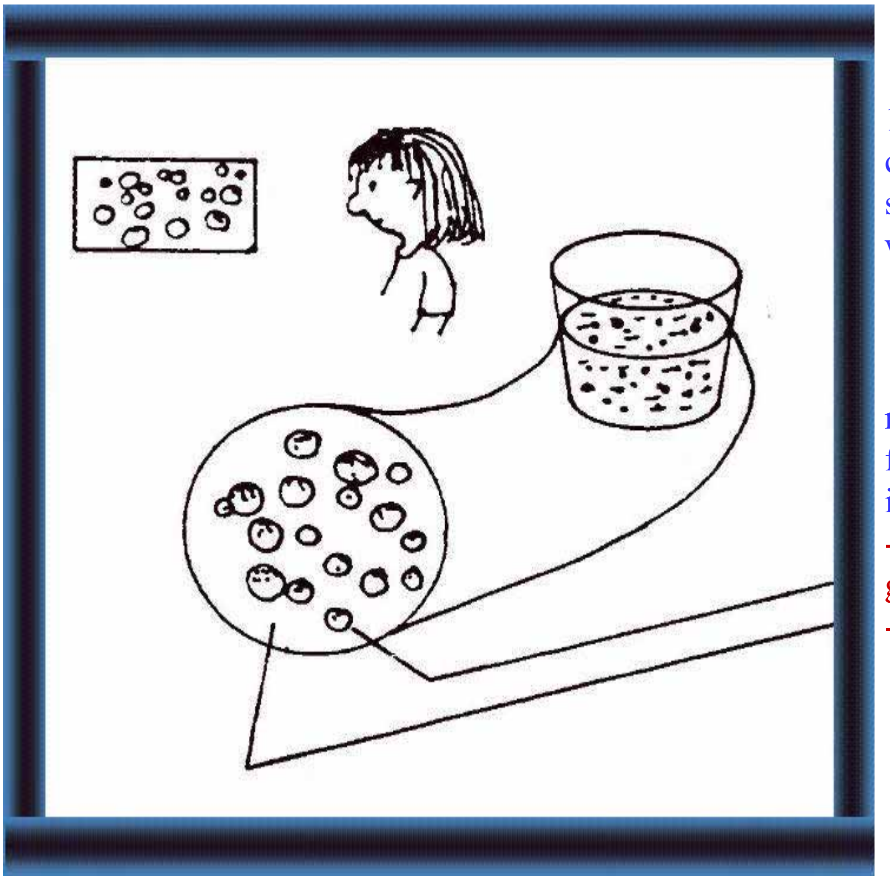


13 Whole milk from cows contain approximately:

87% water

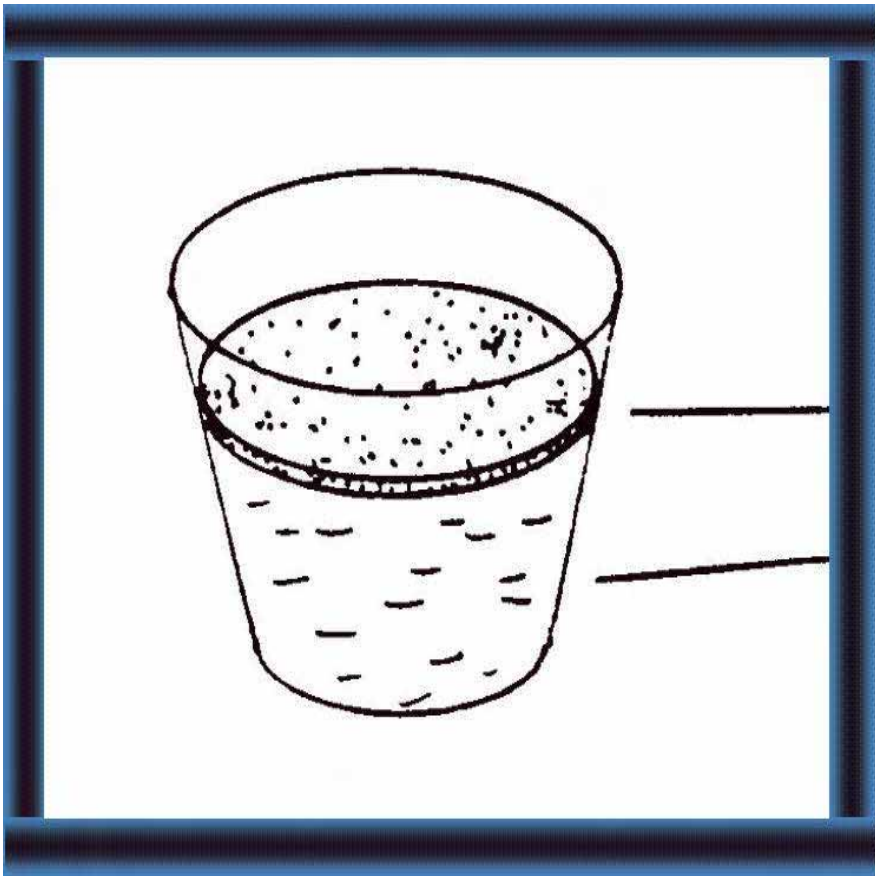
4% butter fat

9% solids-not-fat



14 Milk contains some things we can see.

Fats
There are many small fat globules in milk.
-fat globules
-skim milk



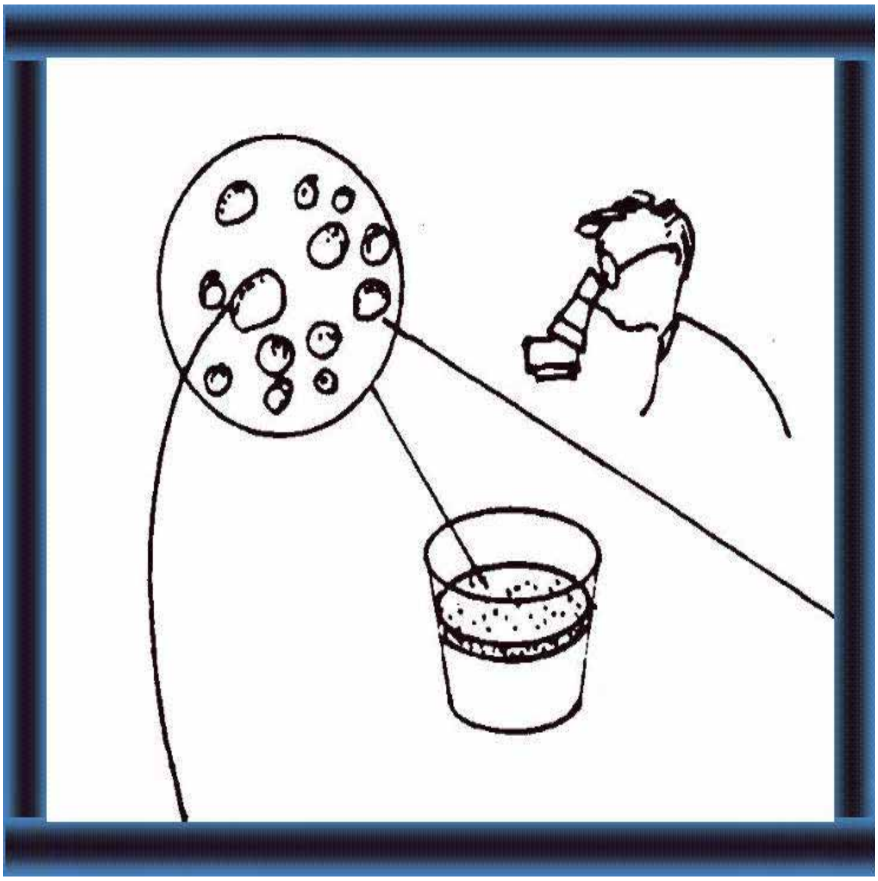
15 If you leave milk to stand, yellowish fat or cream (3.5 - 5%) rises to the top of bluish-white skim milk.

Milk fat (continued)

Each globule is surrounded by a membrane consisting of a thin layer of proteins and phospholipids and a number of other compounds. The membrane protects the globlule, preventing it from joining other globules. Without such a protective layer, the globules would unite and form large masses of fat. Some of the copper contained in the milk and about three-quarters of the phosphatase enzyme is concentrated in the membrane. (18-19)

The membrane also protects the fat from being broken down by the enzymes present in the milk and thereby causing rancid flavour.

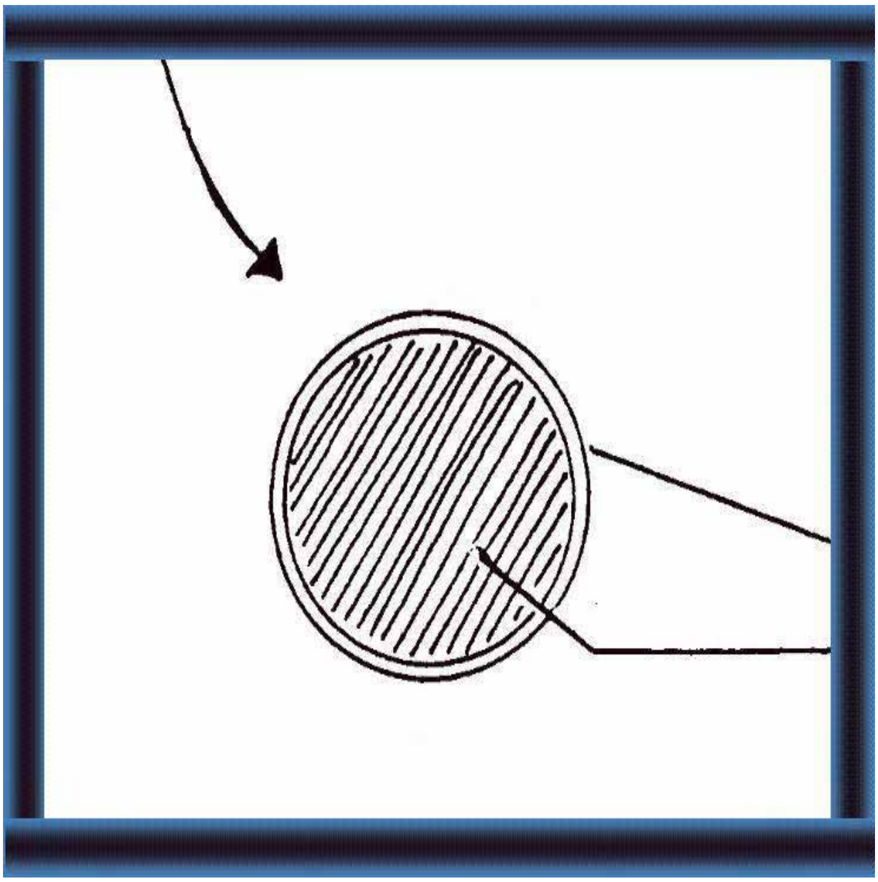
The enzyme that causes this chemical reaction (catalysis) is called Lipase.



16 Fat is not soluable in water.

If you look closely, you can see

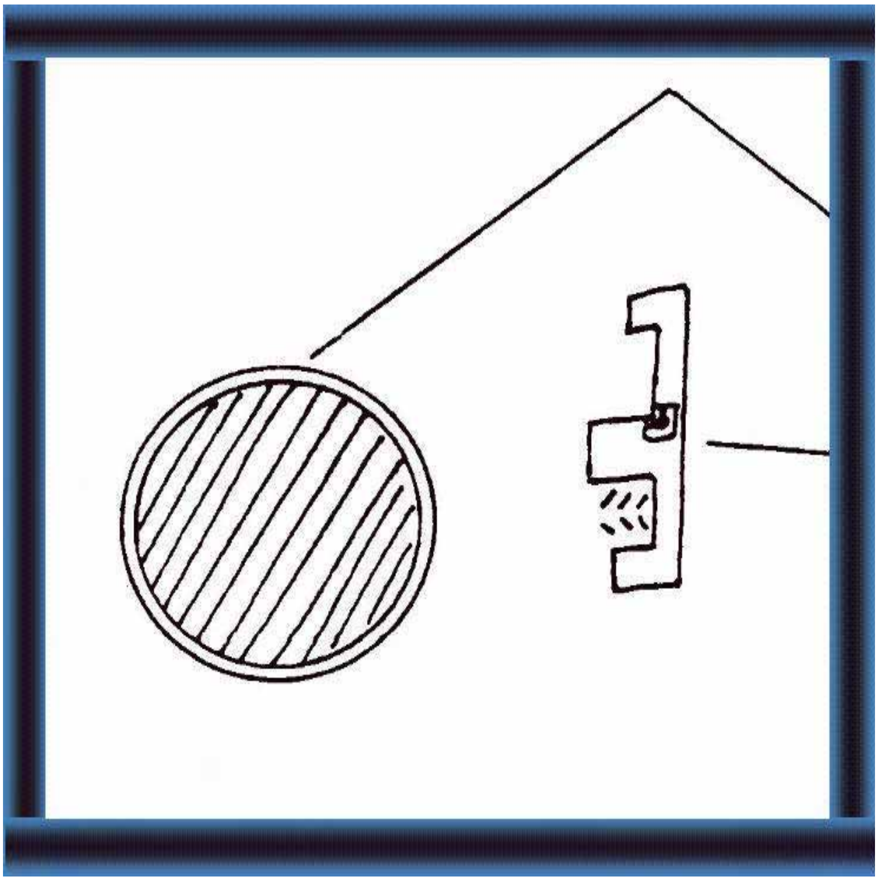
small globules of fat.



17 If you look at a fat globule through a microscope, you can see:

a membrane on the outside

fat on the inside



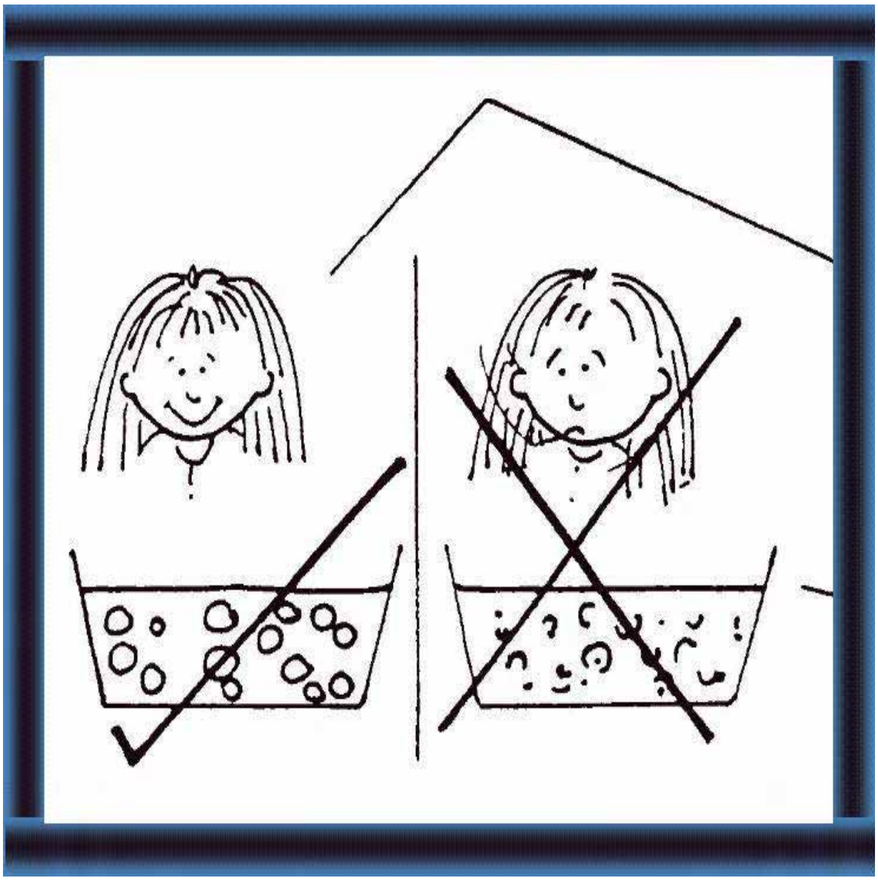
18 The membrane protects the fat from

enzymes in the milk

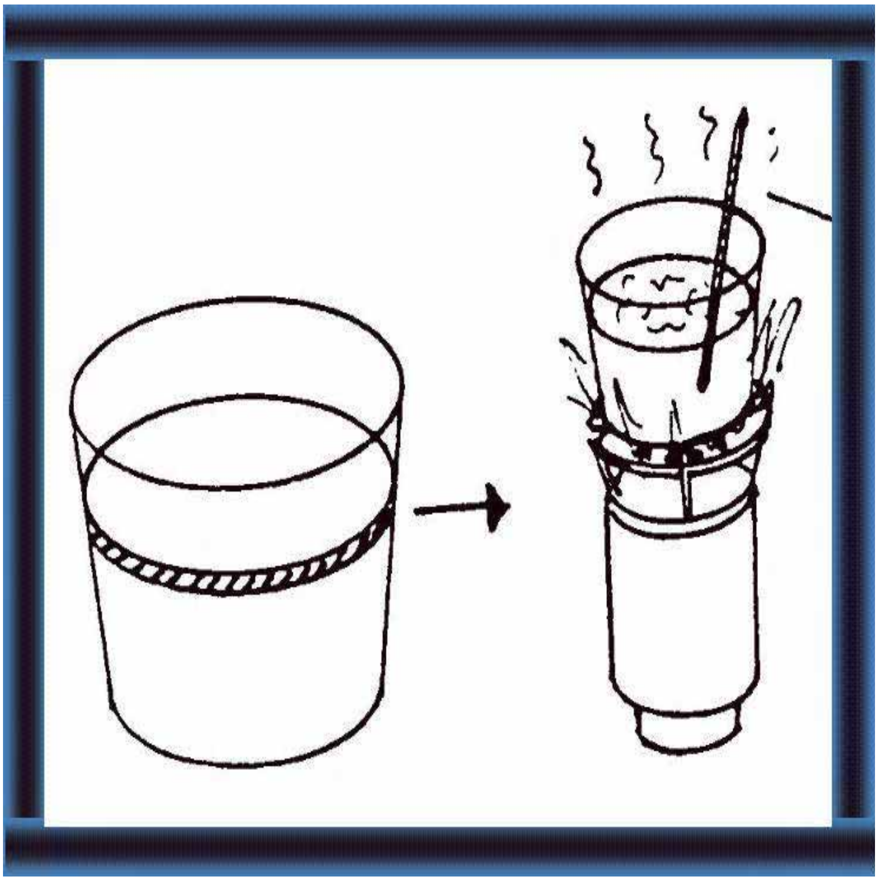
which break down fat and cause bad taste.

19 Gentle treatment of milk is important

to protect fat globules. Large globules rise faster from the skim milk than small ones.

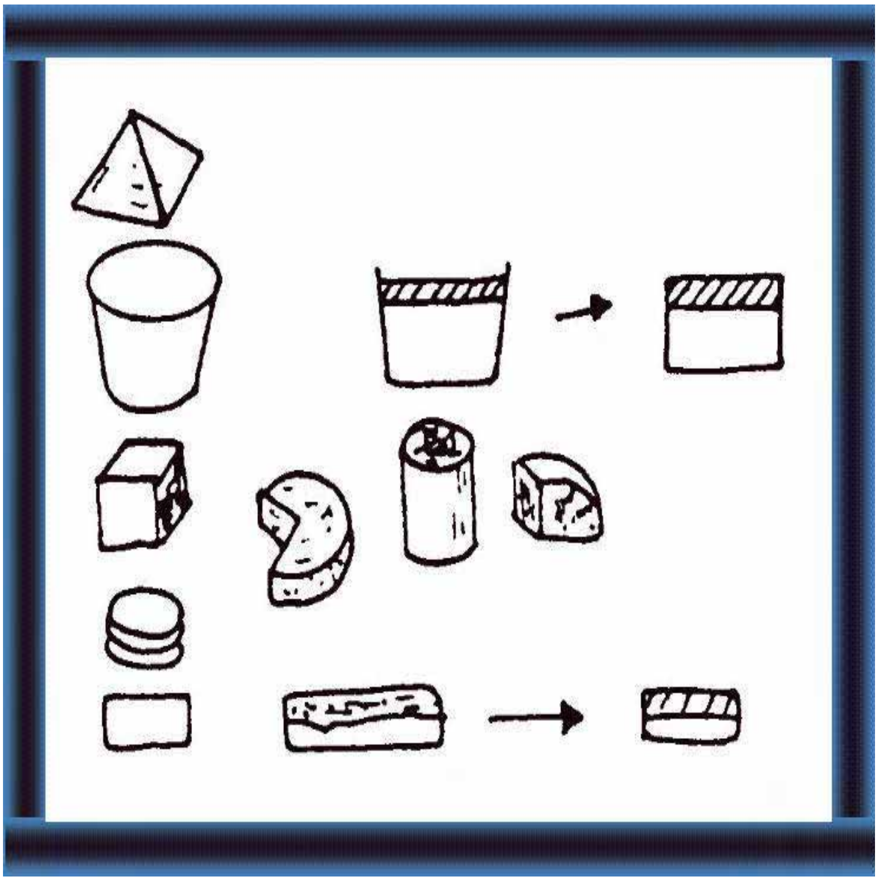


Rough treatment breaks down the membrane that protects fat.



20 Milk fats melt at between 18-40º C.

21 Milk products contain different amounts of



fat:

- **cream**
- **cheese**

10-60%

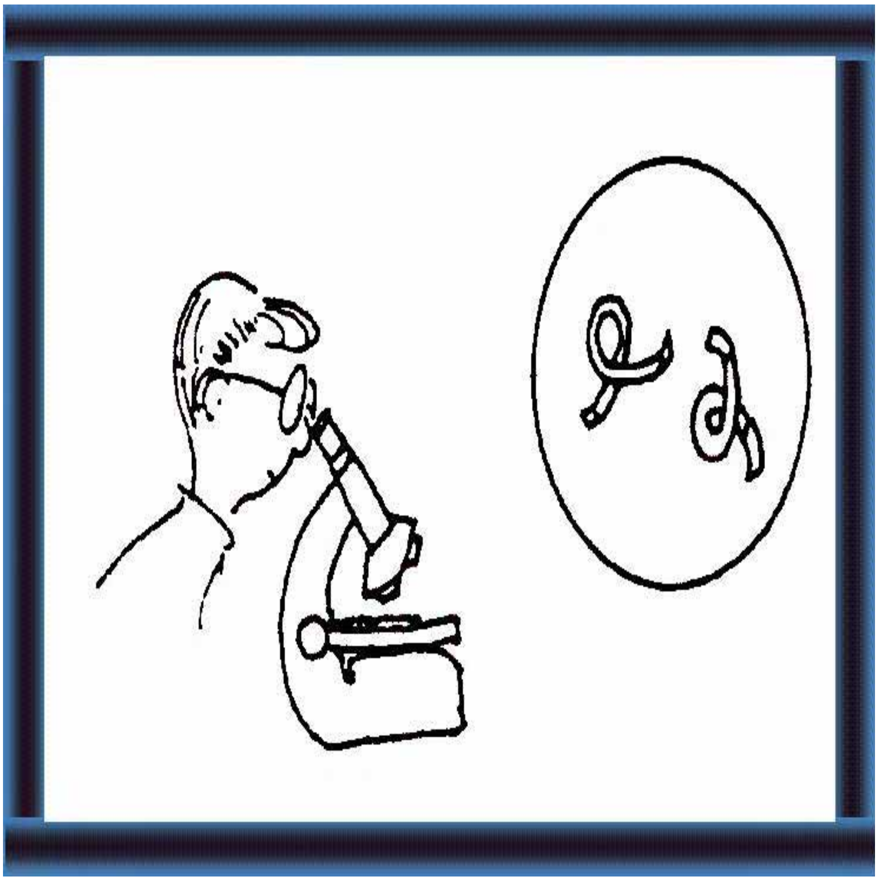
- ghee
- butter

80-90%

Protein (23-25)

Protein is built up of amino acids. There are about 20 different amino acids of which 8 are essential for adults and 9are essential for children. These essential amino acids must be found in your food every day so that your body could build up and maintain skin, hair and muscles. Milk protein is rich in these amino acids and has, therefore, a very high nutritional value and a high coefficient of utelization compared to proteins from vegitable food, for instance soya.

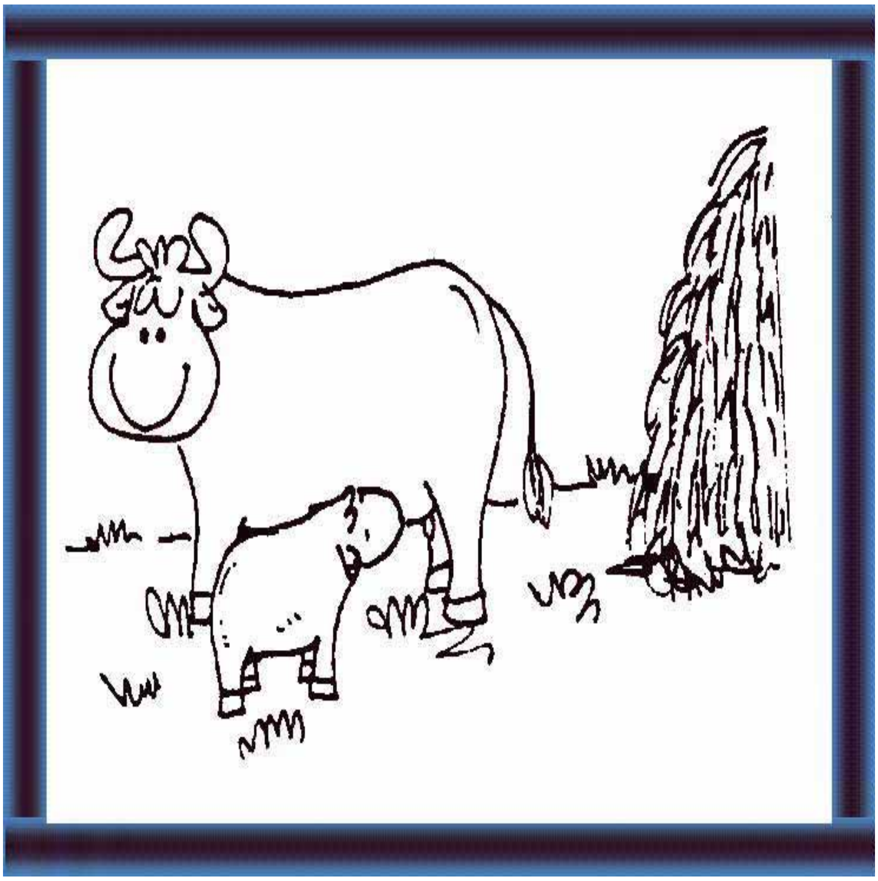
1 glass of fresh milk (200 cc) provides about 9% of an adult's daily protein requirement and about 8% of child's.



22 Milk also contains some things we cannot see.

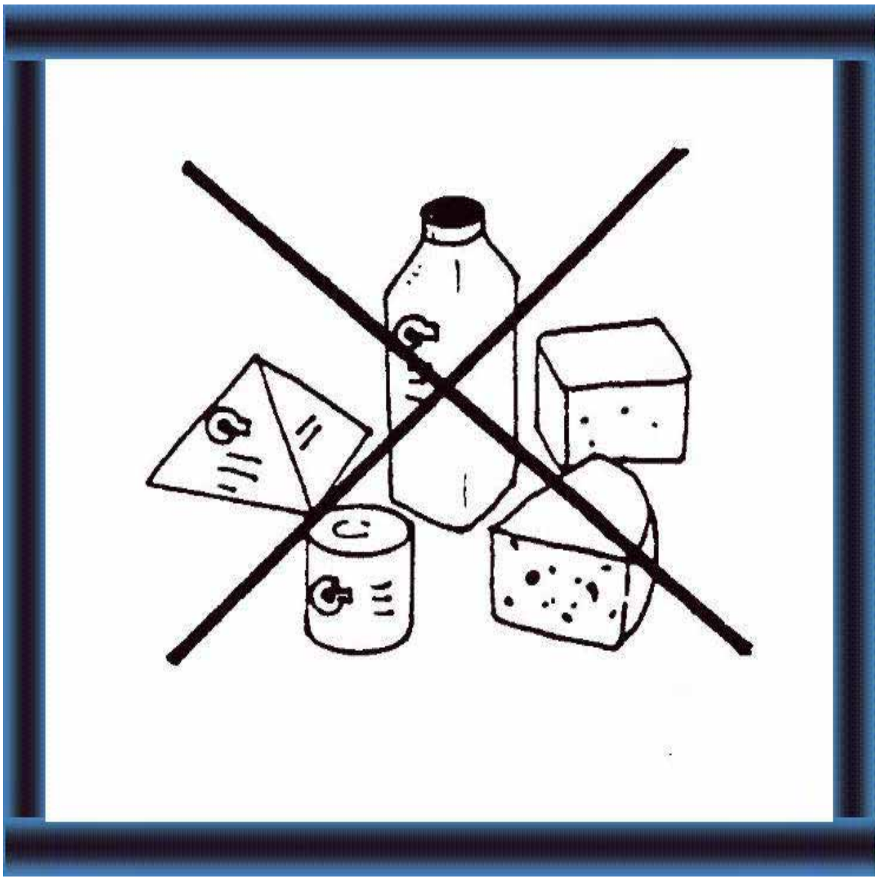
Proteins

23 For 2-3 days after calving the milk (colostrum)

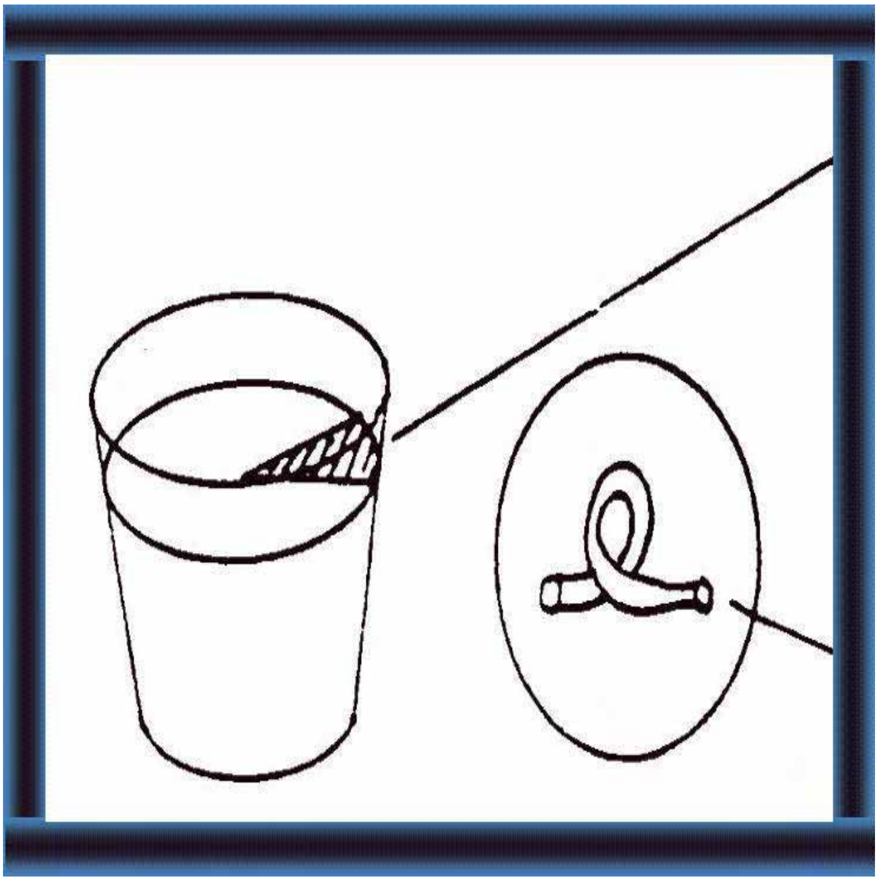


contains:

- high amounts of proteins
- antibodies which protect calves from disease.



24 You cannot use colostrum for dairy products because it coagulates when heated. So do not deliver milk to the dairy for 4-5 days after calving.



25 Normal milk contains

3.4 - 4% proteins which help to build up our bodies.

Milk proteins (26-27)

Milk proteins consists of 2 major groups.

Casein

About 80 % of milk protein is casein which is made up of a number of components together forming complex particles.

Casein is not significantly altered by normal pasteurization procedures. Heating at high temperatures for some time will change the properties of the casein complex and break down certain amino acids. These changes are organoleptically observed as cooked flavour and brown colouration; physically they are observed as changes in the heat stability and rennetability of the milk.

The composition of the casein complex varies within and between species. Thus the procedures to be followed for the manufacture of certain dairy products vary according to the kind of milk being used. The micella in buffalo milk, for example, are much larger than those in cow milk; moreover, they contain more calcium and phosphorus.

There are two different methods of precipitating the casein:

- by souring the milk either by the direct addition of acid or by bacterial acid production;
- by coagulation after the addition of certain enzymes.

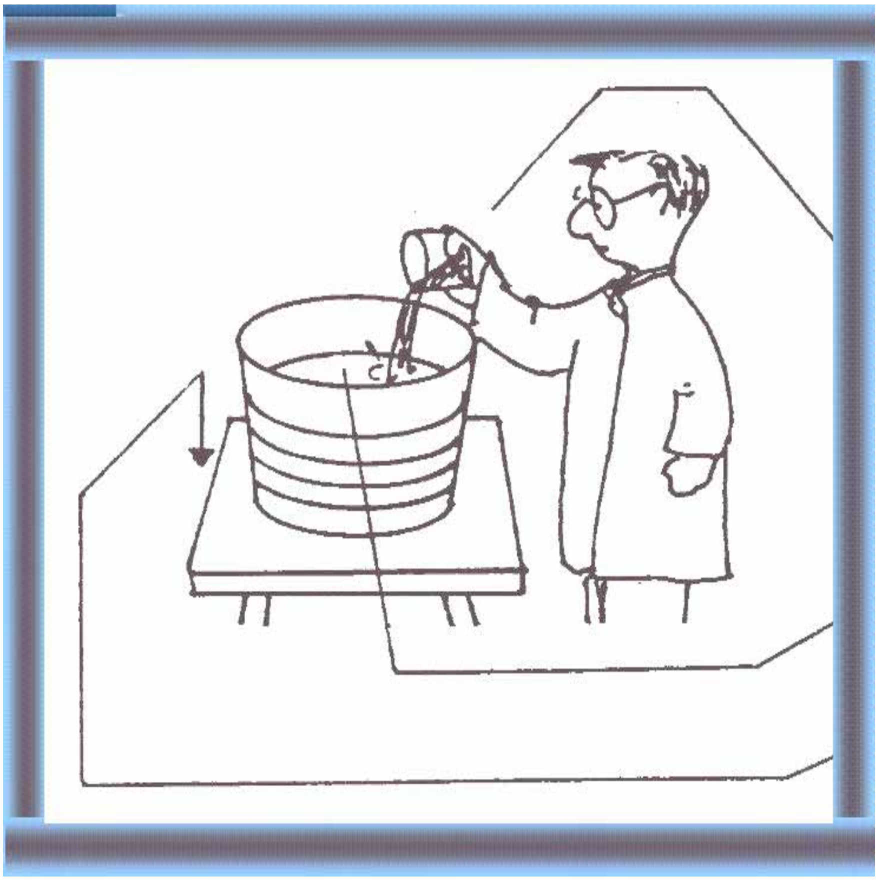
Different names are used for the various states in which casein can exist:

- as it occurs in milk, whether raw or after heat treatment (casein complex);
- as it is precipitated by enzymes (sometimes called the paracaseinate complex);
- as it is precipitated by acid (acid casein).

Whey proteins (serum proteins)

If the milk has not been heat treated, the water-soluble whey or serum proteins stay in the milk serum after the casein has been precipitated by acid or by rennet.

Most of the whey proteins react with casein when the milk is heated to temperatures of 63 C and above. The higher the temperature and the longer the treatment, the more of these proteins will associate with the casein micella. At normal HTST pasteurization only very small quantities are denaturized in this way. Cheese curd from milk, heated to a high temperature, will not release whey as ordinary cheese curd does. Milk-serum proteins in general, and lactalbumin in particular, have very high nutritional values. Their amino-acid composition is very close to a biological opti-mum. Whey protein preparates are widely used in the food industry.

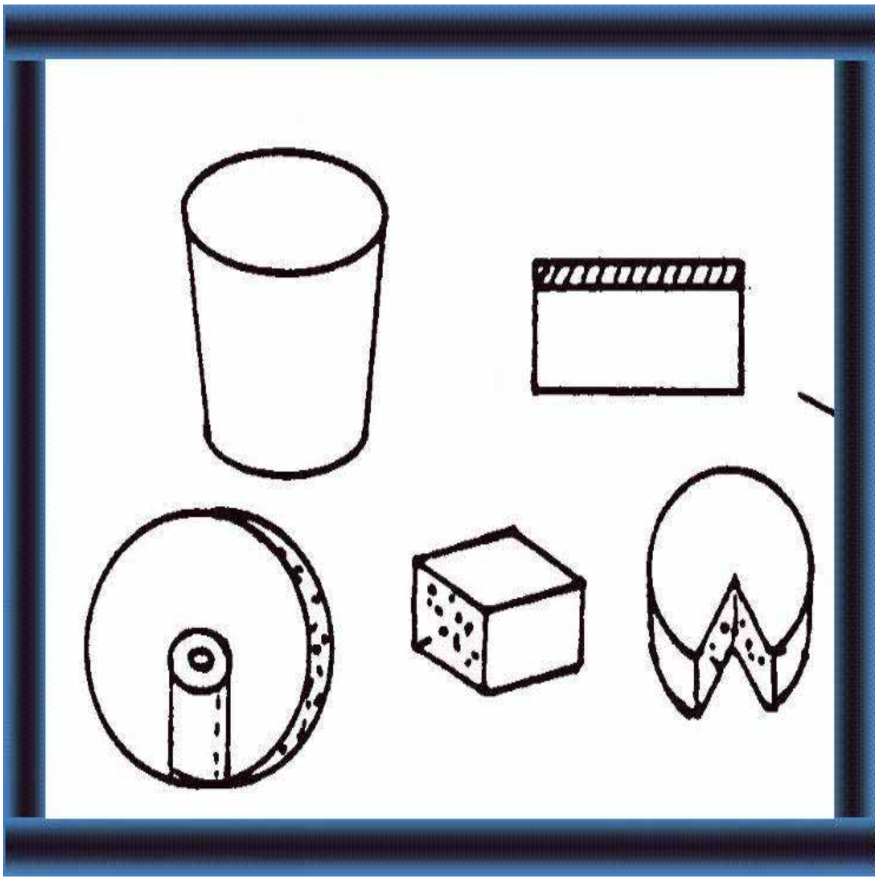


26 There are two main types of protein in milk: caseins and whey proteins.

When you sour milk or add rennet (enzyme),

the whey is liquid and

casein precipitates (curdles).



27 Milk products contain different amounts of protein: cream 2-3 %

cheese 20-40%

Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 1

Milk Composition - part 2

Enzymes (28-29)

Enzymes are a group of proteins produced by living organisms. They have the ability to start chemical reactions and to affect the course and speed of such reactions. Enzymes do this without being consumed. They are therefore sometimes called biocatalysts. An enzyme probably takes part in a reaction, but is released again when it has completed its job.

The action of enzymes is specific; each type of enzyme only catalyses one type of reaction.

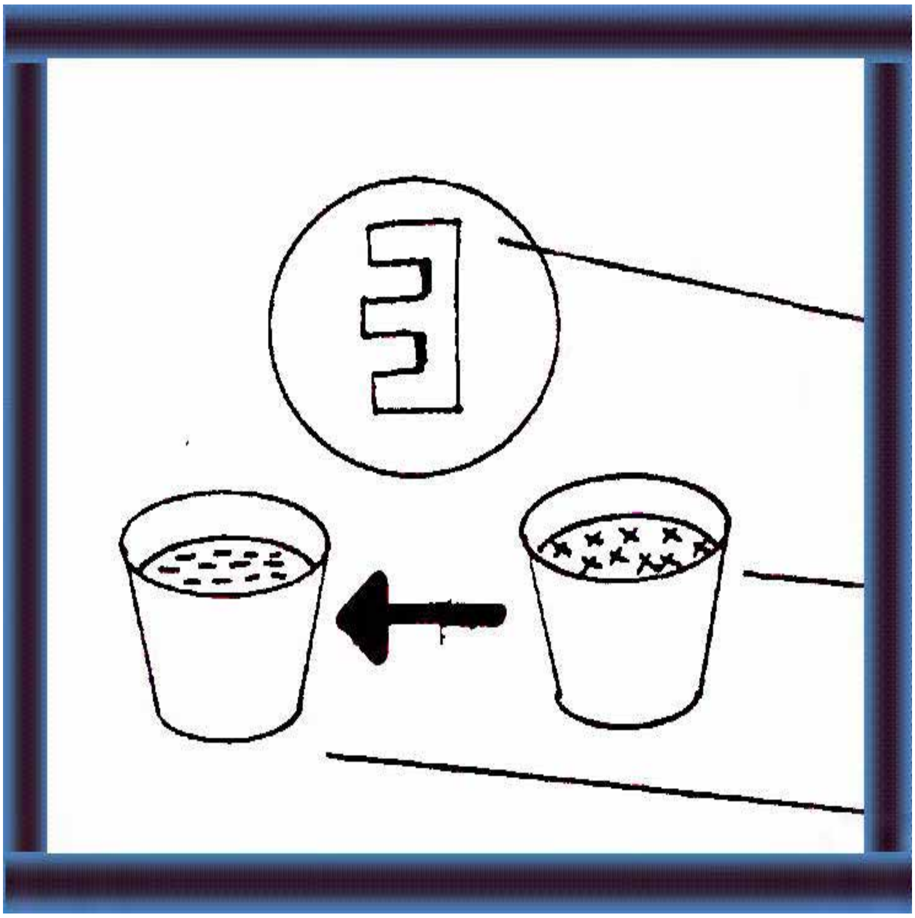
Two factors which strongly affect enzymatic action are temperature and pH. Enzymes are usually most active in an optimum temperature range between 25 and 50 C. The activity drops if the temperature increases beyond optimum, stopping altogether somewhere between 50 and 120 C. At these temperatures the enzymes are more or less completely destroyed (inactivated). The

temperature of inactivation varies from one type of enzyme to another - a fact which has been widely utilized for the purpose of finding the degree of pasteurization of milk. Enzymes also have their optimum pH ranges; some function best in acid solutions, others in alkaline solutions.

The enzymes in milk come either from the cow's udder or from bacteria. The former are normal constituents of milk and are called original enzymes. The latter, bacterial enzymes, vary in type and number according to the nature and size of the bacterial population. Several of the enzymes in milk are utilized for quality testing and control. Among the more important ones are peroxidase, catalase, phosphatase and lipase.

Lipase (30-31)

Lipase splits fat into glycerol and free fatty acids. Excess free fatty acids in milk and milk products result in a rancid taste. The action of this enzyme seems, in most cases, to be very weak, though the milk from certain cows may show strong lipase activity. The quantity of lipase in milk is believed to increase towards the end of the lactation cycle. Lipase is, to a great extent, inactivated by HTST pasteurization, but higher temperatures are required for total inactivation. Many microorganisms produce lipase. This can cause serious problems as this enzyme is very resistant to heat.

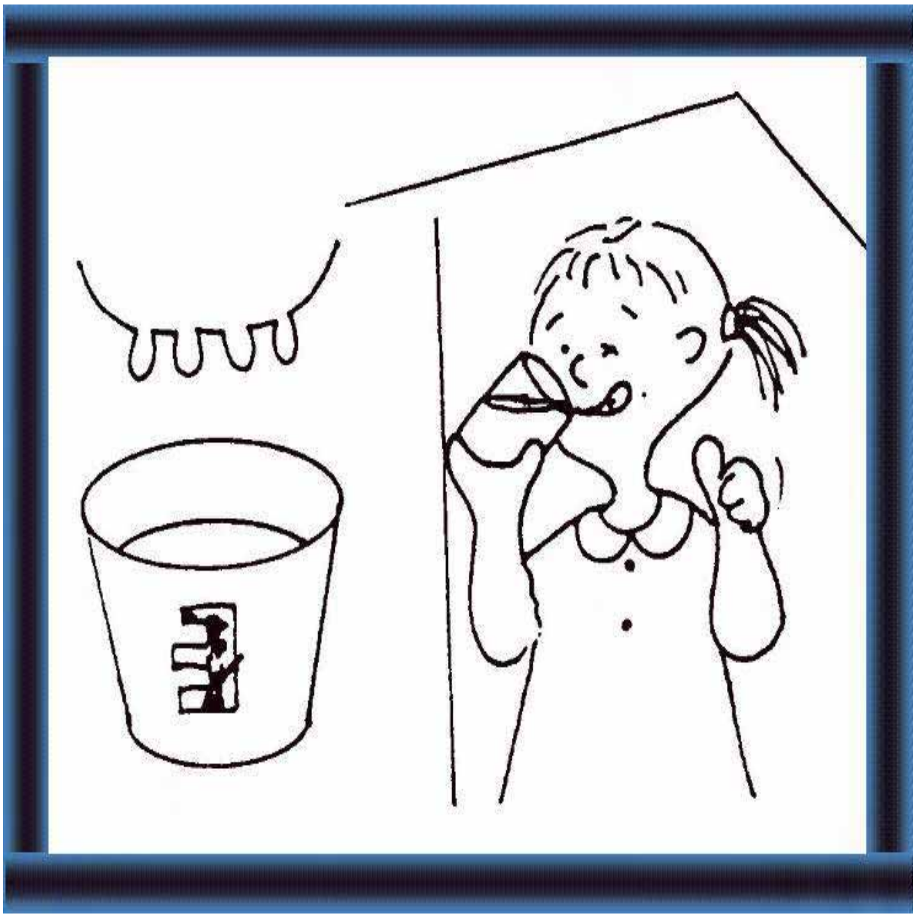


28

Enzymes start chemical changes:

- one substance in milk changes

to other substances.



29 Some enzymes come from

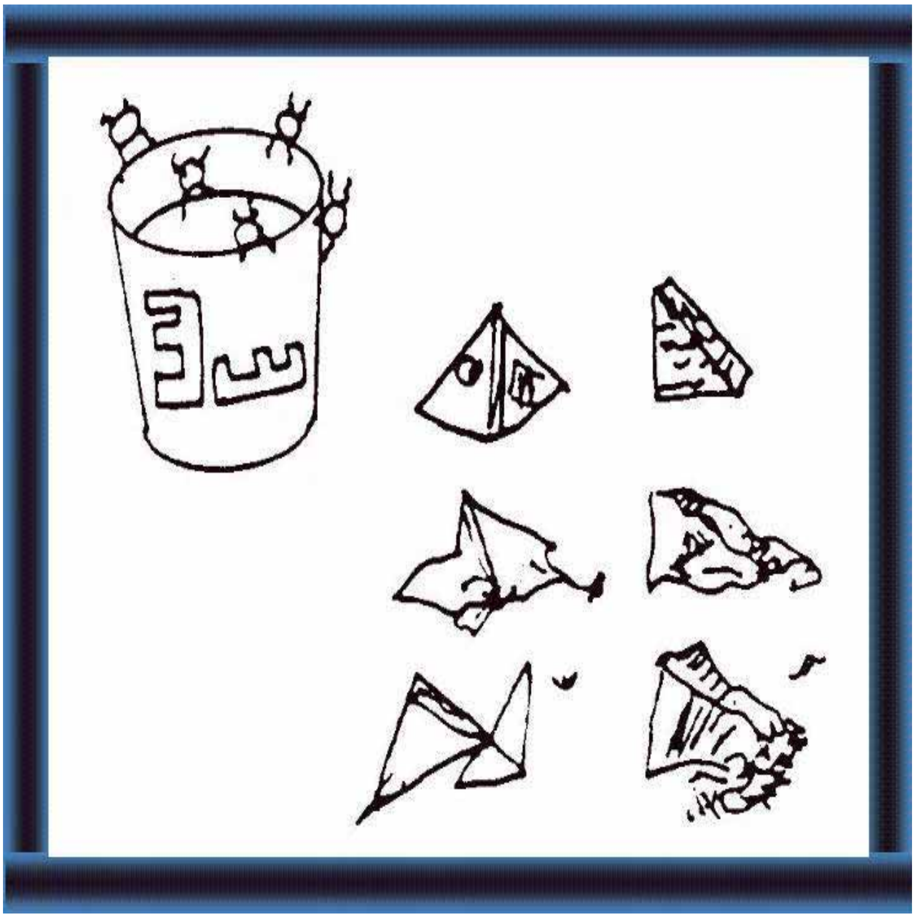
the udder.

Pasteurization usually destroys them.

30 Other enzymes come

from bacteria, e.g. on dirty equipment, and change the milk to have a bad taste and smell.

Pasteurization does not always destroy them.



31 Milk products made from this milk are poor quality.

Lactose (32 - 35)

Lactose is a sugar and belong to the group of organic chemical compounds called carbohydrates.

Carbohydrates are the most important source in our diet. Bread and potatoes, for example, are rich in carbohydrates, an provide a reservoir of nourishment. They break down into high-energy compounds which can take part in all biochemical reactions, where they provide the necessary energy. Carbohydrates also supply material for the synthesis of some important chemical compounds in the body. They are present in muscles as muscle glycogen and in liver as liver glycogen. Blood sugar is also composed of carbohydrates.

Glycogen is an example of a carbohydrate with a very large molecule. Other examples are starch and cellulose. Such composite hydrocarbons are called polysaccharides and have giant molecules made up of many glucose molecules. In glycogen and starch the molecules are often branched, while in cellulose they are in the form of long, straight chains.

The lactose content of milk varies between 3.6 and 5.5 %. Figure 2 shows what happens when lactose is attacked by lactic acid bacteria. These bacteria contain an enzyme called lactase which attack lactose, splitting its molecules into glucose and galactose. Other enzymes from the lactic acid bacteria then attack the glucose and galatose, converting them into various acids of which lactic acid is the most important. This is what happens when milk goes sour, i.e. fermentation of lactose to lactic acid. Other micro-organisms in the milk generate other breakdown products.

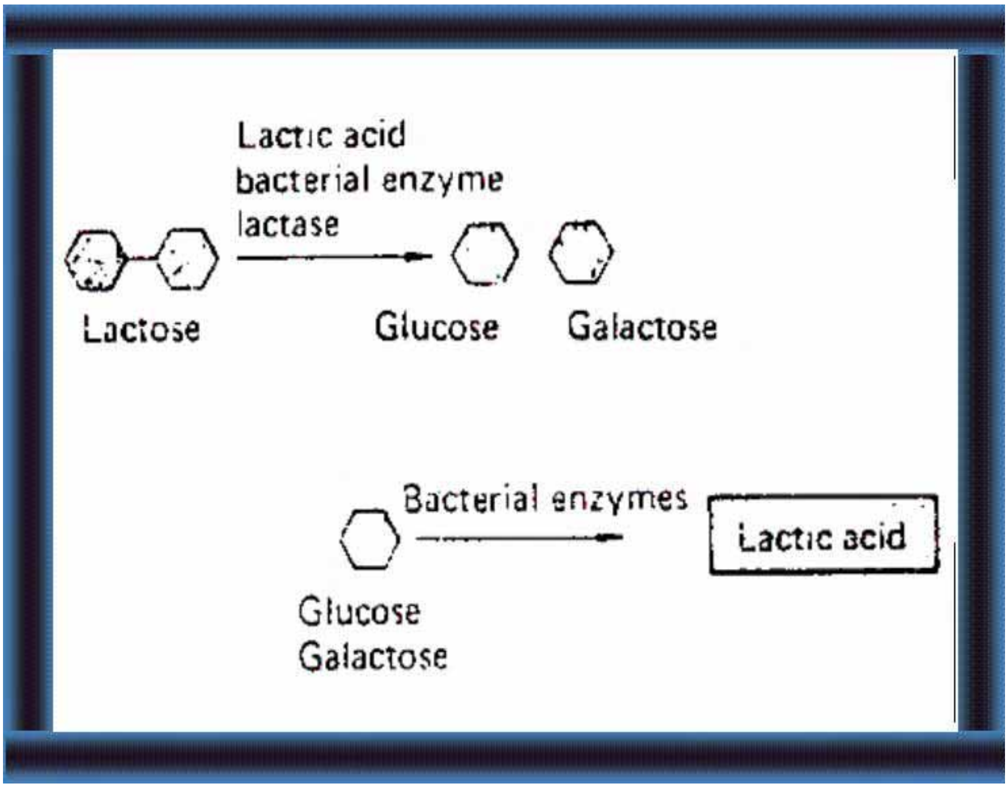


Figure 2: Break Down of Lactose to Lactic Acid

If milk is heated to a high temperature, and is kept at that temperature, it turns brown and acquires a caramel taste. This process is called caramellization and is the result of a chemical reaction between lactose and proteins, the so called Maillard reaction.

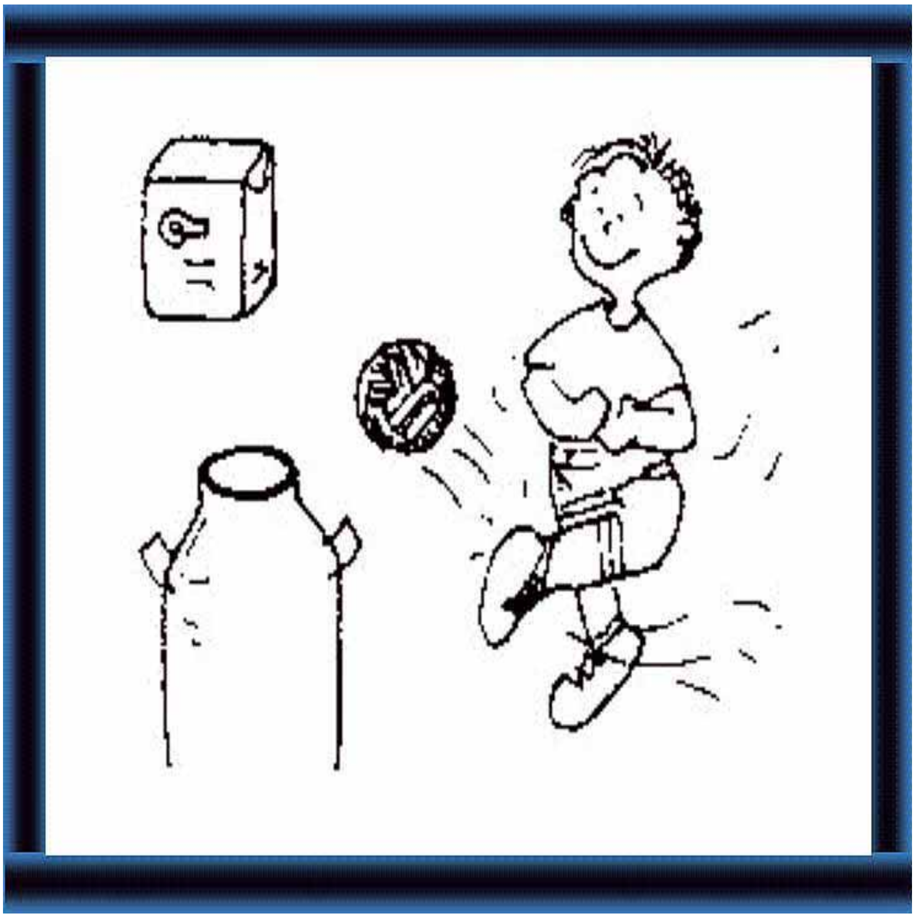
Lactose is water soluble, occurring as a molecular solution in milk. In cheese-making most of the lactose remains dissolved in the whey. Evaporation of whey in the manufacture of whey cheese increases the lactose concentration further. Lactose is not as sweet as other sugars; it is 30 times less sweet that cane sugar, for example.

Lactose

32
Lactose is a milk sugar and

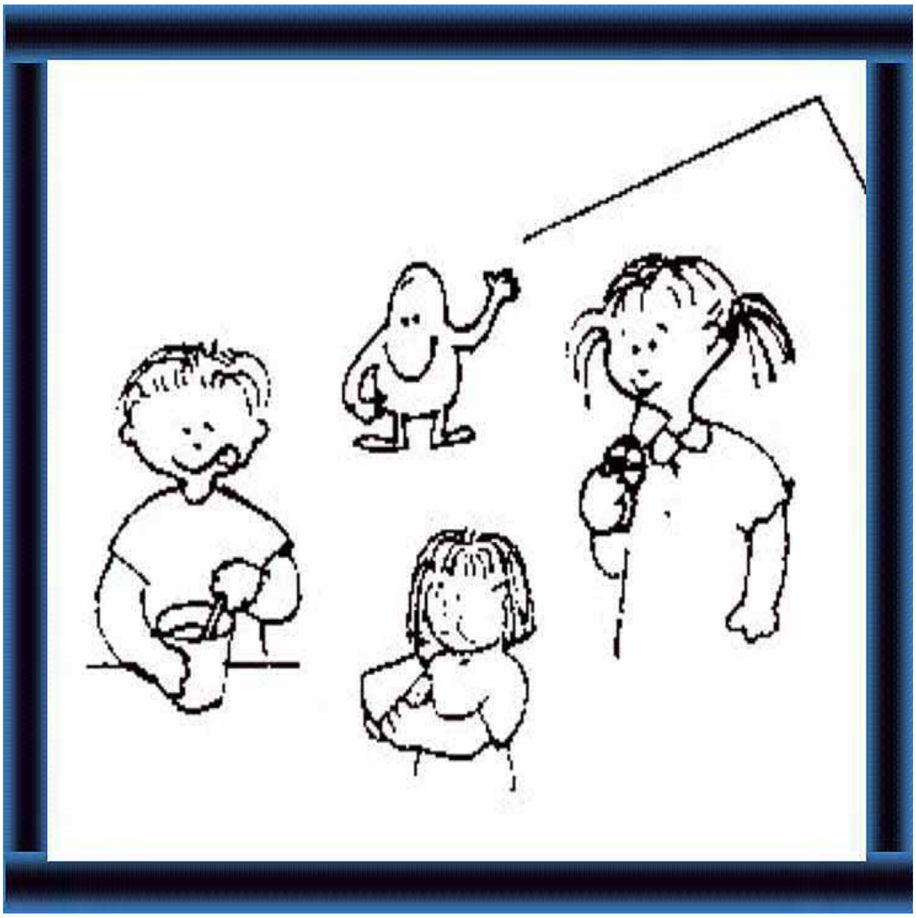
milk contains 4.6 - 4.7%.

It gives milk a slightly sweet taste and is soluble in water.



33 Lactose is a carbohydrate and

gives our body energy.



34 Lactose changes into lactic acid with helps from

lactic acid bacteria and produces the fresh sour taste in sour milk, yoghurt, cheese and other products.

35 After strong heating, the lactose gives the milk

a brownish colour and a caramel taste.

Vitamins (36)

The vitamins in milk can be divided into two groups, those soluble in fat and those soluble in water. Vitamins are organic compounds, whose presence in the organism is necessary for its normal functions. They cannot be produced by the organism itself, and therefore they must be taken in through the food.

The fat soluble vitamins in milk are A, D, E, and K. Milk fat also contains carotene which can be changed to vitamin A. The B and C vitamins make up the water soluble vitamins. The B vitamin complex consists of a series of vitamins of which the following can be found in milk: Thiamin (B_1), Riboflavin (B_2), Niacin, Folic acid, Pyridoxin (B_6), Biotin, Kolin (B_{12}) and Inositol.

The water soluble vitamins are partly destroyed by heat treatment. Among the fat soluble vitamins only vitamin A can be denatured in milk. This is done by oxidation.

Vitamin A (37)

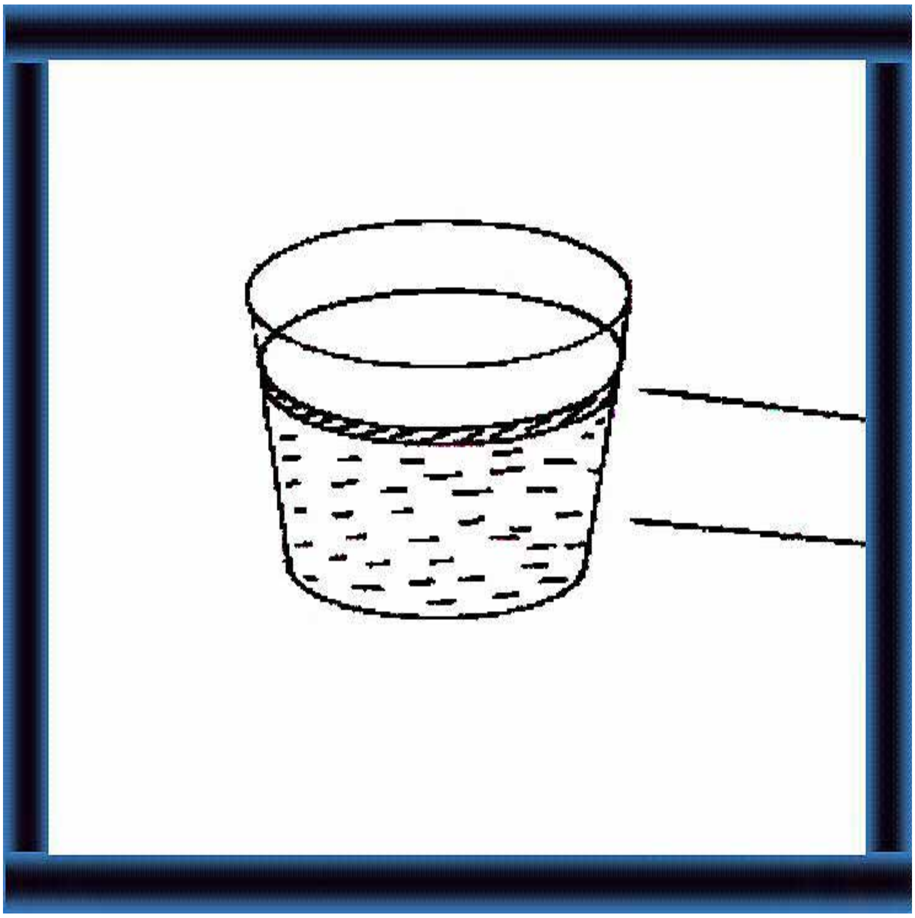
1 glass of full-fat milk provides about 8 % of an adult's and about 10 % of child's daily vitamin A requirement.

Deficiency of vitamin A can cause eye diseases.

Vitamin B_2 (38)

1 glass of fresh full-fat milk provides about 12 % of a child's and of an adult's daily vitamin B_2 requirement.

Vitamins

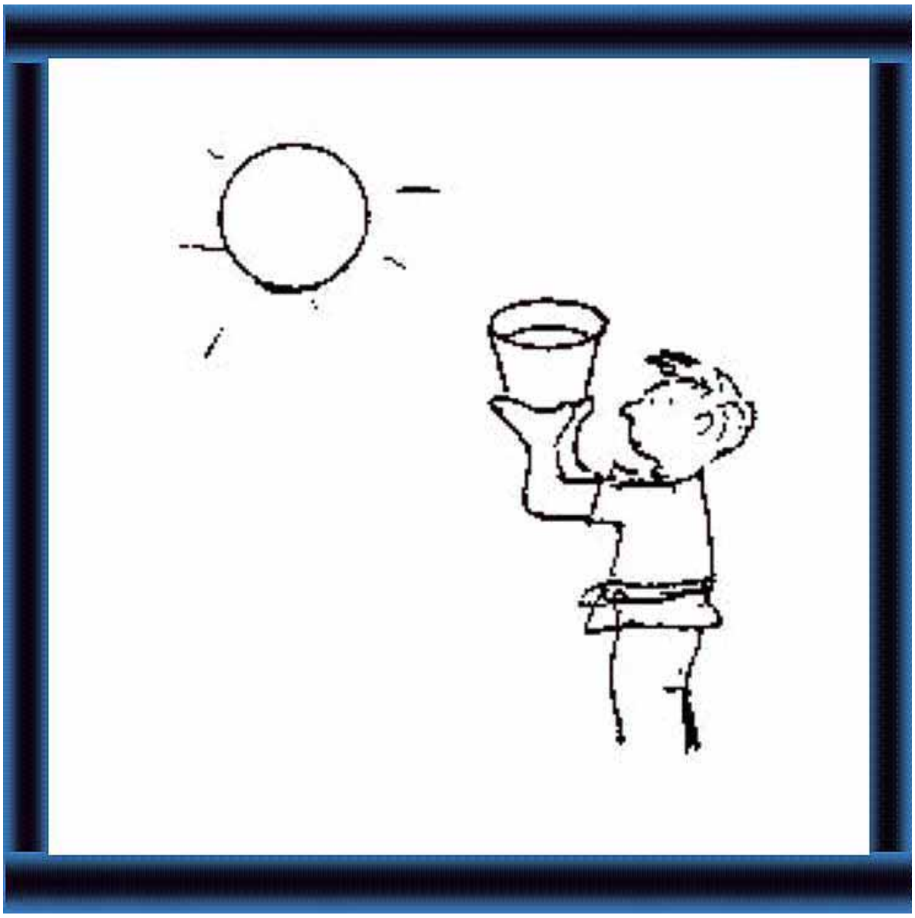


36 Milk contains many vitamins. If our body lack vitamins we get disease.

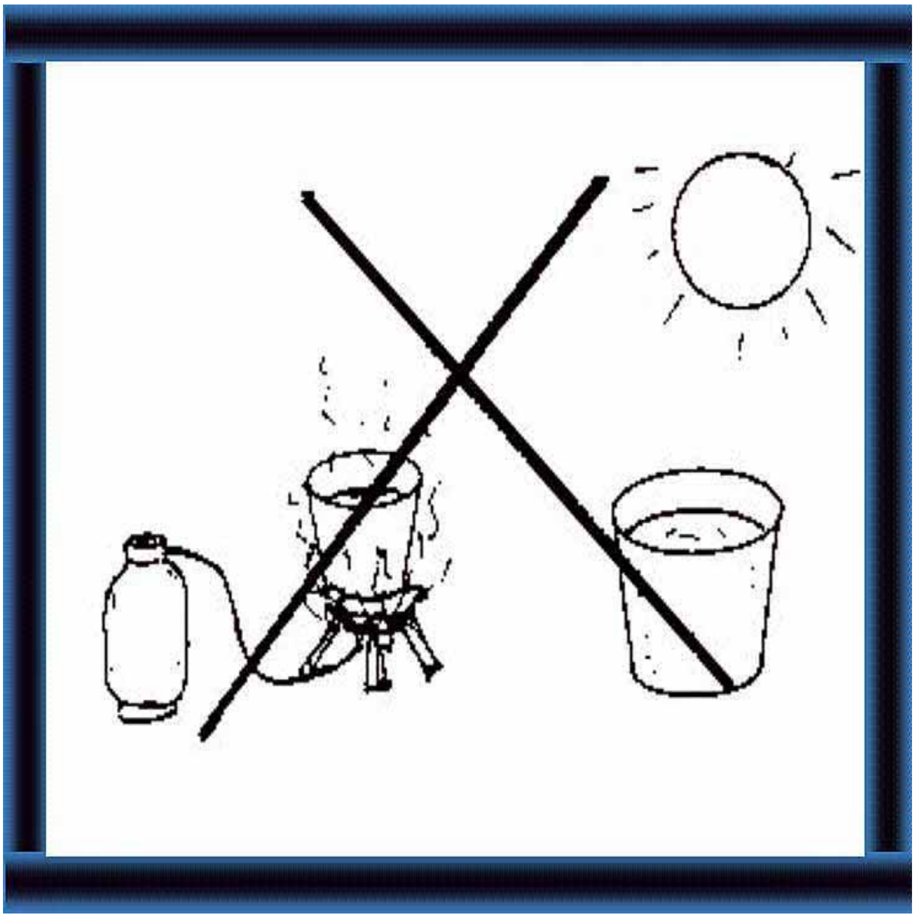
Some vitamins are soluble in cream (A, D, E, K).

Other vitamins are soluble in skim milk (B, C) i.e. they are water soluble.

37 A lot of



vitamin A gives the milk fat a rich yellowish colour because of carotene.



38 leaving milk in strong light reduces the amount of vitamins B2 and C.

Minerals (39)

Milk contains a number of minerals. The total concentration is less than 1 %. Mineral salts occur in solution in milk serum or in casein compounds. The most important salts are those of calcium, sodium, potassium and magnesium. They occur as phosphates, chlorides, citrates and caseinates. Potassium and calcium salts are the most abundant in normal milk. The amounts of salts present are not constant. Towards the end of lactation, and even more so in the case of udder disease, the sodium chloride content increases and gives the milk a salty taste, while the amounts of other salts are correspondingly reduced.

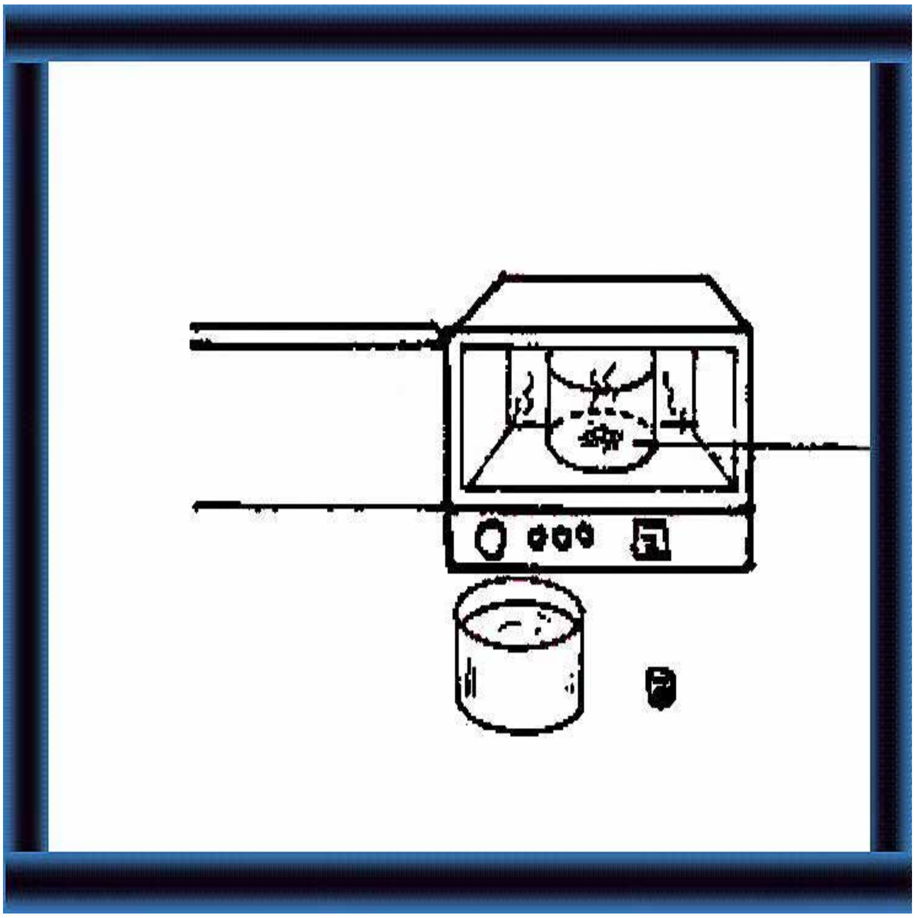
Calcium (40)

Calcium is necessary to build up children's teeth and bones and to maintain adult's bones. Calcium also serves many other functions in the body. Other calcium sources are fish (where the bones are eaten as well) and leafy vegetables.

1 glass of milk provides about 40 % of an adult's and 30 % of a child's daily calcium requirement.

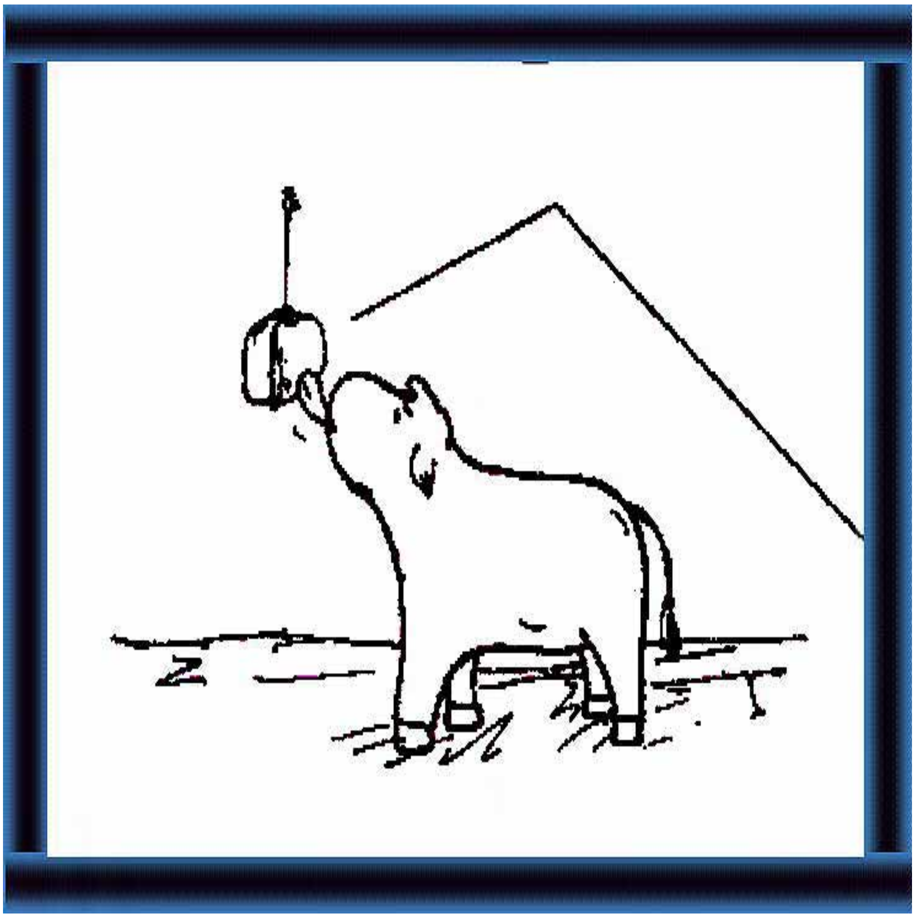
White corpuscles (41-42)

Milk always contains white blood corpuscles (leucocytes). The content is low in milk from a healthy udder, but increases if the udder is diseased - usually in proportion to the severity of the disease.



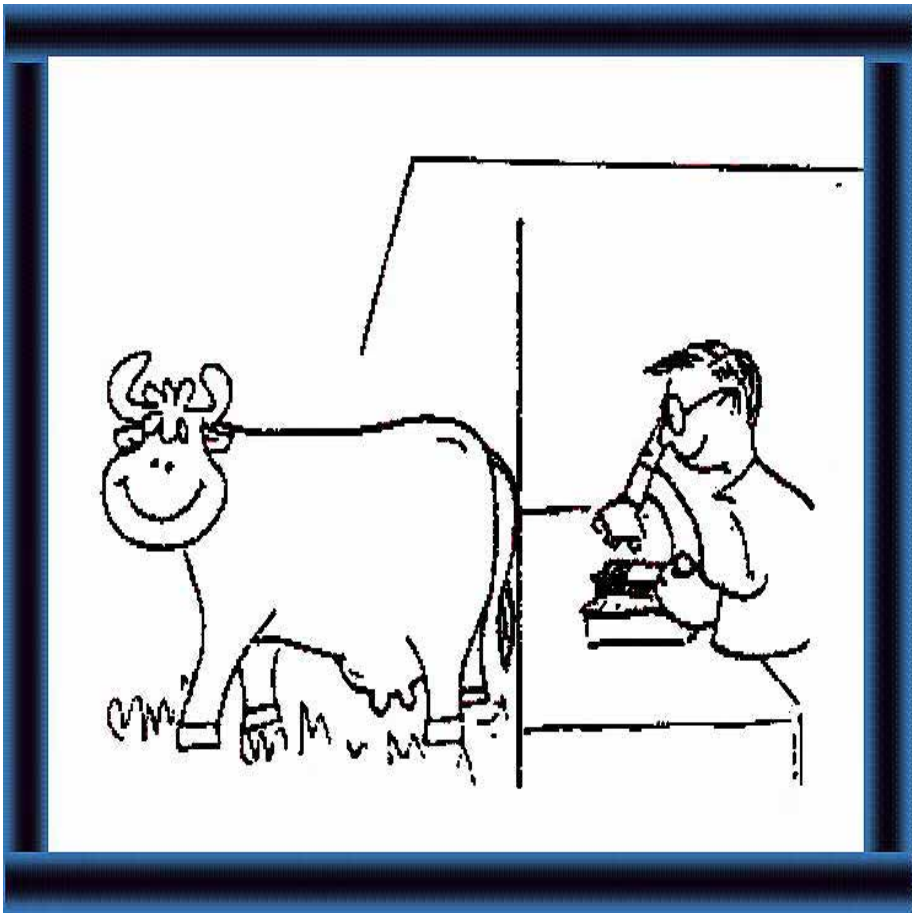
39 When the dry matter in the milk burns, ash remains.

The ash contains minerals which make up about 1% of the milk.



40 Milk is rich in some minerals. e.g. calcium and phosphate for bones and teeth, but poor in others e.g. iron - calves need a supplement to prevent anaemia.

White Corpuscles

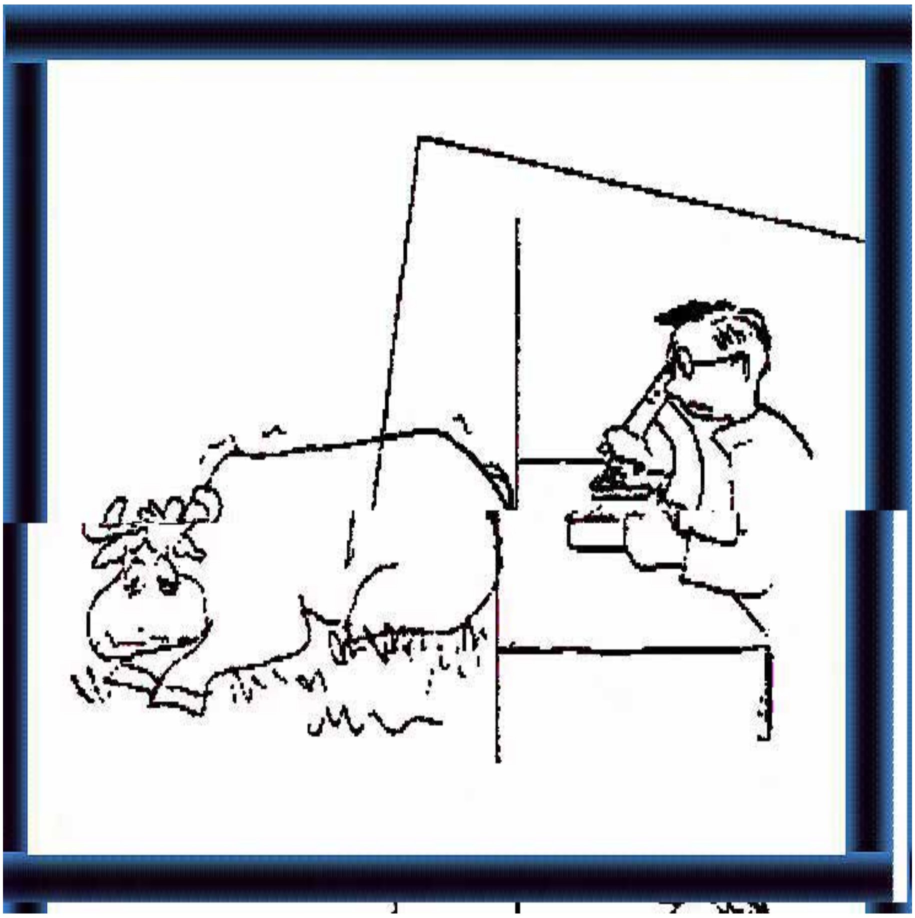


41 Healthy cows have

few white corpuscles in their milk.

42 If the udder is diseased the milk will have

many white corpuscles.



Do not use milk from diseased udders for drinking or for making products.

Bacteria (43-46)

The quality of milk is largely determined by the number and the types of bacteria present in the milk.

Each bacterium consists of only one cell. Bacteria multiply by dividing into new cells. This process can be very rapid. Some bacteria need only twenty minutes to divide into two new bacteria.

So, after forty minutes there may be four bacteria, after one hour eight, etc. After four hours, one single bacterium may have multiplied to four thousand!

Milk is a very good medium for bacteria and in a relatively short time large numbers of bacteria can develop in milk if it is not properly cooled. Cooling of the milk prevents the growth of most types of bacteria to a considerable degree. If milk has to be stored for 12 - 18 hours only, cooling down to 8ºC is enough. If milk must be stored for one day or longer, cooling down to 4ºC is necessary.

Types of bacteria

Lactic acid bacteria change milk sugar into lactic acid. They are found everywhere: in the air, the stable, on clothes and on milking equipment (especially if not properly cleaned). Milk is easily contaminated with these bacteria.

Coli bacteria also change milk sugar, but not only into lactic acid. They also form gases. Coli bacteria are mostly found in faeces.

Infectious bacteria are commonly found in soil and water, but also on milking equipment which is not properly cleaned. In the latter case they can infect milk. They affect the protein and sometimes the fat in milk, giving it a bad flavour.

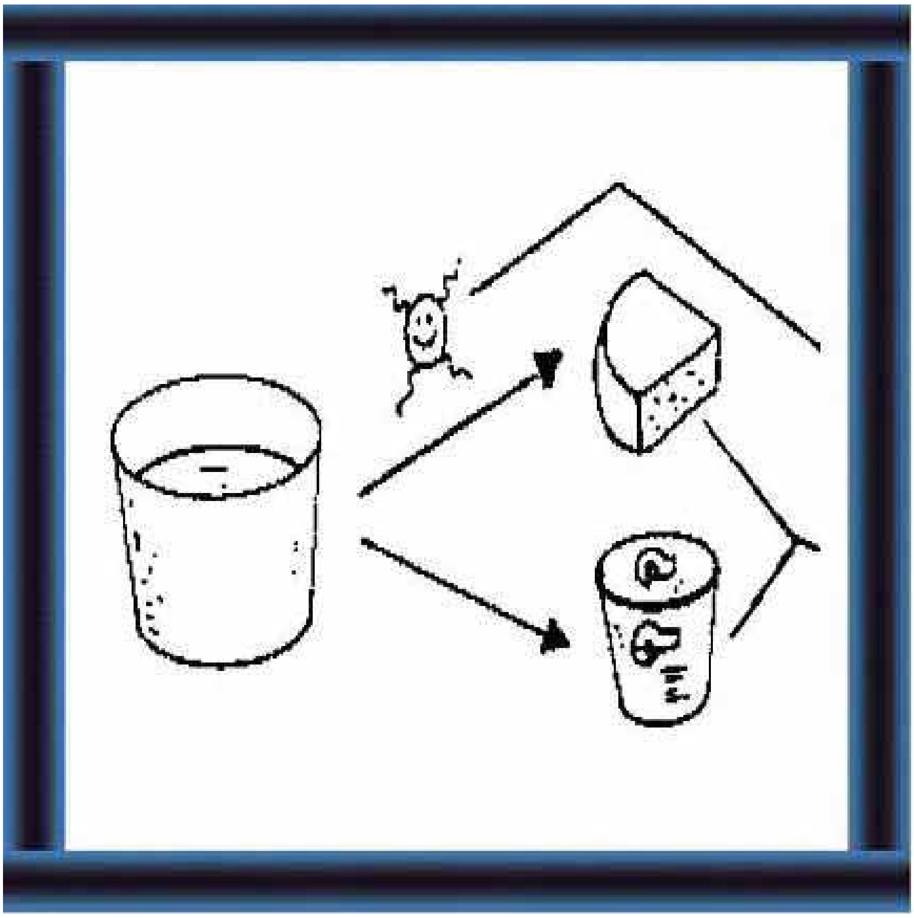
Butyric acid bacteria are commonly found in (bad quality) silage. By feeding this during milking, the milk will be contaminated. Therefore, silage should only be fed after milking is finished. The presence of butyric acid bacteria in milk causes problems if the milk is used for cheese making.

Mastitis bacteria are present in milk when the udder of the cow is not healthy and has developed udder infection.

On the farm, proper cleaning and disinfection of the milk equipment helps to prevent the development of a large number of the above mentioned bacteria.

Note: Dust or dried cow dung may contain as many as 1,000,000,000 bacteria per gram!

Bacteria

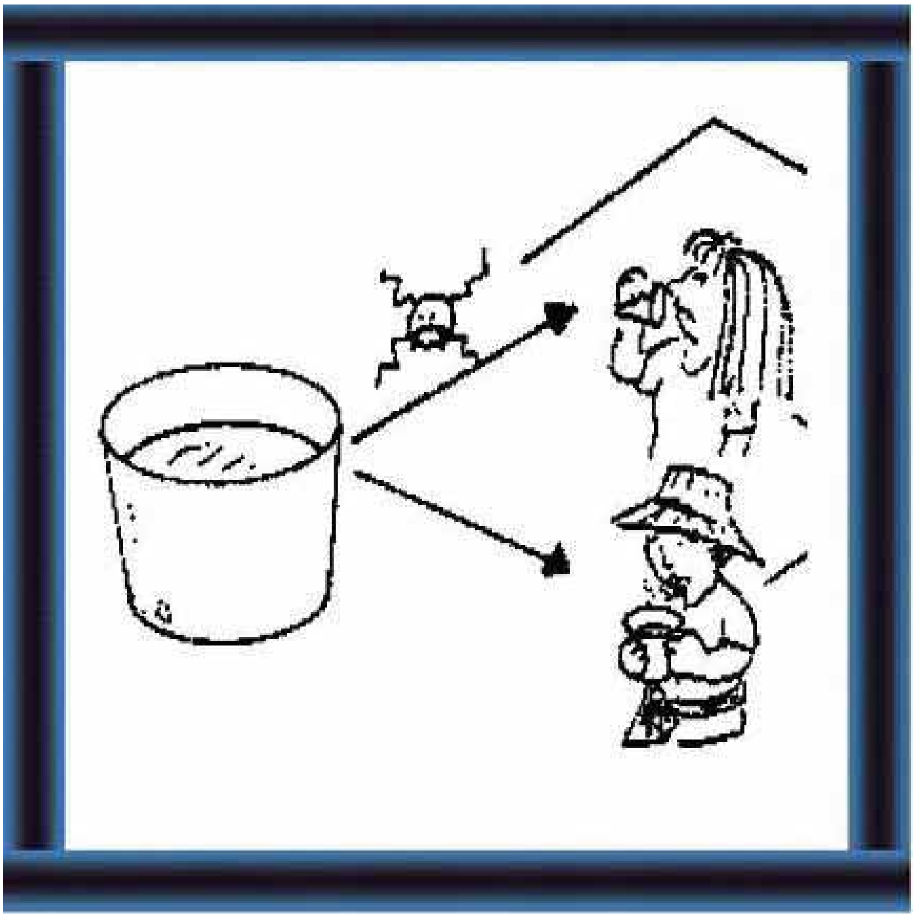


43 All milk contains bacteria.

Some bacteria cause useful changes

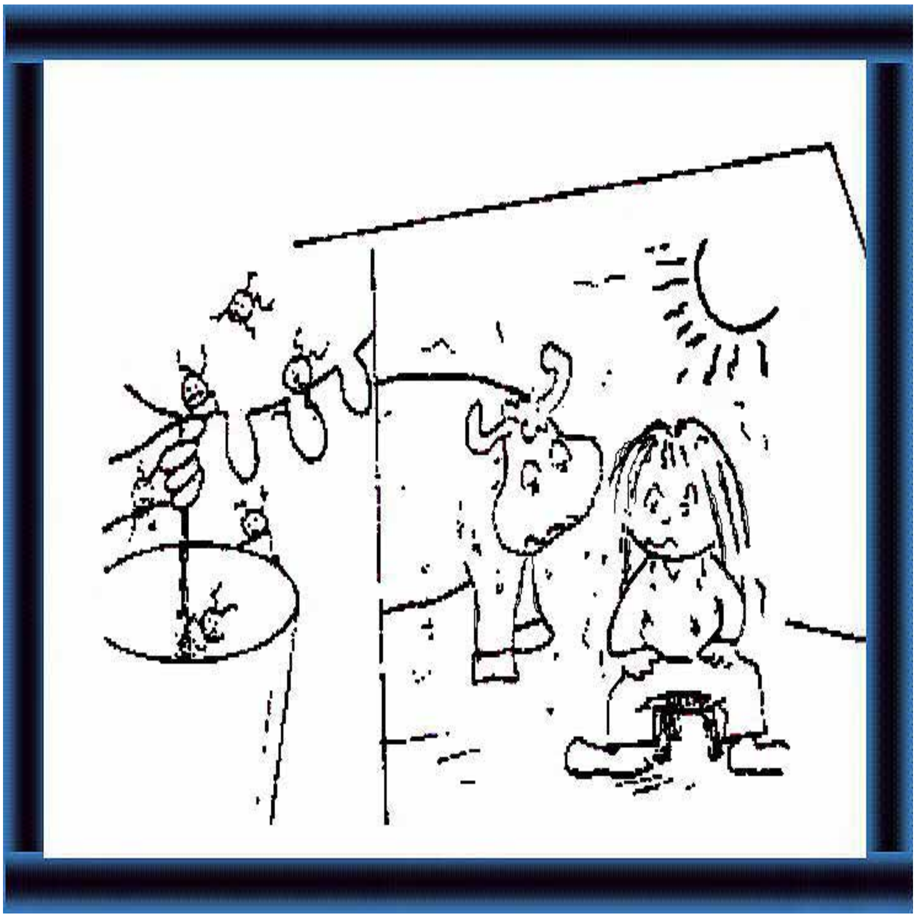
e.g. in making cheese, yoghurt and other milk products.

44 Other bacteria cause



harmful changes such as bad flavours or smells

and bad keeping quality.

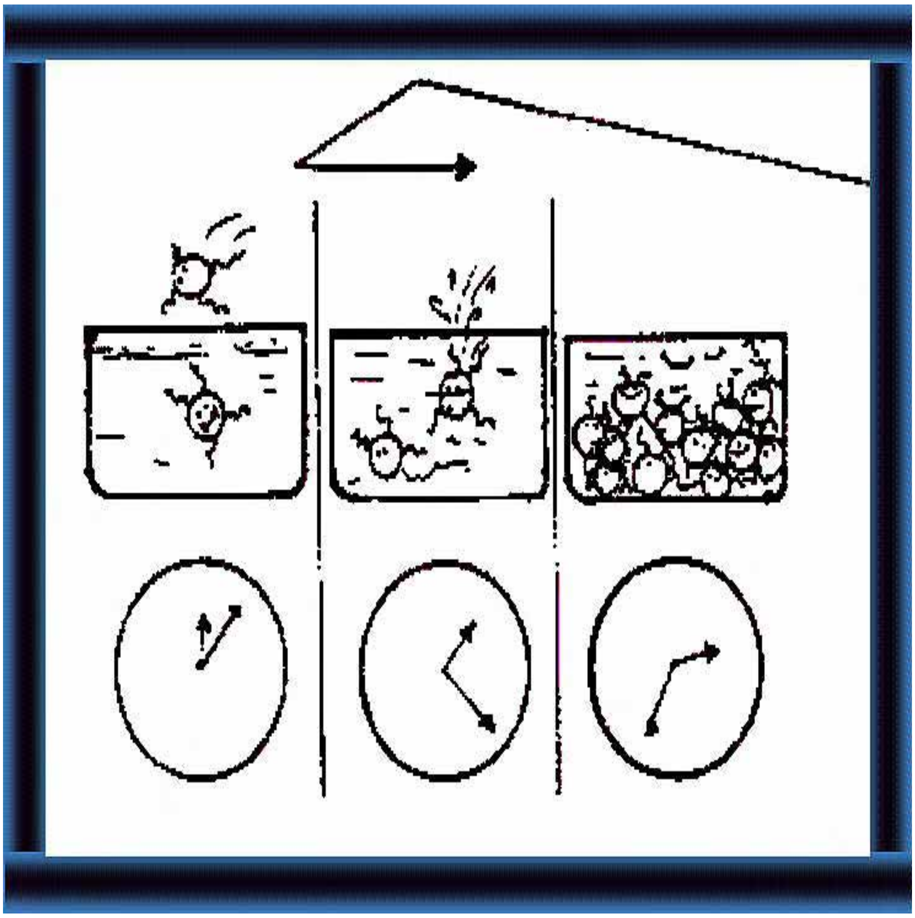


45 There are more bacteria:

-on dirty udders, hands and containers

-in diseased udders

at warm temperatures.



46 Bacteria reproduce quickly.

Try to slow the reproduction of bacteria by keeping your milk:

-cool
-clean.

Small-Scale

Dairy Farming Manual

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Technology Unit 1

Milk Composition - part 3

Lactation Period

The composition of the milk varies throughout the lactation cycle. During the first days of the laceration cycle composition of the milk varies a lot from the resting period. The milk which is secreted during the first days after calving is called colostrum; it has an increased content of protein and ash. Colostrum contains 20-30% dry matter. The variations in milk in the remaining lactation cycle is shown in Figure 3. Together with increase in fat content , the content of the protein and ash also increase mainly due to an increase in the salt content.

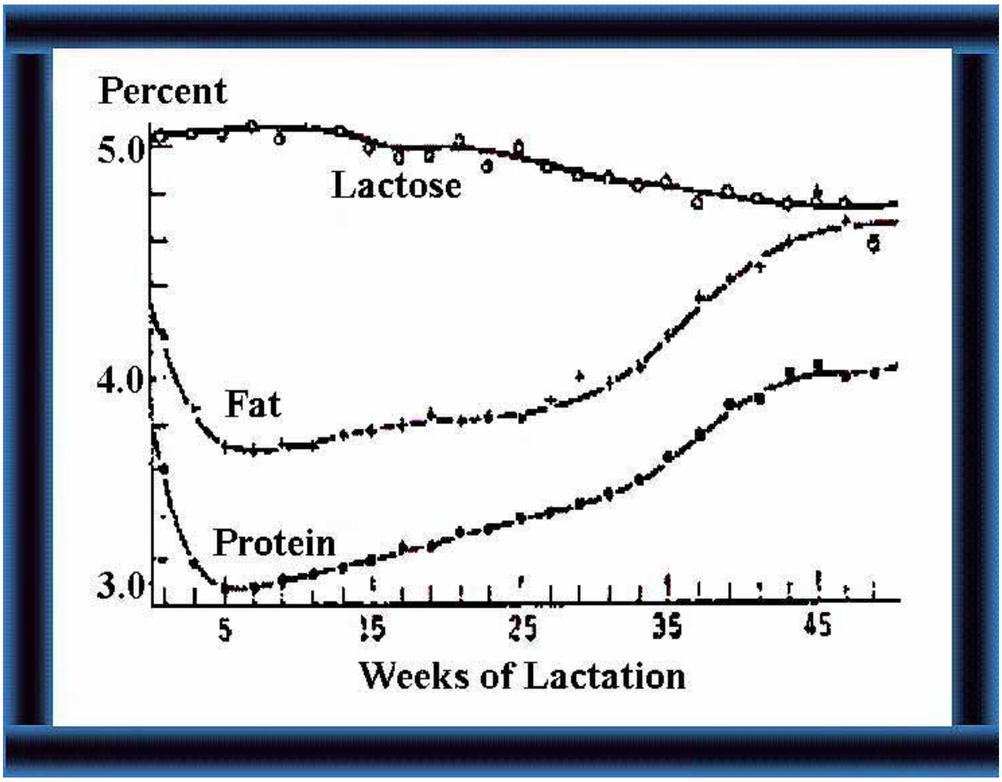


Figure 3: Variations in milk Composition During the Lactation Period.

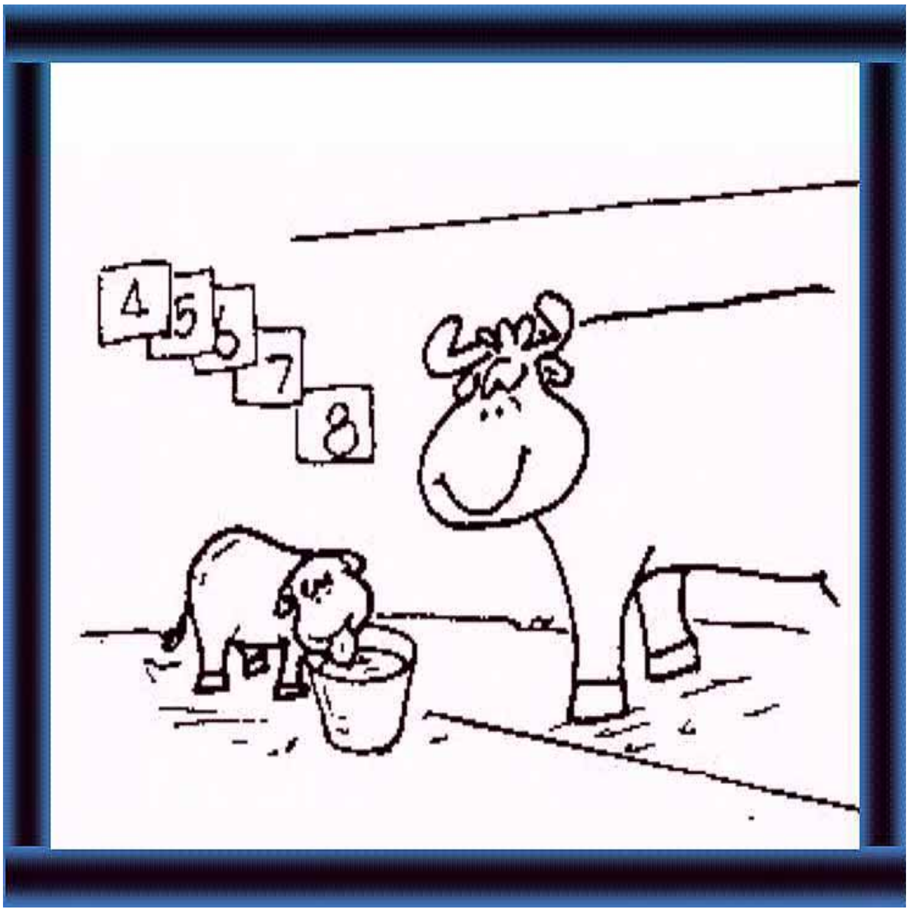
Right after calving, the milk is called Colostrum milk:

	Water	Fat	Protein	Sugar	Salts
at birth	66,4	6.5	23.7	2.1	1.4
after 12 hrs.	79.1	2.5	13.7	3.5	1.1
after 24 hrs.	84.4	3.6	7.1	4.2	1.0
after 48 hrs.	86.0	3.7	4.9	4.4	0.9

Colostrum milk cannot be delivered to the milk factory. About 3-5 days after calving the milk will have reached its normal composition.

What affects milk composition ?

Lactation Period



47 Right after calving,

your cow gives colostum milk.

You cannot deliver this to the milk collecting centre.

48 After 4-5 days

the

composition
is normal

and you
can deliver
your milk.

49
Compare
the
differences
in milk

- at birth
and

- after
five days.

page 24

Time of Milking

Cows are normally milked twice a day: early morning and late afternoon. Milk obtained at the morning milking is much lower in fat (e.g. 3 percent) than at the afternoon milking (e.g. 5 percent).

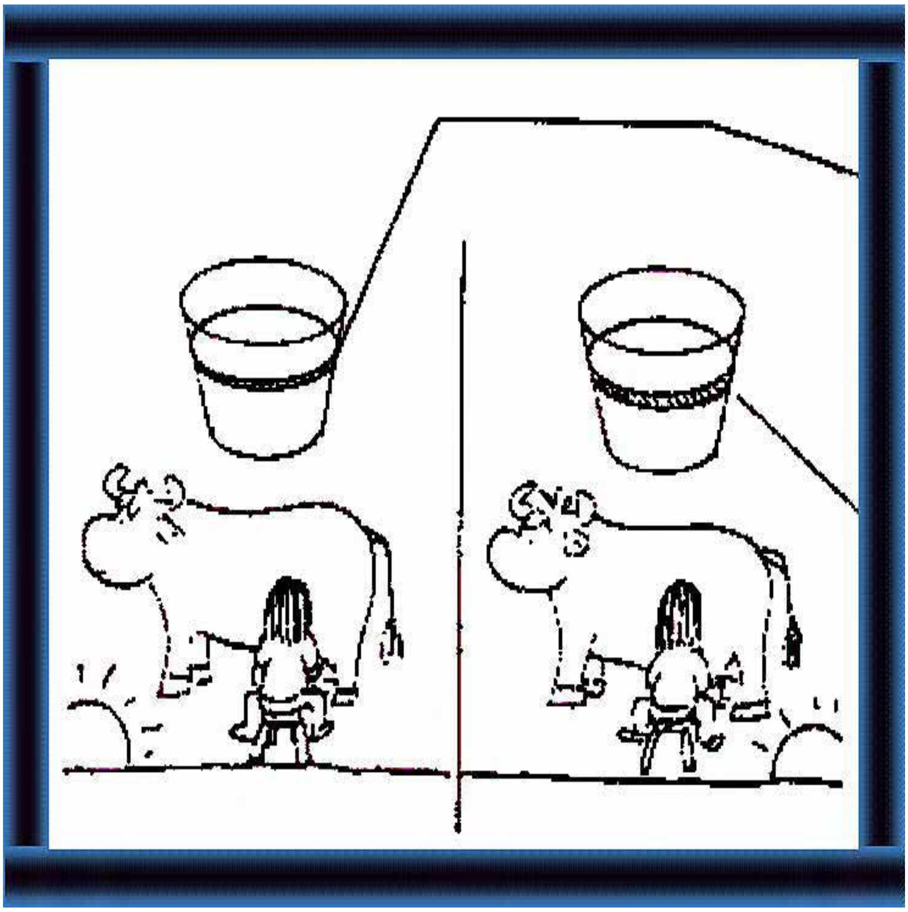
This is not because fat secretion is reduced in the longer night interval but because there is a net carryover of residual milk rich in fat from the night to the day interval.

page 25

Time of Milking

50 Morning milk has

lower fat content



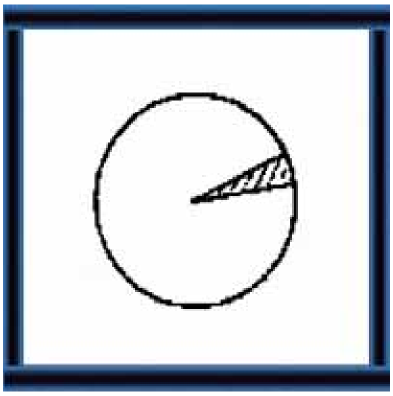
(about 3 parts in 100)

than evening milk (about 5 parts in 100).

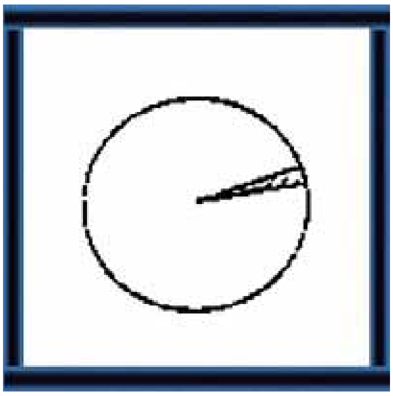
Type of Milk

51 There are many types of milk.

Three major types are:

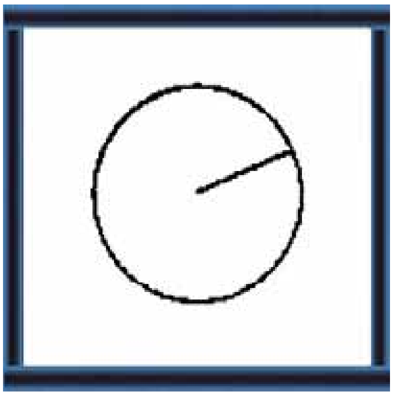
	Fat Content	Energy	Vitamin A and D
Whole Milk		High	High

Low fat Milk



Medium Medium

Skim Milk



Low Low

All three kinds contain almost the same amount of protein.

Type of Animal

Table 2 gives representative values for the main constituents of nutritional importance of the milk of humans and the milch animals. The composition of milk not only differs from species to species but varies widely within any one species and even within breeds or races of one species. Many factors determine composition: physiological variability of the individual, nutrition, stage of lactation, age, season of the year, amount of milk produced - to name only a few. It is clear, therefore, that the values given in the tables can only serve as a general guide and departures from them will be found in quite normal individual animals or herds. The main milch animals have been bred for centuries to produce quantities of milk far in excess of the amounts needed by their young. The milk of these domesticated and highly specialized animals retains the main characteristics of that of the wild stock. As a rule, however, the milk given in much smaller quantity by the wild or less domesticated animals is "richer" in

that it contains more nonfatty solids and often more fat. The cow is more generally used throughout the world than any other milch animal and more is known about its milk, hence the examples quoted for it in the tables are likely to be more accurate.

Species	Fat	Solids (nonfat)	Protein (Nx6.38)	Lactose (Anhydrous)	Calcium	Physiological energy
	g / 100 g					Calories/100g
Human	4.62	8.97	1.23	6.94	0.03	73
Cow:						
Friesian	3.50	8.65	3.25	4.60	0.115	62
Guernsey	4.65	9.10	3.65	4.70	0.13	75
Buffalo:						
Indian	7.45	9.32	3.78	4.90	0.19	100
Goat	4.50	8.70	3.30	4.40	0.13	71
Ewe	7.50	10.90	5.60	4.40	0.20	105
Mare	1.60	8.50	2.20	6.00	0.09	47
Ass	1.50	8.60	2.10	6.20	0.08	46
Camel	4.20	8.70	3.70	4.10	-[1]	70
Yak	7.00	10.90	5.20	4.60	-	100
Llama	3.20	10.30	3.90	5.30	-	65
Reindeer	22.50	14.20	10.30	2.40	-	250

Table 1: Representative values for some major constituents of good quality milk of different species

[1] **In the table a dash (-) denotes lack of information or unreliable information.**

Type of Animal

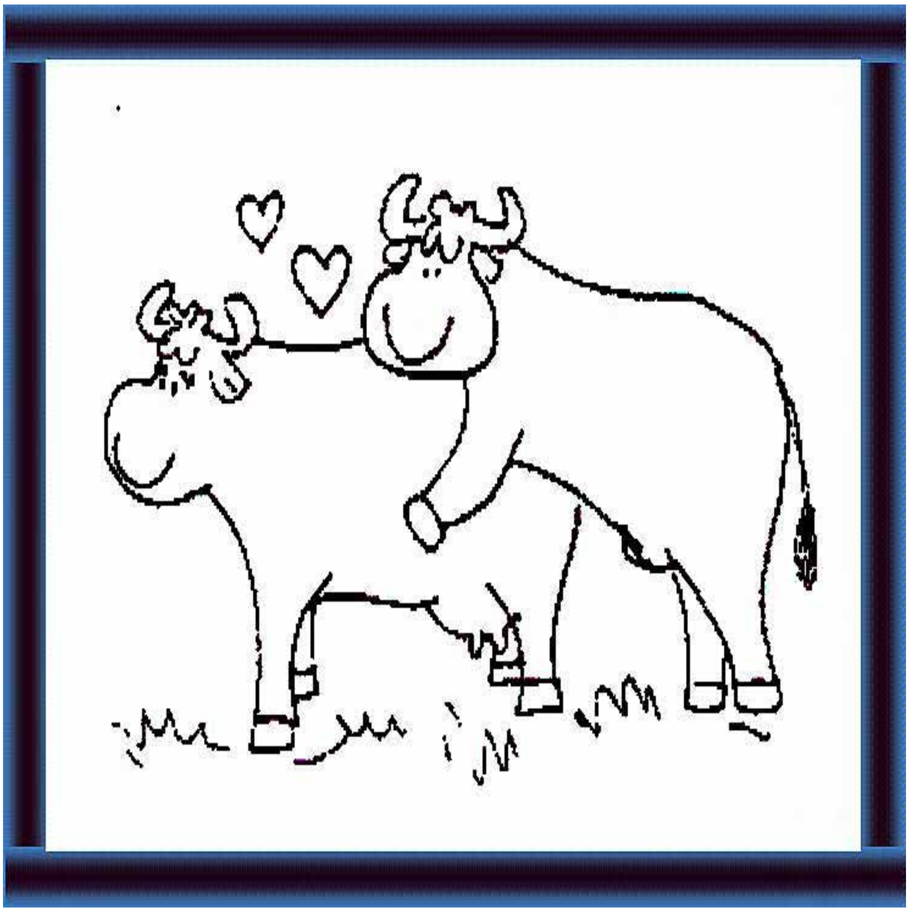
52 Milk from different animals has different compositions (g/100g).

		Fat Content	Solids-not-fat	Note
	Human	4.6	9.0	
	Pure breed cow	3.5-5.0	8.5-9.0	Rich in vitamin A poor in vitamin B
	Zebu cow	5.0-5.5	8.5-9.0	Higher fat content Lower yield

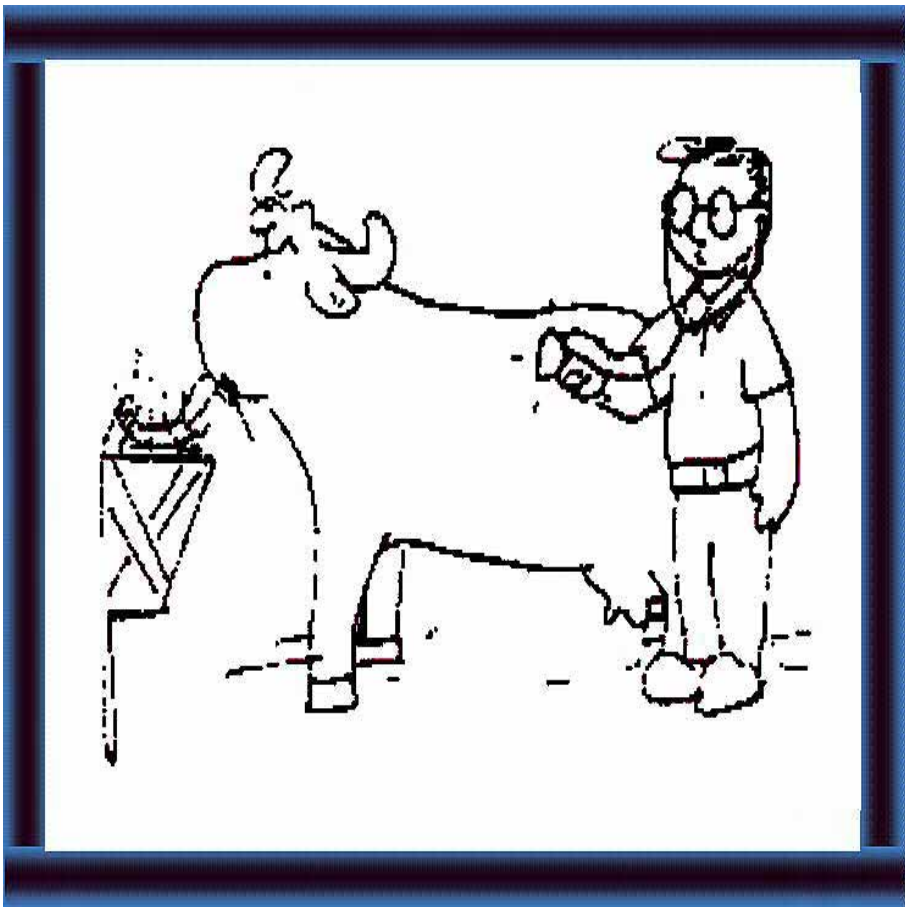
Goat	4.5	8.7	Smell unpleasant, boil soon after milking
Ewe	7.5	10.9	Curdles sooner than cow's milk, cheese matures slower
Mare	1.6	8.5	
Ass	1.5	8.6	
Camel	4.2	8.7	
Yak	7.0	10.9	
Llama	3.2	10.3	
Reindeer	22.5	14.2	

Other Factors

The following also affets the composition of milk.



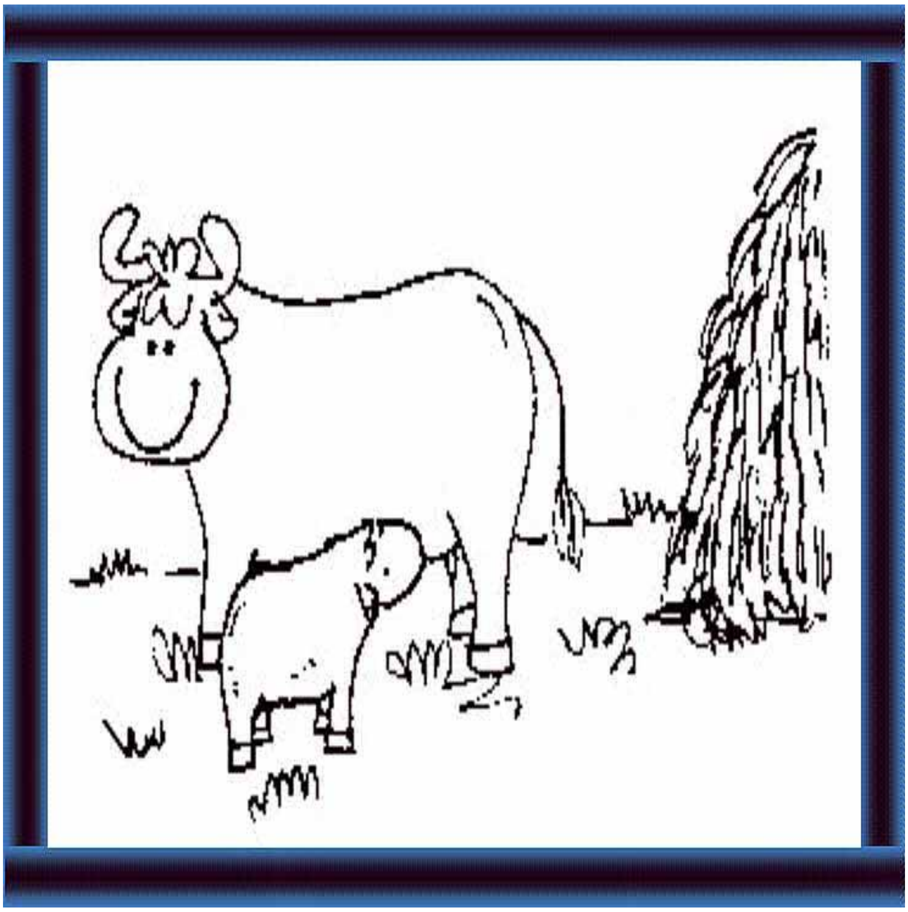
53
Breeding



54
Feeding

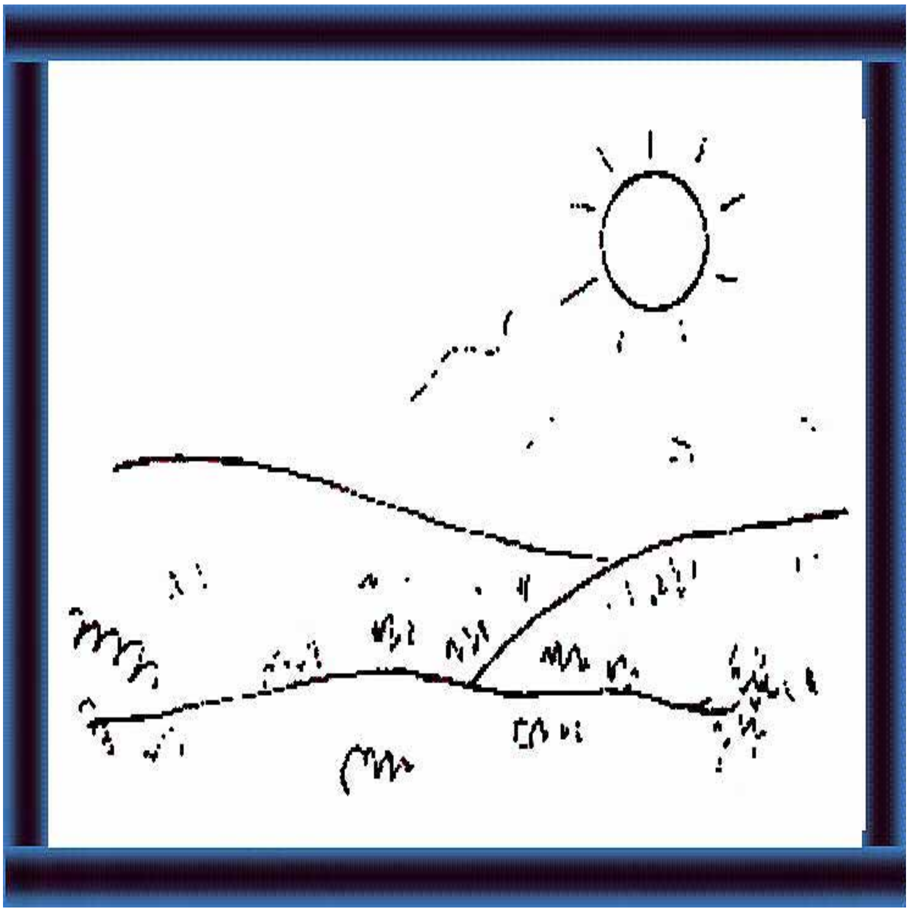
55
Hygiene

page 29

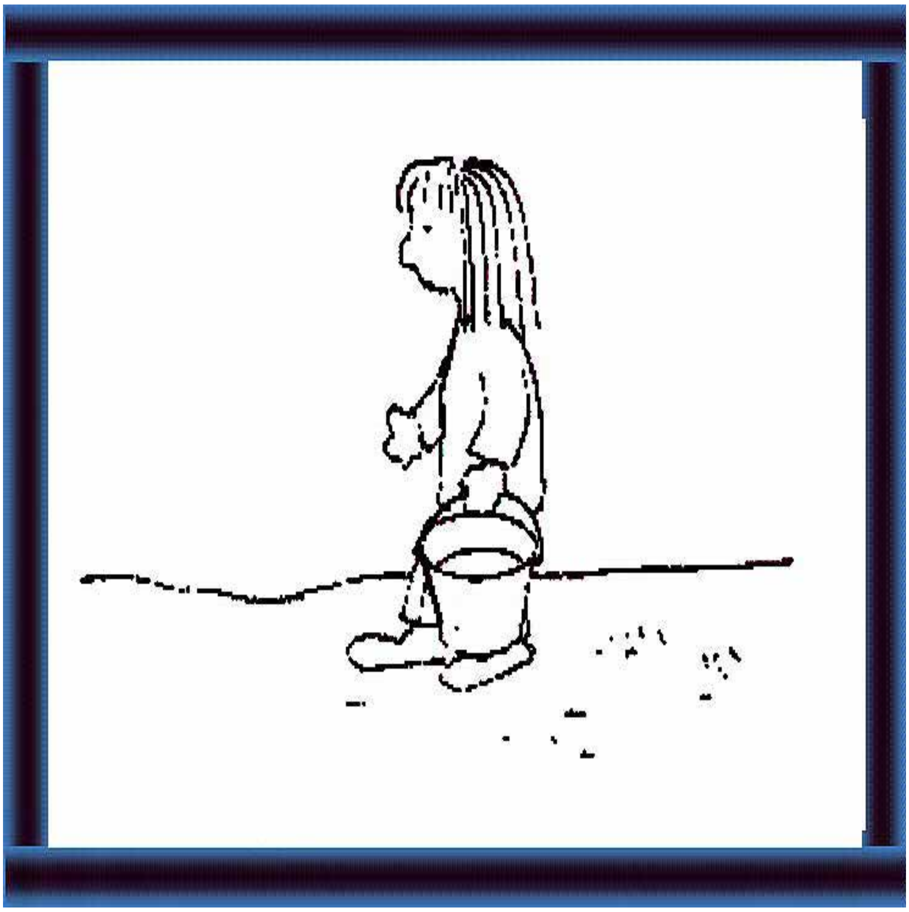


Health

Age



Temperature



58
Handling

Ask your extension worker for advice about these factors.

What do you know about milk composition ?

Reasons for drinking milk

1. **Energy** (5)
2. **Health** (6-7)

Preparation of milk

1. Liquid at room temperature (9)
2. Yellowish-white colour and sweetish smell (10)
3. Freezes at slightly lower temperature than water (11)
4. Slightly heavier than water (12)

Composition

1. Fats (14-21)
2. Proteins (22-27)
3. Enzymes (28-31)
4. Lactose (32-35)
5. Vitamins (36-38)
6. Minerals (39-40)
7. White corpuscles (41-42)
8. Bacteria (43-46)

Factors affecting milk composition

1. Lactation period (47-49)
2. Time of milking (50)
3. Type of milk (51)
4. Type of animal (52)

5. Other factors	**(53-58)**

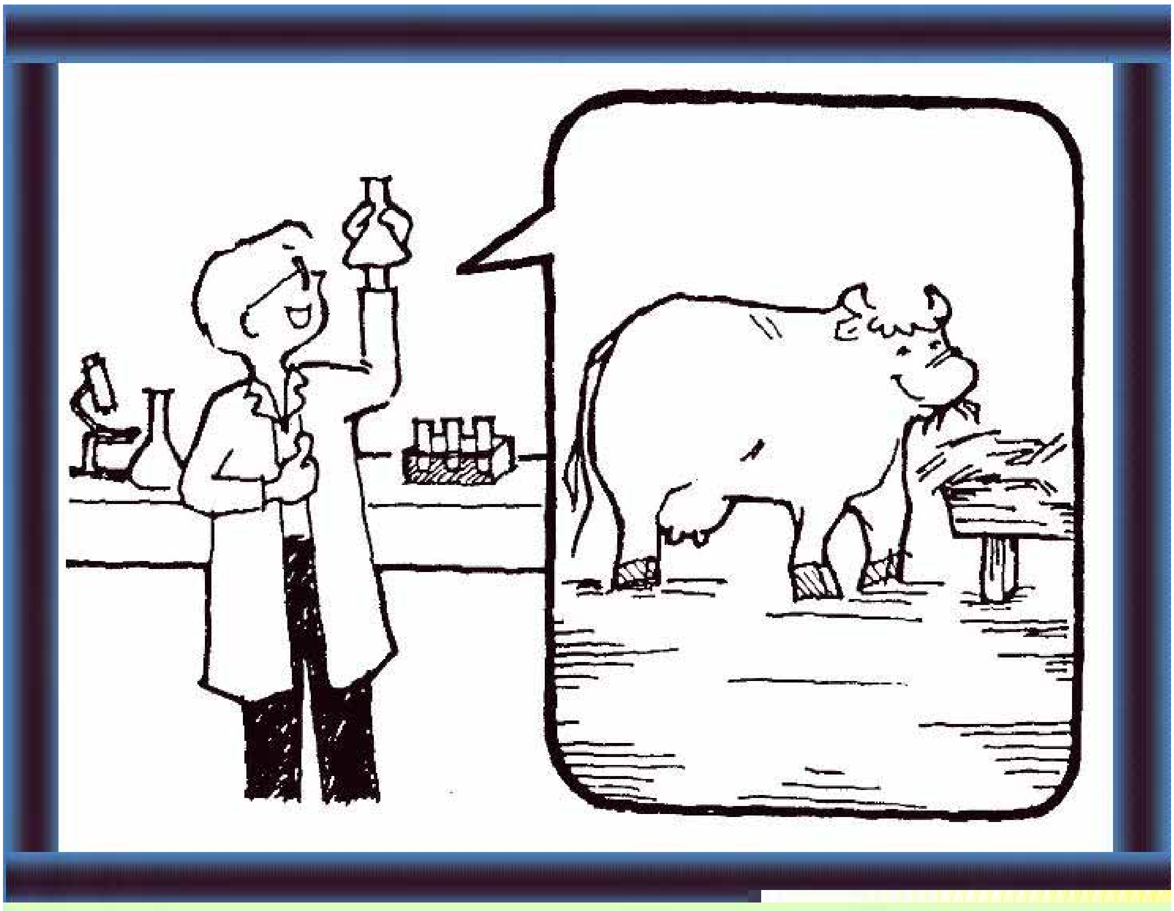
Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 2

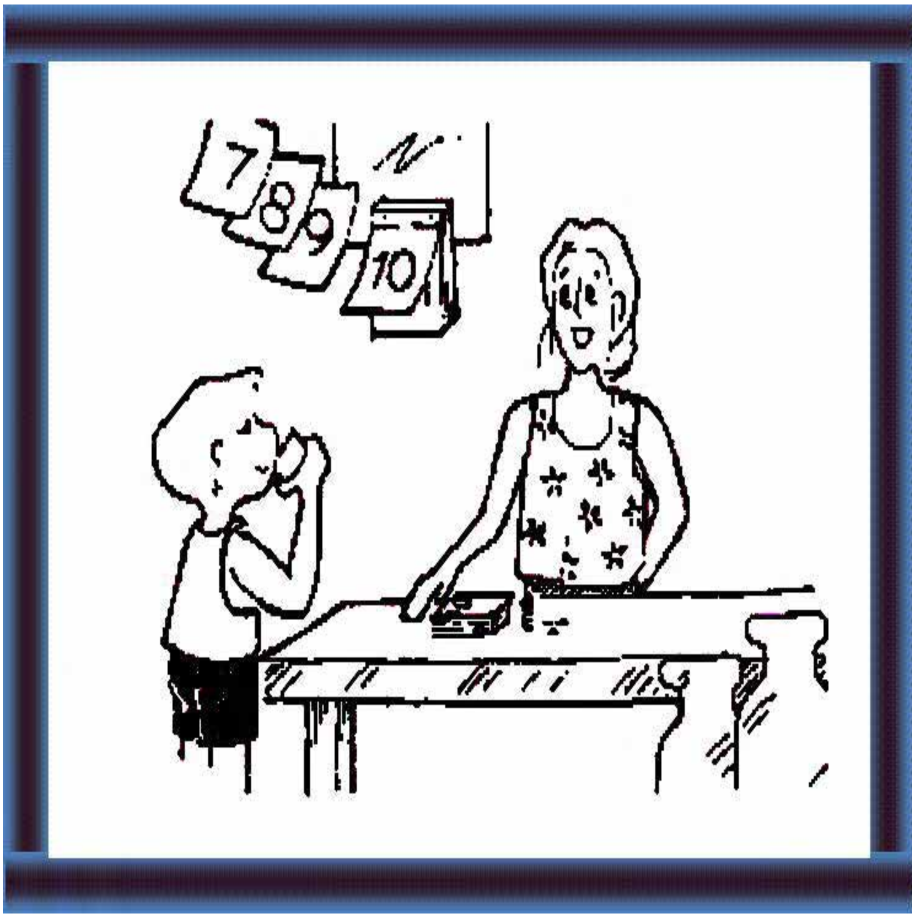
Milk Quality



Extension Materials

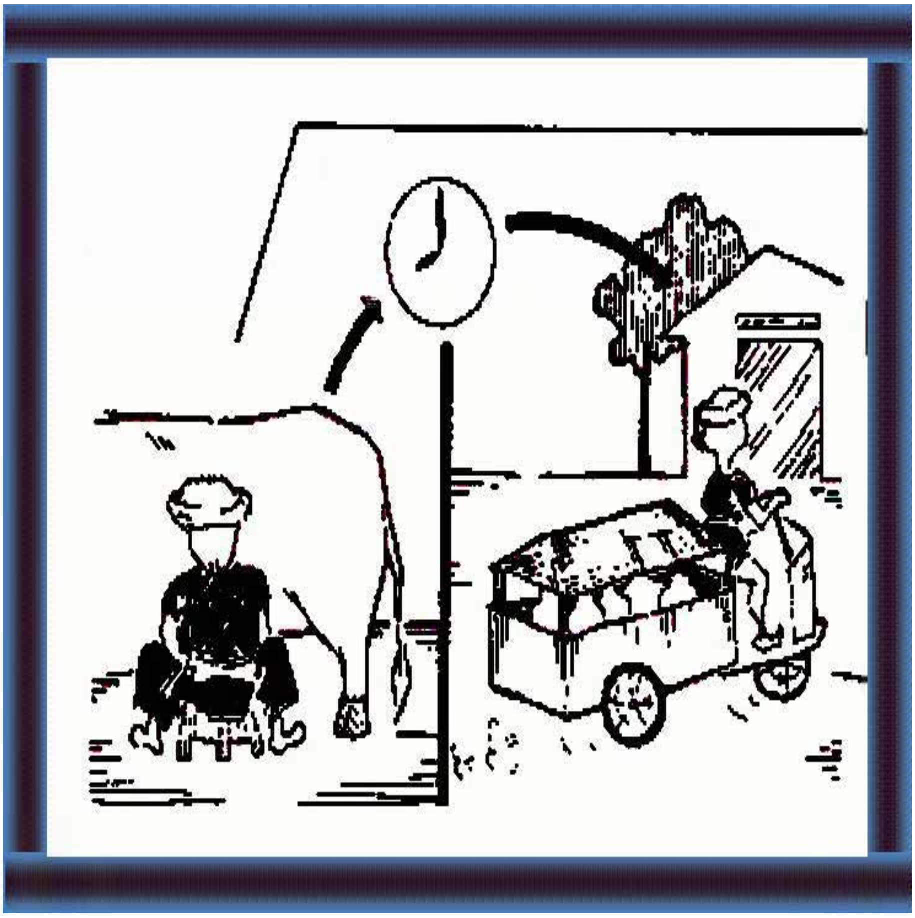
What should you know about milk quality ?

Why should you produce high quality milk ?



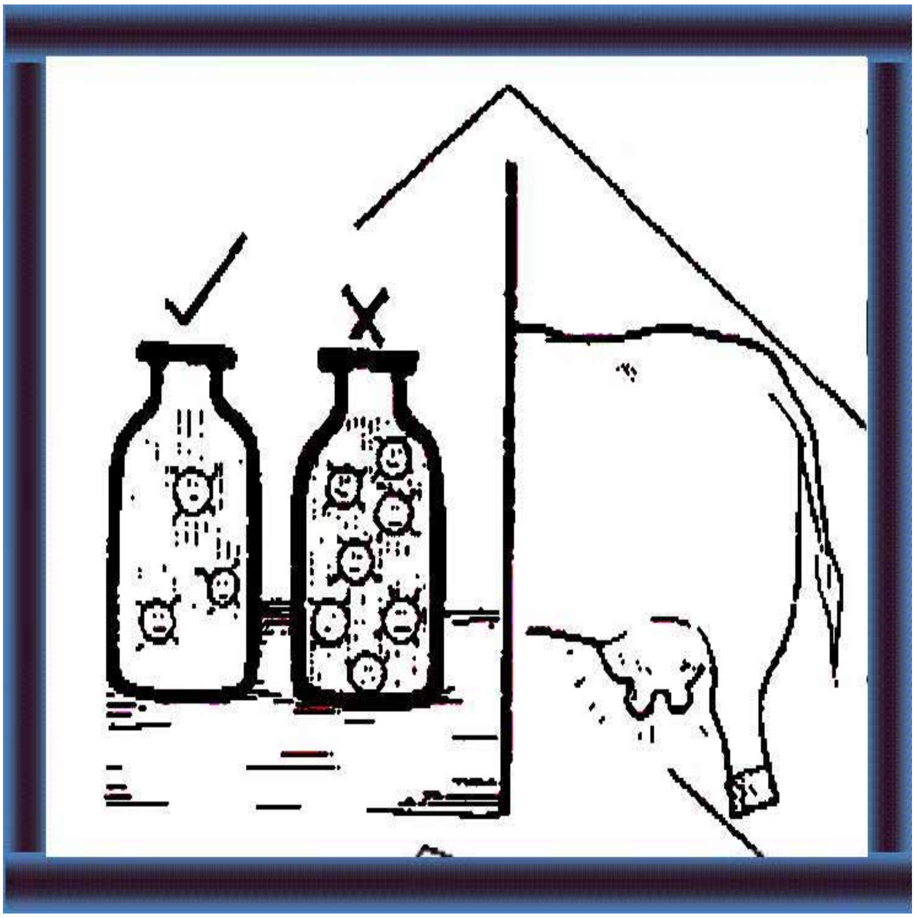
(5 - 8)

1 High quality milk:
- earns you money
- is better for you
-keeps longer.



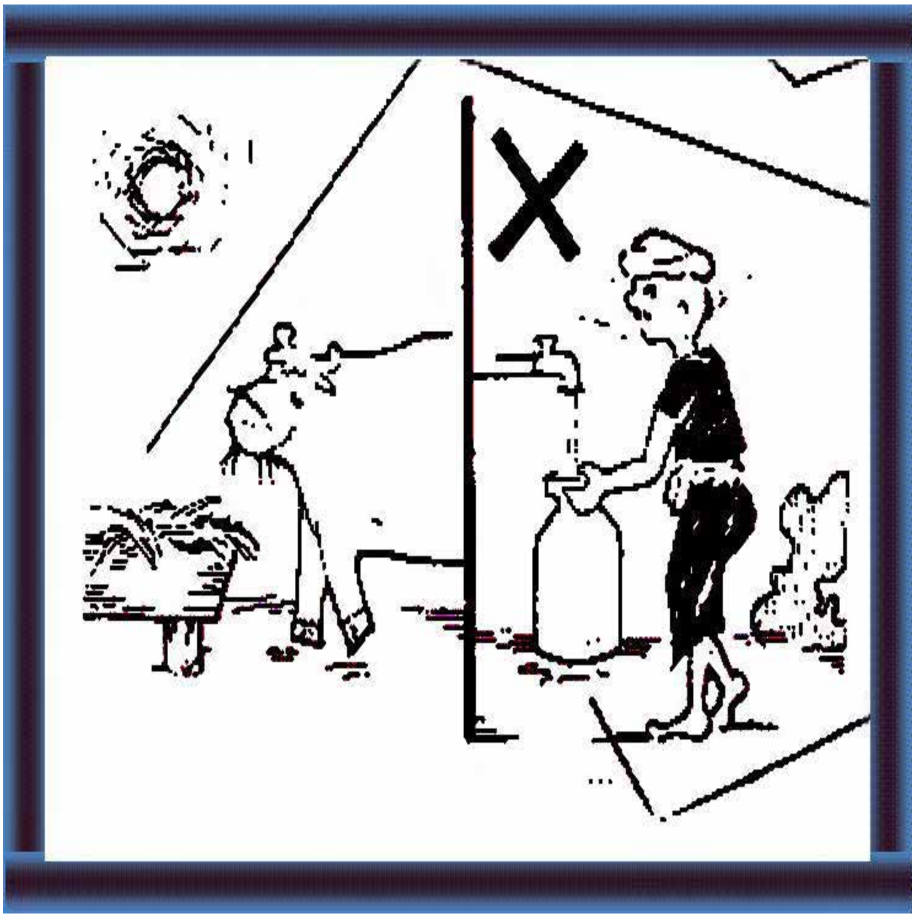
How can you produce high quality milk ? (9 - 12)

2 Make sure:
-you and your cows are healthy
- everything is clean
-you keep your milk cool and deliver quickly.



What affects the quality of your milk ?

3 The number ofbacteria in your milk (13 - 31) and the health of your cows (32 - 34).

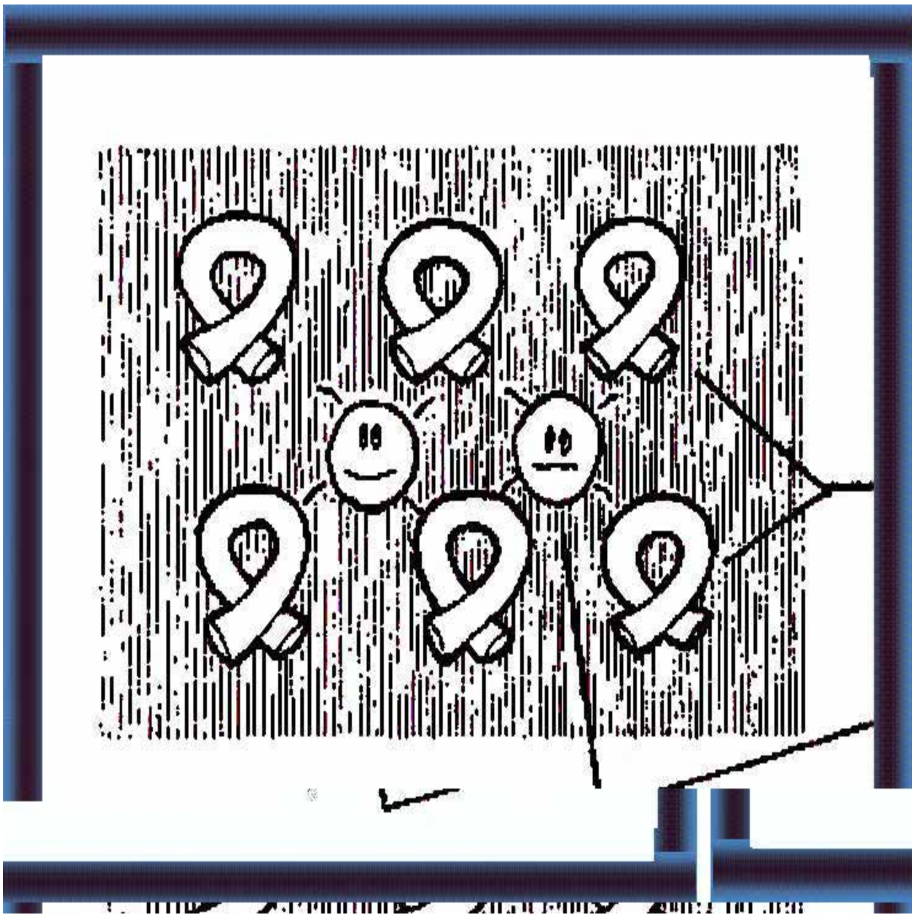


4 Thequality of your feed (35 - 36) and thepurityof you milk (39 - 43).

Why should you produce high quality milk ?

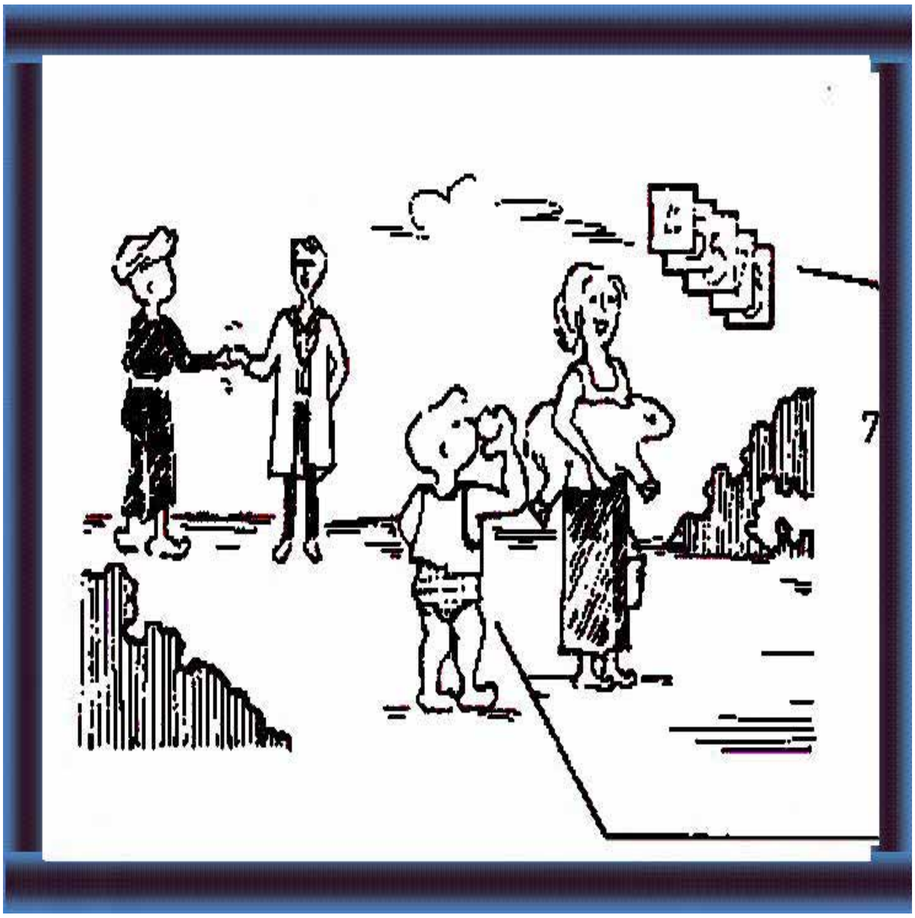
5 They test your milk at the collecting centre - high quality milk gets a good price.

6 High quality milk has



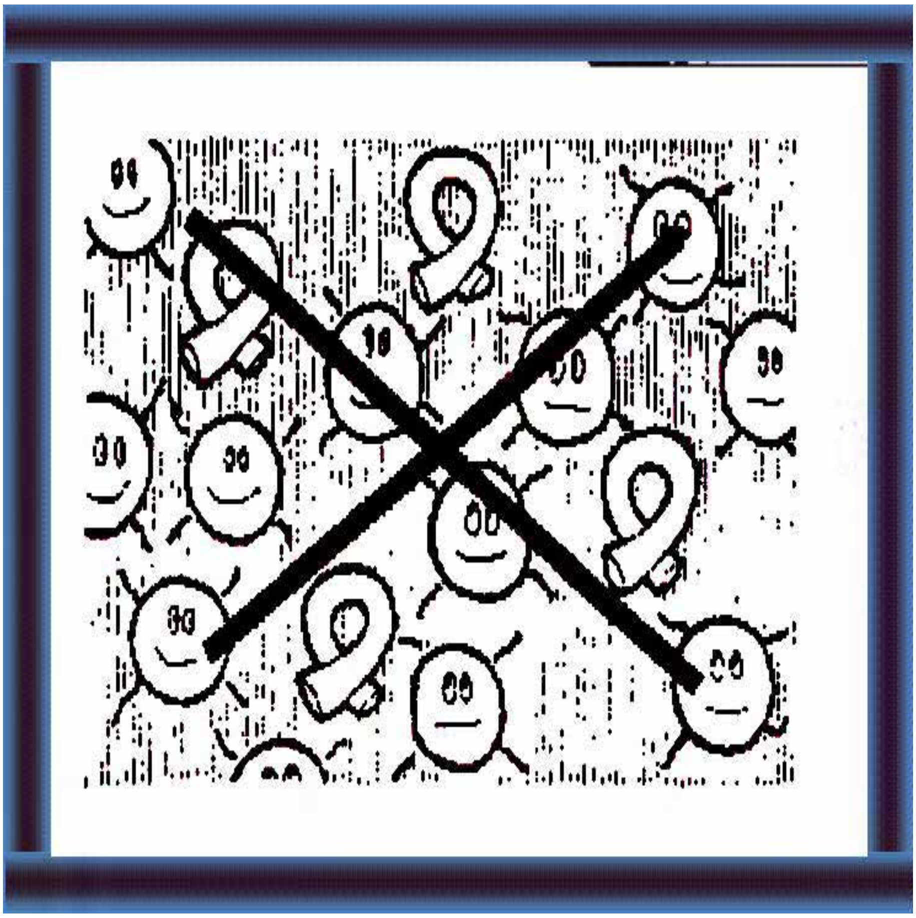
many
nutrient
and

few
bacteria.



7 So it
tastes
good
and
makes
you

strong
and
healthy
and
keeps.



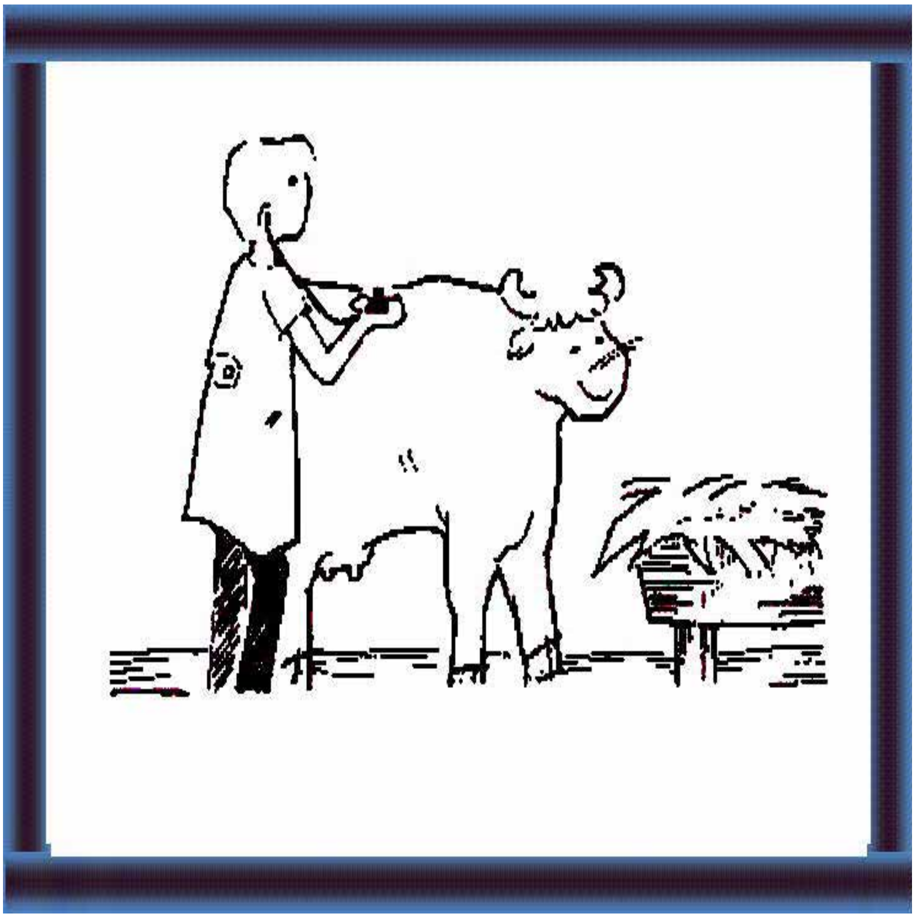
8
Milk
with

many
bateria

tastes
bad
and
does
not
keep.

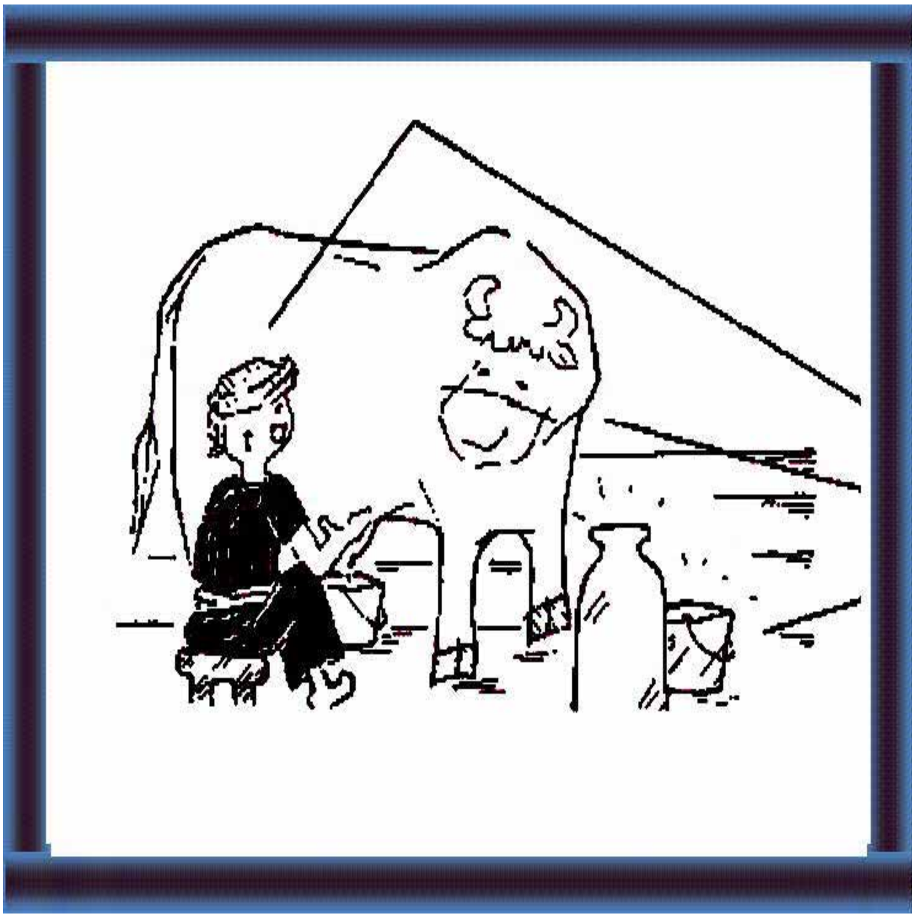
How can you produce high quality milk ?

9
Make



sure:

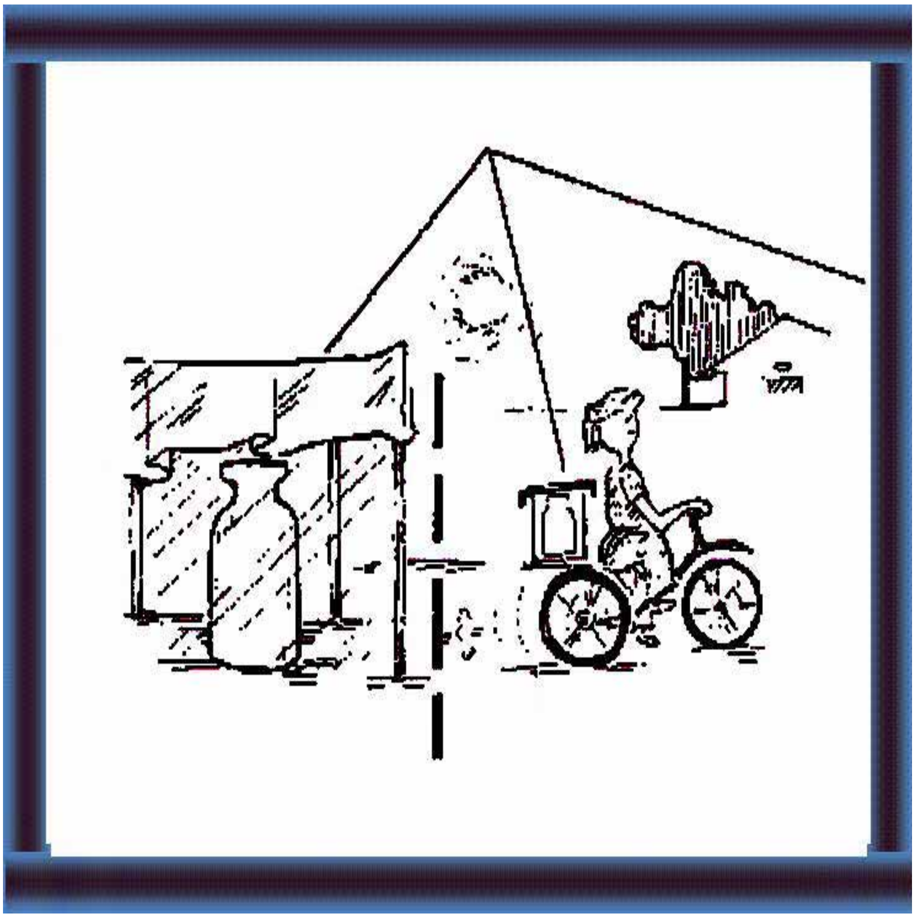
- your cows are healthy



10 you are clean

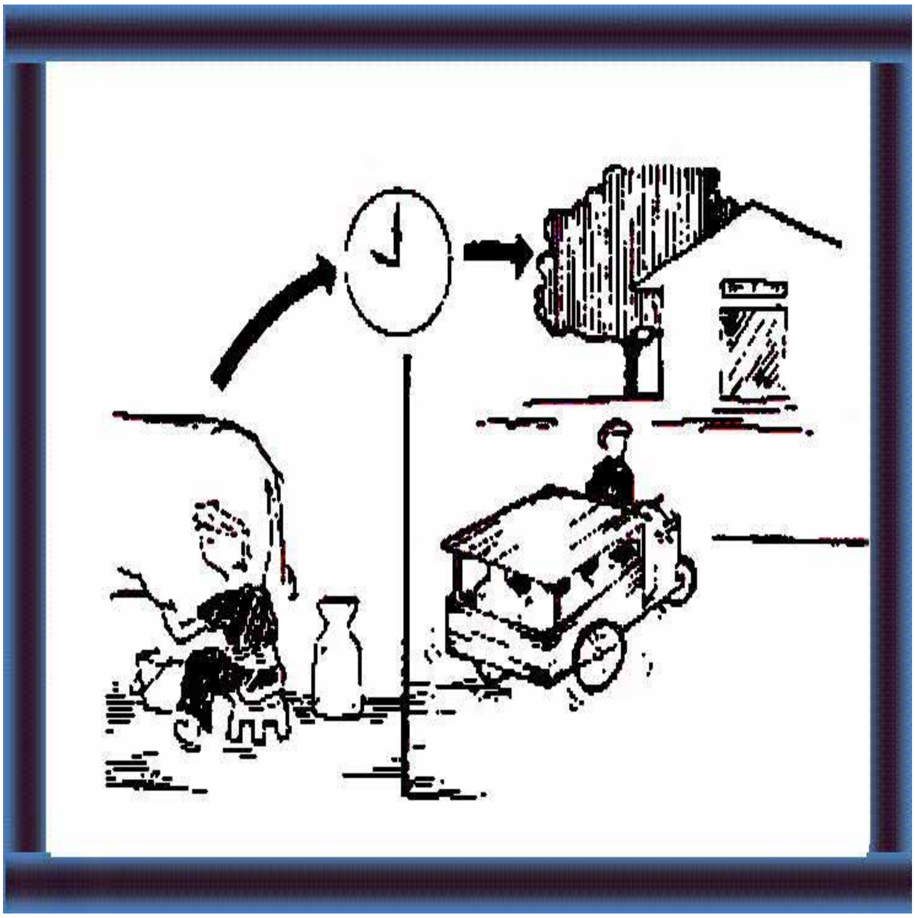
your cow is clean

every thing at the milking place is clean



11
you
keep
your
milk

cool



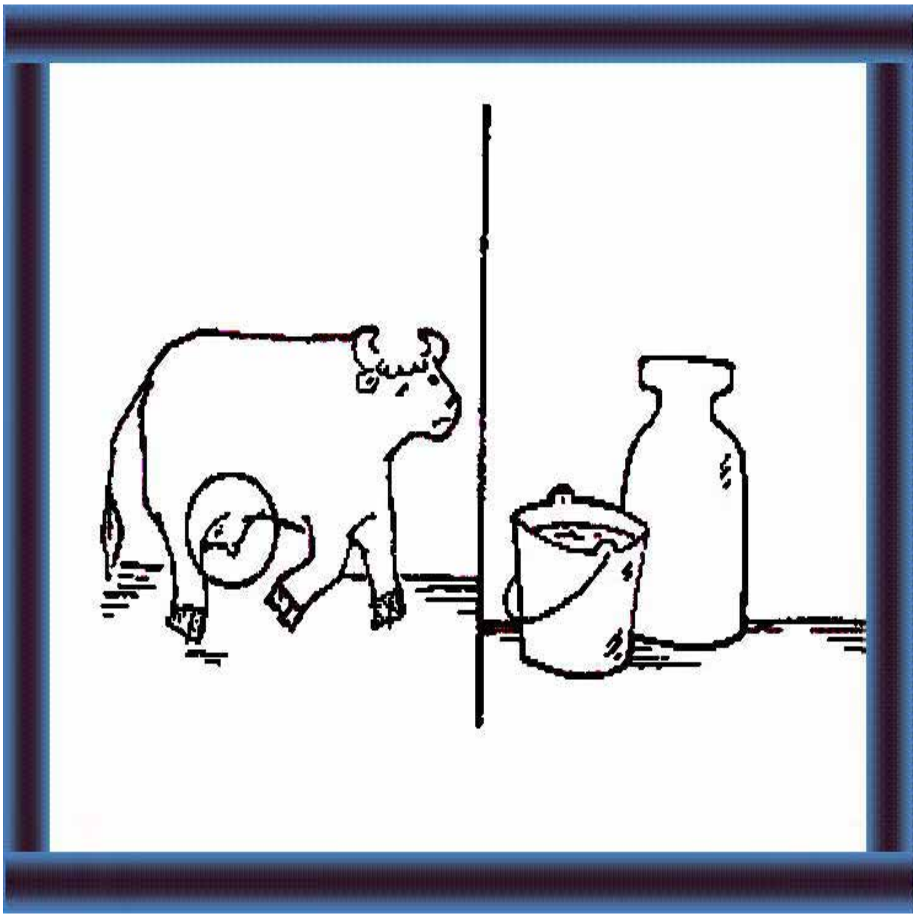
12 you
get your
milk

to the
collecting
centre

in the
shortest
time
possible

What affects the quality of your milk ?

Bacteria

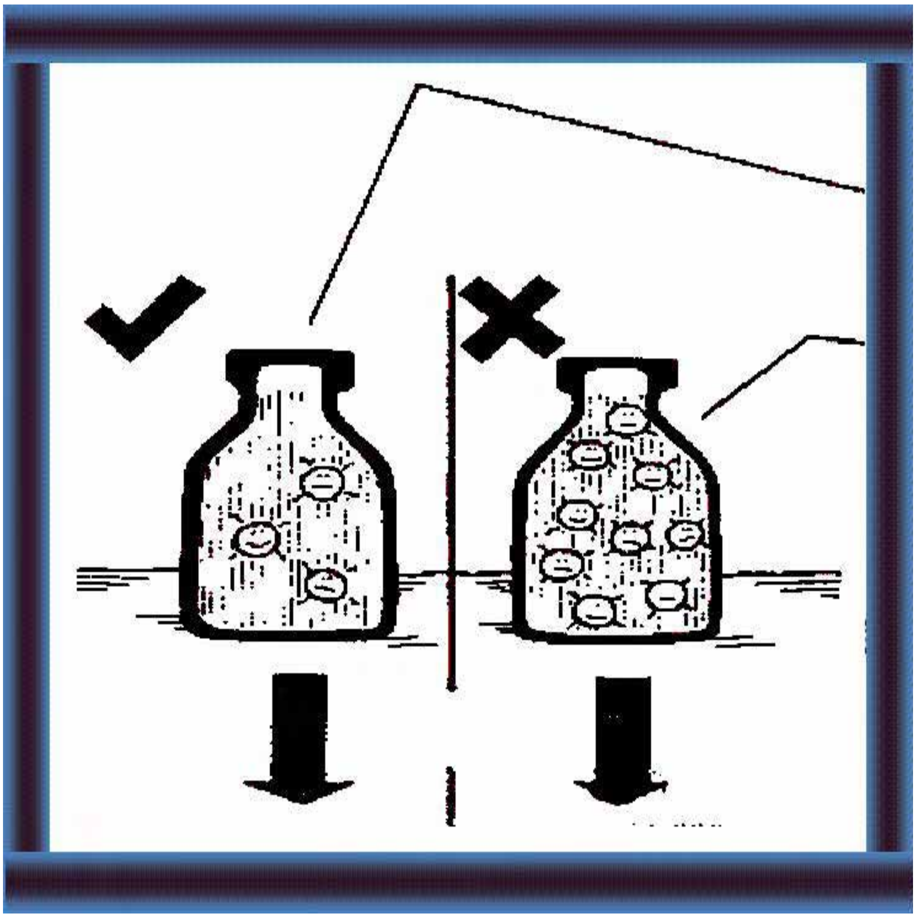


13 all milk contains

some bacteria

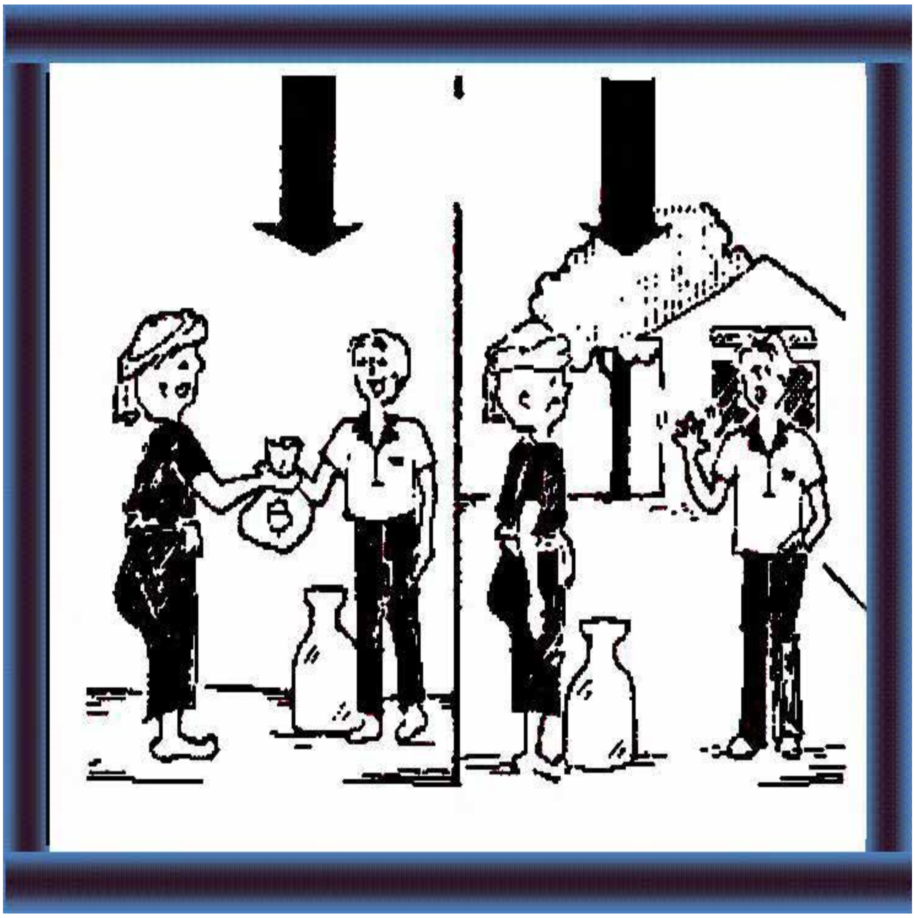
14 Milk with few bacteria is of

high quality.

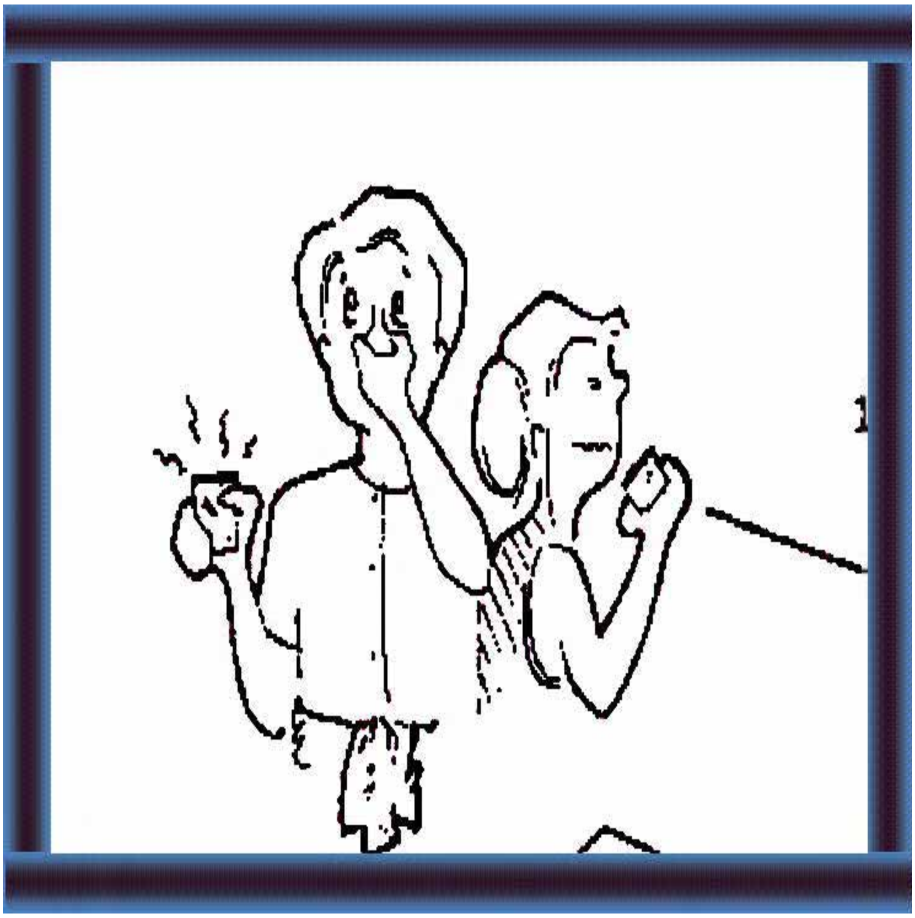


Milk with many bacteria is of low quality.

You get more money for high quality milk.



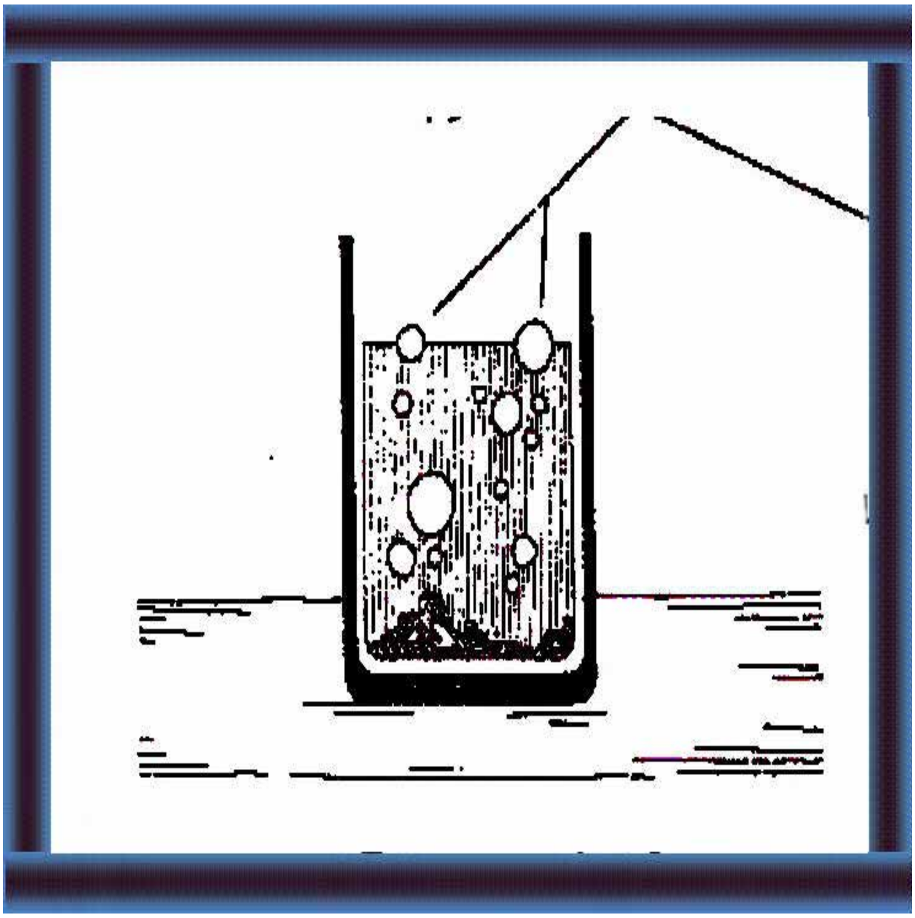
15 if your milk is of low quality and contains many bacteria, you get less money and the milk collection centre may reject your milk.



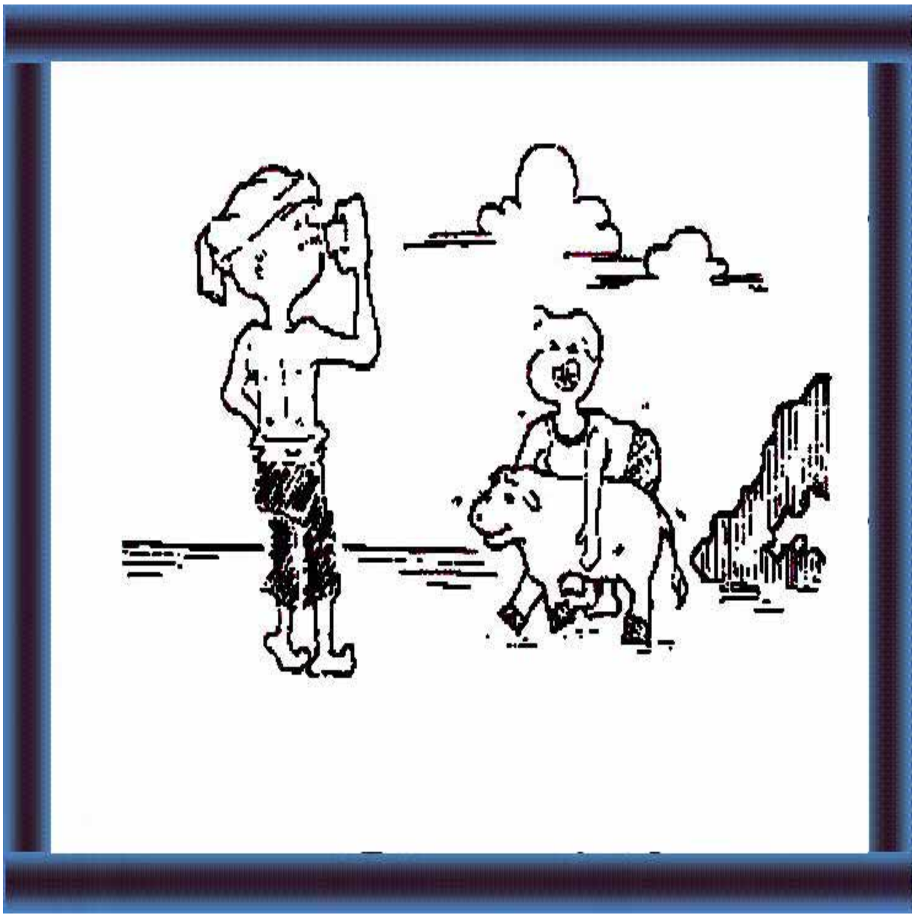
16
Some bacteria produce acids

and turn the milk sour.

17
Some bacteria produce

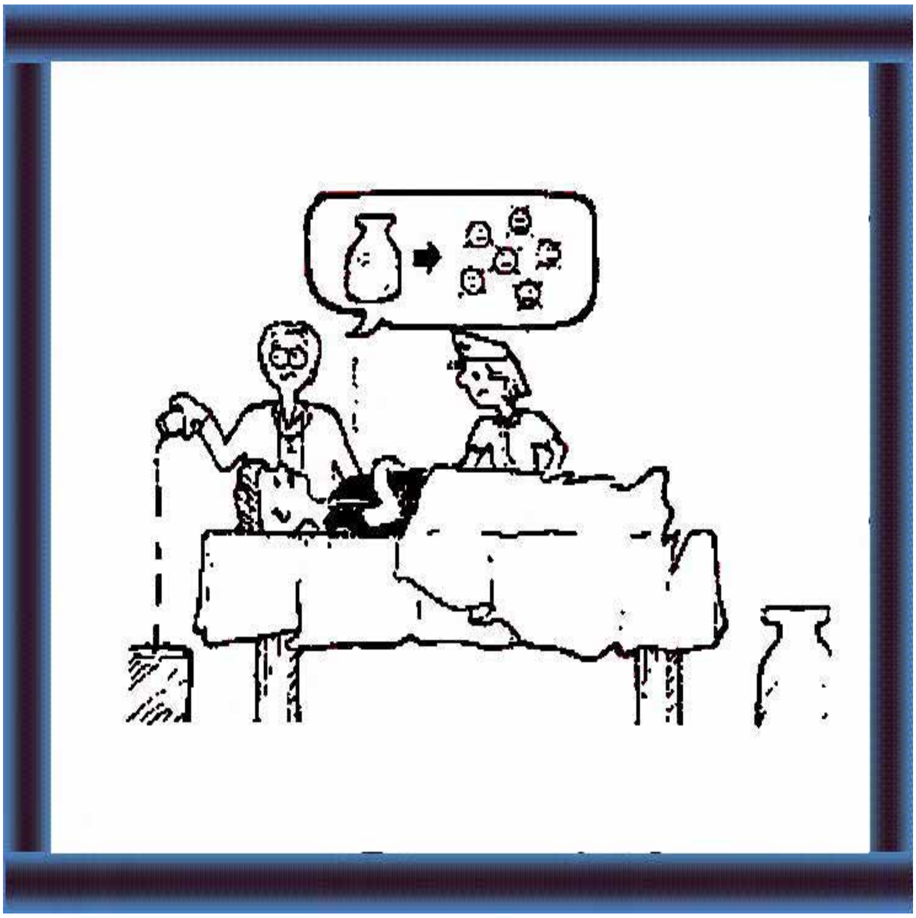


gas and spoil your milk.



18 Most bacteria breakdown your milk

and reduce the nutrient value.



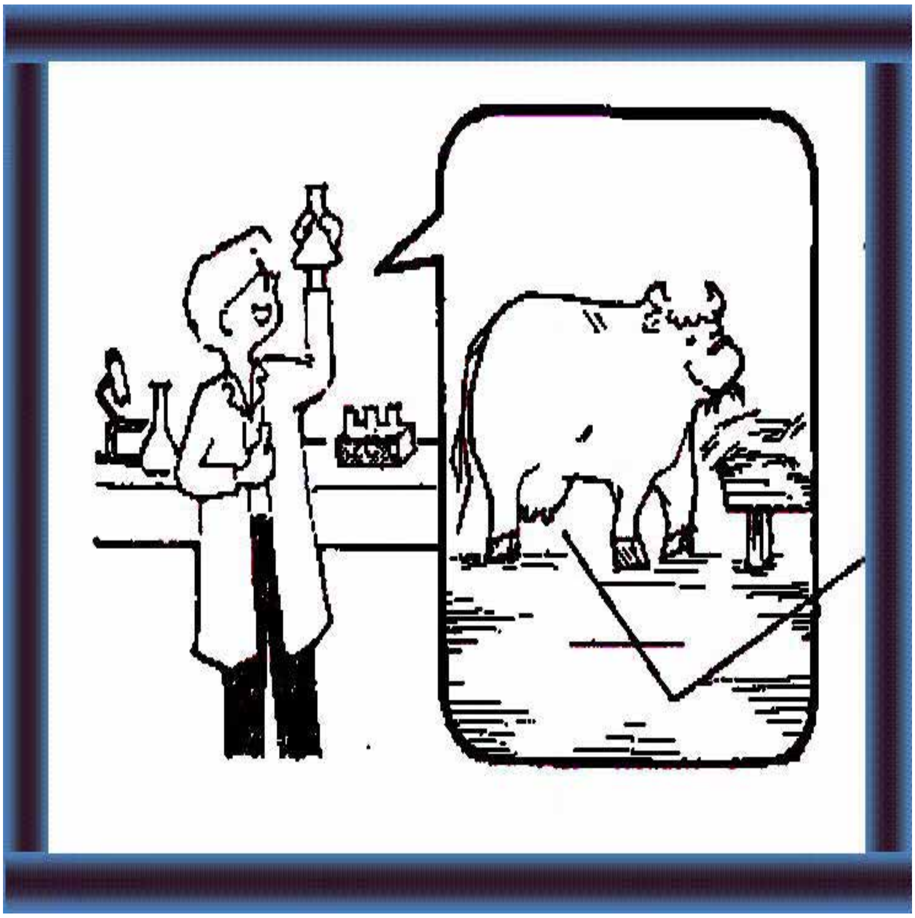
19
Some
bacteria

can
make
you ill

or even
kill you.

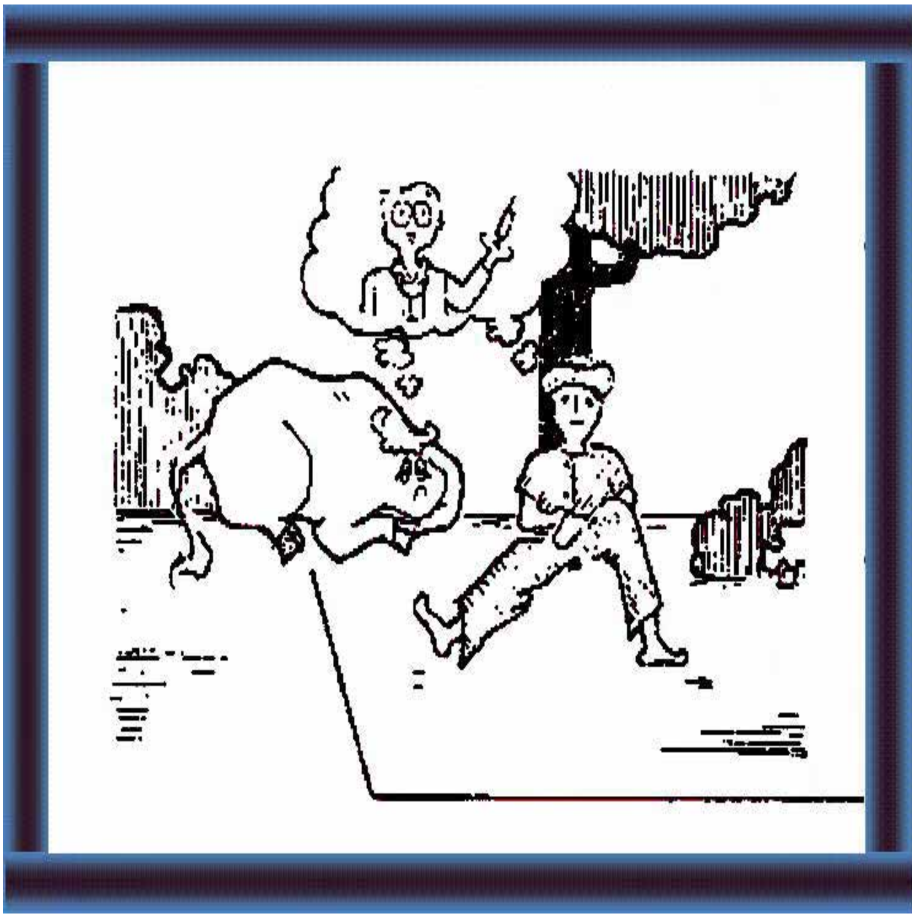
Where do the bacteria come from ?
Your cattle

20
Healthy
udders
produce

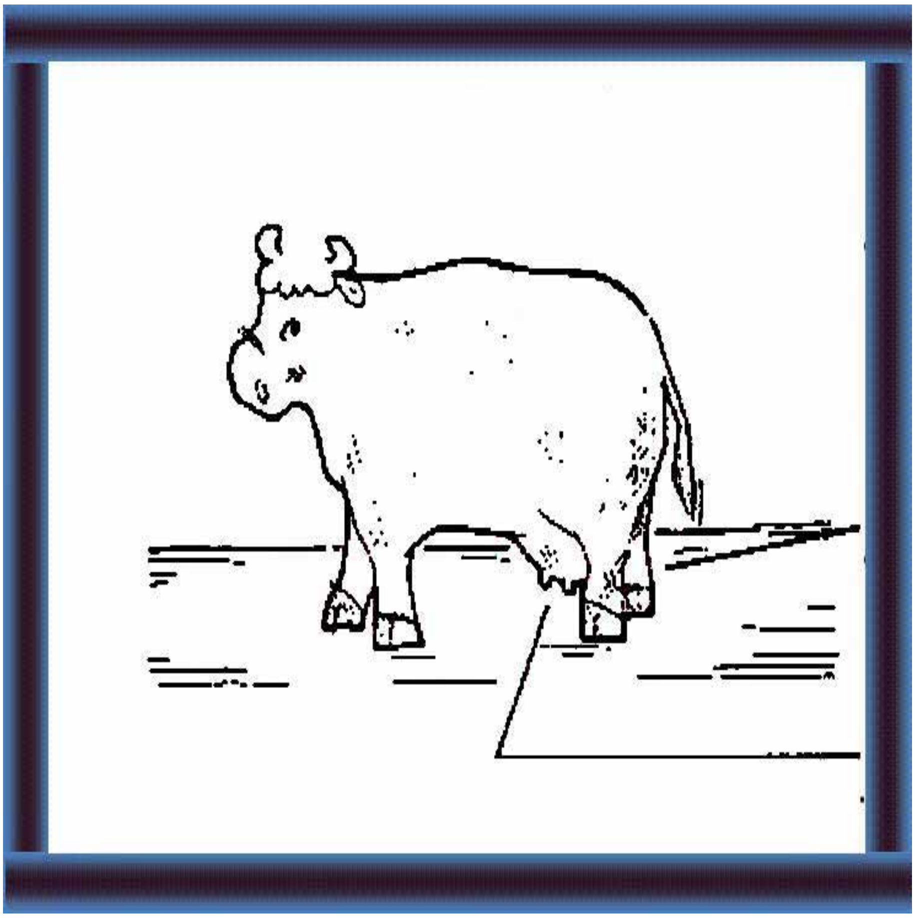


a few bacteria, but only a few.

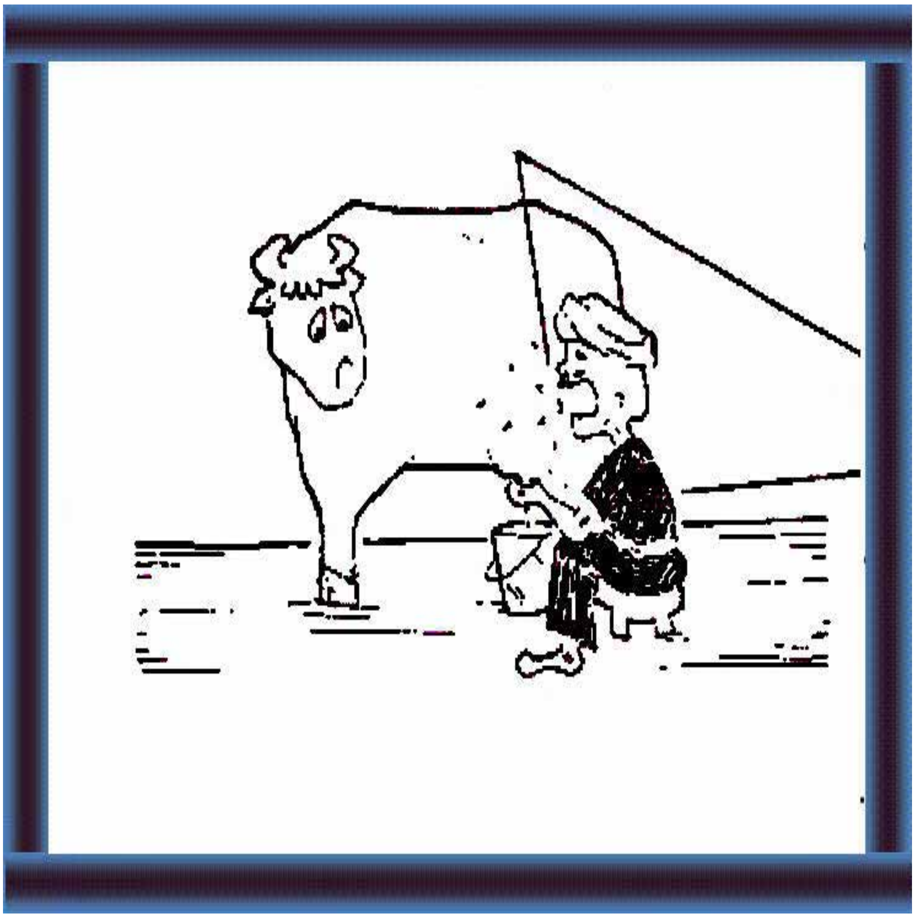
They do not harm your milk.



21 Diseased udders produce many bacteria, which can harm your milk and you.



22 Bacteria come from:
- dirt and faeces on the hind legs, udder and teats.



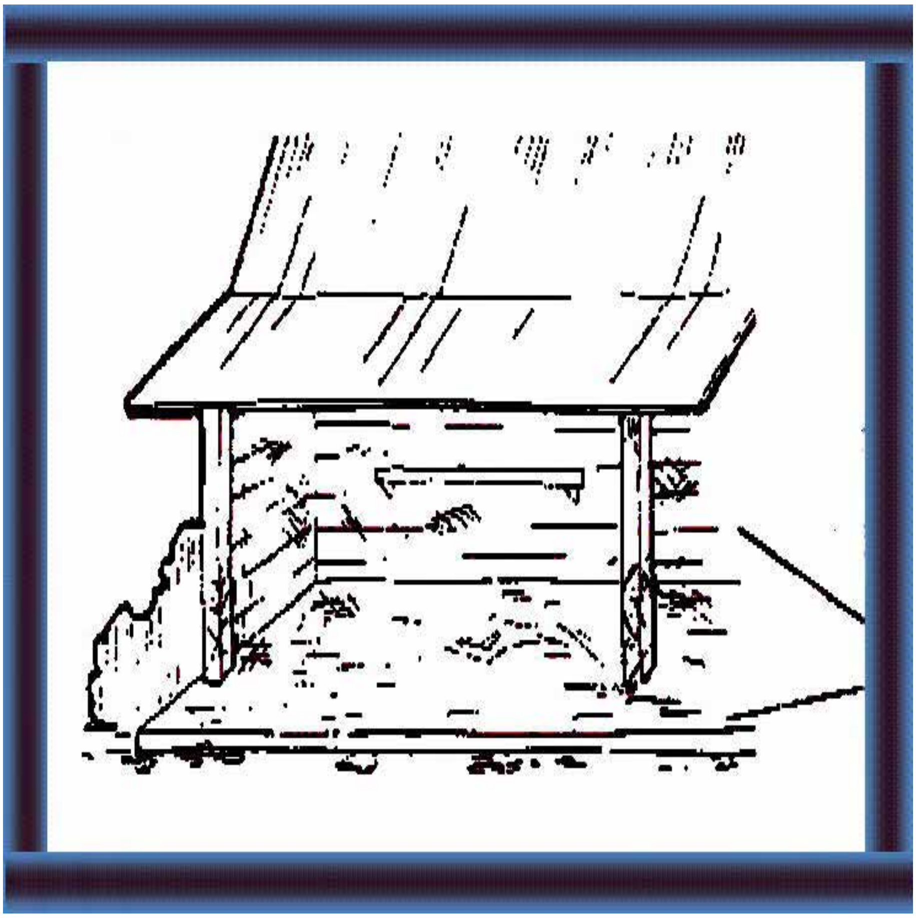
23 You:

- sneezing and coughing
- dirty hands and clothes
- inflamed wounds.

Milking Utensil

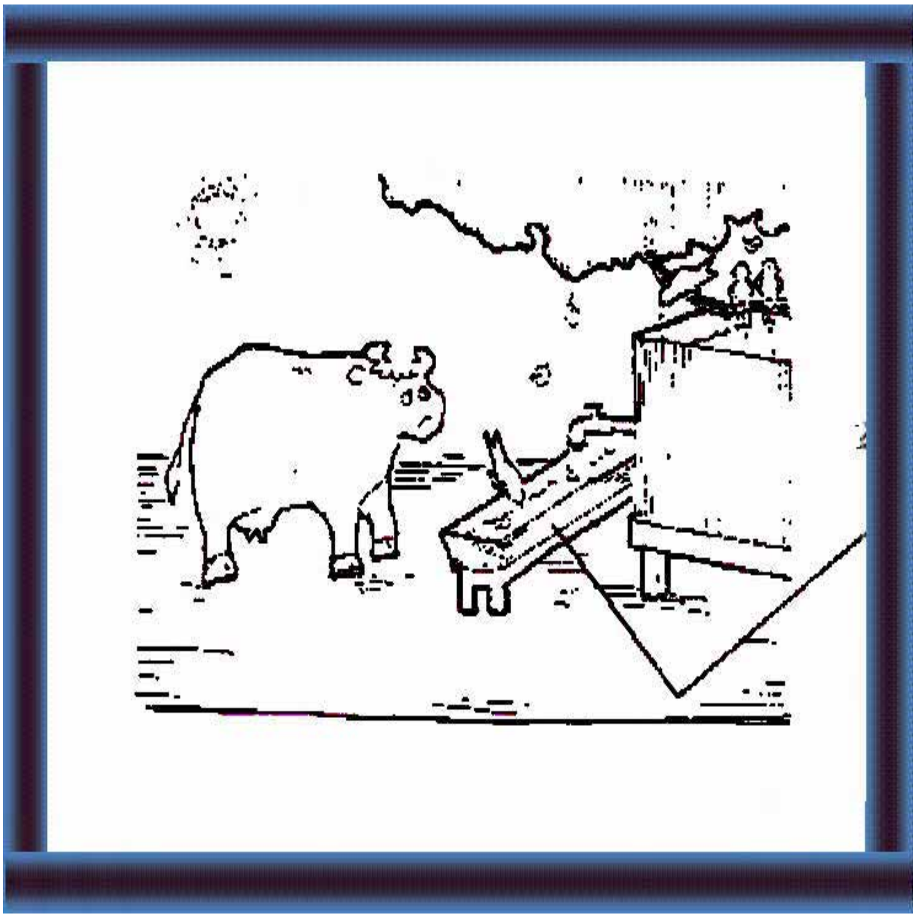
24
Bacteria
come
from:
- dirty
pails
- dirty
strainers
- dirty
churns
- dirty
udder
cloths

Environment



25 Dirty walls and floors

26 Dust carries bacteria from:
- the surroundings
- the manure heap
- residues
- the soil



27 Dirty water contains many bacteria.

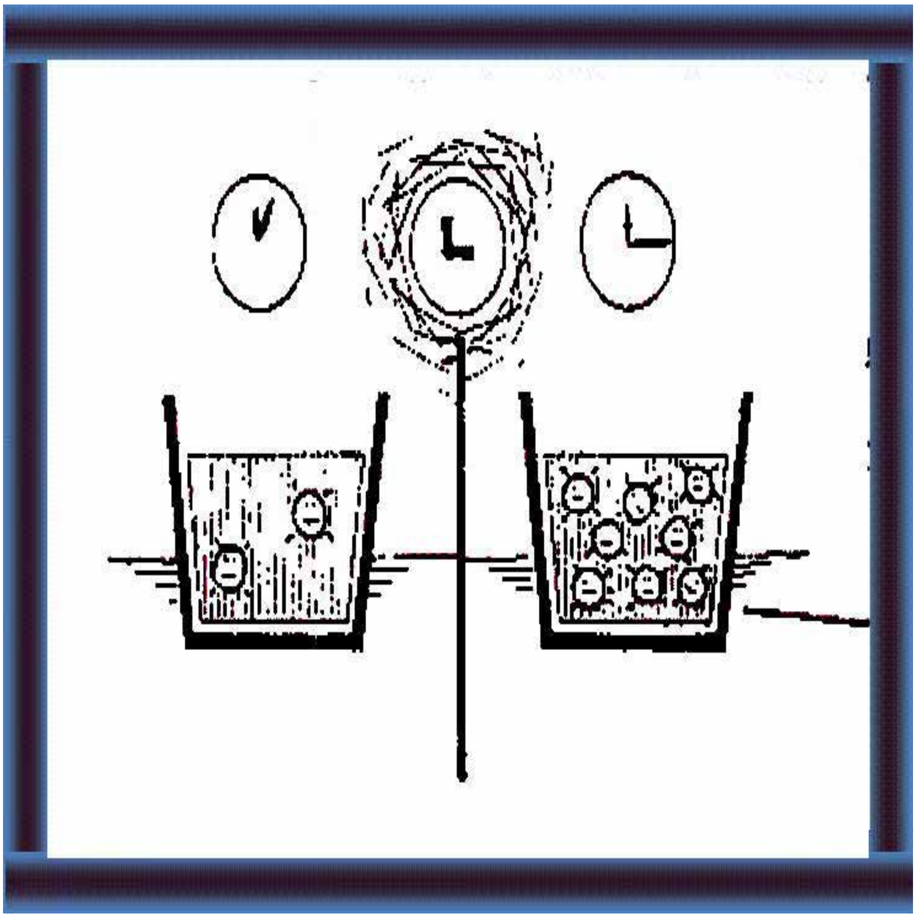
How can you keep the number of bacteria in your milk low ?

During milking

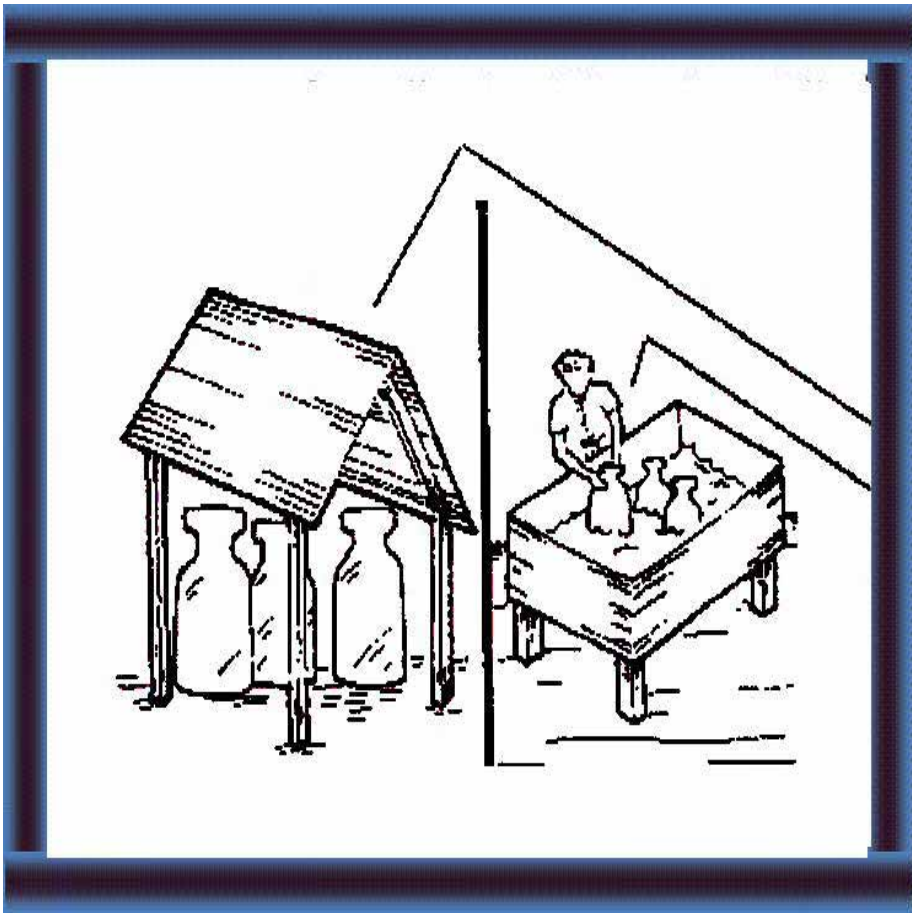
28 Keep milk clean by:
-

milking in a clean cow shed - using clean milking utensils -using clean milking practices.

During storage

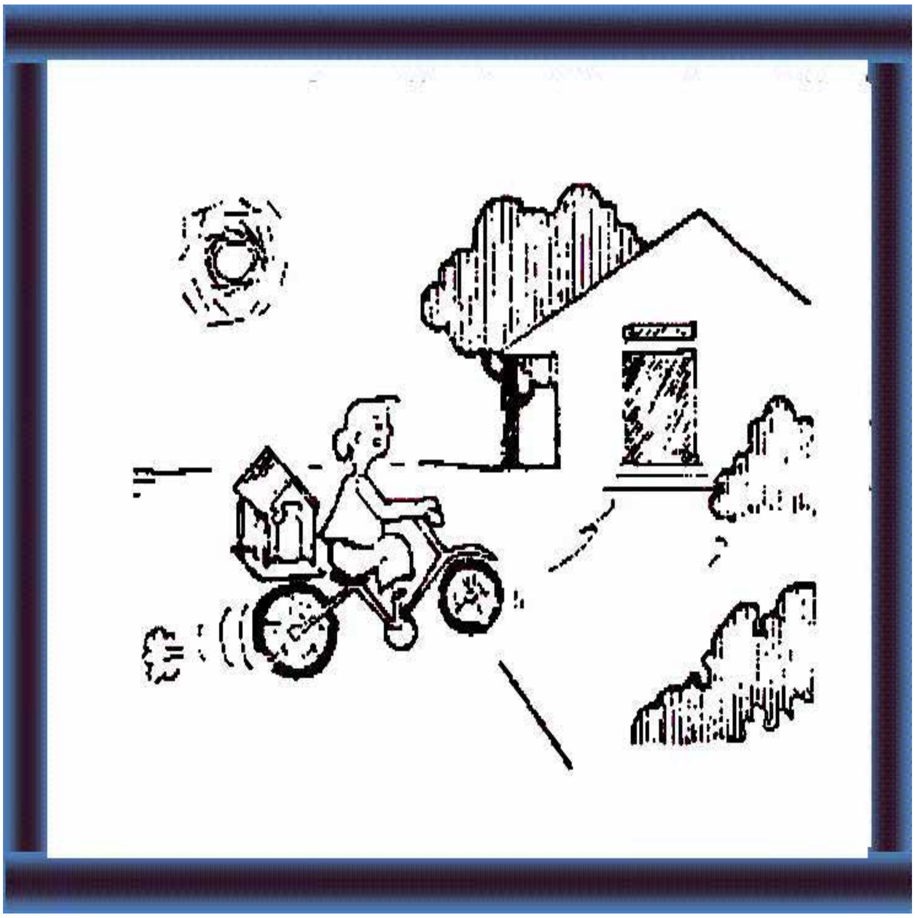


multiply quickly in a warm place.



30 Keep the collected milk in cans in a shady and cool place. Dip the cans in cold water before and after nilking.

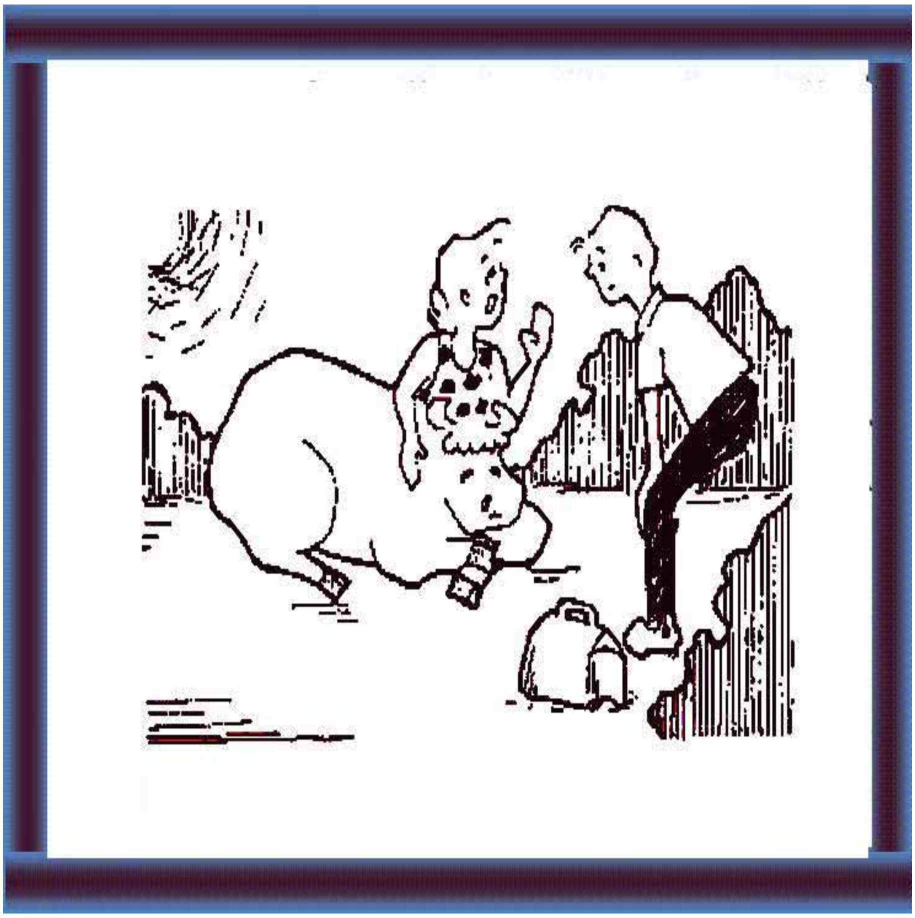
During transport



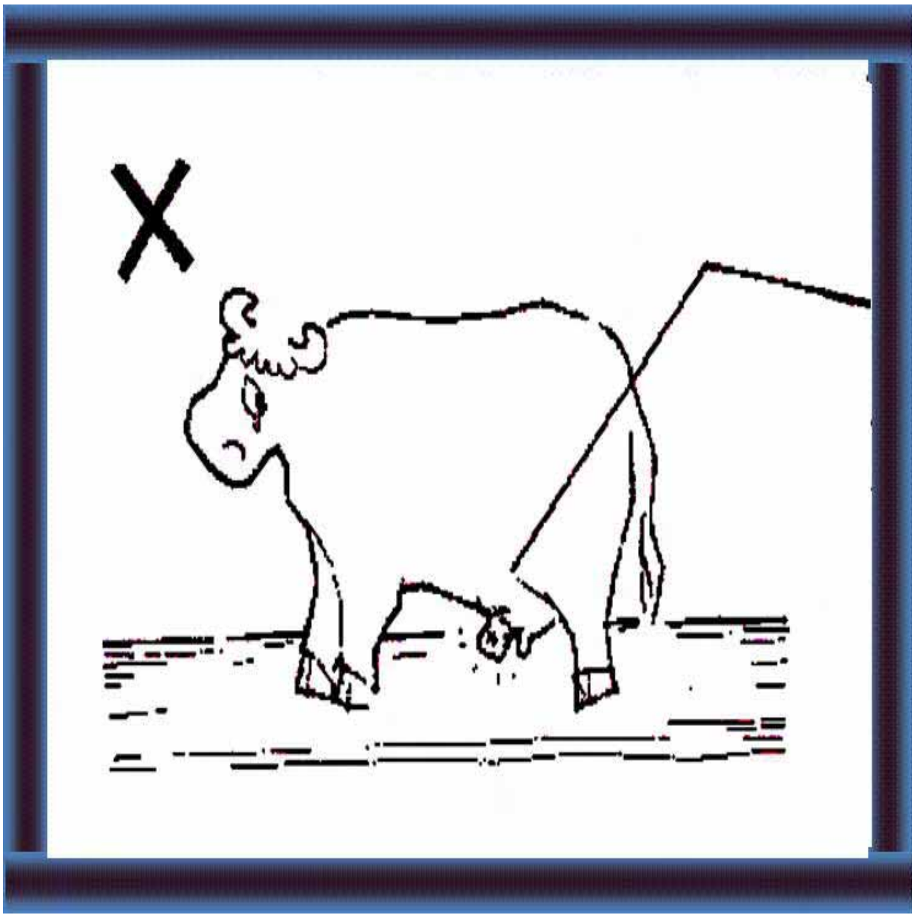
31 Get your milk to the collecting centres as soon as possible after milking.

Health

32 High

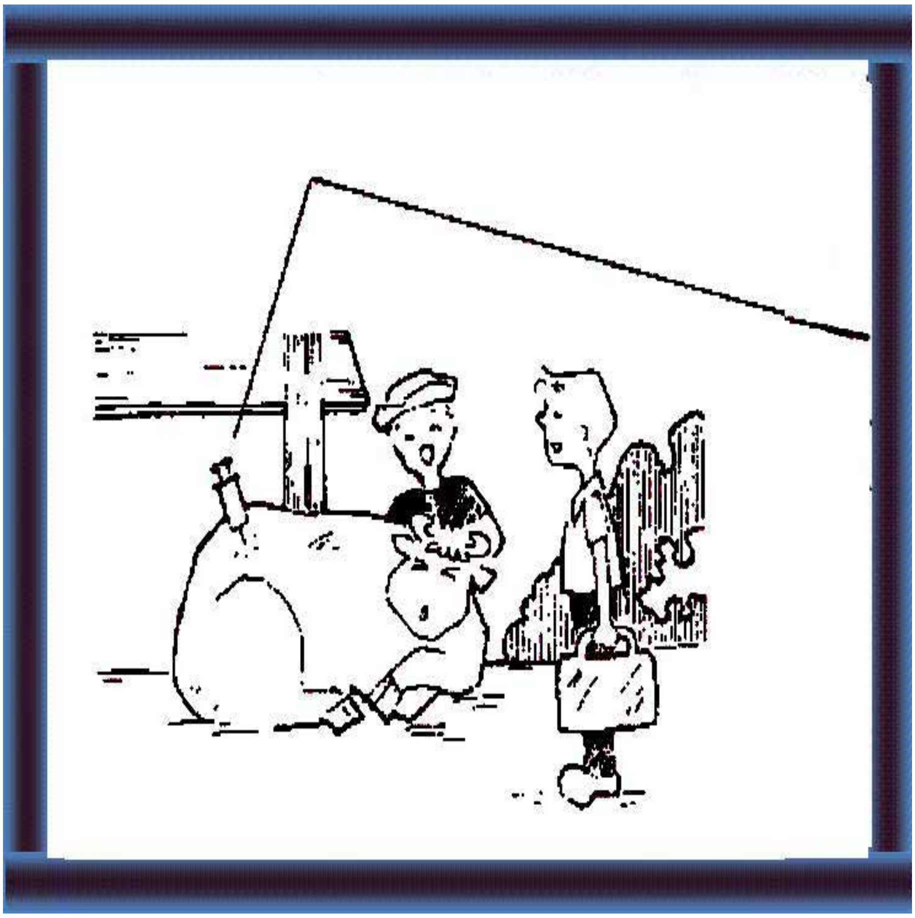


quality milk comes from healthy cows. If your cow is sick, consult your extension worker.



33 If your cow has

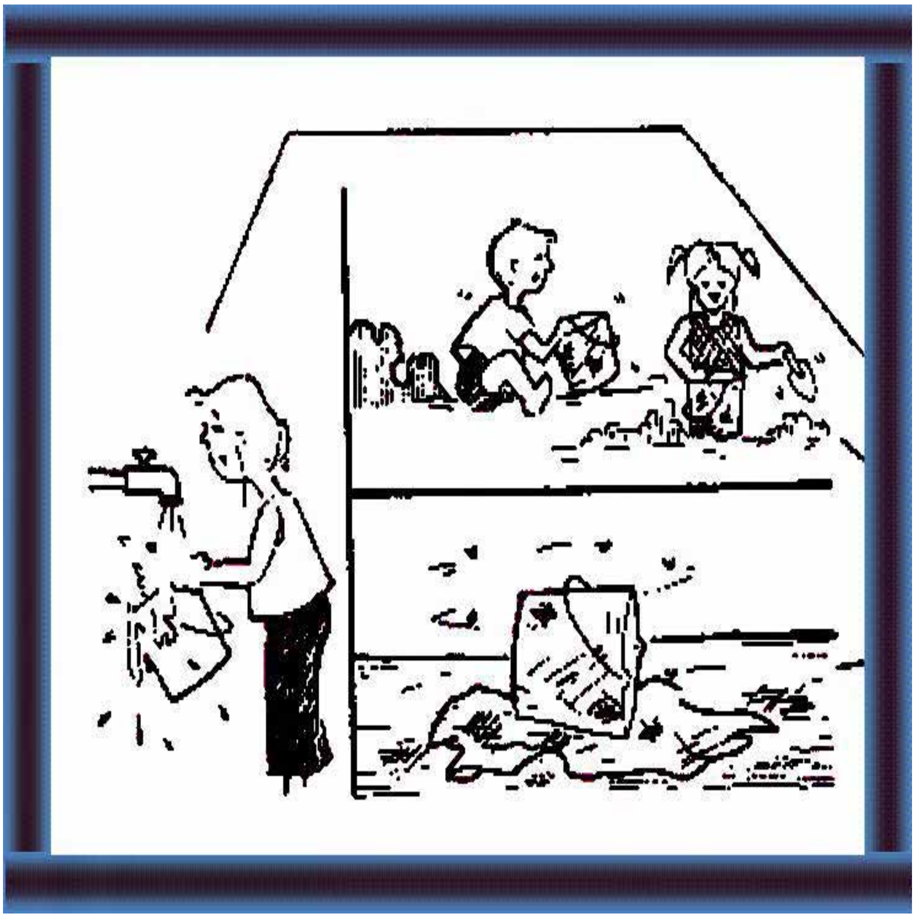
mastitis, do not deliver your milk. The collecting centre will reject it.



34 If your cow had antibiotic injections, do not deliver your milk until you consult your veterinatian or extension worker.

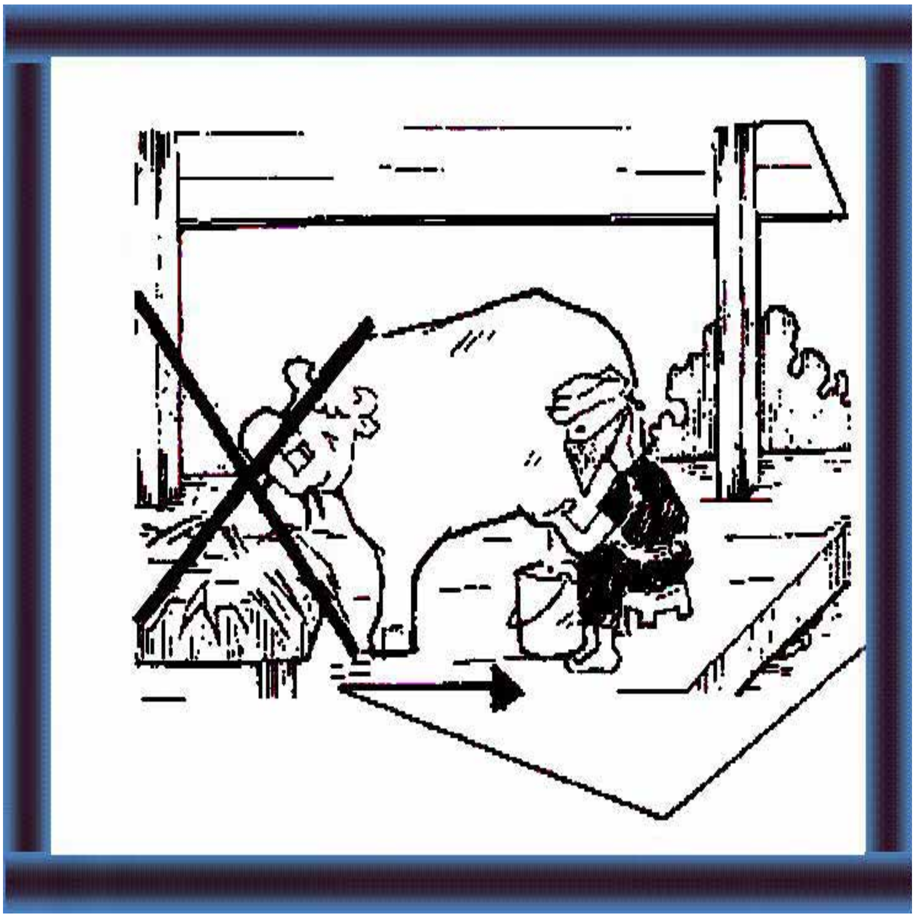
Feeding

35 If your milk has bad taste or smell, you may have to improve:



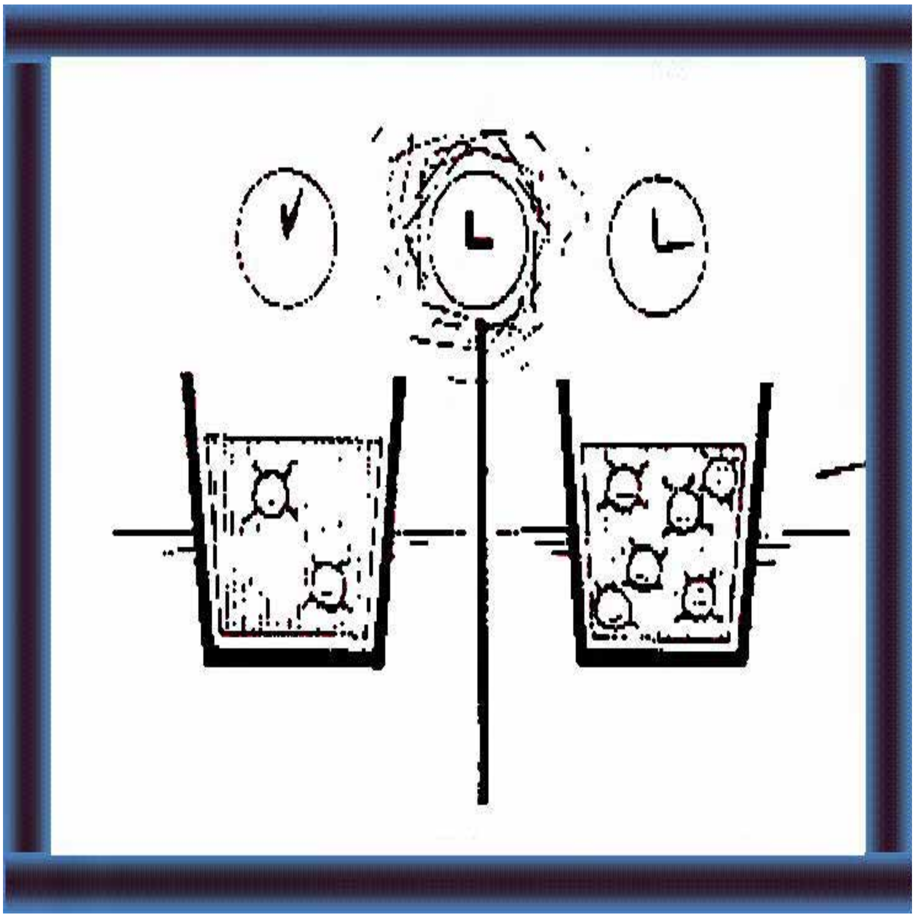
- cleaning
- handling
- storing

of milking utensils.



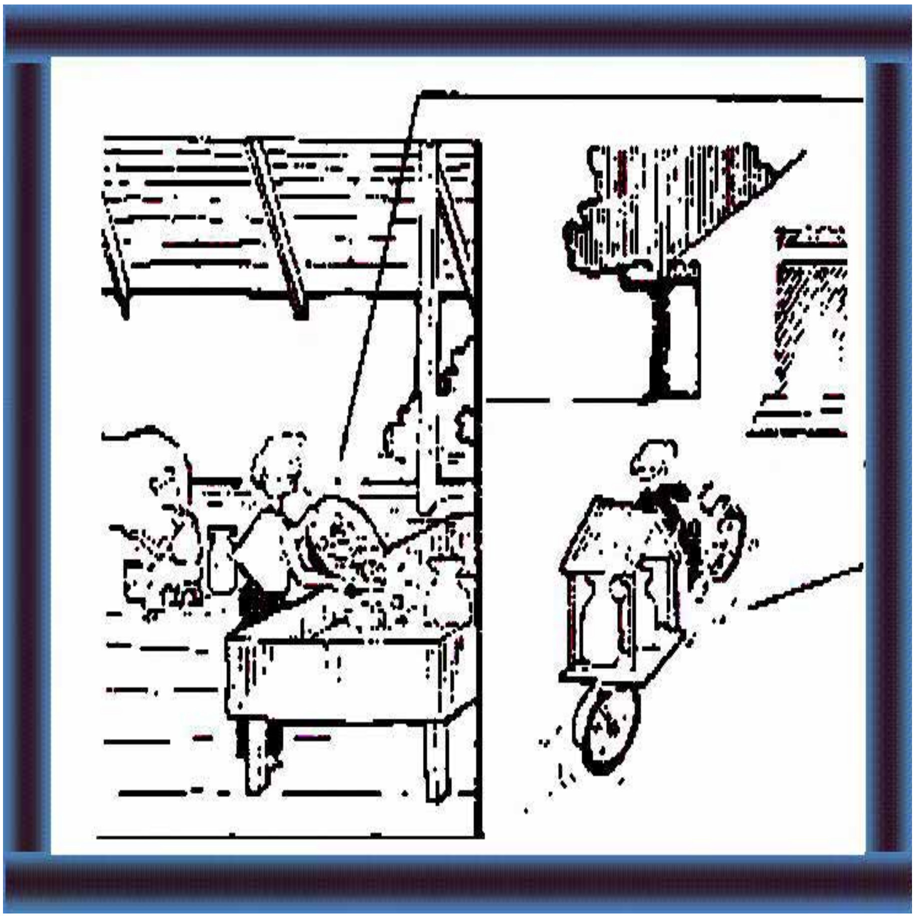
36 Do not feed silage and wet crop residues at the milking place. Smells from this and other feed may pass to your milk.

Temperature



37 Bacteria multiply in warm milk. Your milk has a bad smell and taste and spoils quickly.

38 Cool your milk after milking or deliver your milk



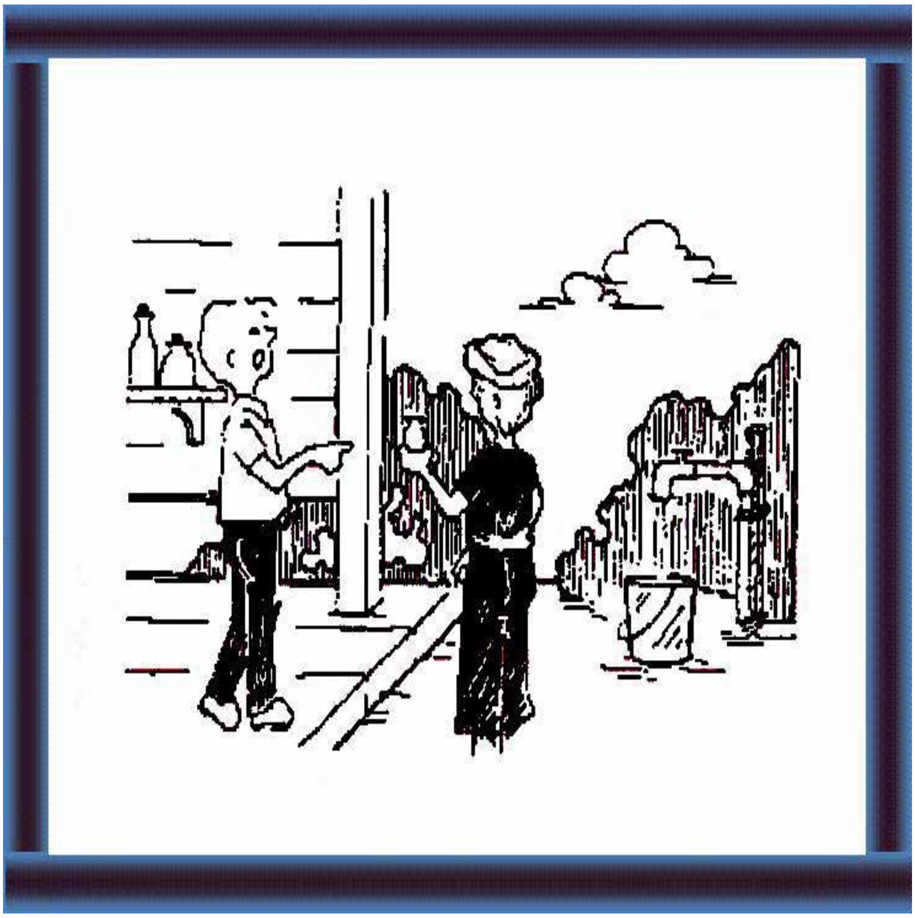
immediately to the collecting centre.

Purity

How do you make sure your milk is

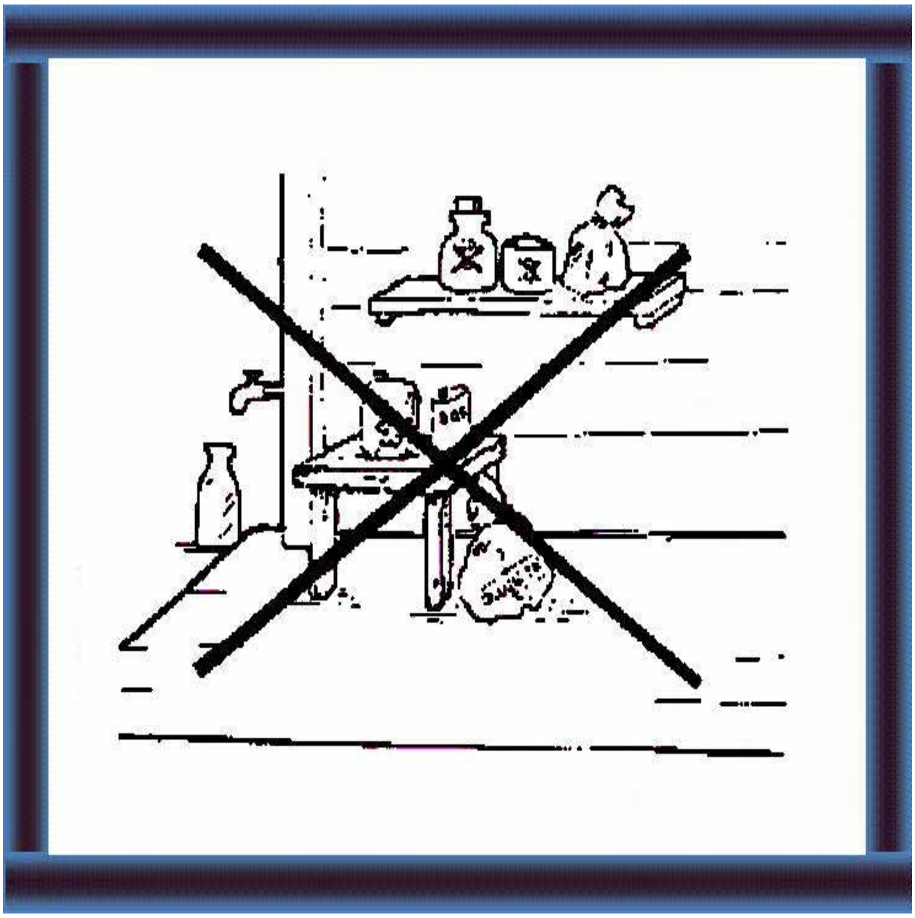
pure ?

39 Never add water
or anything else to your milk.



40 Make sure you use detergents and disinfectants to clean your milking equipment.

Follow instructions carefully and consult your extension worker.

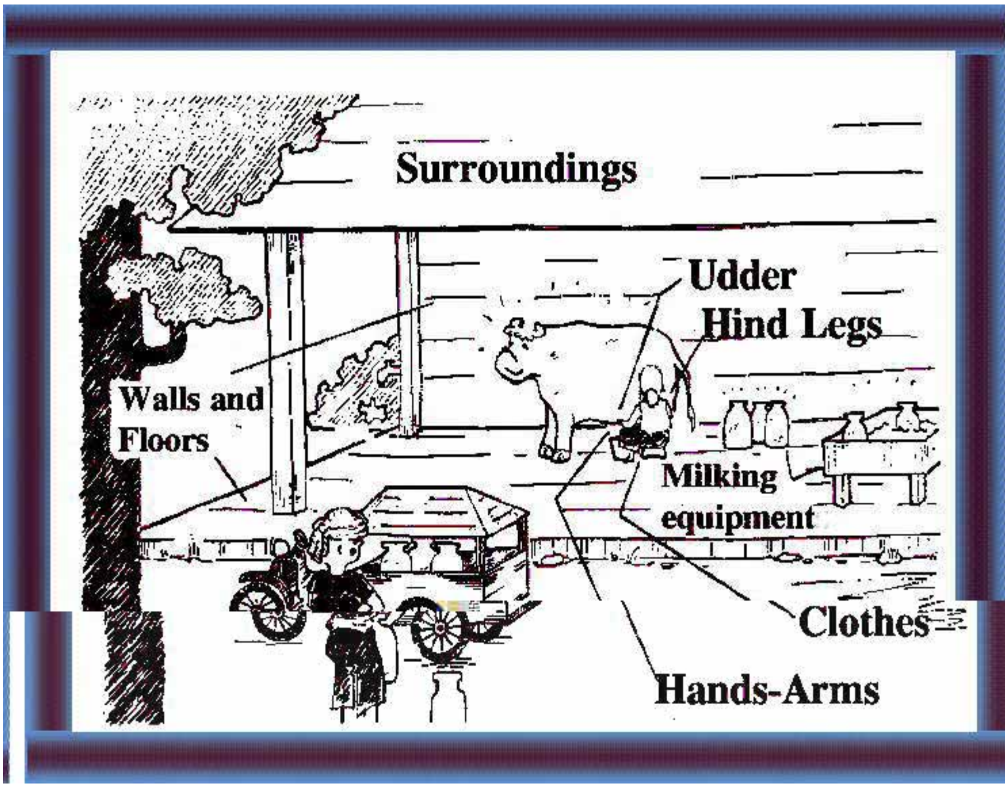


41 Keep insecticides, pesticides and other chemicals away from the milking shed and the water supply.

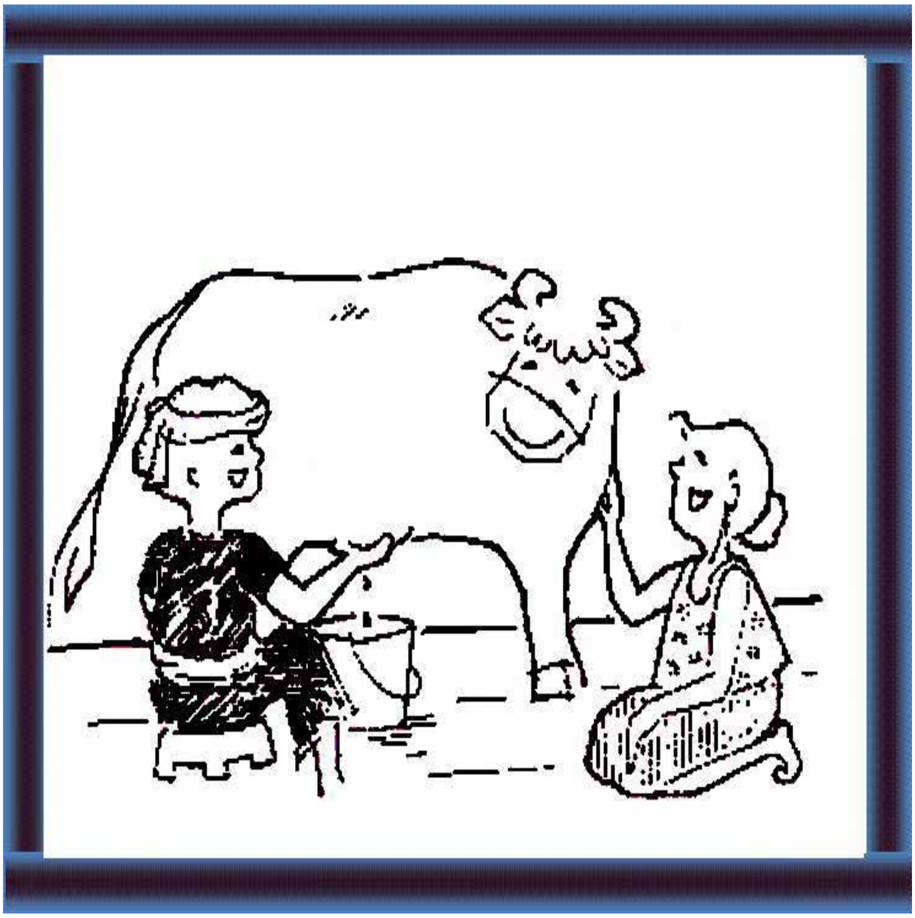
Hygiene

What do you clean ?

42 Everything



Milking



43 Prepare yourself, your equipment and your cow well before milking.

Apply the proper hand milking practice. (see H 7.2 Milking)

What do you know about milk quality ?

Reasons for producing high quality milk

1. Higher price (5)
2. Taste, nutritative value and keeping ability (6-8)

How to produce high quality milk ?

1. Healthy cow (9)
2. Hygiene (10)
3. Temperature (11)
4. Delivery time (12)

Factors affecting the quality of milk

1. Bacteria
   - number and milk payment (13-15)
   - effects of bacteria (16-19)
   - where bacteria come from (20-27)
   - keeping the number of bacteria low (28-31)
2. Health
   - mastitis (33)
   - antibiotics (34)
3. Feeding (35-36)
4. Temprature (37-38)
5. Purity
   - additives (39-40)
   - chemicals (41)
6. Hygiene (42)
7. Milking (43)

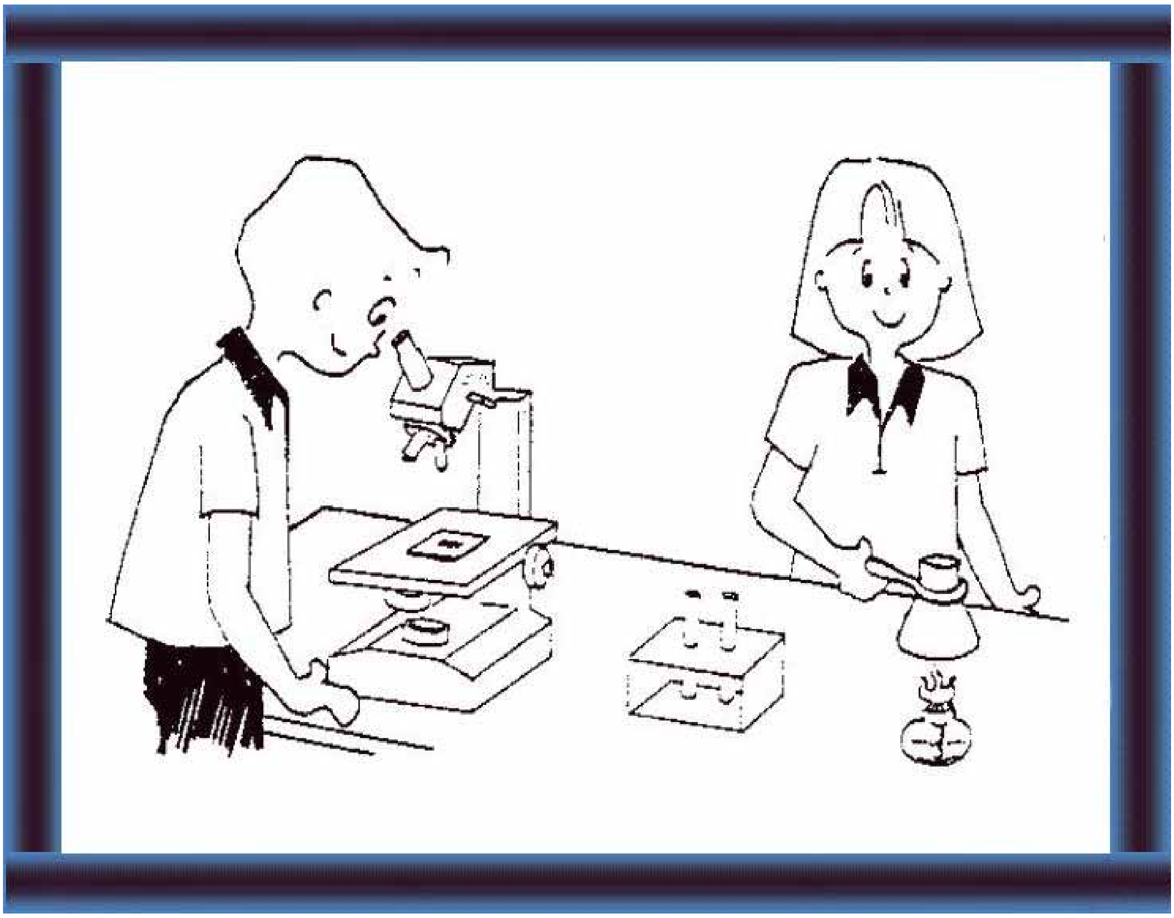
Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 3

Milk Quality Control



Technical Notes

Numbers in brackets refer to illustrations in the Extension materials.

Introduction

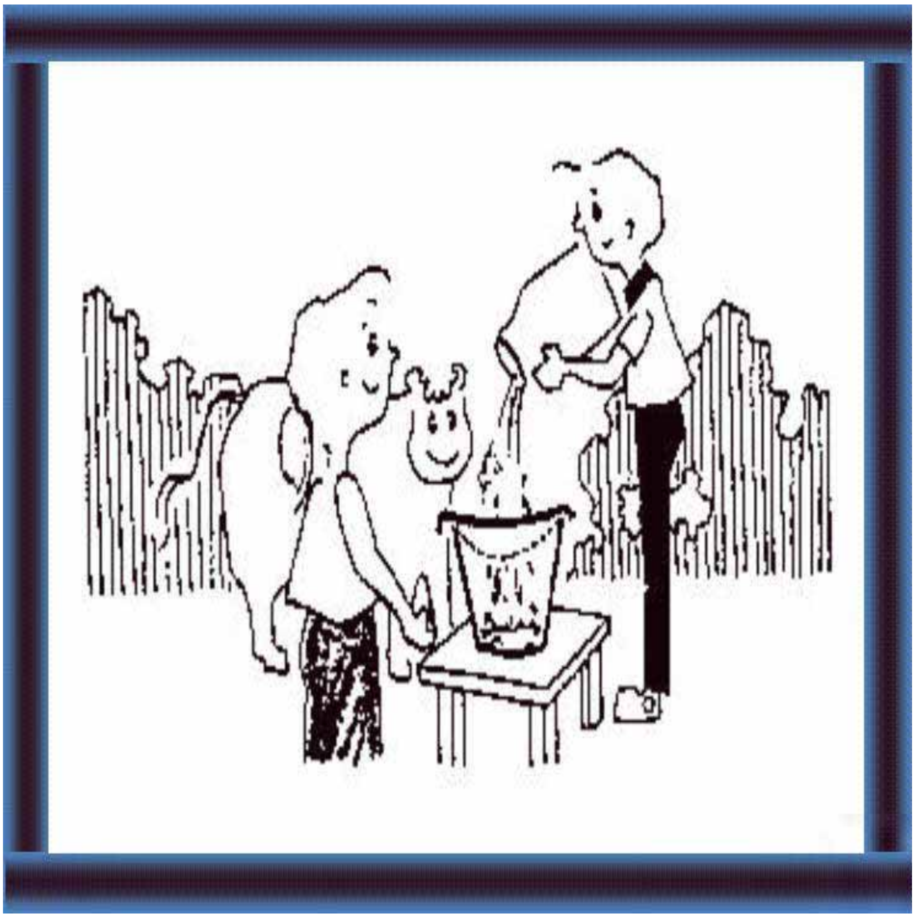
Milk in the udder of healthy animals has very little bacteria. It is only after leaving the udder that the milk can be contaminated with bacteria if proper hygenic handling is not undertaken. Sources of contamination include:

Milking Utensils
The milker
The air

The skin of the animal
Inflammed udders

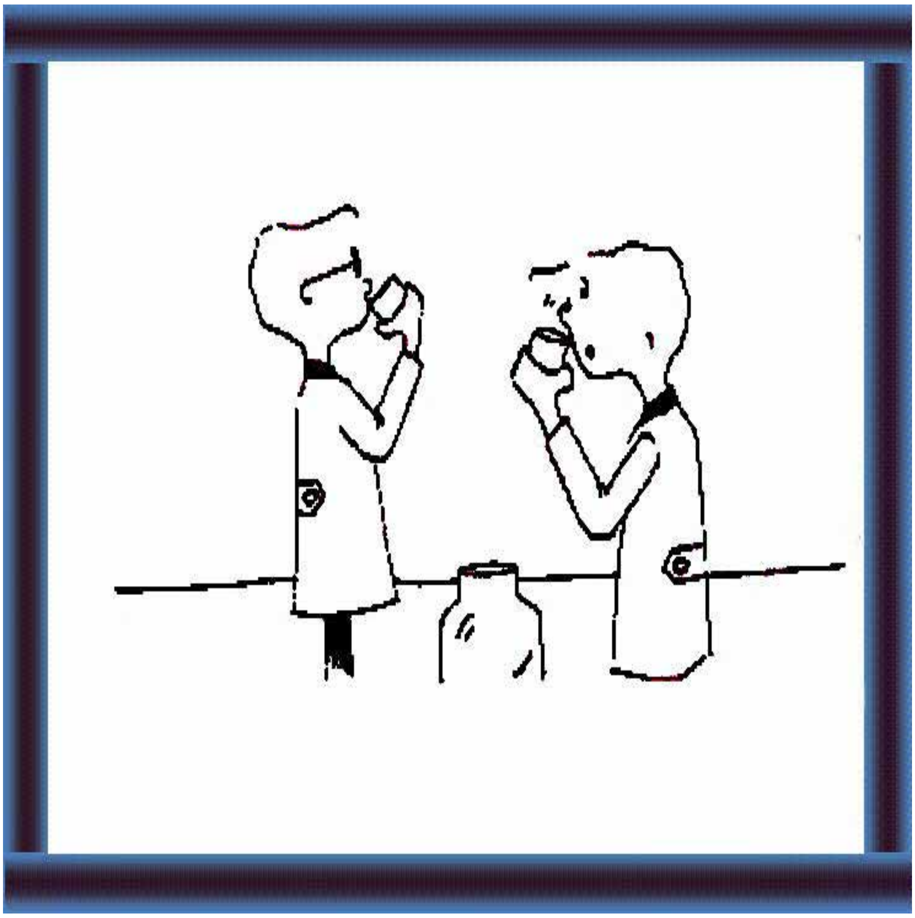
Extension Materials

What should you know about milk quality control ?



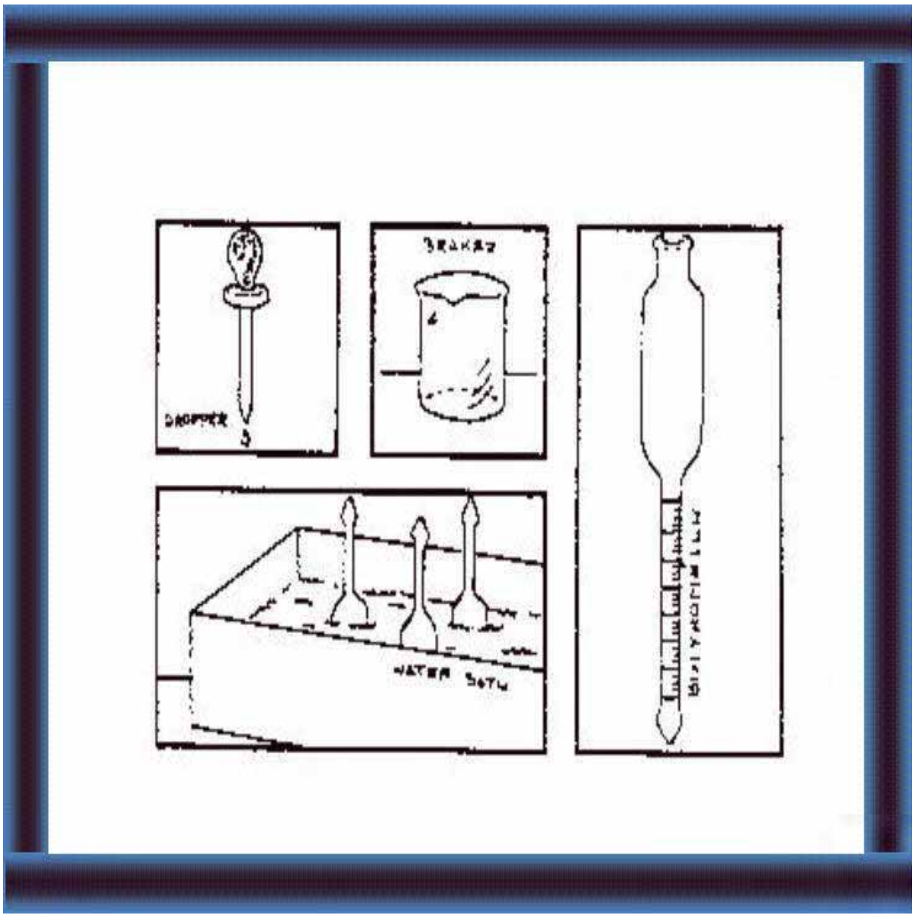
1 How does the milk collecting centre control the quality of milk ? (4-6)

They visit your farm and test your milk.



2 What do they test your milk for ? (7-24)

They test for:
- hygiene and physical properties
- animal health and bacteria
- composition and suitability for processing.



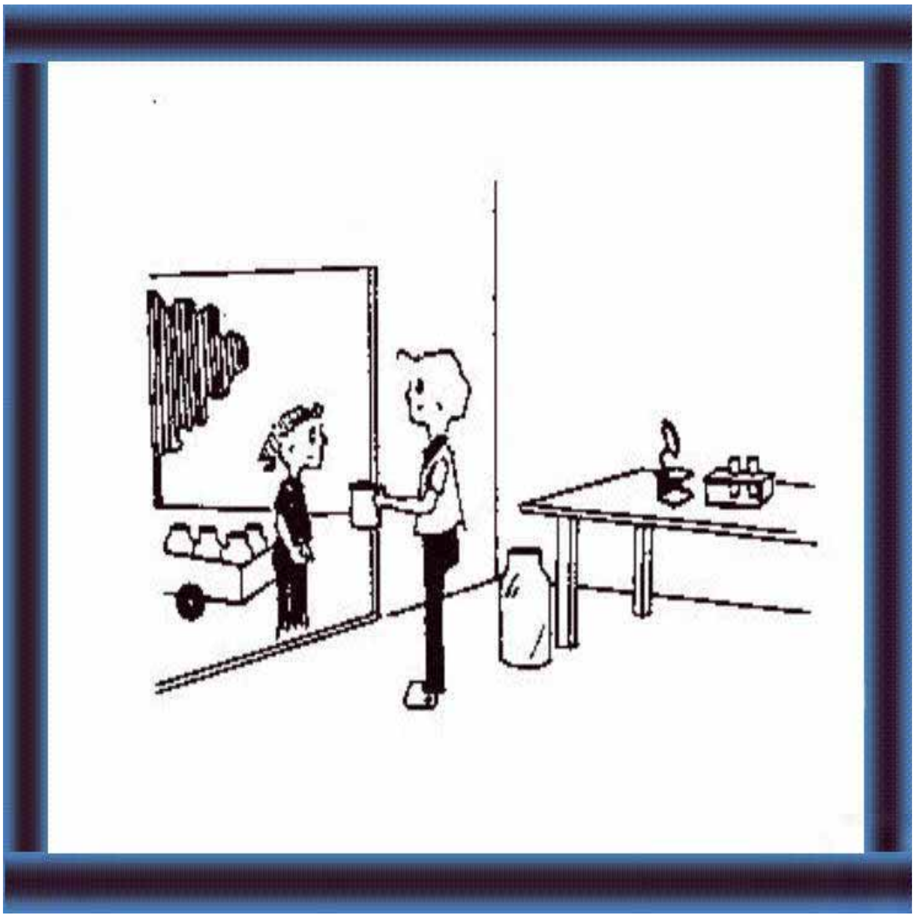
3 How do they test your milk ? (7-24)

They have special equipment for each test.

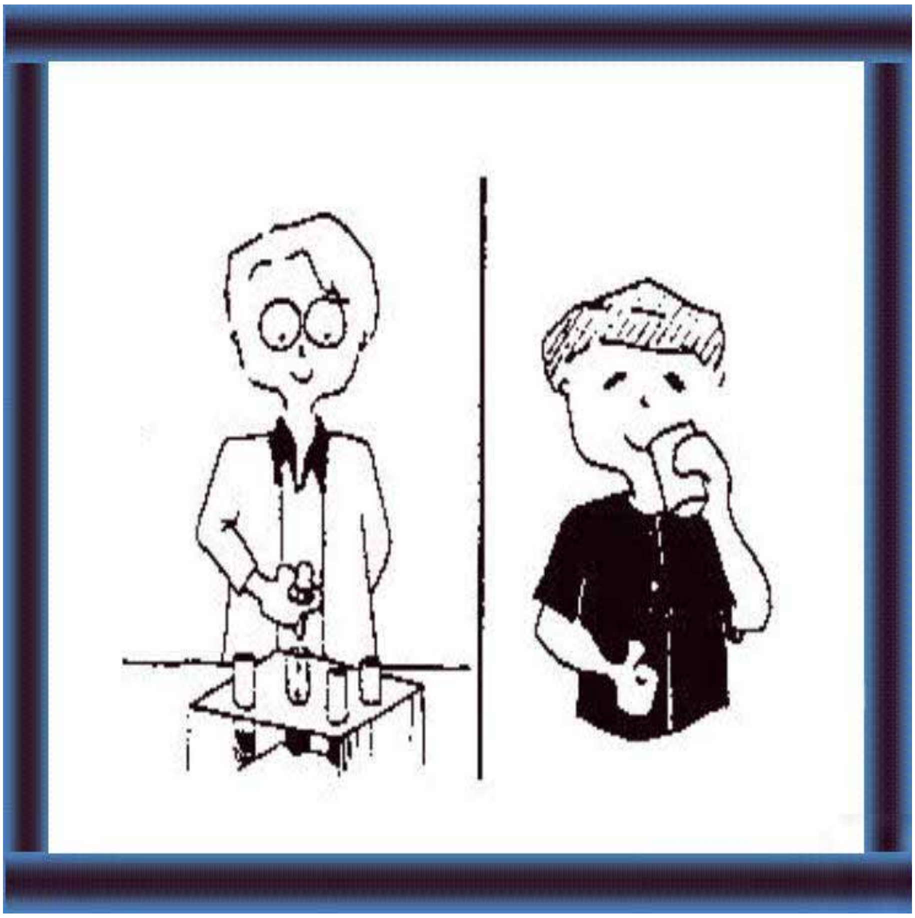
How does the milk collecting centres control the quality of milk ?

4 Workers from the milk collecting centre visit your farm and keep records.

5 They test your milk



on delivery to see if it is suitable for processing. If it is not suitable, they will reject it!



6 The milk collecting centre or factory control the quality of milk to make sure it tastes good and is safe to drink.

Testing for Hygiene

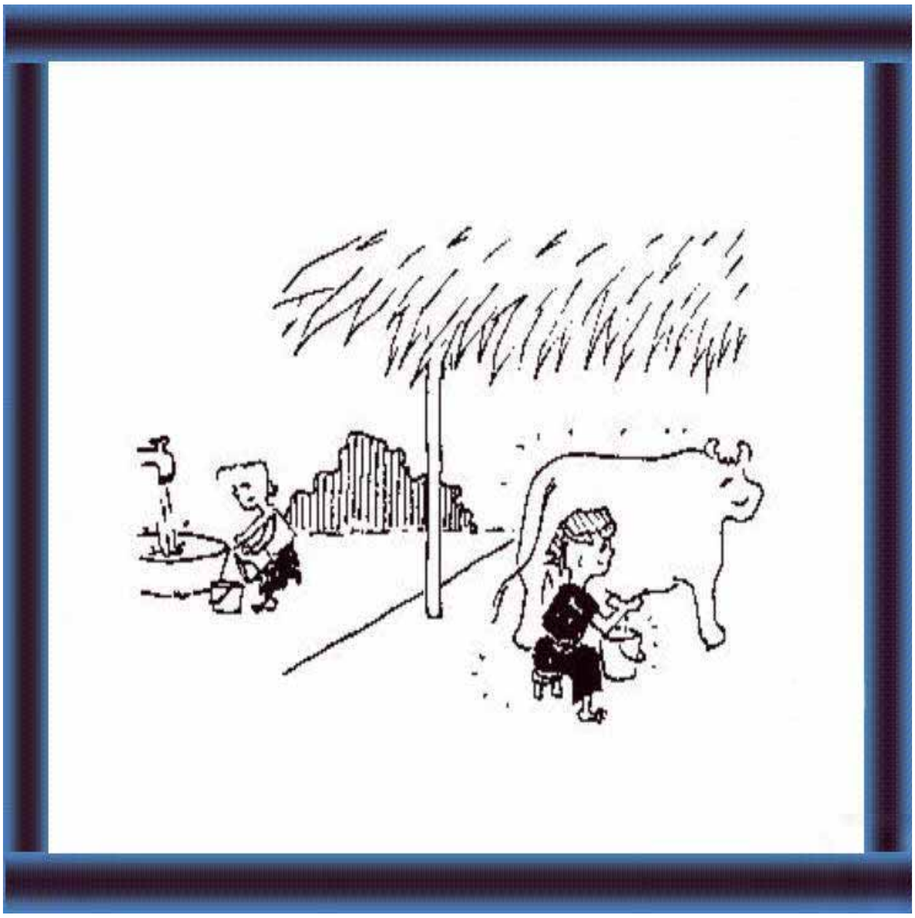
The Sediment Test (8)

During the milking and handling of the nilk all kinds of dirt can get into the milk, such as straw, dust, hairs, flies etc. By filtering a representative sample of the milk through a white disc (The Sediment Test) these dirt particles become visible.

This test gives a very good indication of the cleanliness of the milk with respect to visible dirt. The test is also useful when training farmers in clean milk production and can also be used for the classification of milk (milk payment). It is obvious that a high amount of visible dirt also indicates high bacteria content.

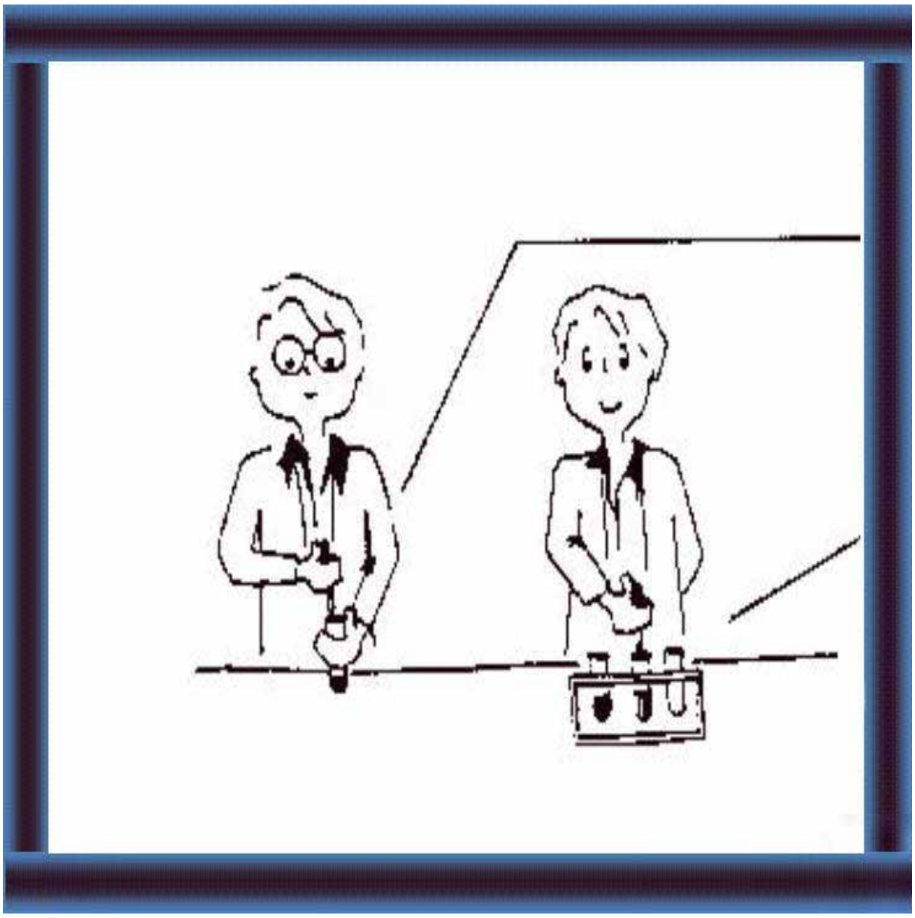
How do they test for hygiene ?

7 They visit your farm and look at your
- buildings
- equipment



- cows
- working methods
- and you to make sure you keep everything clean and your cattle are healthy.

8 On delivery, they check the empty containers and filter your milk to see how much dirt there is.



9 They test one sample of your milk before accepting it to make sure it is suitable for processing and they take other samples for laboratory tests.

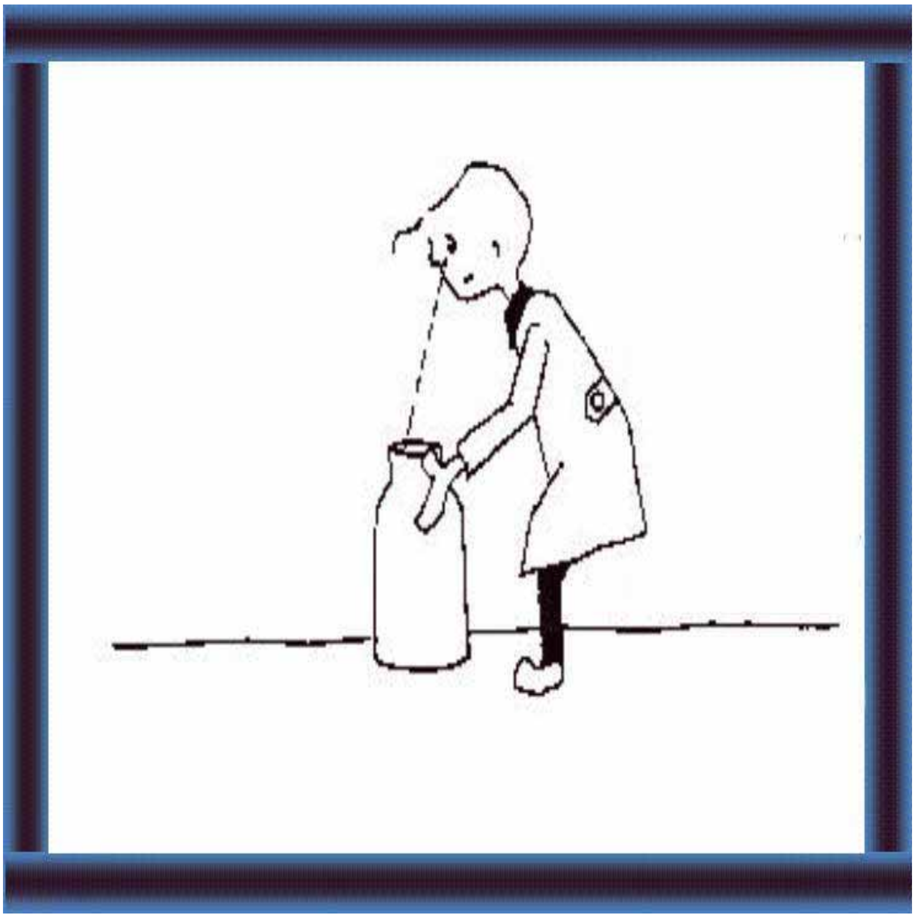
Testing for Physical Properties

A bad smell or taste in the milk can be caused by bacterial growth, chemical reactions and by flavours being absorbed in the milk.

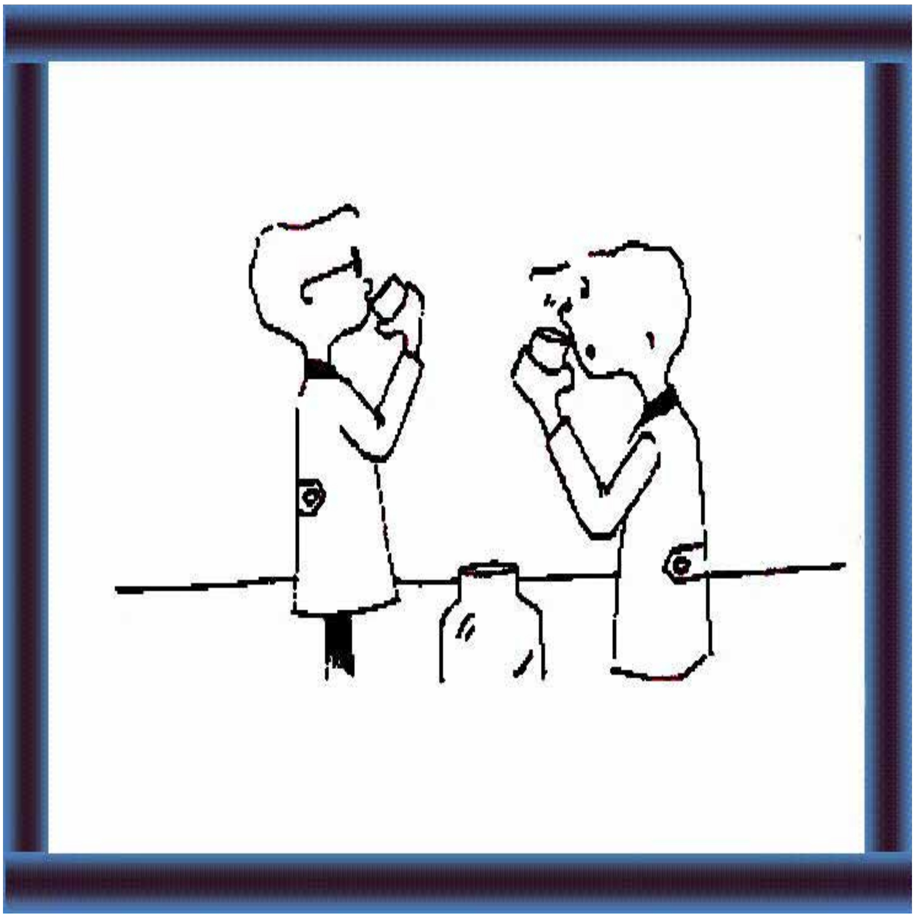
Flavours which are usually absorbed by milk are: feed flavours, medicine flavours, chemical flavours and unclean flavours. Silage flavour is easily absorbed by the milk either directly or indirectly via the cow. However, if the silage is well-preserved and fed in reasonable quantities there will be no problem with silage flavour. Flavours from onions and certain weeds may be absorbed via the cow.

Unclean flavours are often due to unclean sheds and animals. Keeping the milk too long in an open container in the milk shed may also cause unclean flavour. Medicine and chemical flavours usually come from medicine used to treat the cows and from detergents and disinfectants which have not been properly rinsed off the milking utensils. (11)

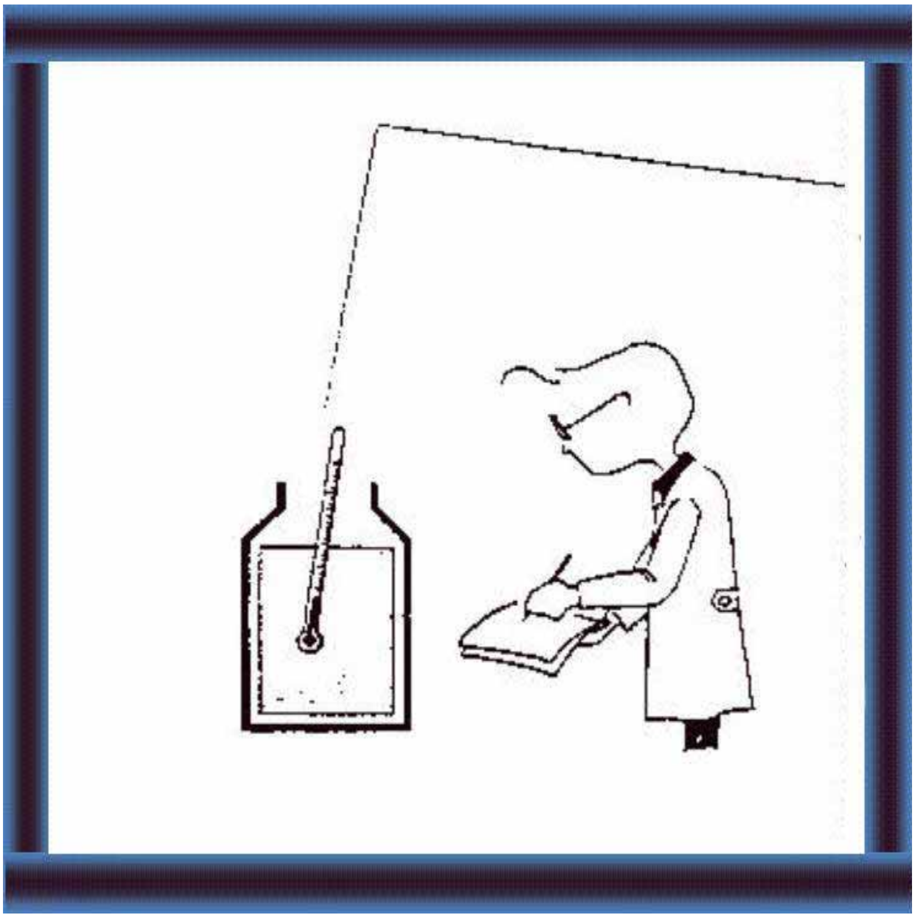
How do they test the physical properties of your milk ?



10 They look at your milk to check the colour and make sure that it is not lumpy.



11 They smell your milk and taste it. Bad smell or taste shows low quality of milk.



12 They measure the temperature of your milk upon delivery. To store very clean milk for 24 hours, you need a temperature of less than 10 C. Less clean milk needs lower temperatures.

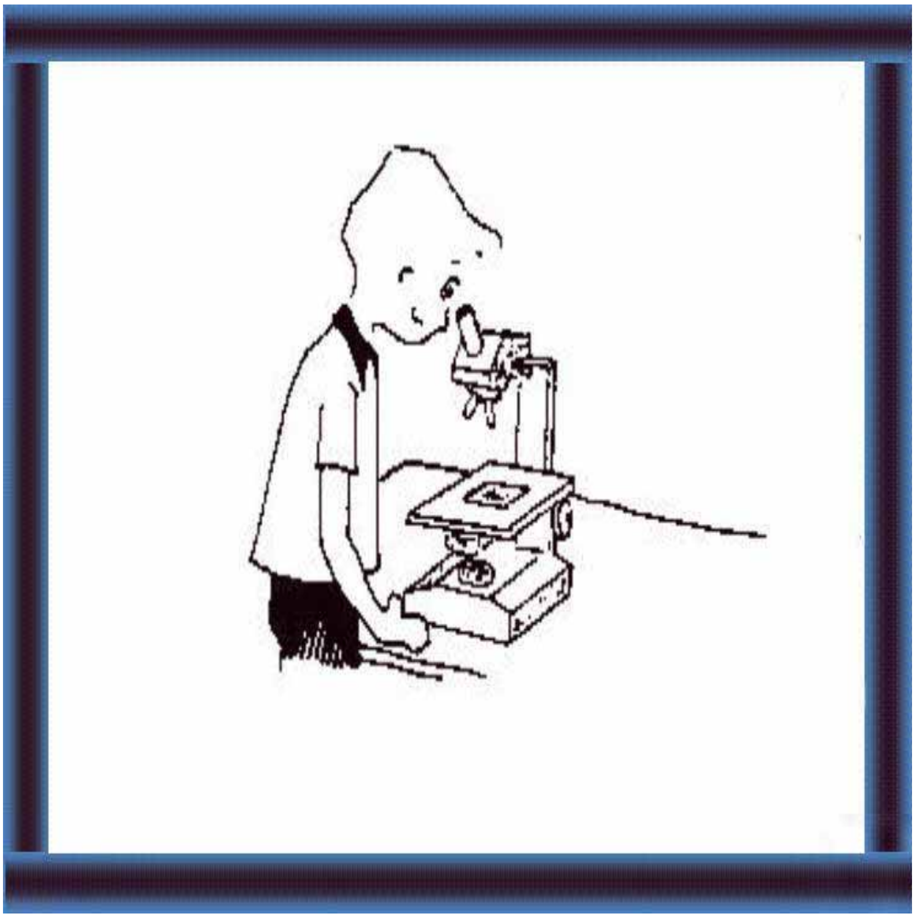
Testing for Healthy Animals

The cell count can be undertaken by means of a microscope or automatic cell counter. The cells consist of leucocytes, lymphocytes and epithelium cells. Milk from healthy cows/ udders normally contains from 100,000 to 300,000 cells per ml. If an udder is diseased (Mastitis) the number of cells (leucocytes and lymphocytes) will increase. The age of the cow and the stage of lactation will also influence the number of cells. (13)

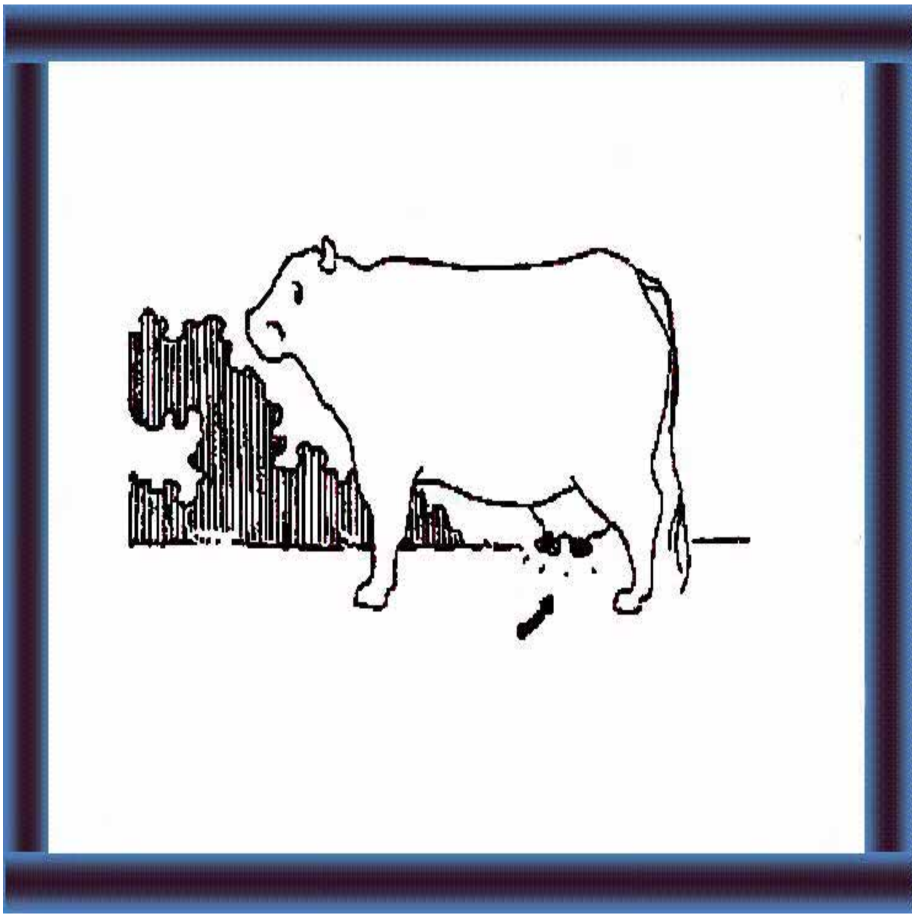
In the case of diseased cows, blood clots may get into the milk. (14)

Milk containing antibiotic residues cannot be used for dairy products. This is particularly true for products which have to be fermented by lactic acid producing bacteria, as this will be inhibited by the antibiotics. (15)

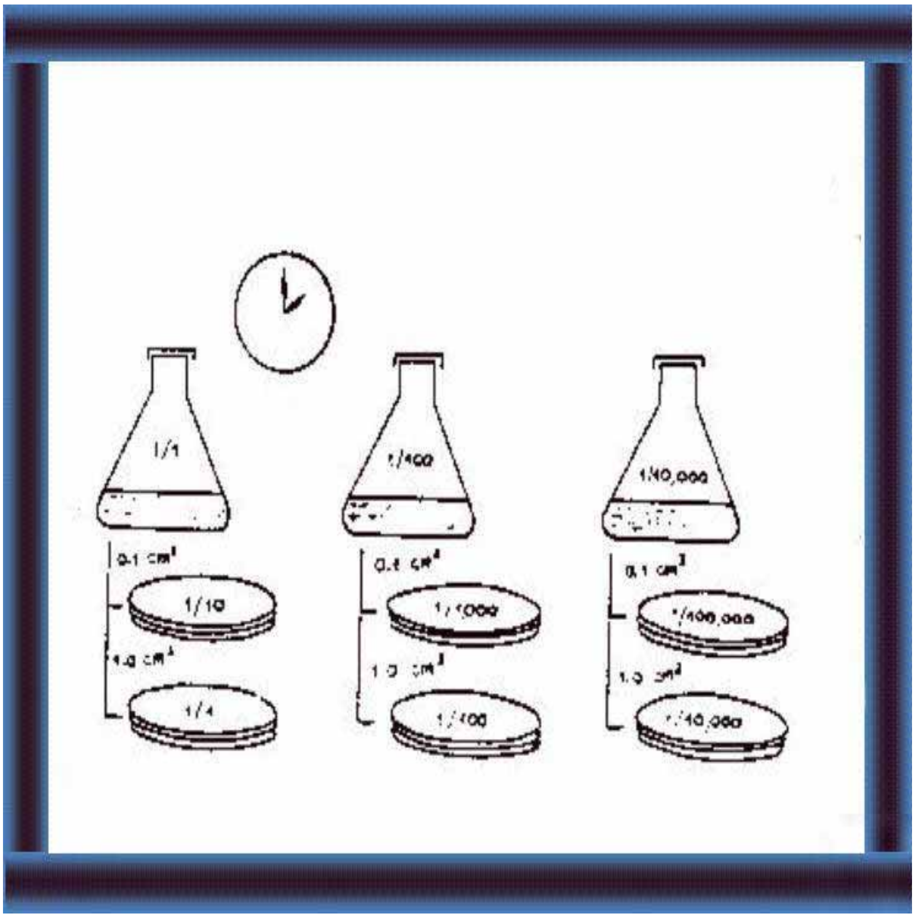
How do they test for healthy animals ?



13 They count the number of cells in your milk and check for blood.



14 Many cells or blood in the milk shows that your cow has mastitis or another disease.



15 They incubate your milk with a special bacteria to check if antibiotics are present.

Testing for Bacteria

Dye Reduction Tests (16-17)

The two most common dye reduction tests are the Methylene Blue Test and the Resazurin Test. These dyes will, when added to milk which is incubated at 37 C, be chemically reduced if there is microbial activity in the milk. Generally, the time required to change the colour of the dye is shorter if there is high bacterial activity in the milk (many bacteria) and longer if there is low bacterial activity (few bacteria).

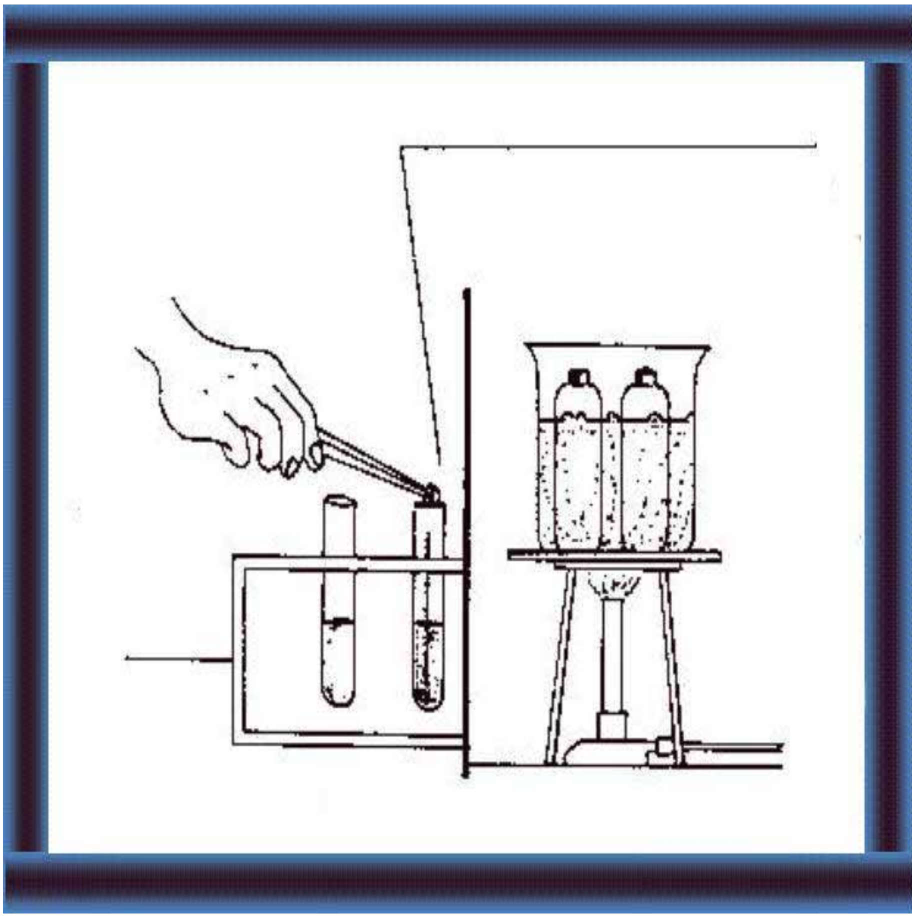
Dye reduction tests do not indicate anything about the kind of bacteria in the milk, they only indicate the number of bacteria.

Plate Count Test (18)

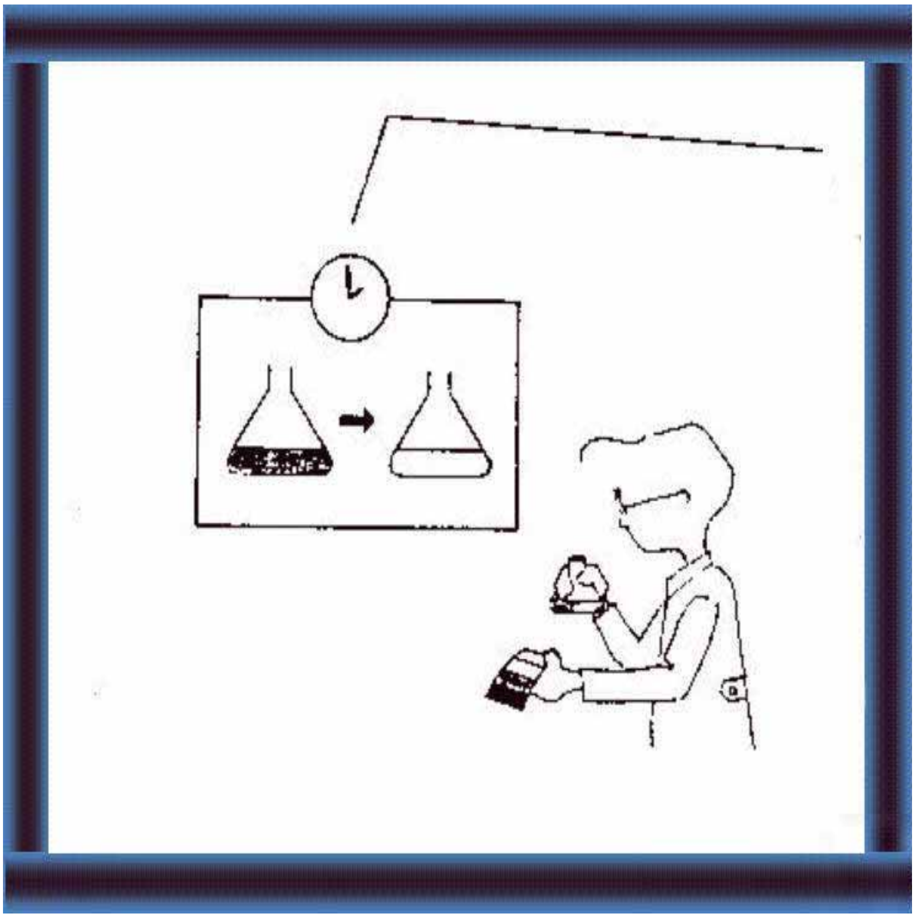
The plate count method is used for determining total number of bacterial colonies per ml sample. A measured amount of milk is placed on agar plates and the number of colonies are counted after incubation.

Microscope Count Test (18)

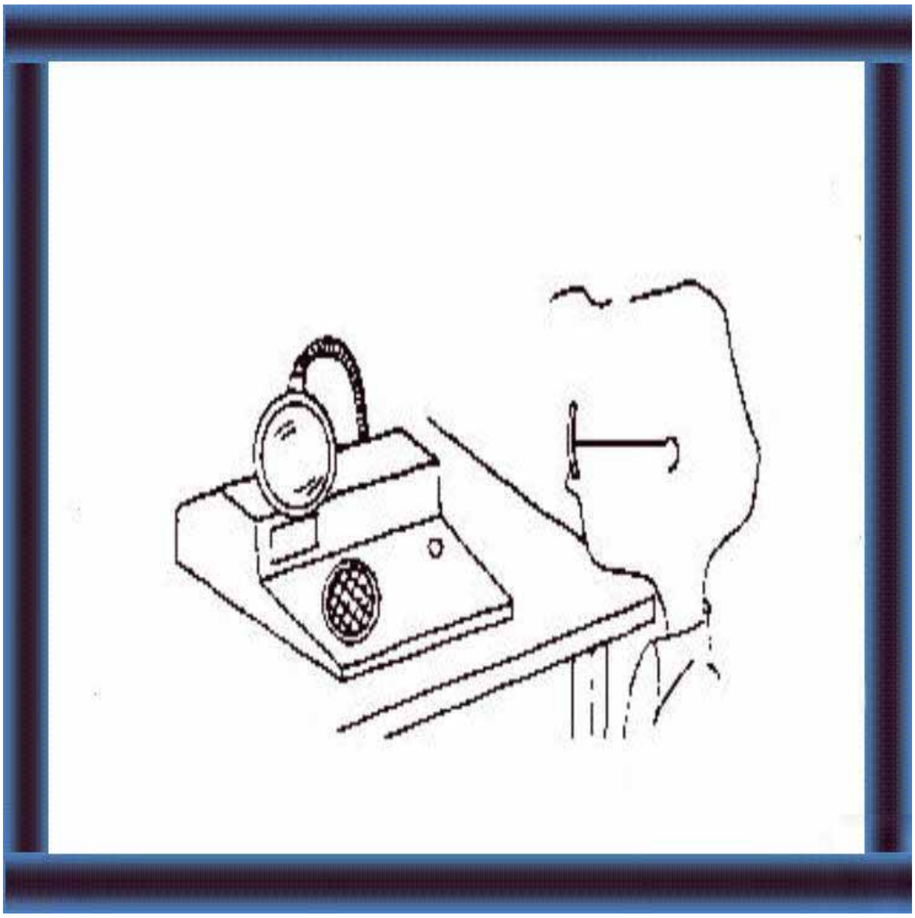
To obtain the amount of single bacteria present in milk, a direct count must be carried out, using a microscope.



16 For a quick test they add a dye to your milk.



17 Then they check the time for the colour to disappear. The shorter time, the more bacteria.



18 For an accurate test, they count the number of bacteria in your milk.

Testing for Composition

Measuring freezing point (19)

The normal freezing point of milk is a little lower than the freezing point of water owing to dissolved components (mainly lactose and salts). The freezing point, being one of the most constant physical characteristics of milk, is used to detect adulteration of milk with water.

The freezing point of cows milk varies between -0.53 C and -0.59 C with -0.54 C being the average value. Values below -0.53 C usually indicate extraneous water.

A cryoscope is used for determination of the freezing point.

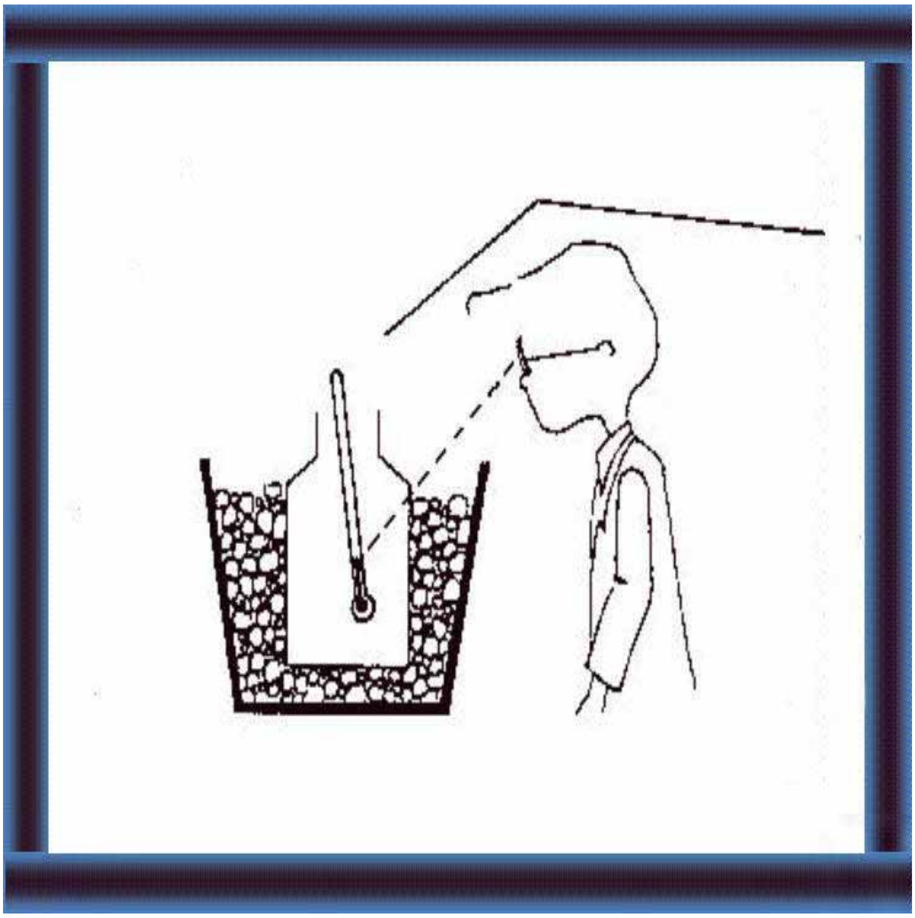
Measuring density (20)

Another method to detect adulteration with water is by measuring the relative density of the milk. The method is not as reliable as detection by determination of freezing point but is easier to carry out and requires less sophisticated equipment. The density of milk normally varies between 1.028 and 1.034 g per ml at 15^{o}C depending on the composition. The density of water is 1.0 g per ml. A lactodensimeter and glass cylinder are required for the test.

Measuring fat content (21)

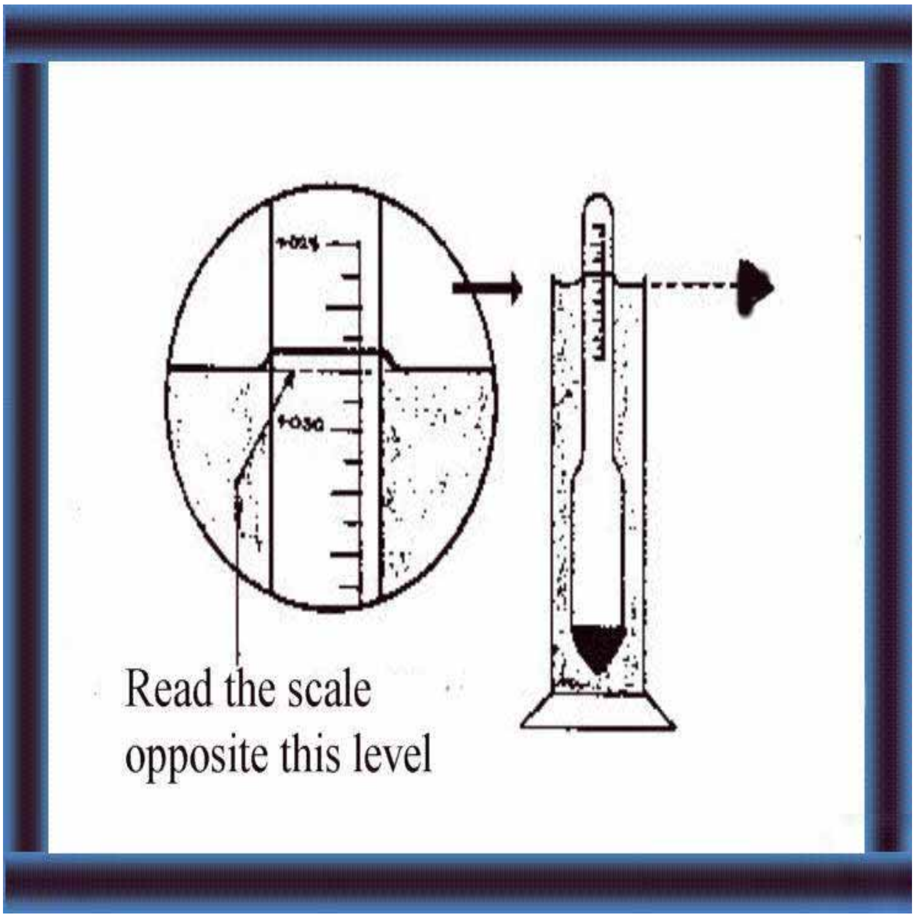
For small to medium scale operations the Gerber test is used for determination of fat content in the milk. The test is a volumetric method in which fat is separated from skimmilk by centrifugal force. Sulphuric acid is used to dissolve the protein that forms the membrane around the fat (fat globules) and amyl alcohol is added to improve the separation of fat from protein.

How do they test for composition ?

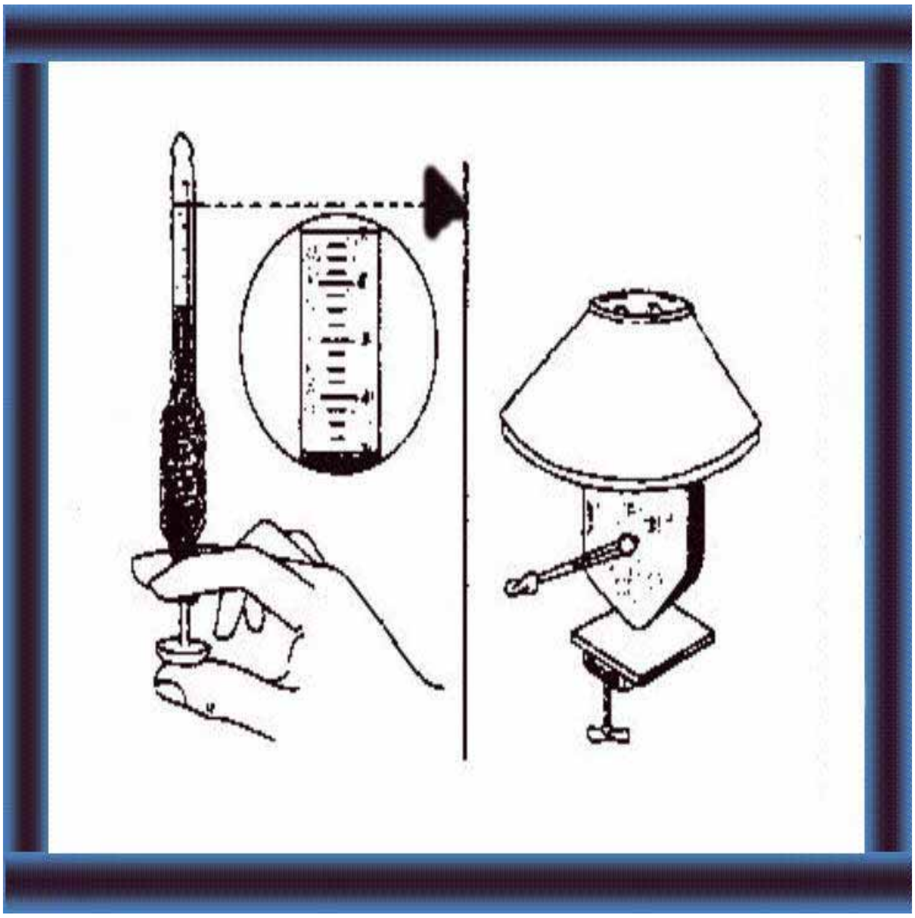


19 They measure the freezing point, if it is abnormal, your milk may contain excess water, detergents or other substances.

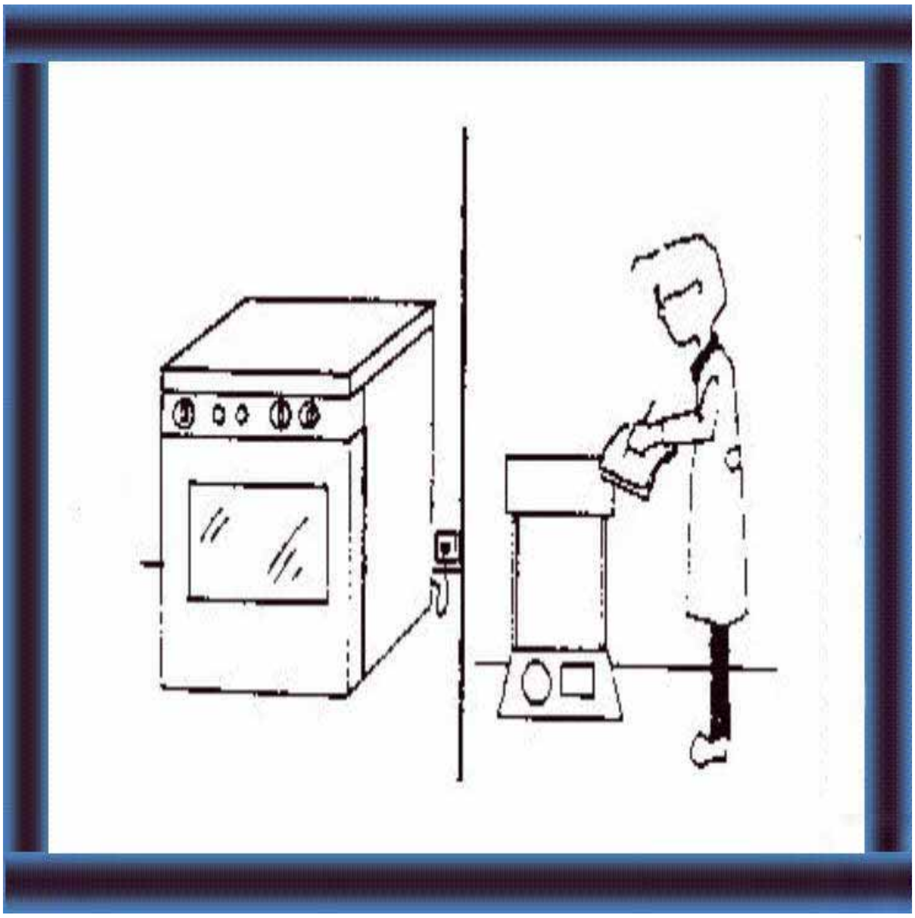
20 They measure the density of your milk with lactometer. If it is abnormal, perhaps:-



some one added water or another substance- some one removed the cream- your milk is colostrum.



21 They separate the fat from the skim milk and measure how much fat your milk contains.

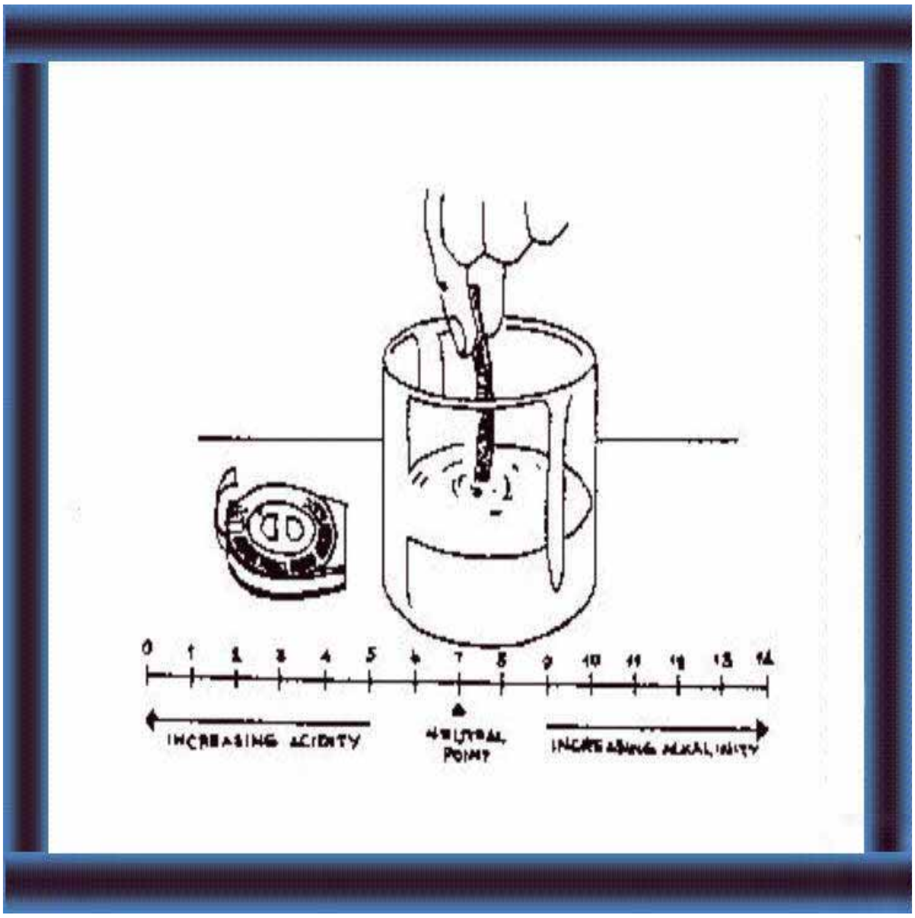


22 They may dry the milk and measure the total solids content.

Testing Suitability for Processing

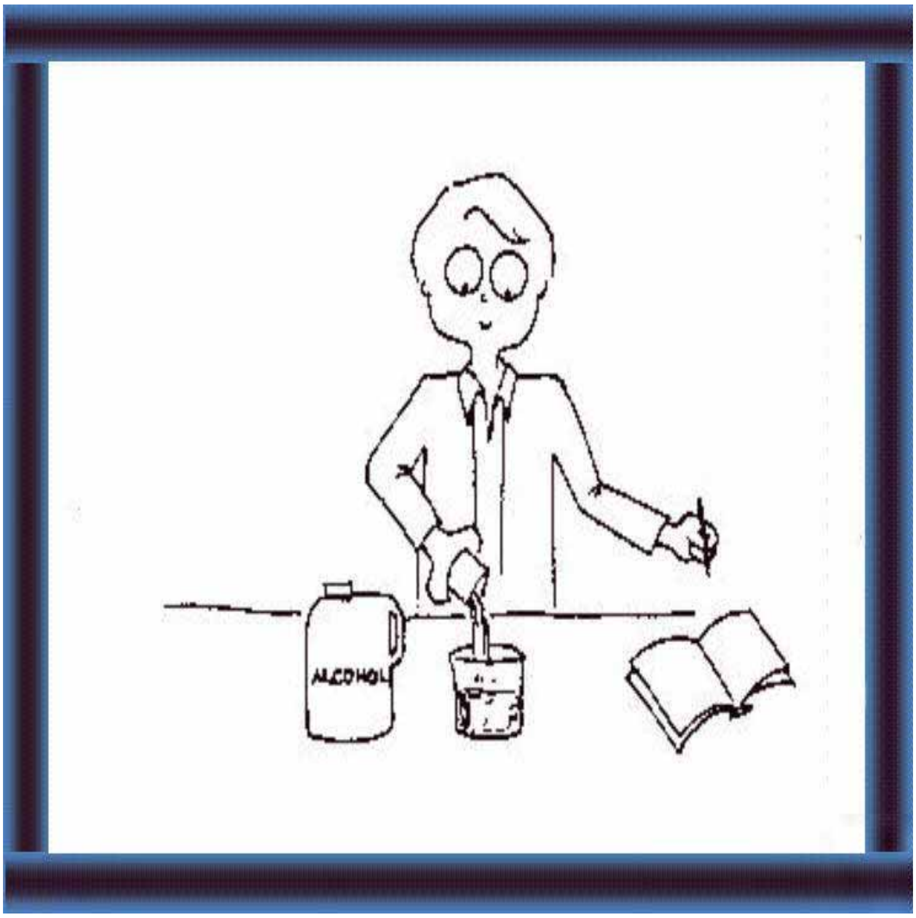
The titratable acidity test is carried out in order to check whether milk contains a large amount of lactic acid which will reduce the heat stability and thereby the suitability for processing. The milk will clot when it is heated. Different procedures are employed to test the acidity, however the principle is the same: A dye which changes colour at a specific pH is added to the milk which is then titrated with a base (added little by little) until the colour changes. By recording the volume of base required and the volume of the milk sample, the amount of lactic acid can be calculated. This test is also used for testing fermented products. The lactic acid is produced by bacteria in the milk. The milk becomes sour.

How do they check if your milk is suitable for processing ?



23 They measure the acidity of your milk. If it is abnormal, your milk is low quality.

24 They add alcohol to your milk. if the mixture curdles, it is not suitable for



pasturization. This may show:
- bacteria (acid production)
- mastitis
- residues (e. g. detergents)
- colostrum.

What do you know about milk quality control ?

How to control milk quality

1. **Farm visits** (4)
2. **Milk tests** (5)

How to test for hygiene

1. **Farm inspection** (7)
2. **Visual checks and filtrations** (8)

3. Samples for laboratory testing (9)

How to test physical properties

1. Visual checks - colour and textures (10)
2. Organic checks - smell and taste (11)
3. Temperature (12)

How to test for animal health

1. Cell counts for mastitis and other diseases (13-14)
2. Incubate with bacteria for antibodies (15)

How to test for bacteria

1. Dye test (16-17)
2. Bacteria count (18)

How to test for composition

1. Freezing point for adultration (19)
2. Density for adultration (20)
3. Fat content (21)
4. Toral solid content (22)

How to test suitability for processing

1. Acidity for quality (23)
2. Alcohol test for curdling
   - suitability for pasturization (24)

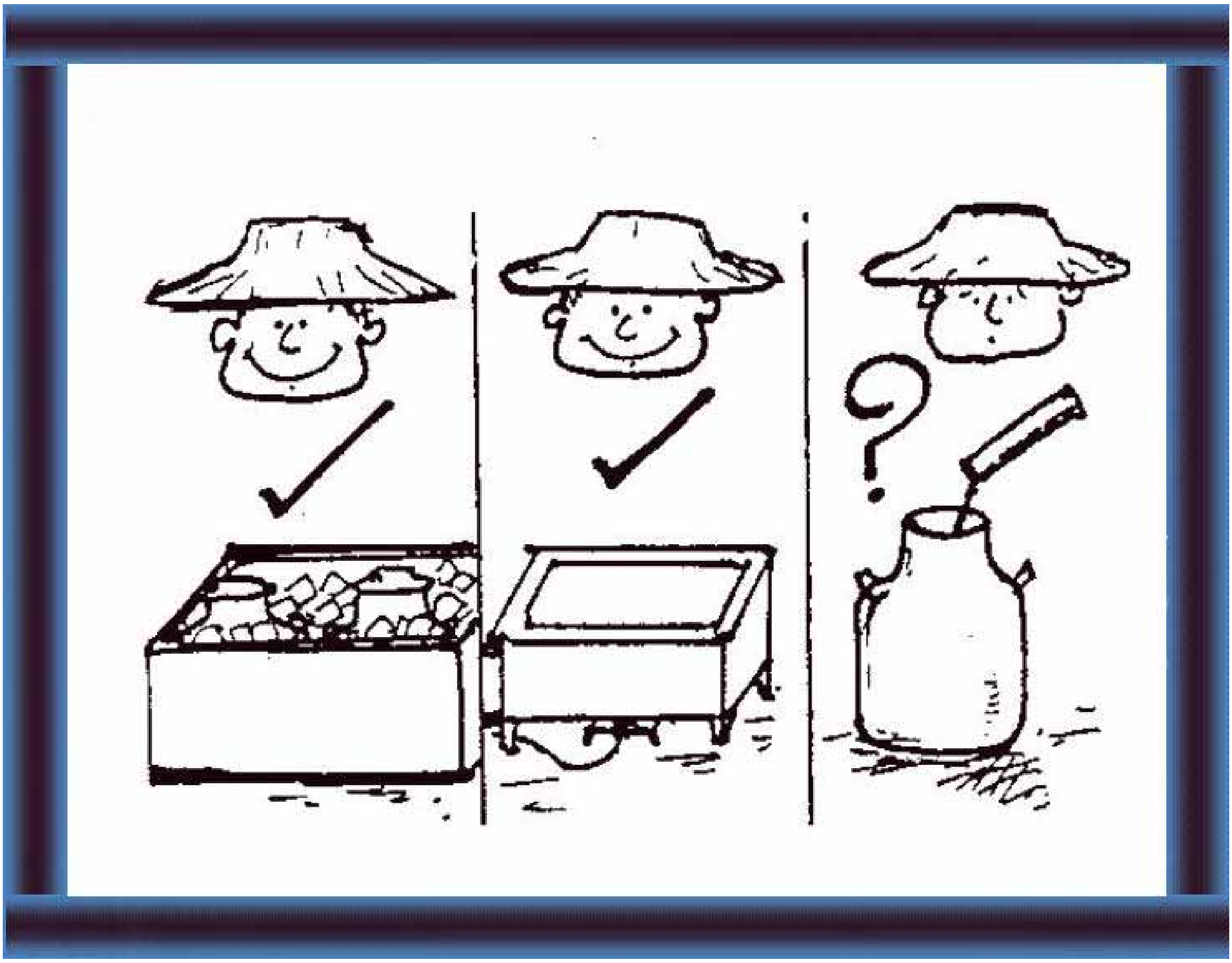
Small-Scale

Dairy Farming Manual

Volume 1

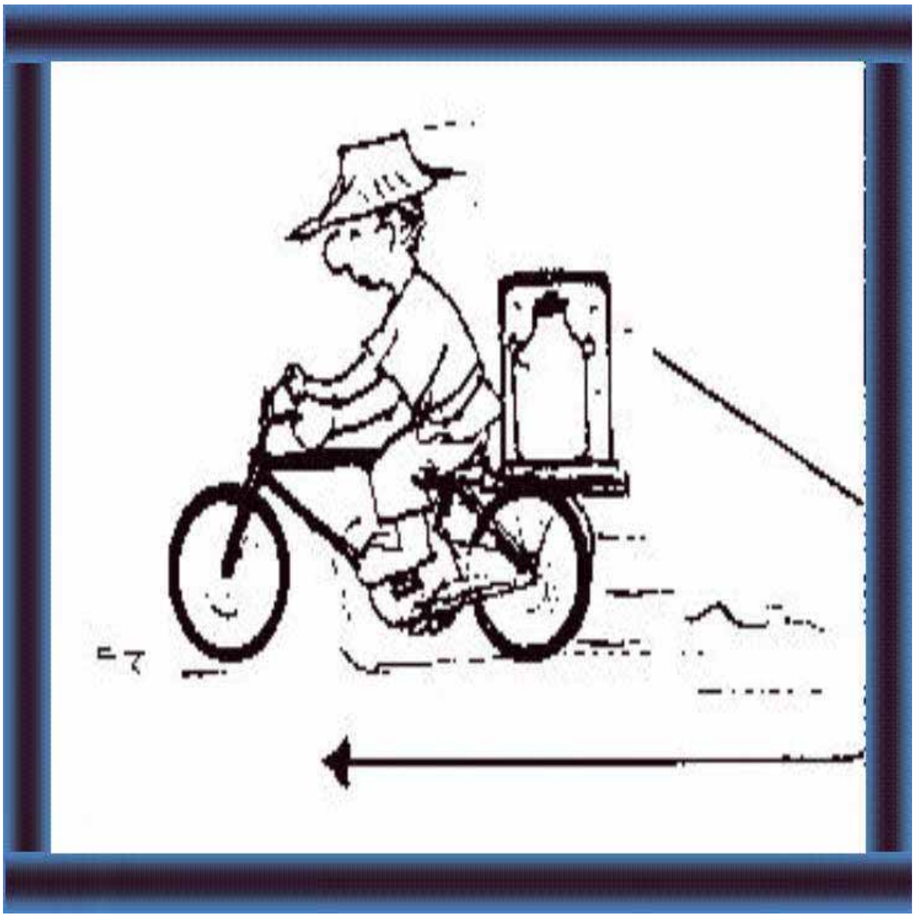
Technology Unit 4

Milk Preservation



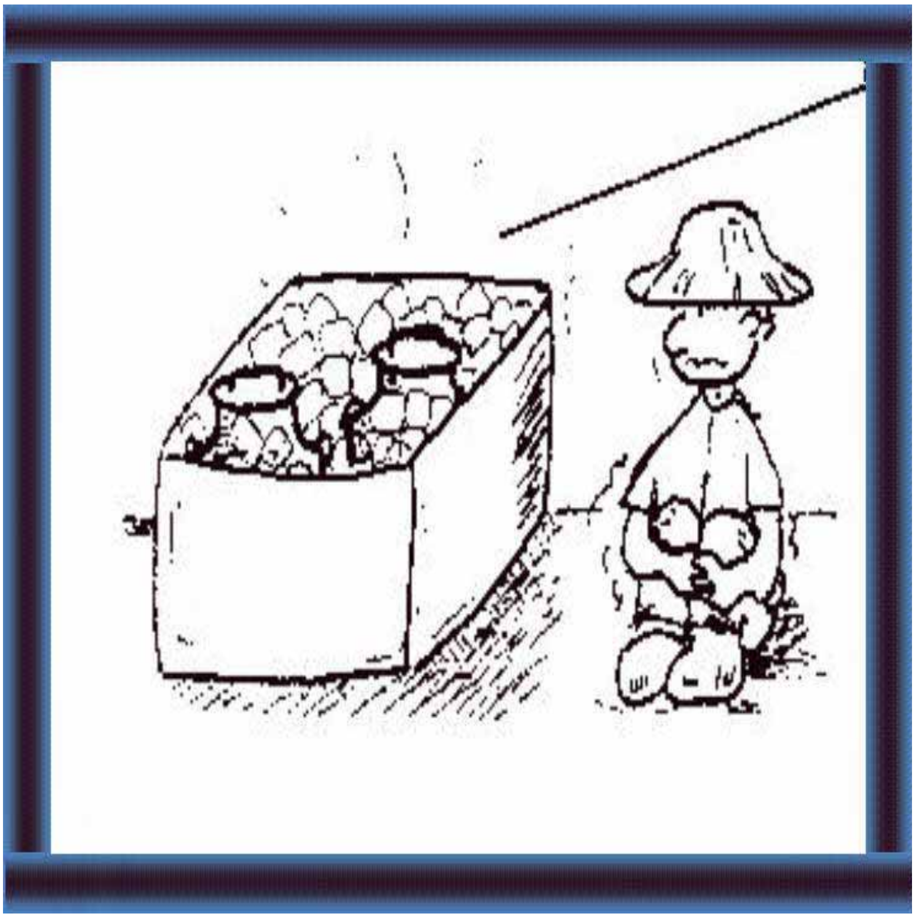
Extension Materials

What should you know about milk preservation ?



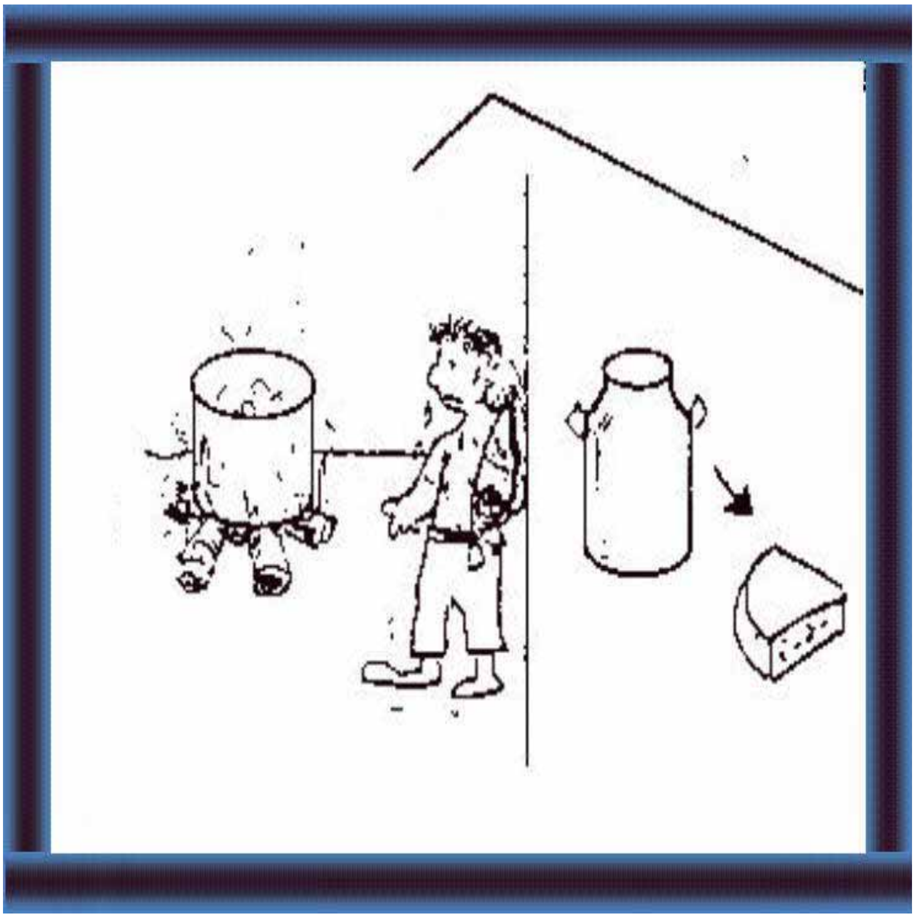
What is important in preserving milk ? (5-7)

1 It is important to make sure that your milk is:
- clean
- cool
- delivered quickly



Why cool your milk ? (8-25)

2 Keeping your milk cool reduces damage.



Why heat treat and process your milk ? (26-29

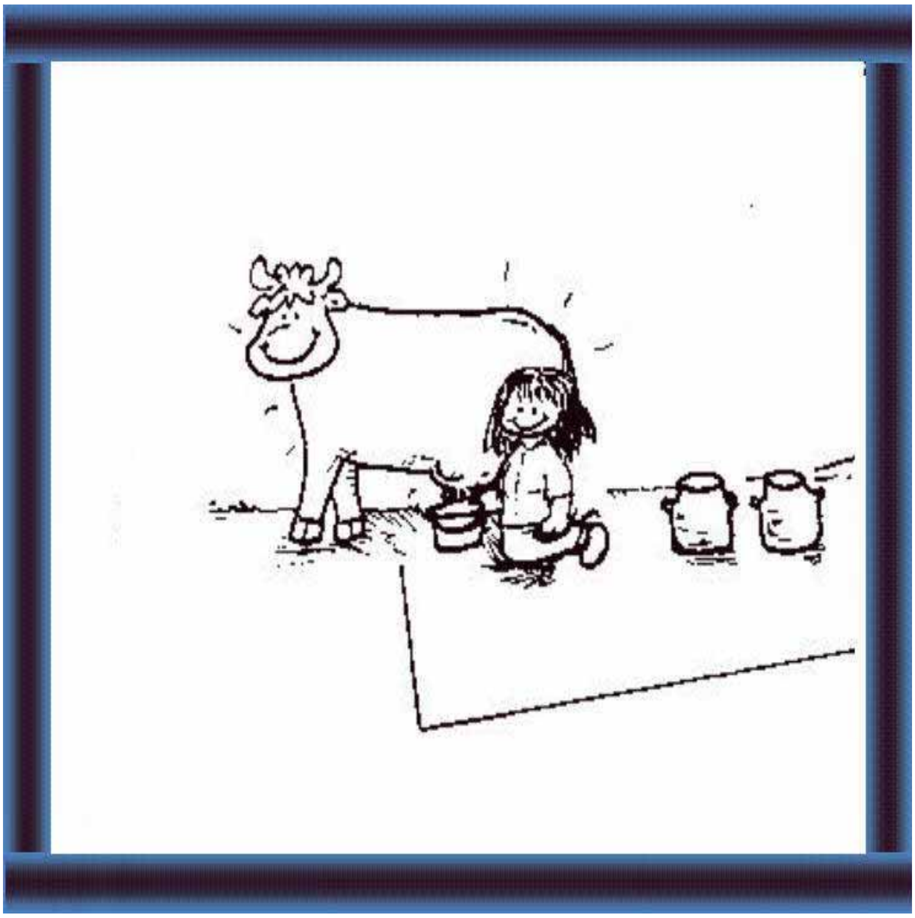
3 Heat treatment kills bacteria and your milk keeps longer. Processed products like cheese keep longer too

Can you use chemicals to preserve your milk ? (30-49)

4 Yes, but you must ask your extension worker

or milk collecting centre for advise

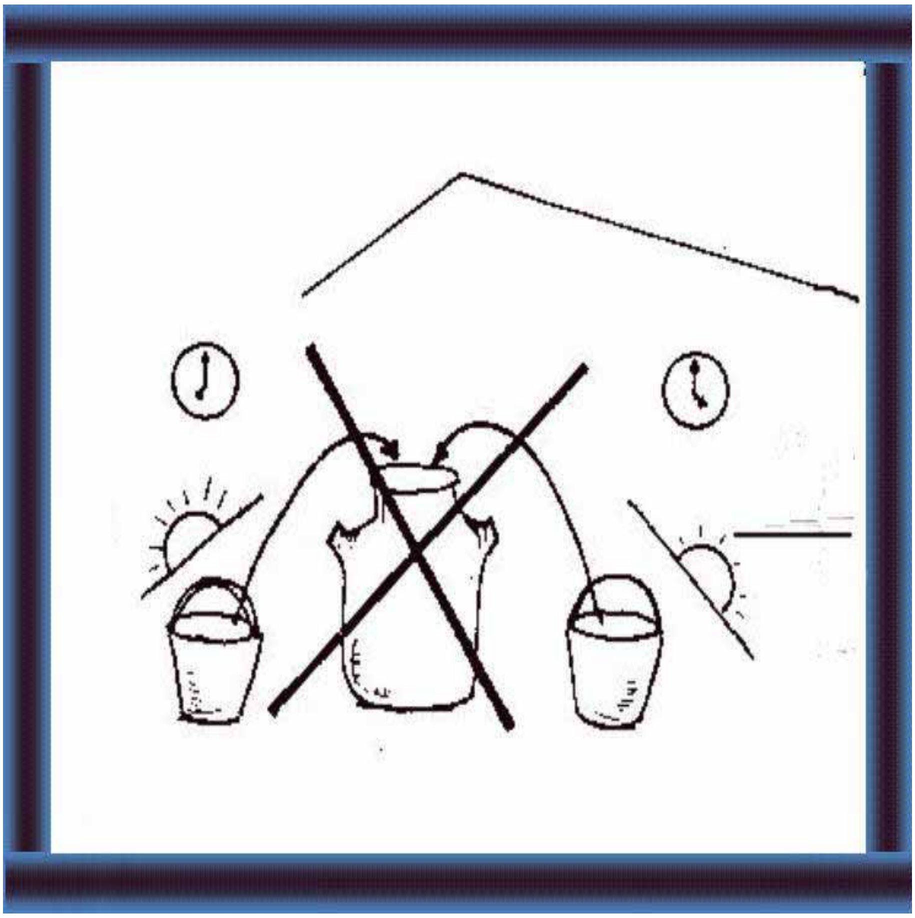
What is important in preserving milk ?



5 All of the ways of preserving milk depend upon the initial hygenic quality of your milk.

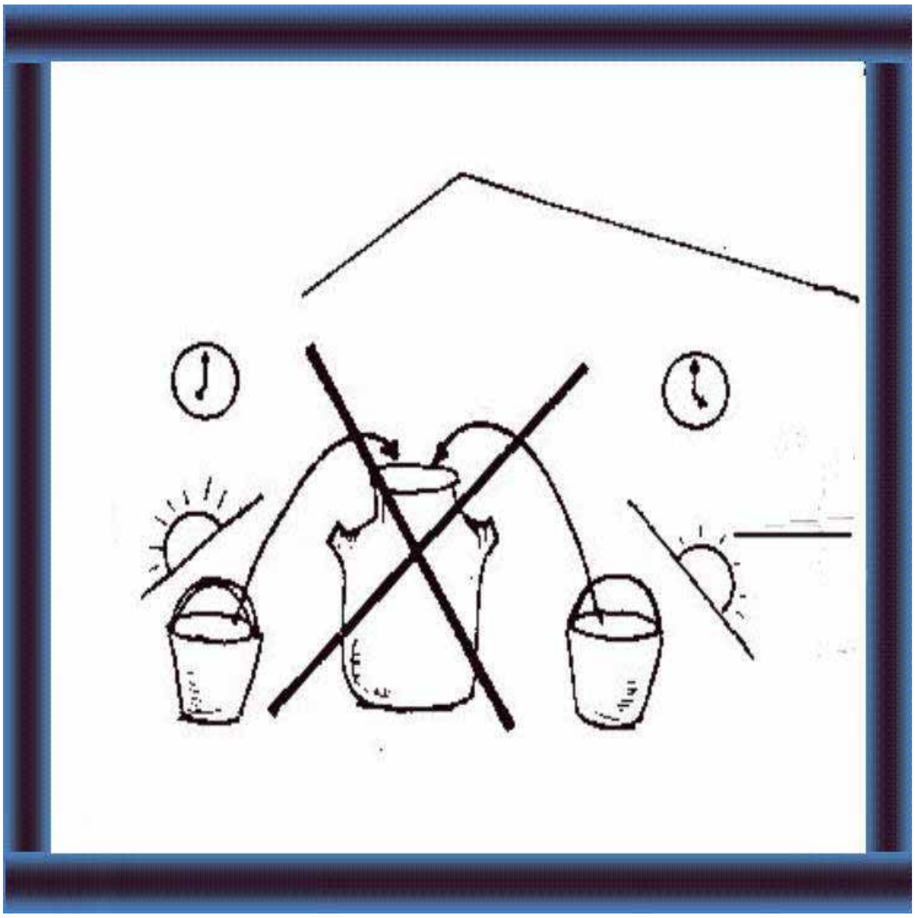
Make sure everything is clean and you cattle are healthy.

6 Do not mix warm (morning) milk with cool



(evening)
milk.

Keep it
separate for
the collecting
centre
or cool warm
milk before
mixing.



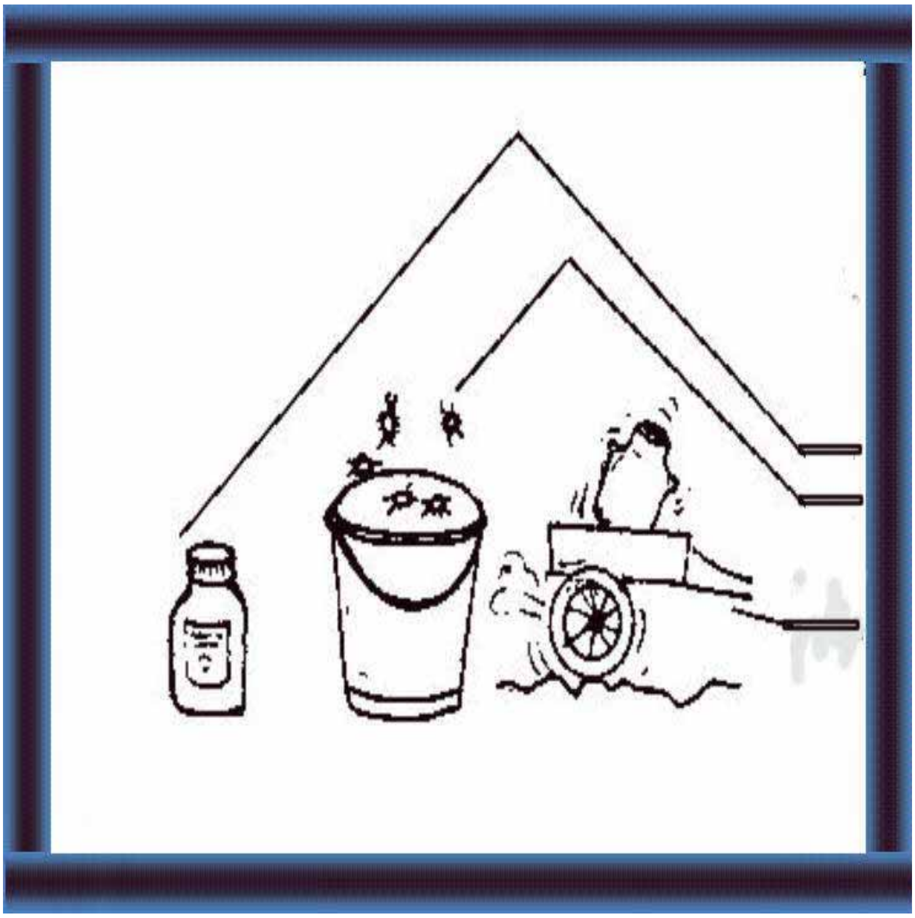
7 Whatever
method of
preservation
you use,
plan with
farmers near
you
and your
collecting
centre
to deliver the
milk
in the shortest
time possible.

Why cool your milk?

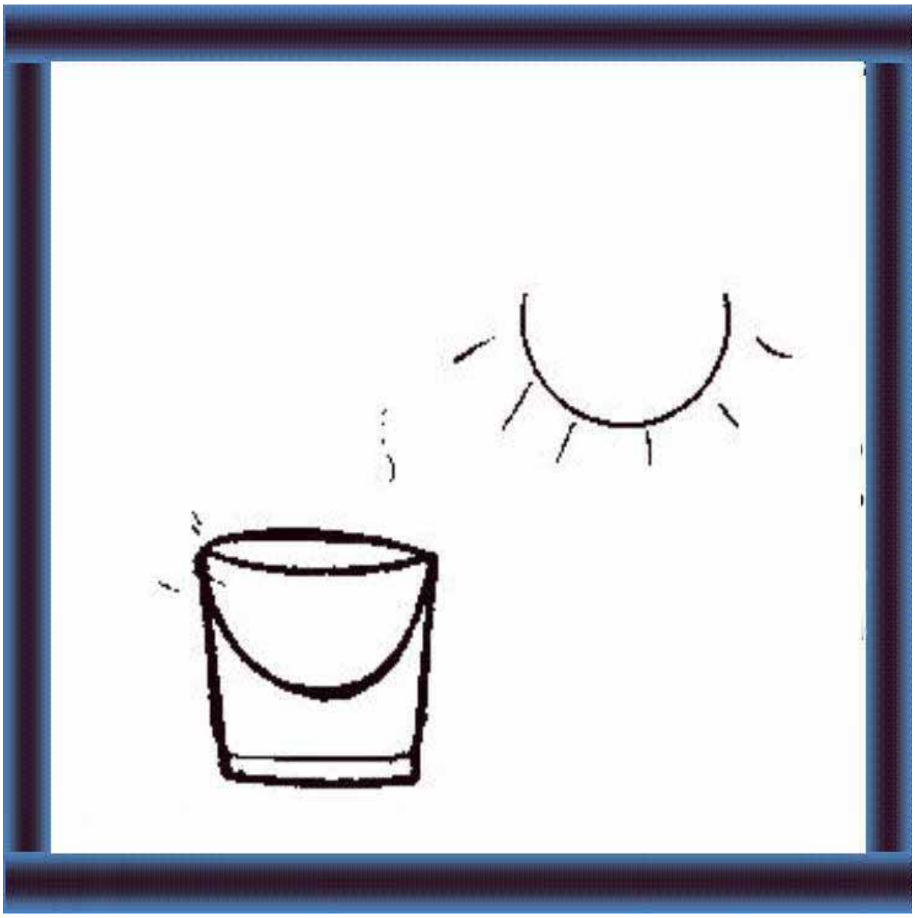
8 If everything is clean and you and your cow are healthy, your milk will be:

- fresh
- good quality
- quite stable.

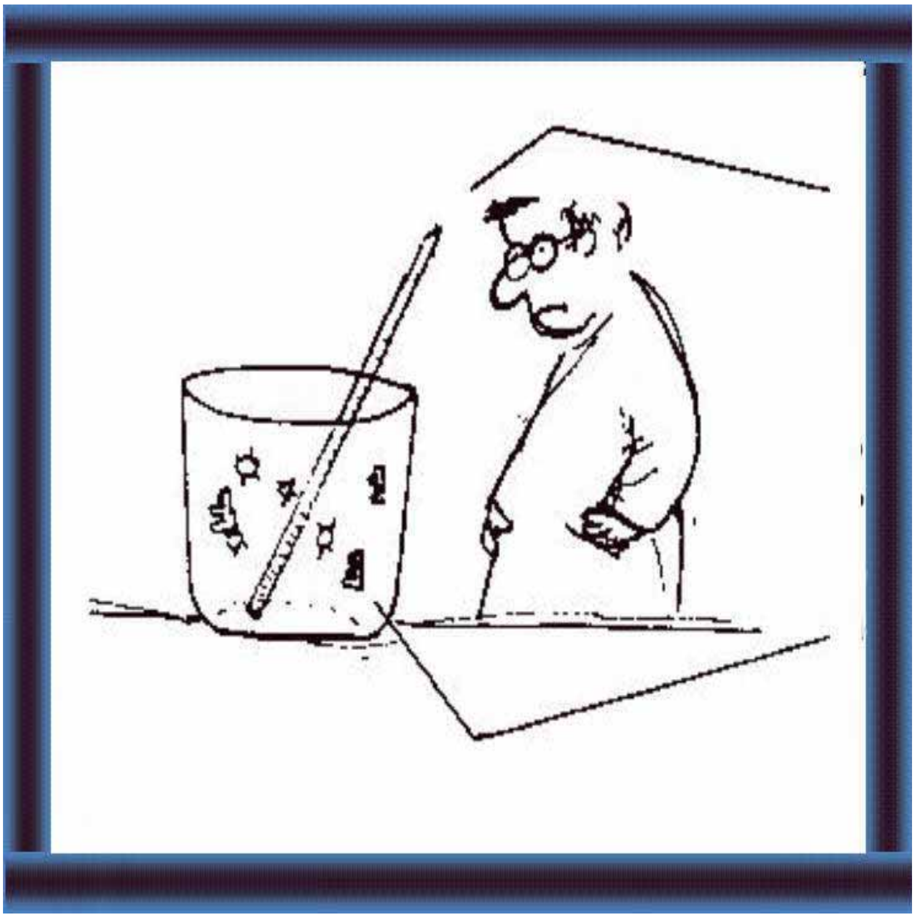
9 When you store or transport your milk



many things can damage it:
- chemicals
- bacteria
- bad handling.

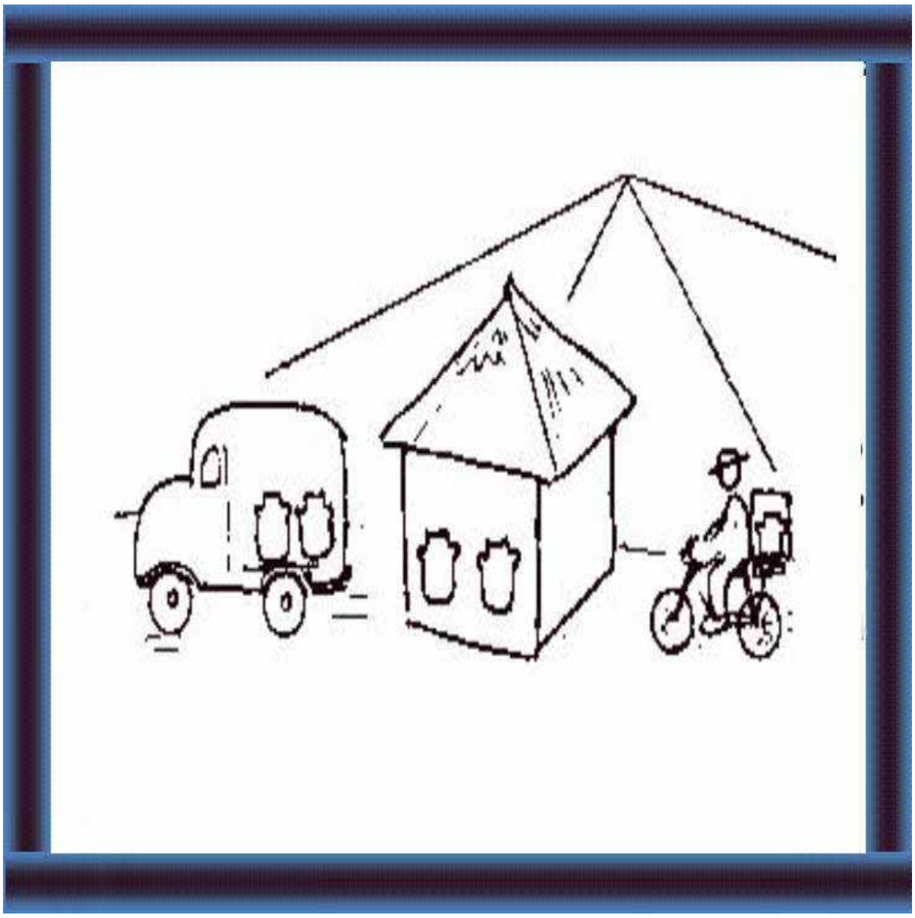


10 If your milk is warm, there will be more damage from chemicals, bacteria and bad handling.



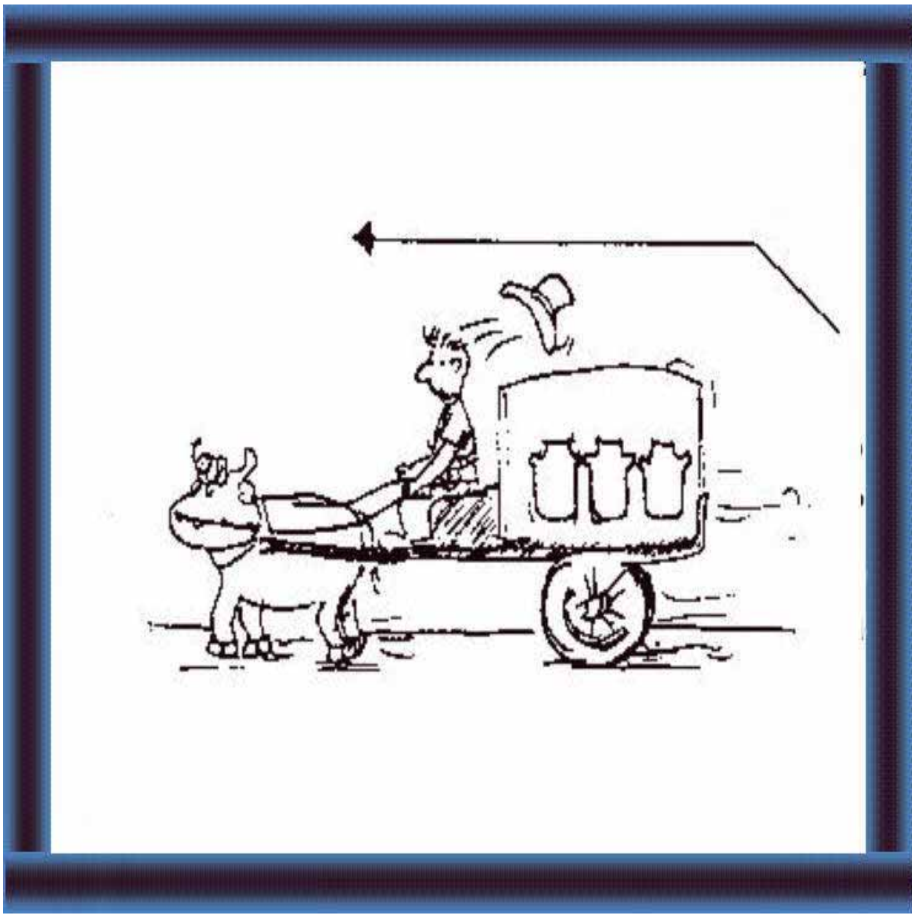
11 Temperatures between 15-40 C are bad for milk. There is high enzyme activity and bacteria multiply quickly.

12 Keeping your milk



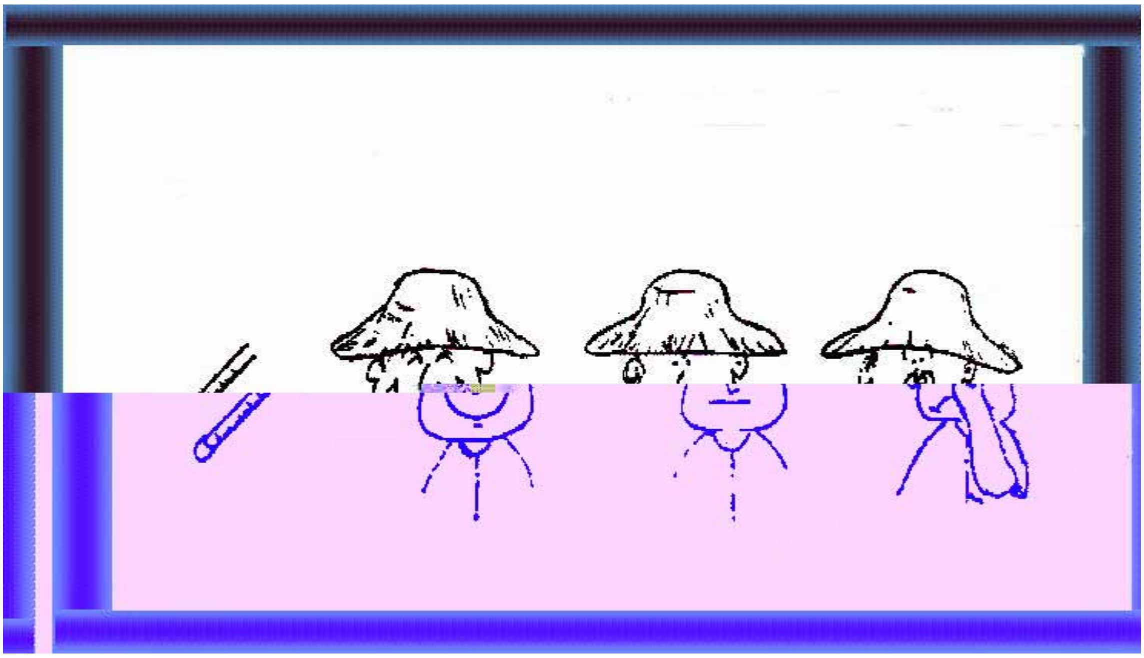
cool reduces damage.

About 4 C is the best temperature to keep milk.



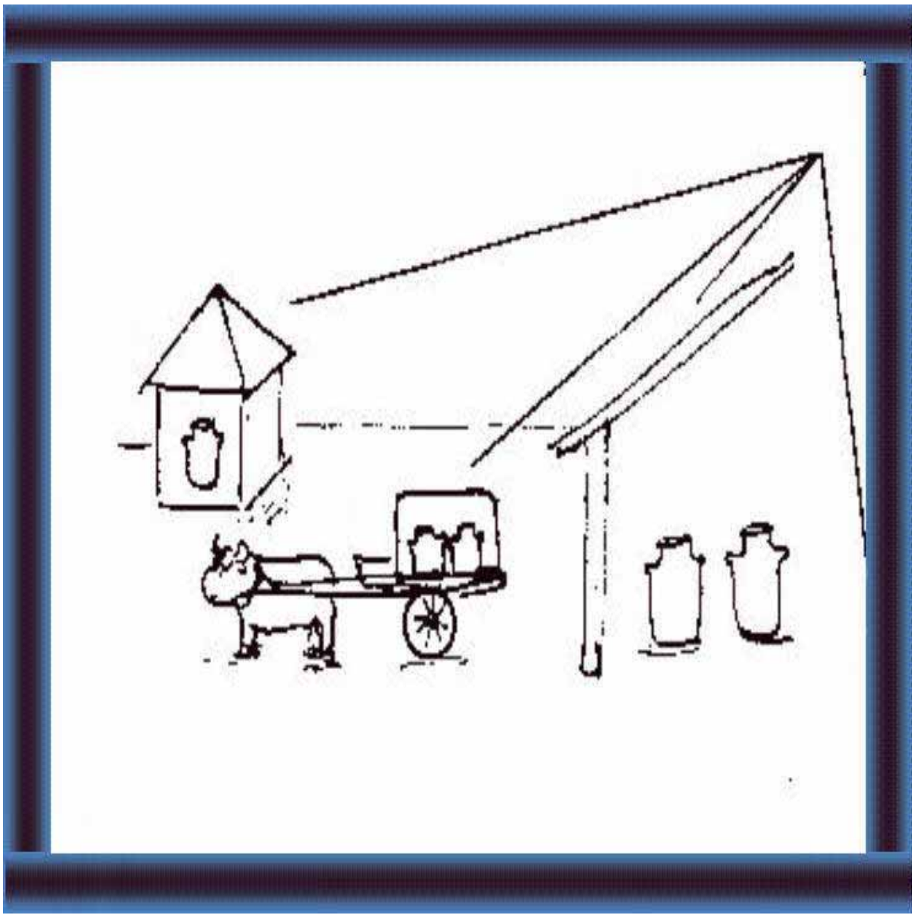
13 If you can deliver your milk within one to two hours and the milk collecting centre has good cooling facilities, cooling your milk at home is not essential. How long can you keep your milk?

14 This depends on the:
Temperature and hygiene



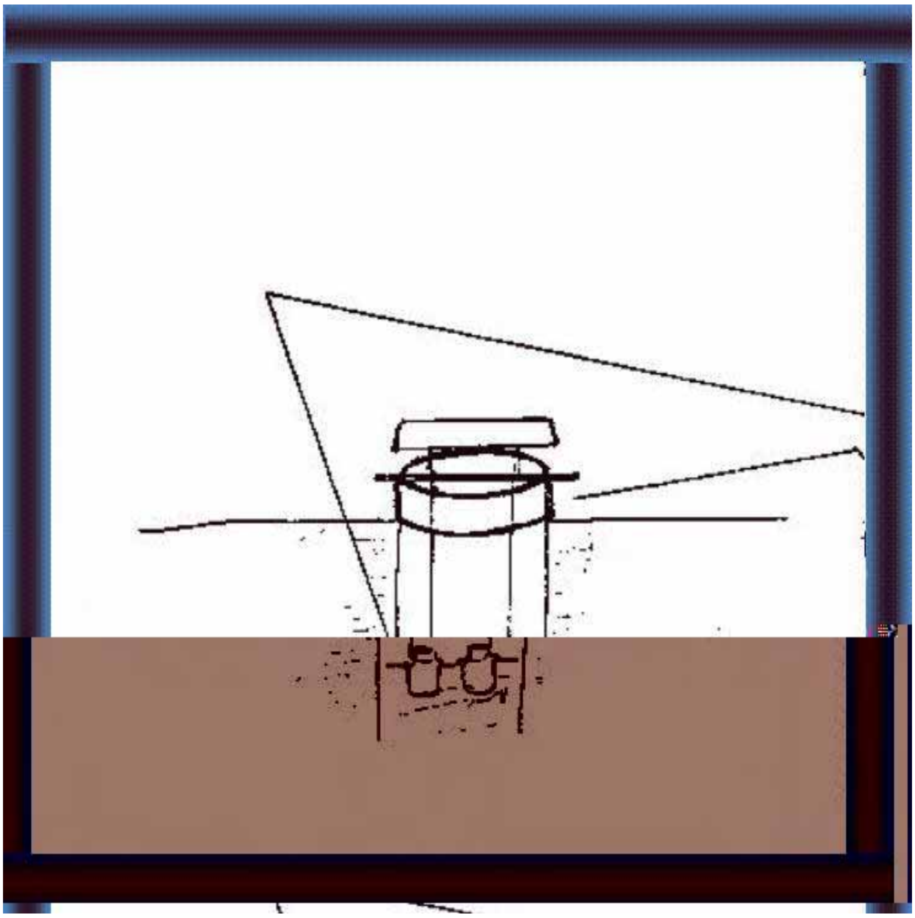
oC	Very clean milk	Clean milk	Dirty milk
4	good quality	good quality	poor quality
10	good quality	bad quality	very bad quality
20	poor quality	turned bad	turned bad
35	bad quality	turned bad	turned bad

How can you cool your milk?



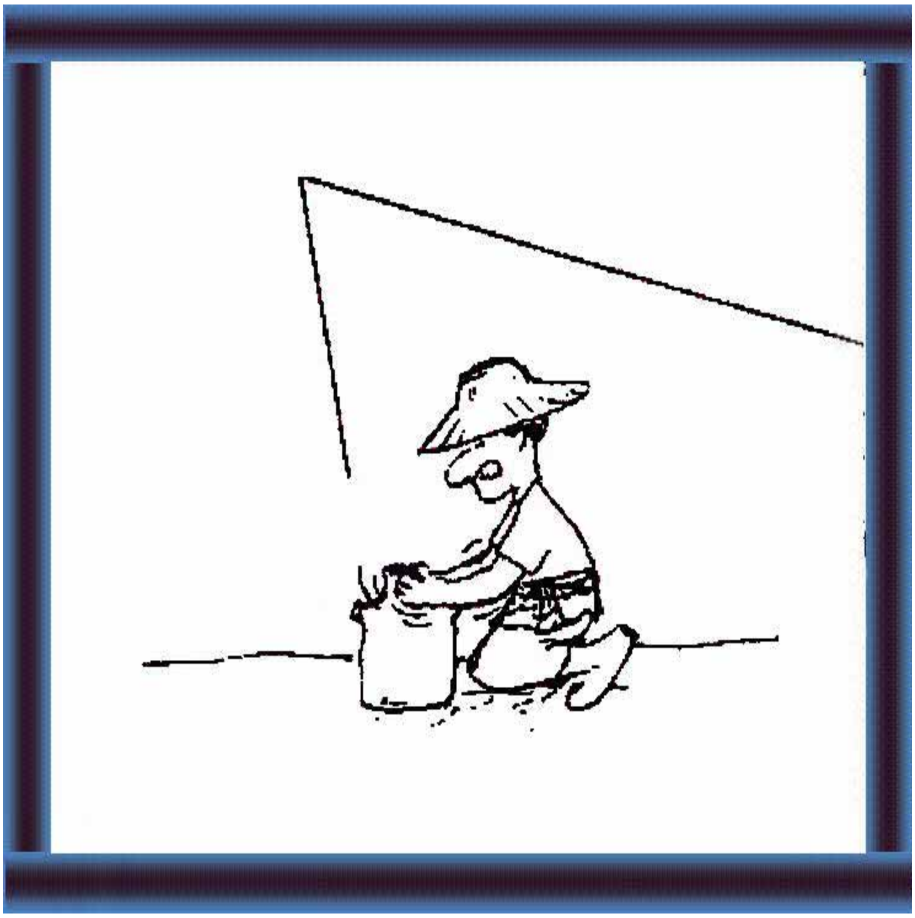
15 You can keep your milk

in the shade or
in a dark, well-ventilated place.



16 You can put your milk cans in a well.

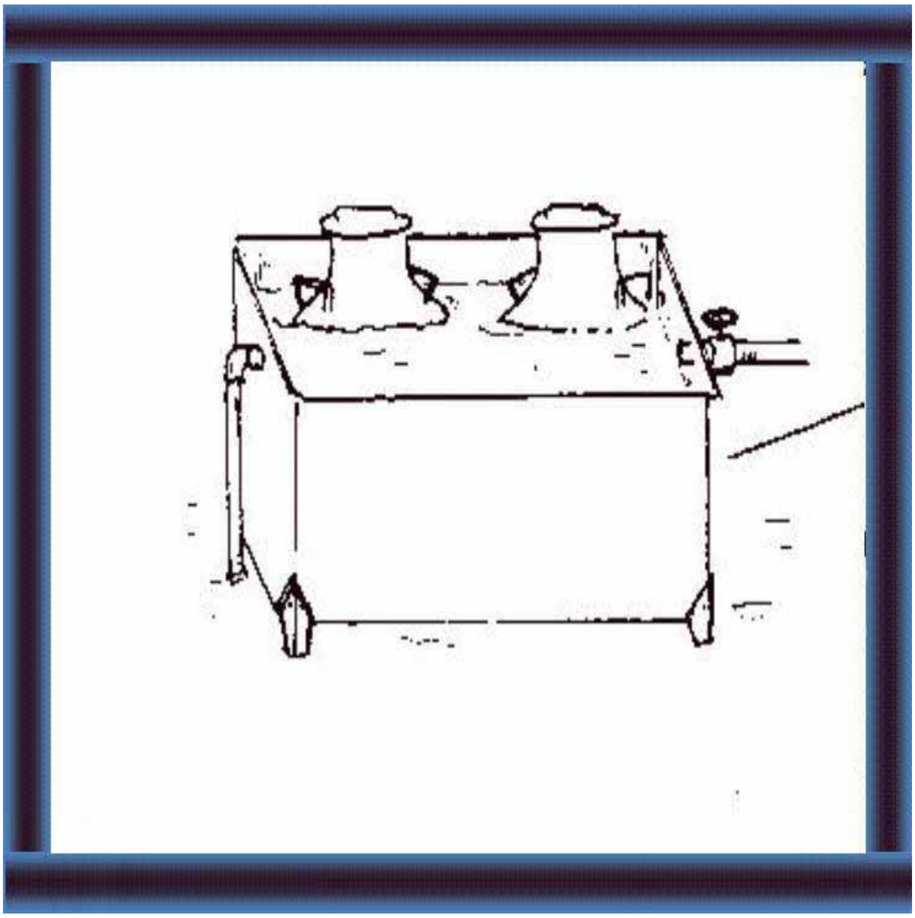
If you use the water for drinking, be careful it does not become dirty.



17 Make sure the tops are tight or cover with cloth so that water from the well does not get into your milk.

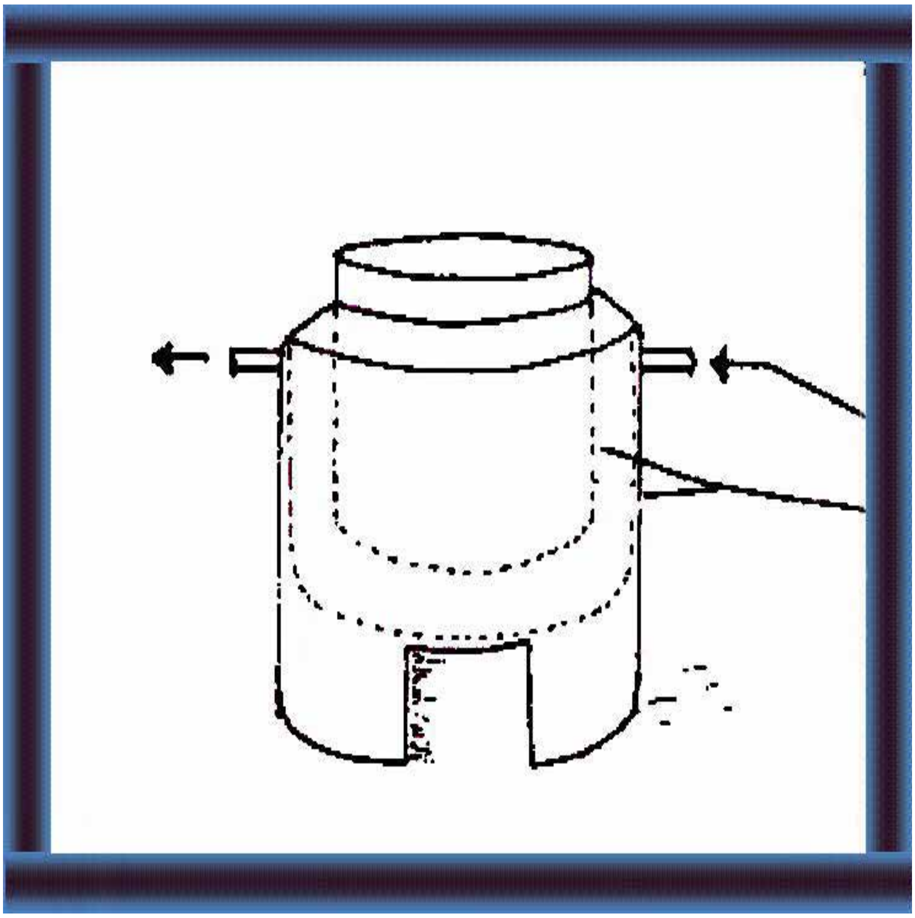
You can use cooling tanks

18 If you have a good supply of water, put your cans into a cooling tank. The temperature of your milk



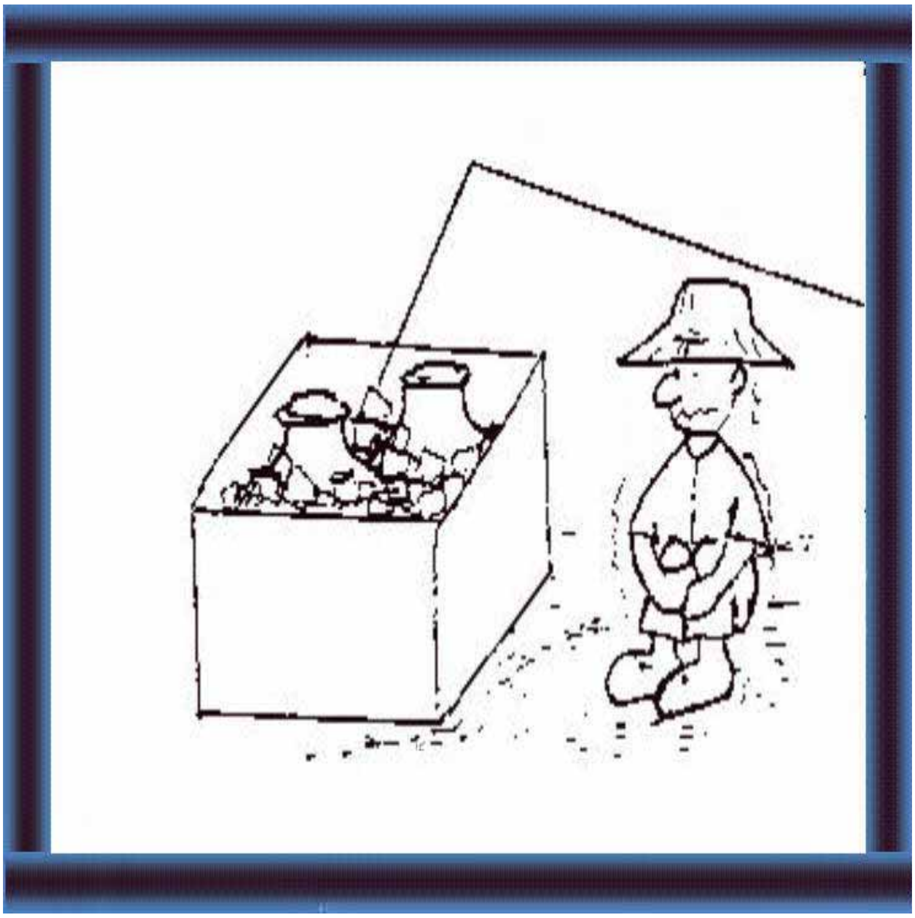
is 3-5 C above the temperature of the water (after some time in the water).

Milk ºC	Water ºC
7	3
10	6
13	9
16	12



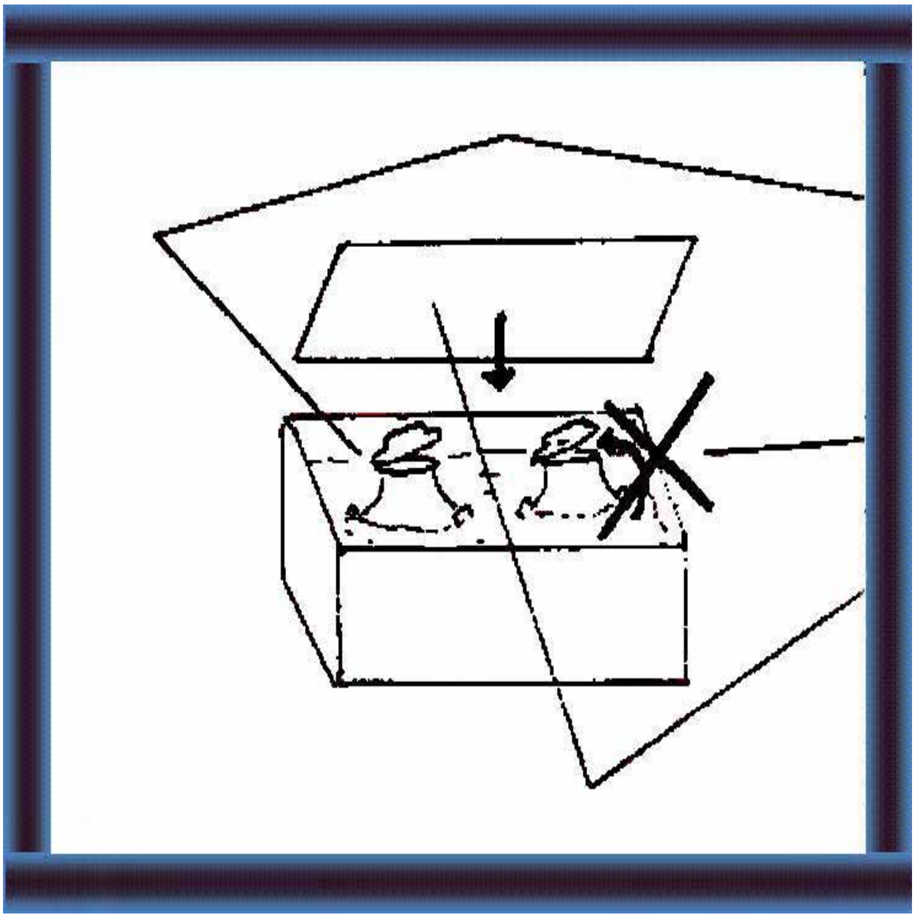
19 For large quantities of milk,

pass cool water through a double envelope.



20 If ice is available,

you can use it for cooling your milk.

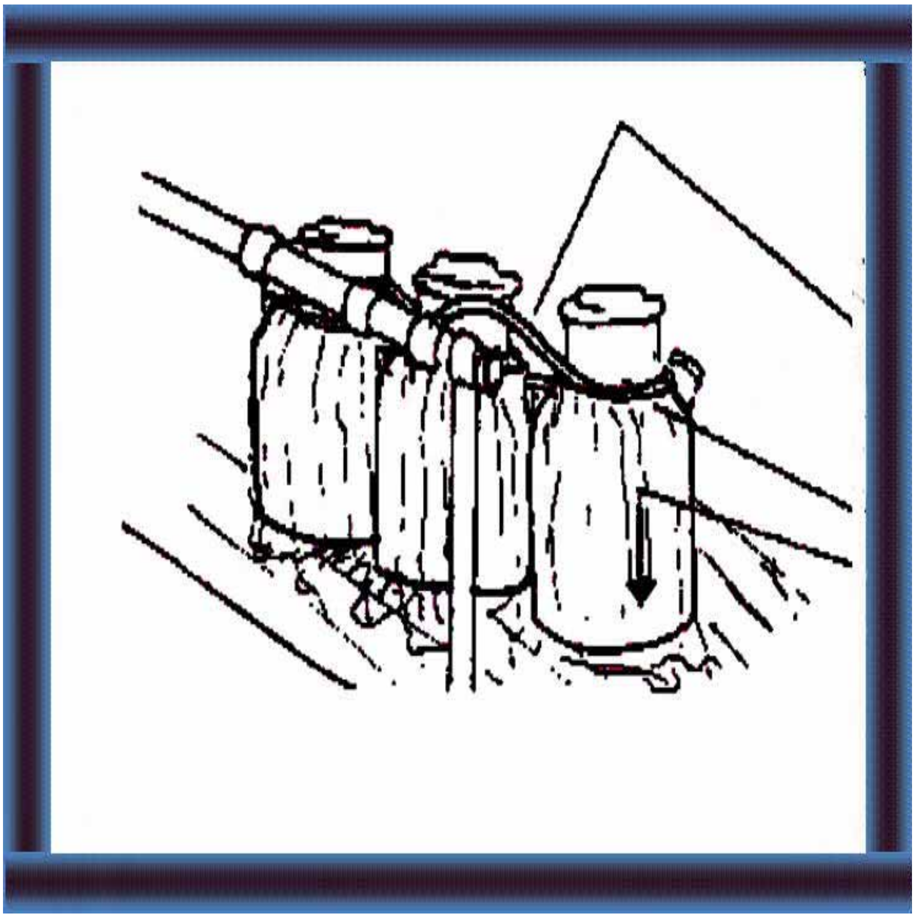


21 Loosen the lids of the cans to allow the air to escape.

Make sure no water gets into the milk.

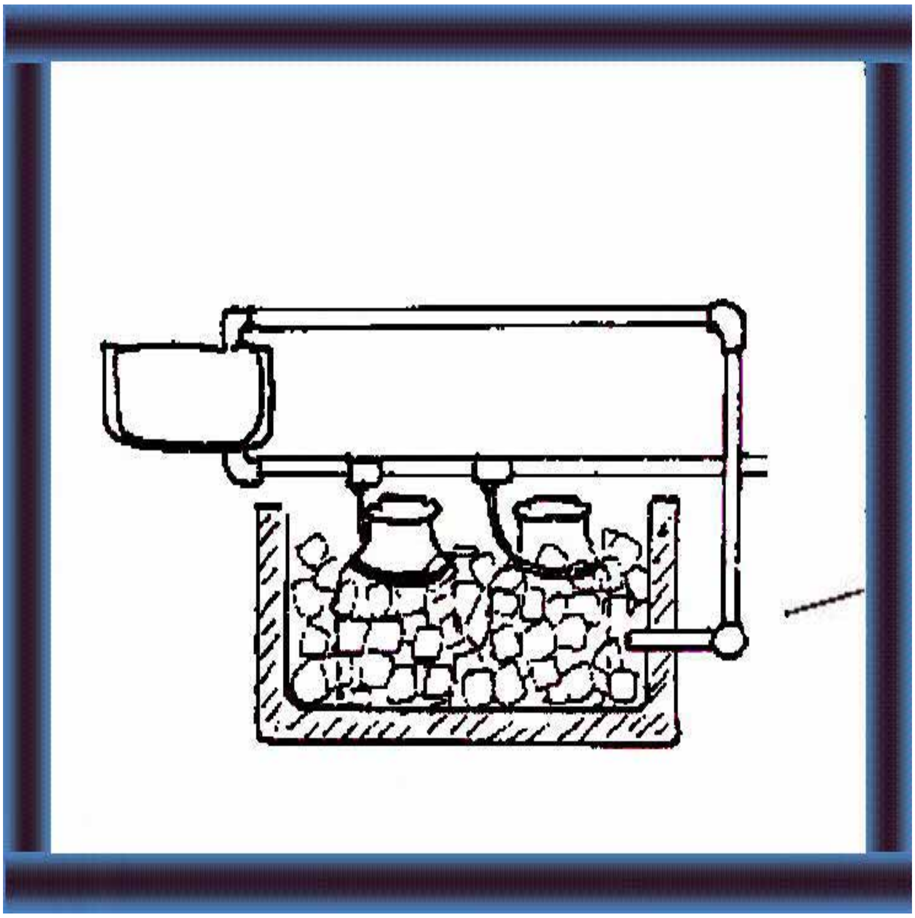
Cover the cooling tank cans with a lid to protect the milk from insects and dust.

You can use cooling rings



22 If cool (10 C or less) running water is available, you can pass it through a perforated ring so that it flows over the cans.

23 If you have a big farm (400-500 l

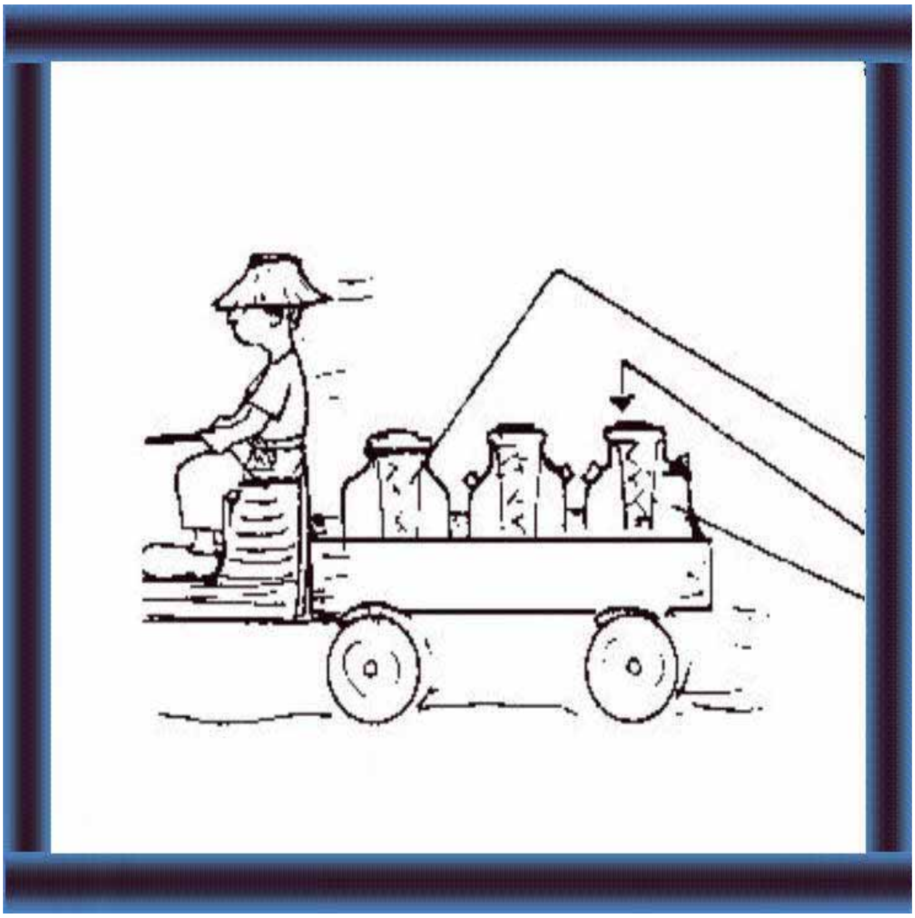


milk/day),
use a
mechanical
farm

cooling tank
which runs on
electricity.

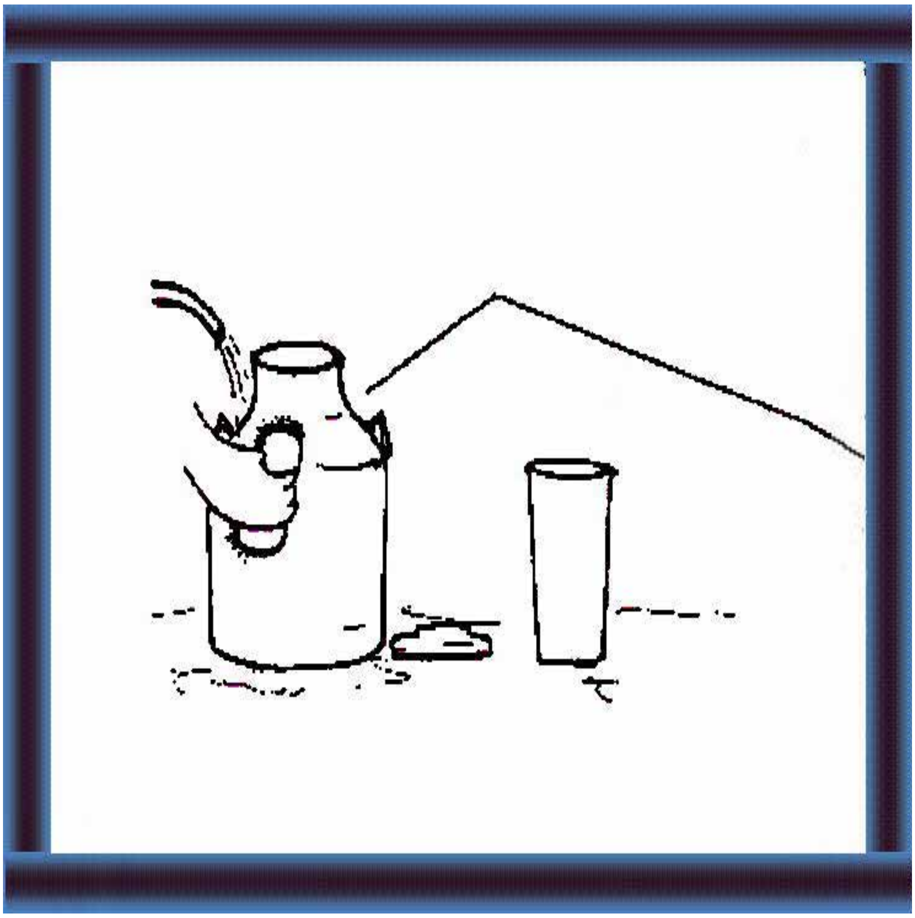
You can use ice cones

24 If you
send small
amounts of
milk
a long way,



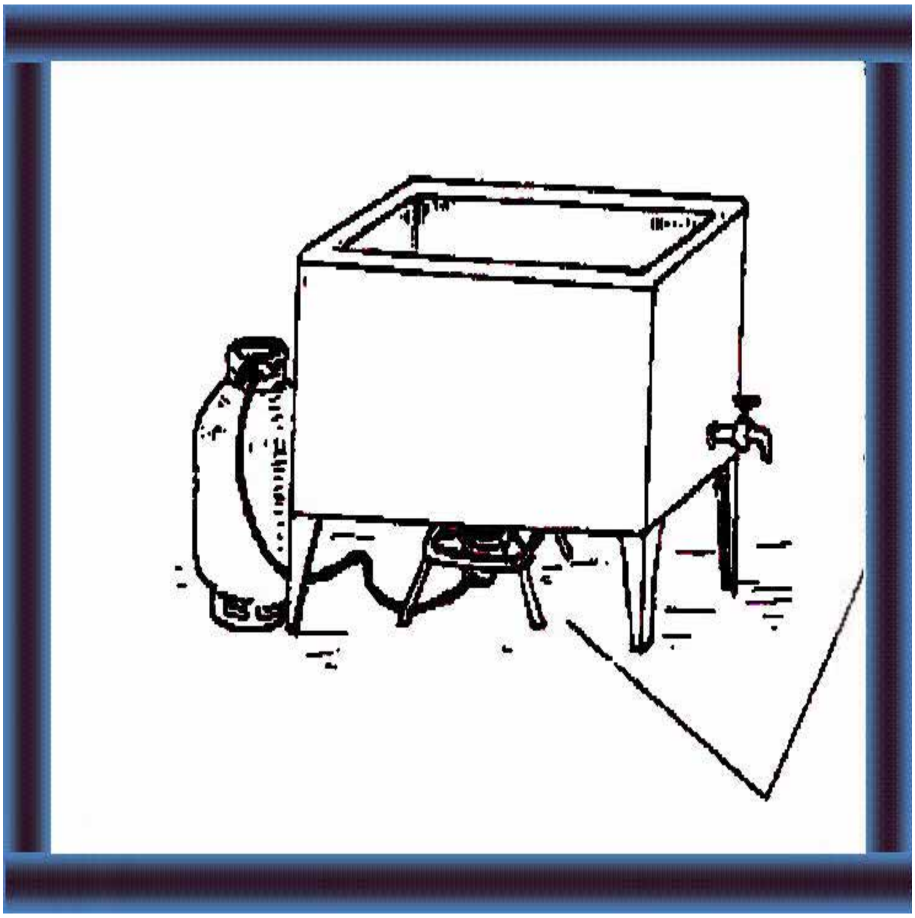
you can use ice cones.

Fill the cones with crushed ice and place in the milk.



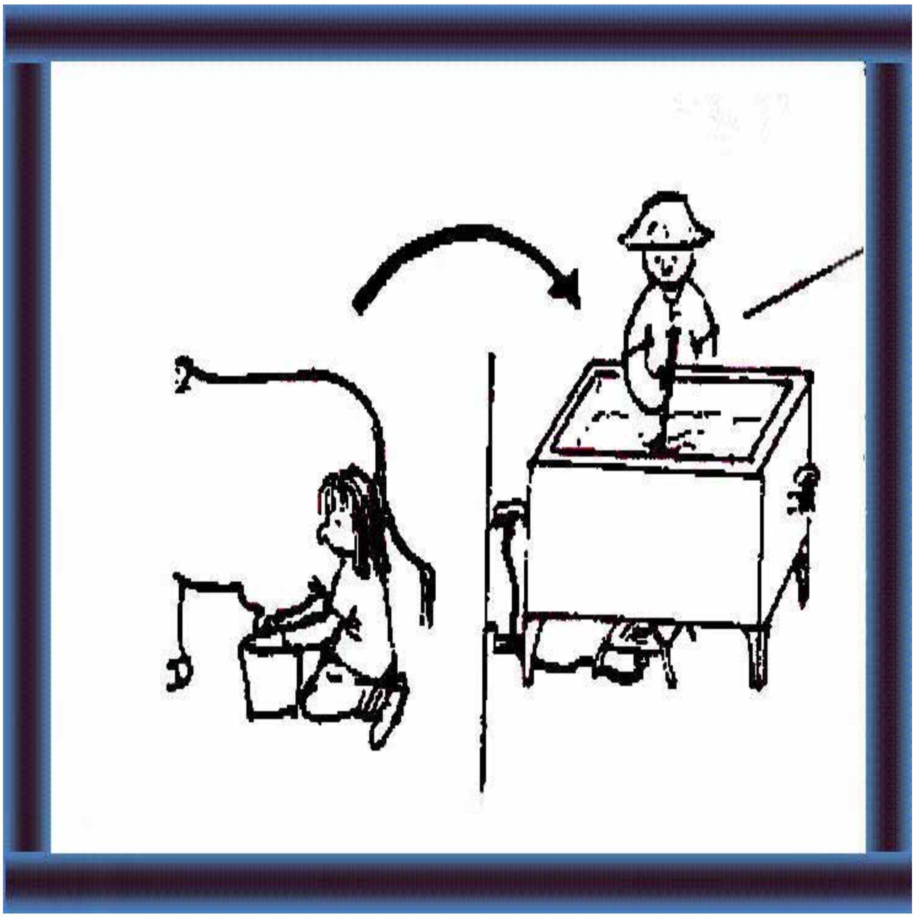
25 Clean the cones carefully after use and again before use.

Why heat treat your milk?



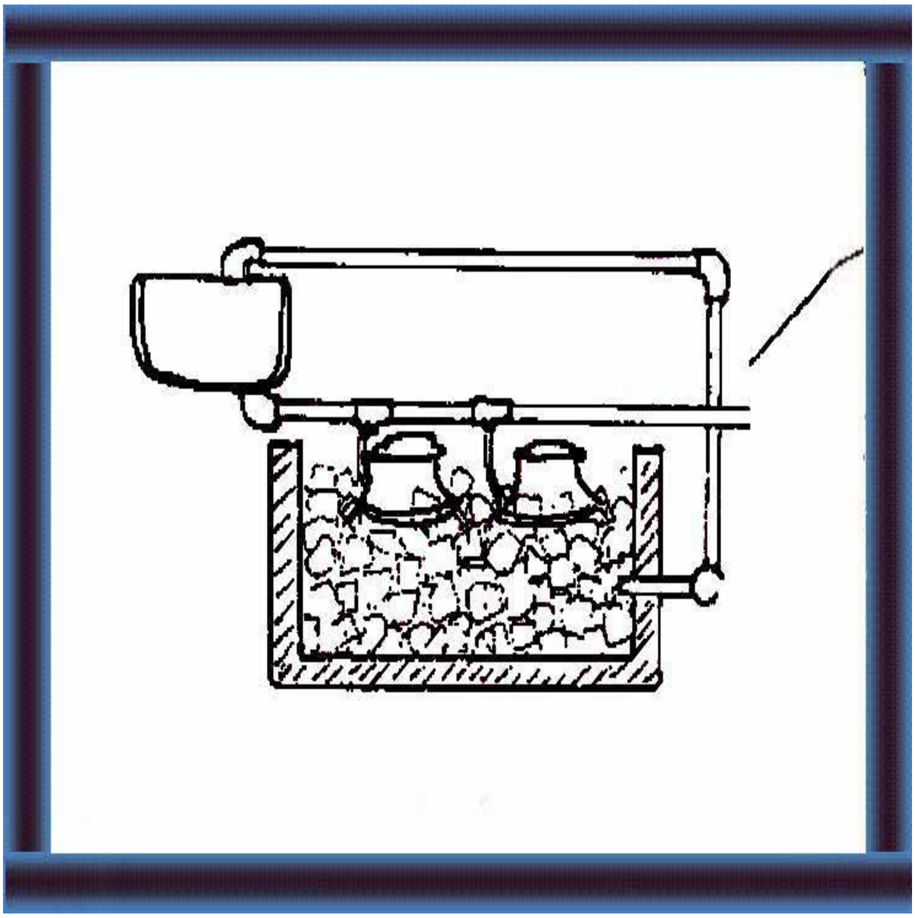
26 If you heat your milk before storing, you kill many bacteria, so you can keep your milk longer.

27 Thermatisation



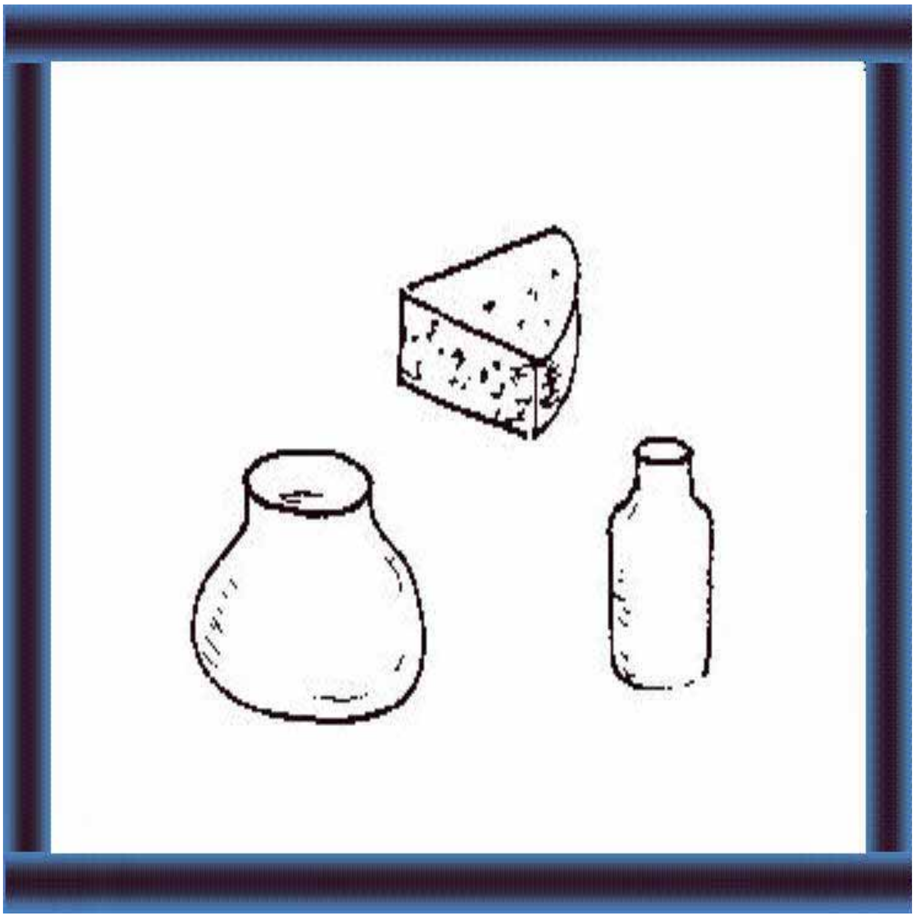
is low heat treatment.

As soon as possible after milking heat your milk to 65 C.



28 Then cool down as fast as possible to under 10 C. (See T.9 Milk Treatment)

Why process your milk?

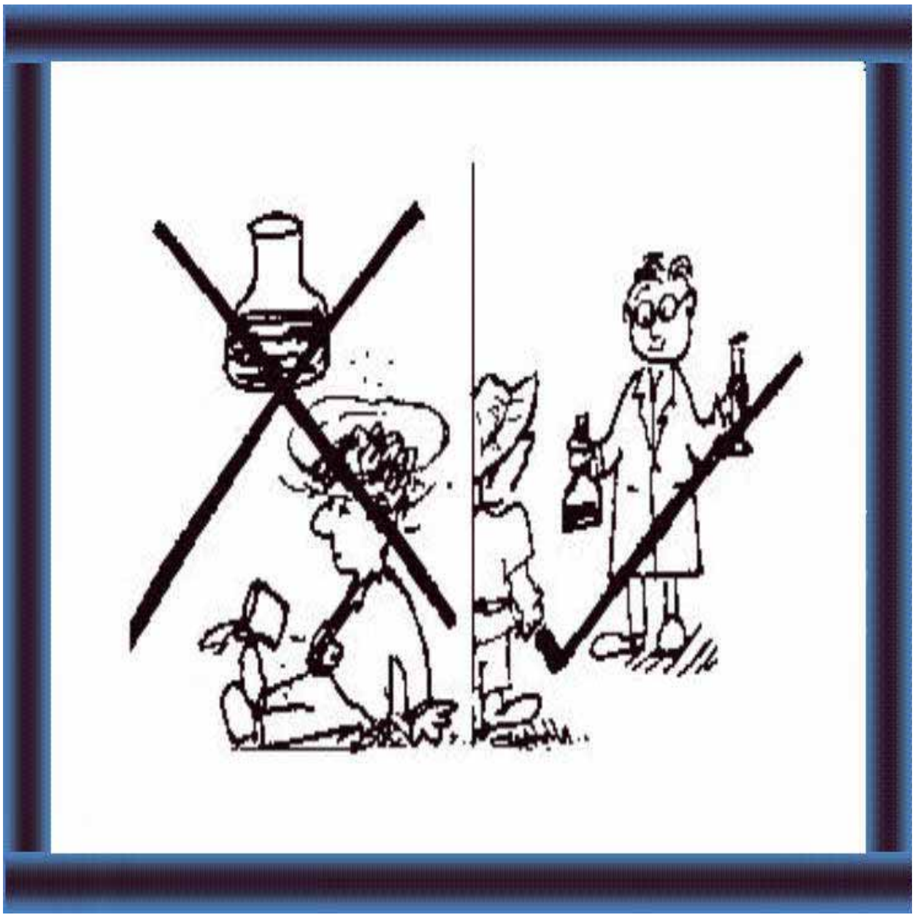


29 For quick local consumption, you can preserve your milk by processing it into products such as:
- cheese
- curd
- pasteurized milk
- yoghurt.

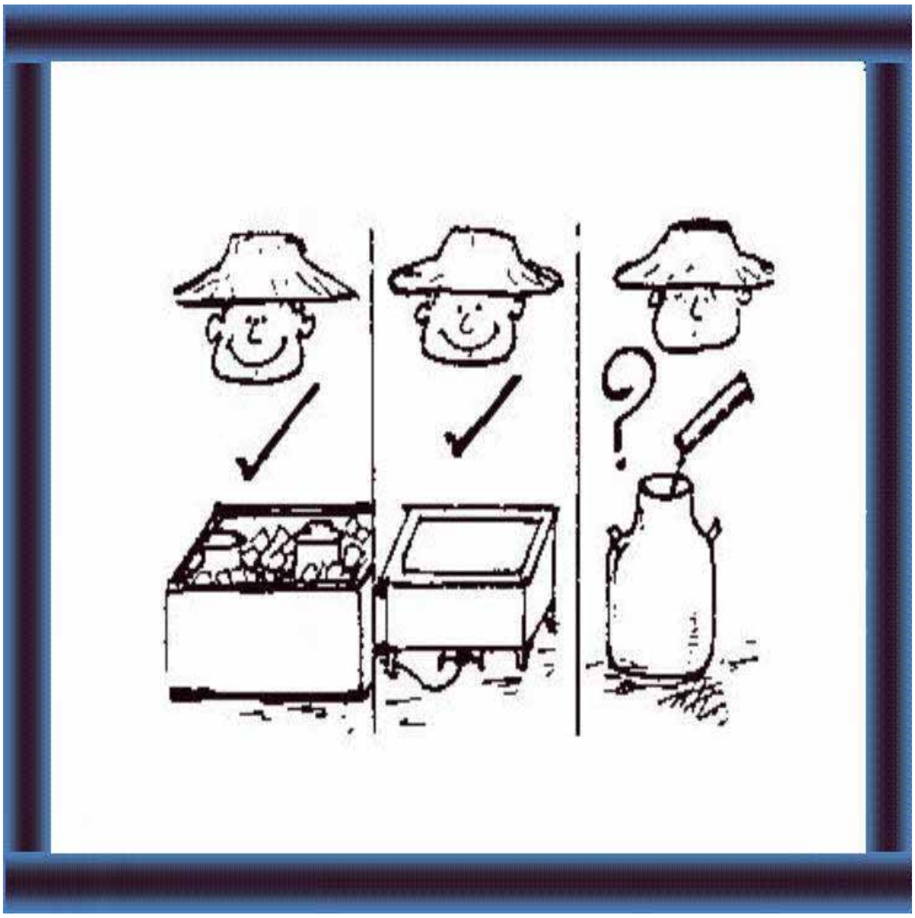
(See T.10 Milk Production Manufacture)

Can you use chemicals to preserve your milk?

30 Yes, but the milk collecting

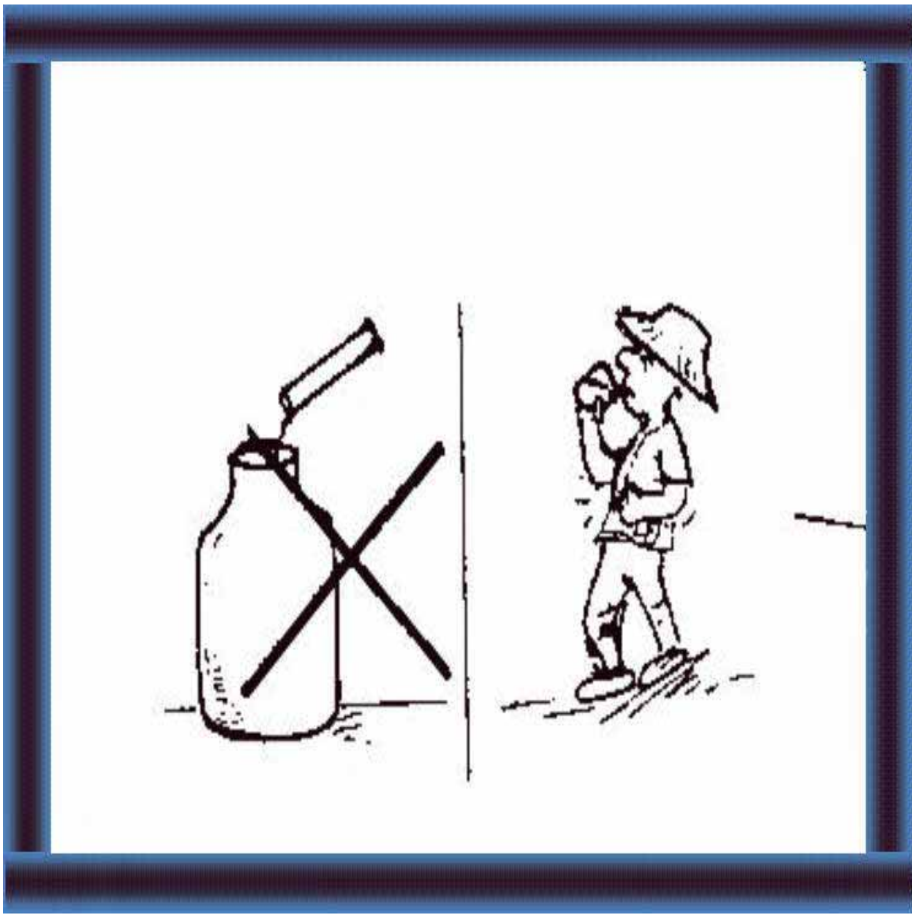


centre should advise you because you need to use the correct types and amounts of chemicals.



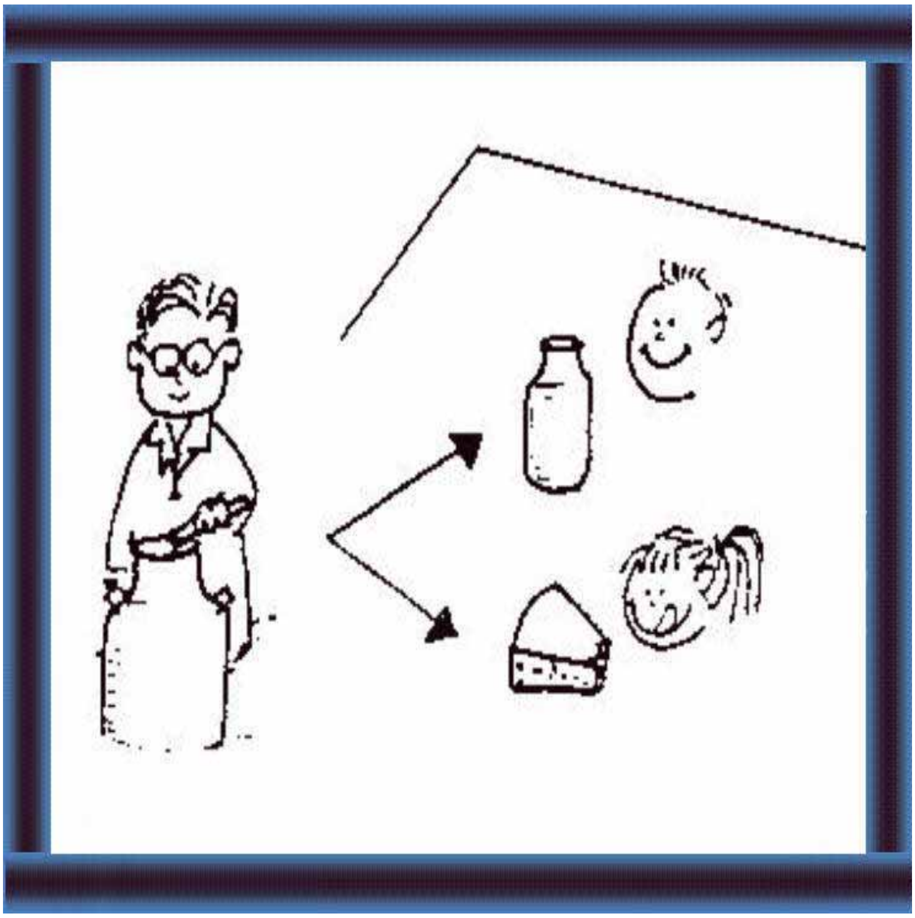
31 Only use chemicals in your milk if you cannot cool it.

Heat treat your milk or deliver to a collecting centre quickly after milking.



32 Only use chemicals in the milk you deliver to a dairy plant.

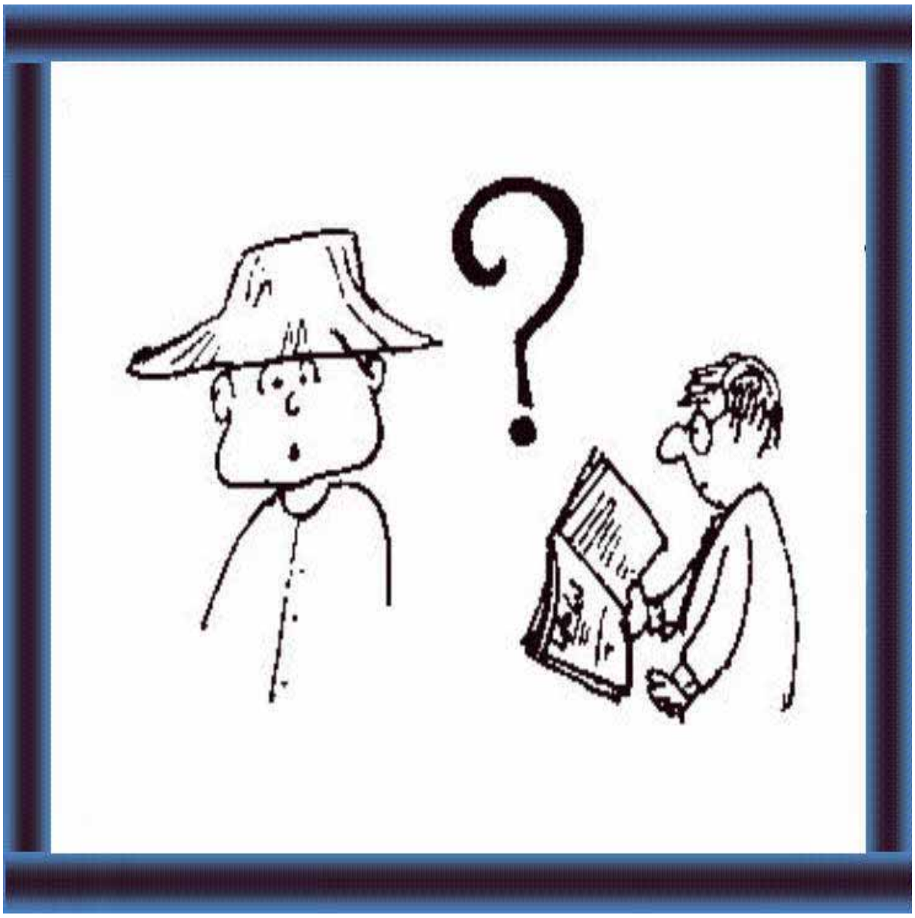
Do not use chemicals if you drink your own milk or if you deliver your milk to anywhere but a dairy plant.



33 The dairy plant will

process your milk so that the chemicals are not harmful.

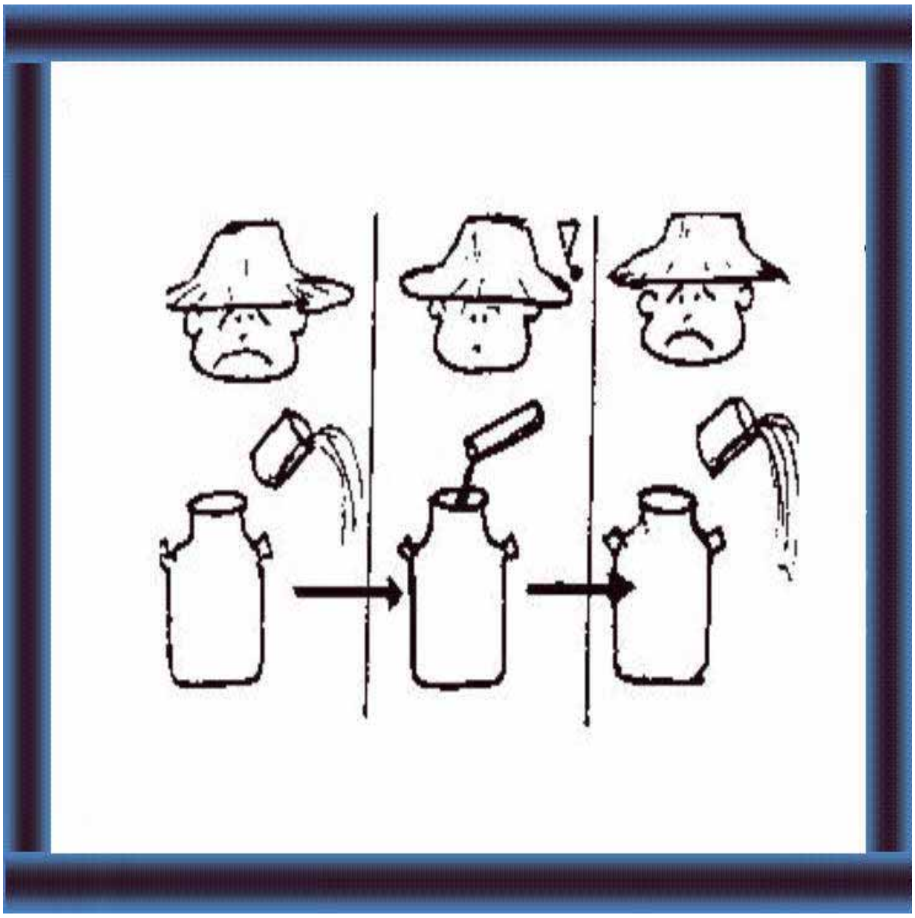
Is it legal to use chemicals?



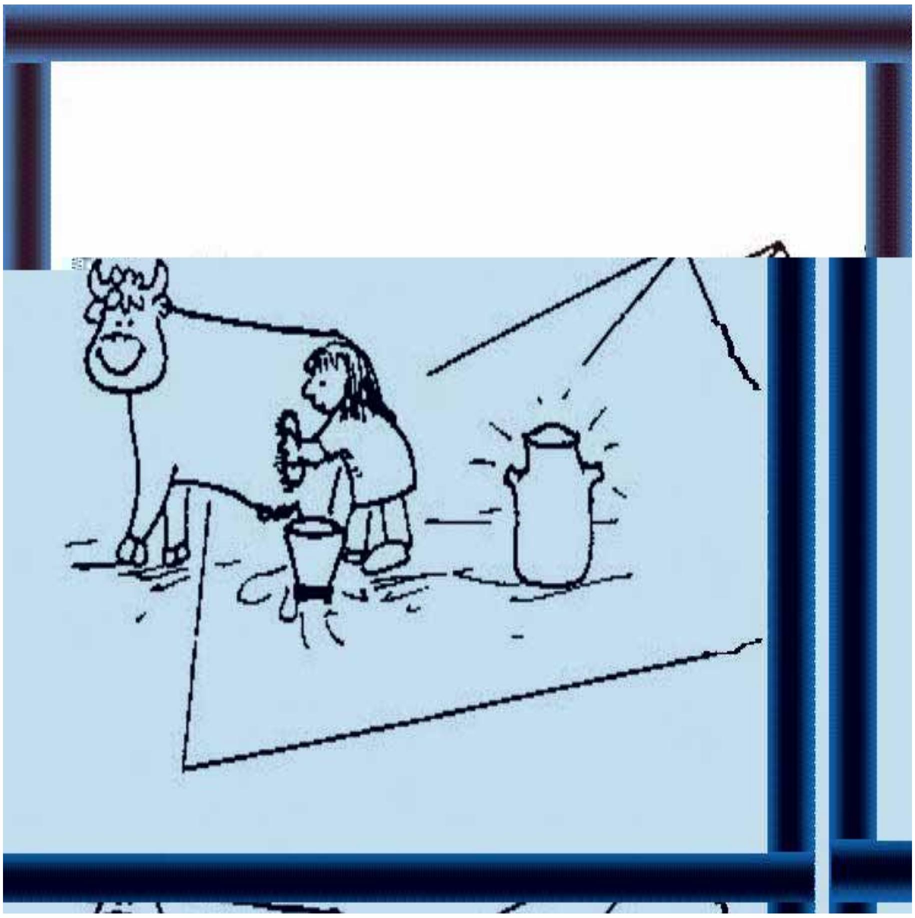
34 You must check if the use of chemicals is legal in your country

Do chemicals make your milk clean?

35 No,



you cannot change poor quality milk into good quality milk by using chemicals.



36 Good quality milk comes from

hygiene and

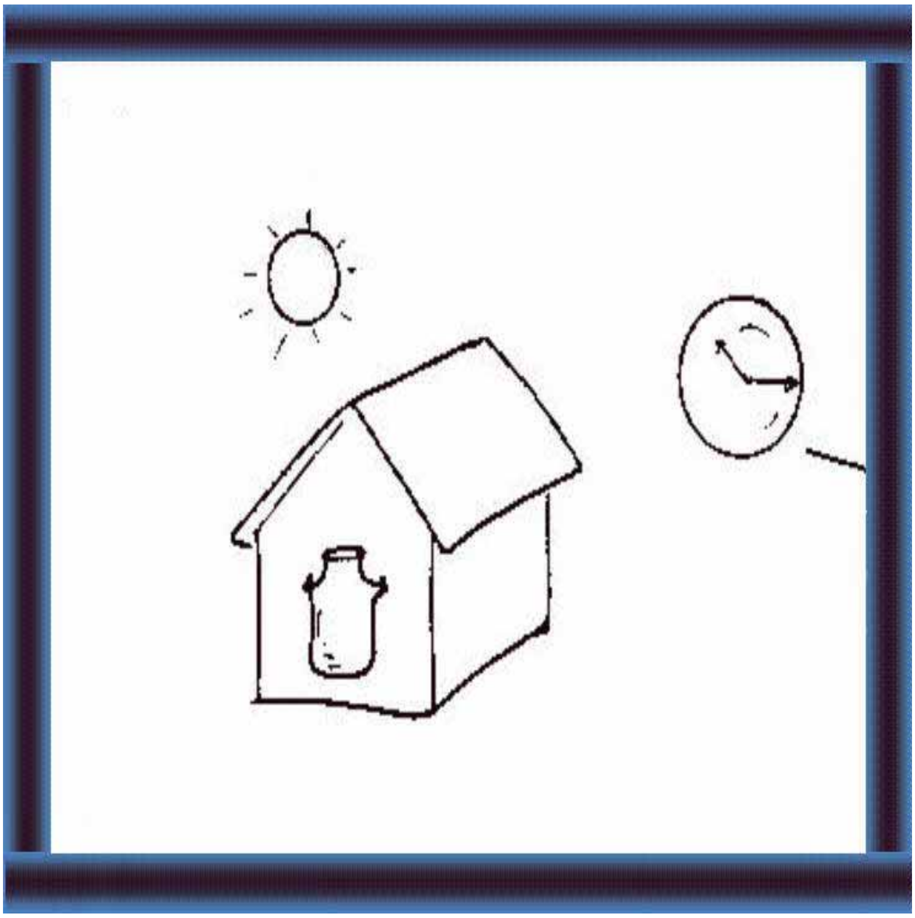
healthy animals.

37

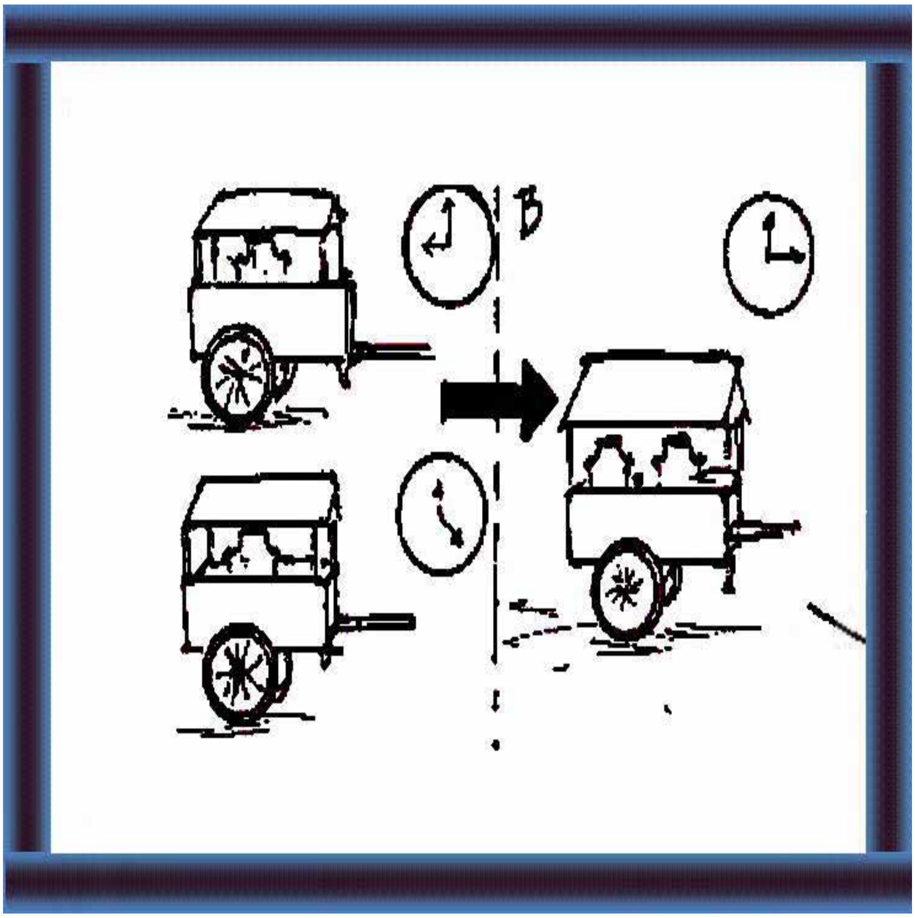
- keeping your milk cool and handling it gently.

Why use chemicals to preserve your milk?

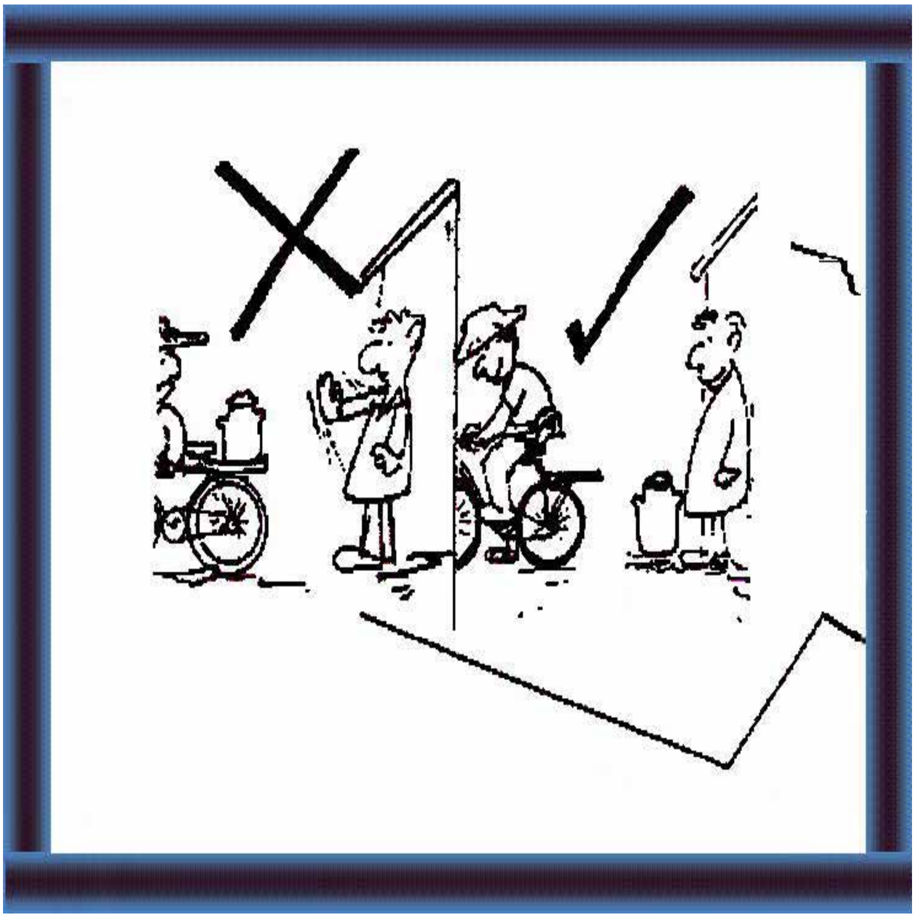
38 You can keep



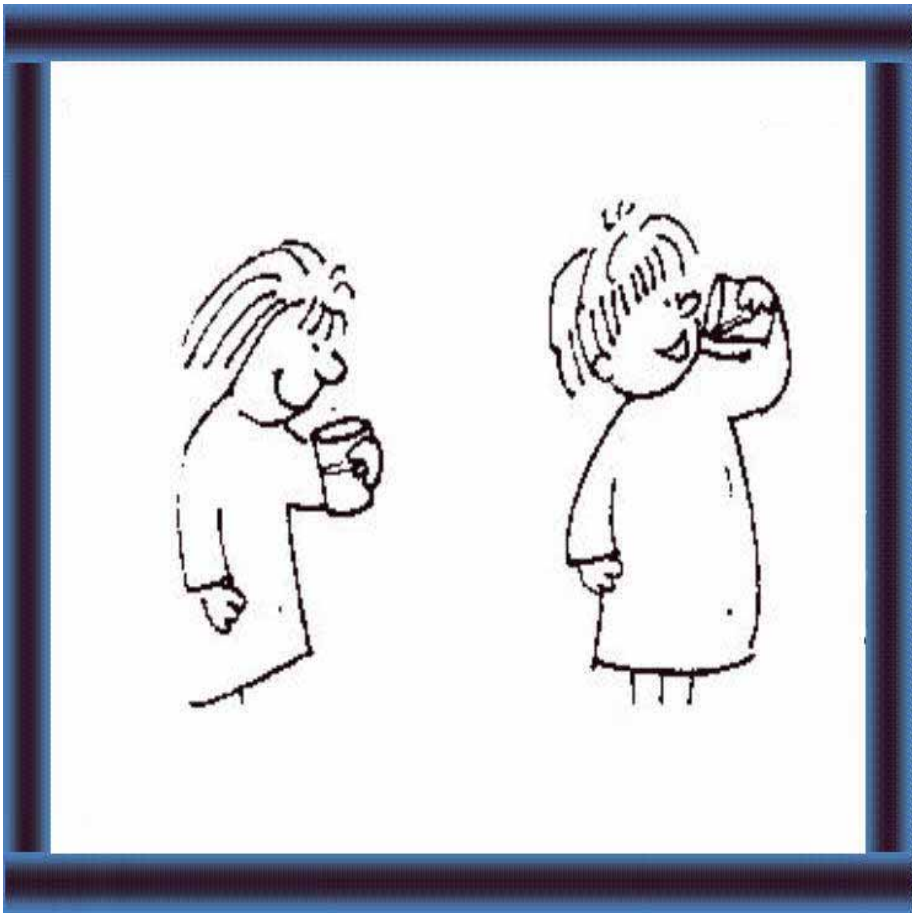
uncooled milk longer,
even in high temperatures.



39 You can keep cooled milk longer and therefore, reduce the numberof deliveries.



40 You can deliver milk which spoils and the dairy plant rejects if you do not use chemicals.



41 If you use chemicals correctly, they have little effect on the physical quality of the milk.

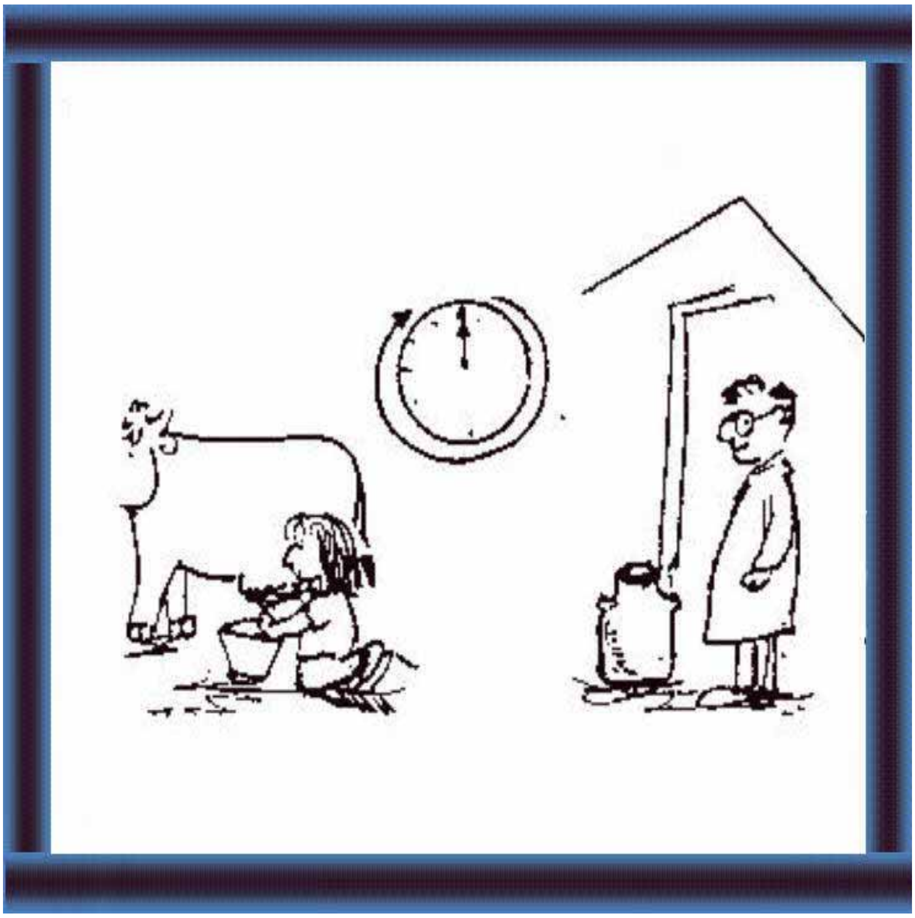
How can you use hydrogen peroxide to preserve your milk?

42 Add the correct amount of liquid hydrogen peroxide or solid carbamide peroxide to your milk.

Important

Ask your extension worker or dairy plant to advise on adding chemicals to your milk.

43 The dairy plant gets rid of the peroxide by adding the correct amount of catalase to your milk.



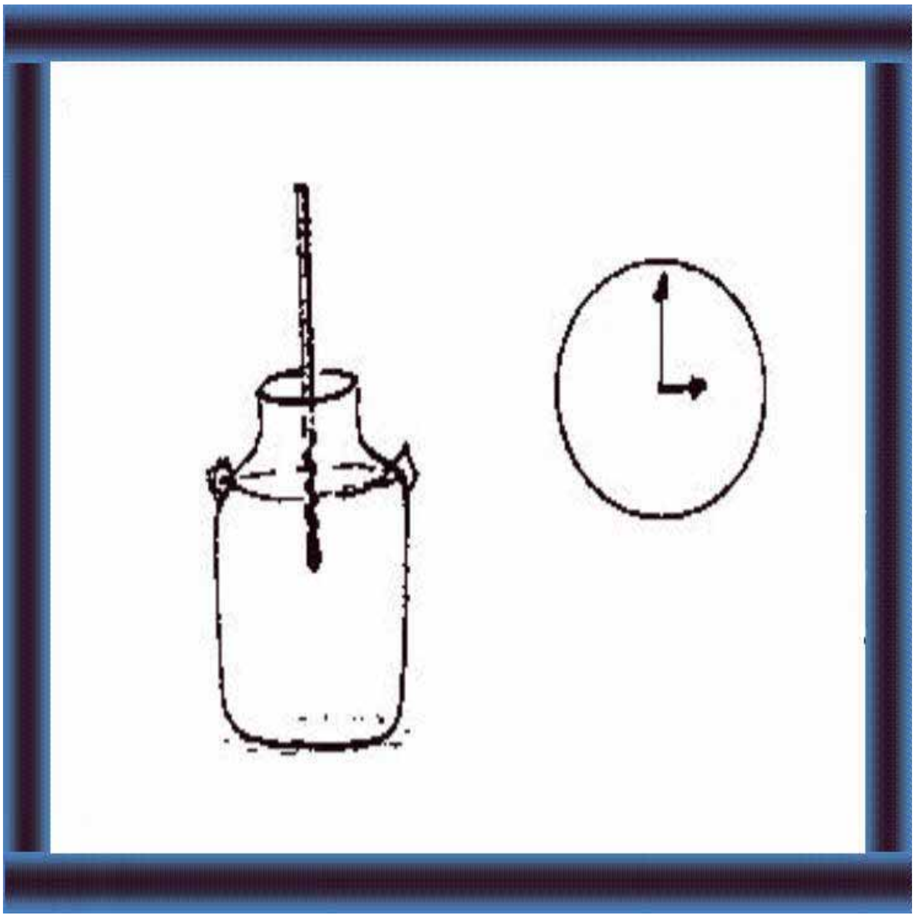
44 You can preserve your milk from 6 to 24 hours in tropical temperatures if your milk is good quality in the first place.

How can you use the lactoperoxide system to preserve your milk?

45 Within 2-3 hours of milking:

- add 14 mg of sodium thiocyanate for each litre of milk
- stir well
- add 30 mg of sodium percarbonate for each litre of milk
- stir well.

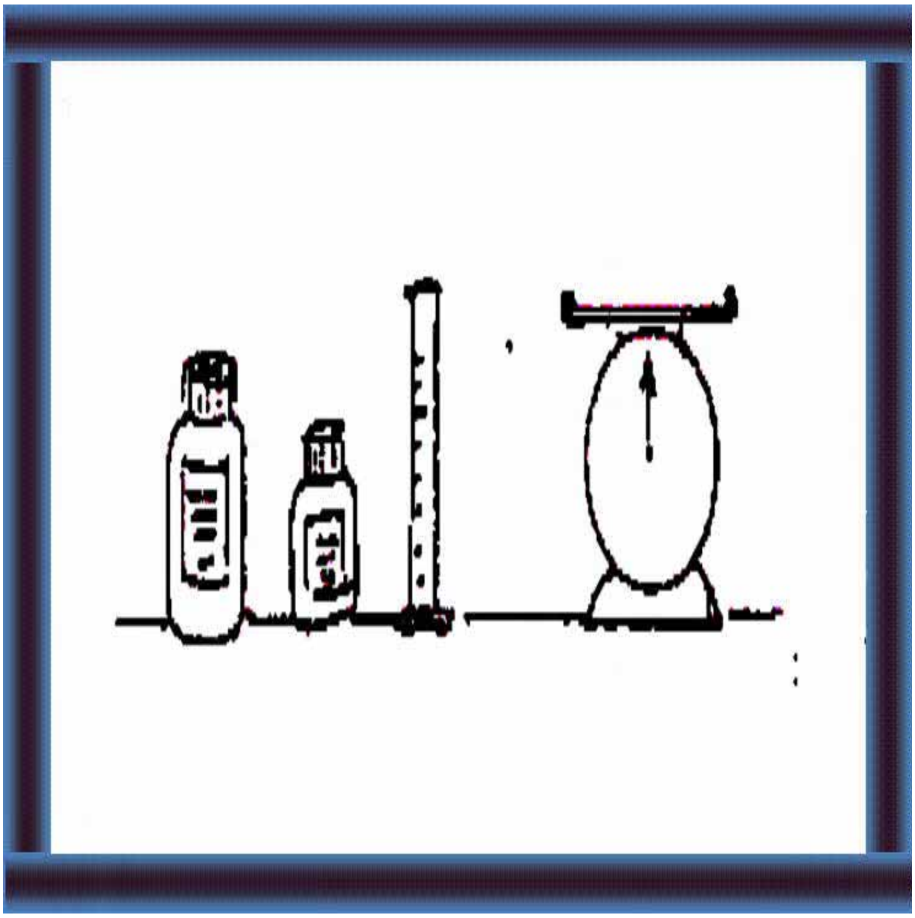
Important
Add the chemicals in the correct order.



46 You can keep your milk for up to the following times:

Temperature (C)	Time (hours)
25 - 30	8
20 - 25	12
15 - 20	18
10 - 15	30
4	48

Remember



47 Use only the right amounts of the right types of chemicals.

Consult your milk collecting centre.

48 Make sure you get

new chemicals often.

Always check the instructions on the label.

49 Keep all chemicals out of reach of children and animals and away from food and drinking water.

What do you know about milk preservation?

Important factors

1. Hygiene	(5)
2. Temperature	(6)
3. Quick delivery	(7)

Reasons for cooling milk

Cooling milk reduces:

1. damage	(10-12)
2. enzyme activity and rate of increase of bacteria	(11)

Keeping time

Depends on:	(14)
1. temperature	
2. hygiene	

Methods of cooling milk

1. Traditional:	
- shade	(15)
- well	(16)
2. Cooling tanks	(18-21)
3. Cooling rings	(22-23)
4. Ice cones	(24-25)

Heat treatment

1. Reason: kill bacteria	(26)
2. Thermatisation	(27-28)

Processing	**(29)**

Use of chemicals

1 When to use chemicals	**(30-33)**
2 Legality	**(34)**
3 Limitations	**(35-37)**
4 Reasons for use	**(38-40)**
5 How to use hydrogen peroxide	**(42-44)**
6 How to use the lactoperoxide system	**(45-46)**
7 Points to remember	

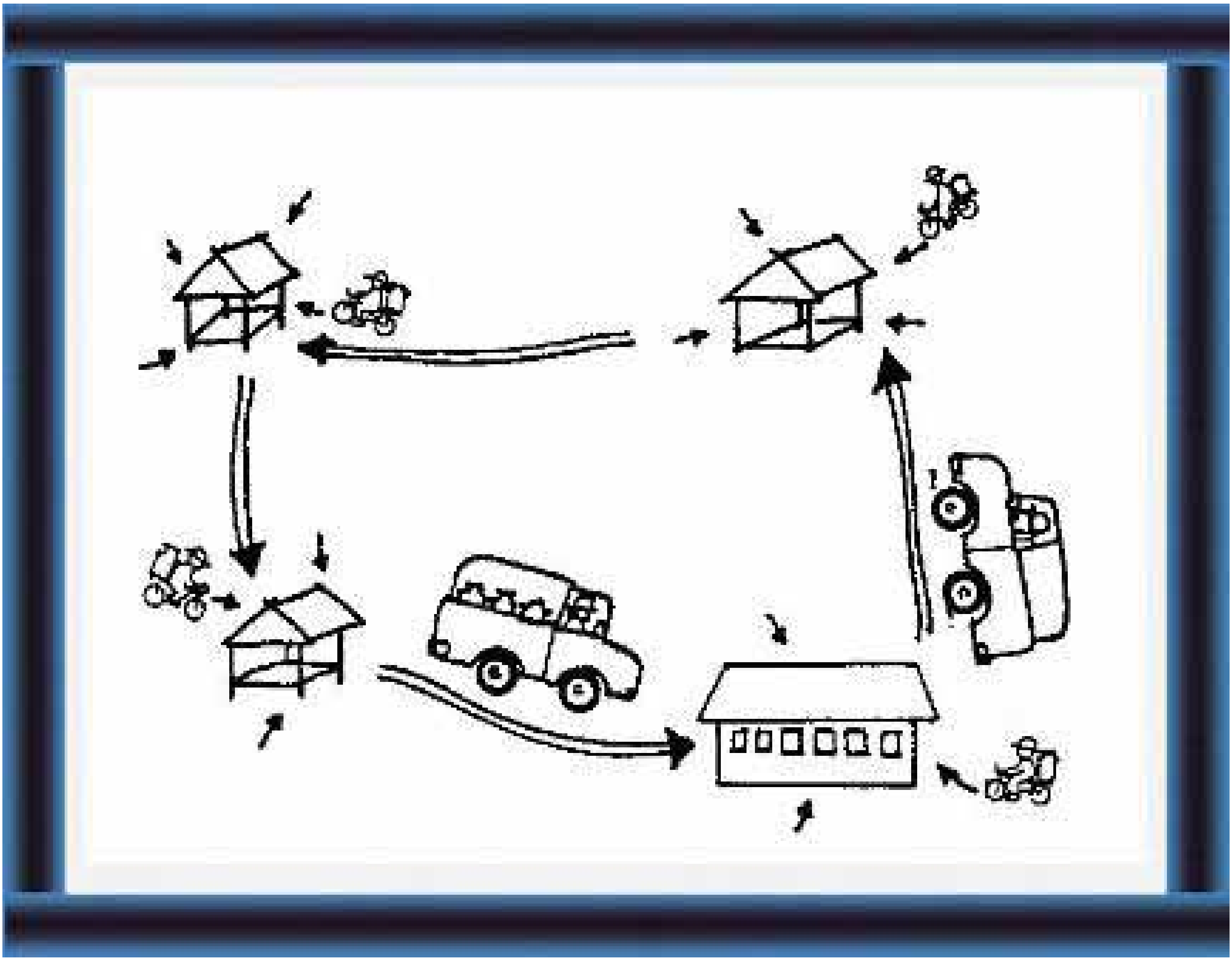
Small-Scale

Dairy Farming Manual

Volume 1

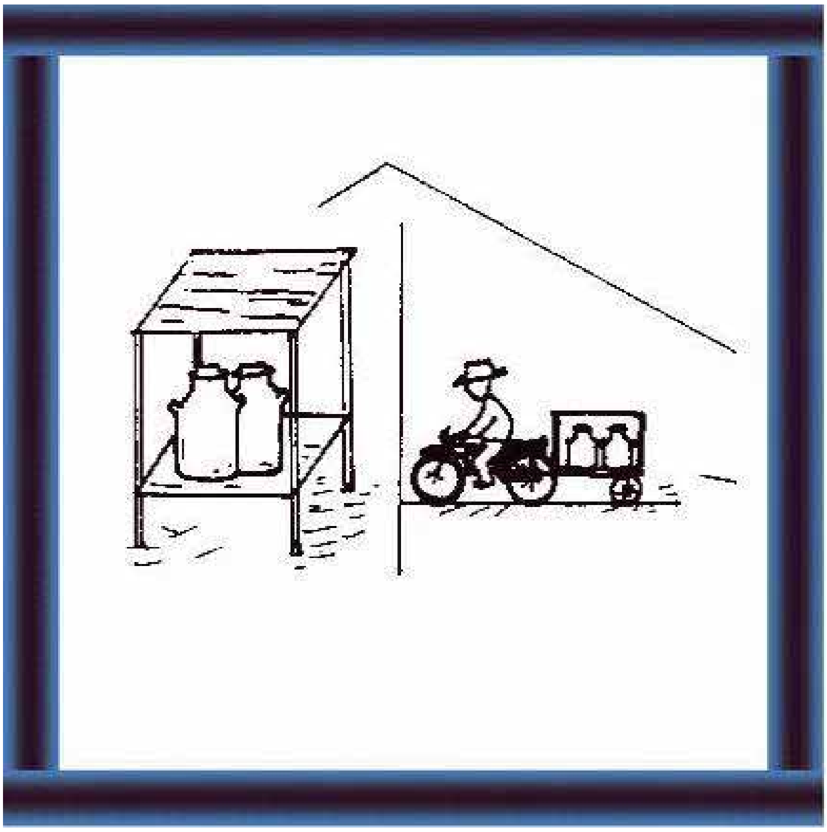
Technology Unit 5

Milk Transport

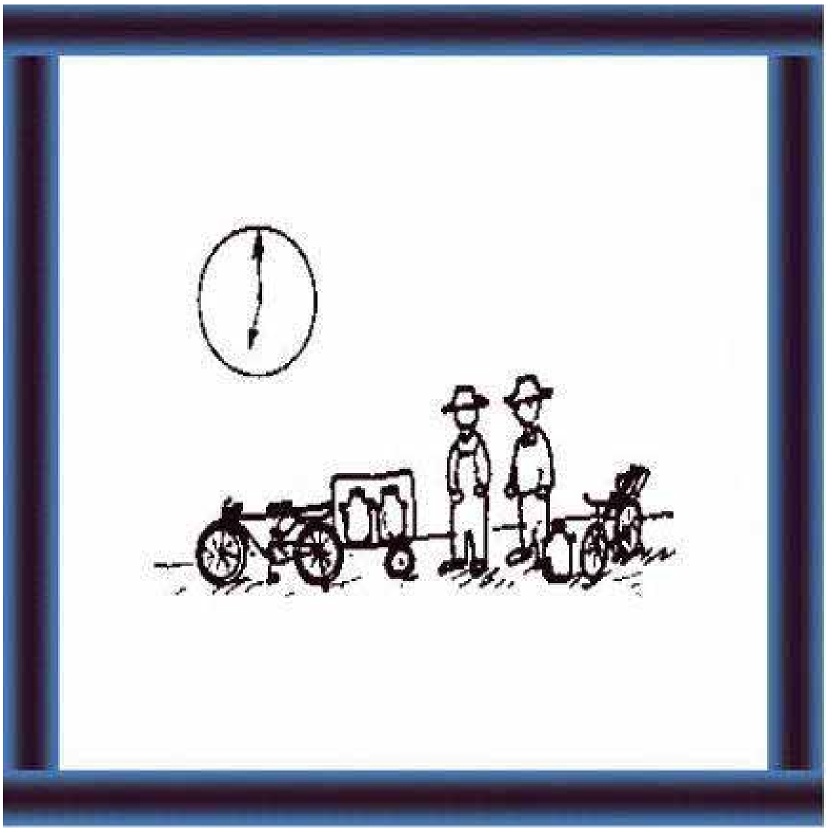


Extension Materials

What should you know about milk transport ?

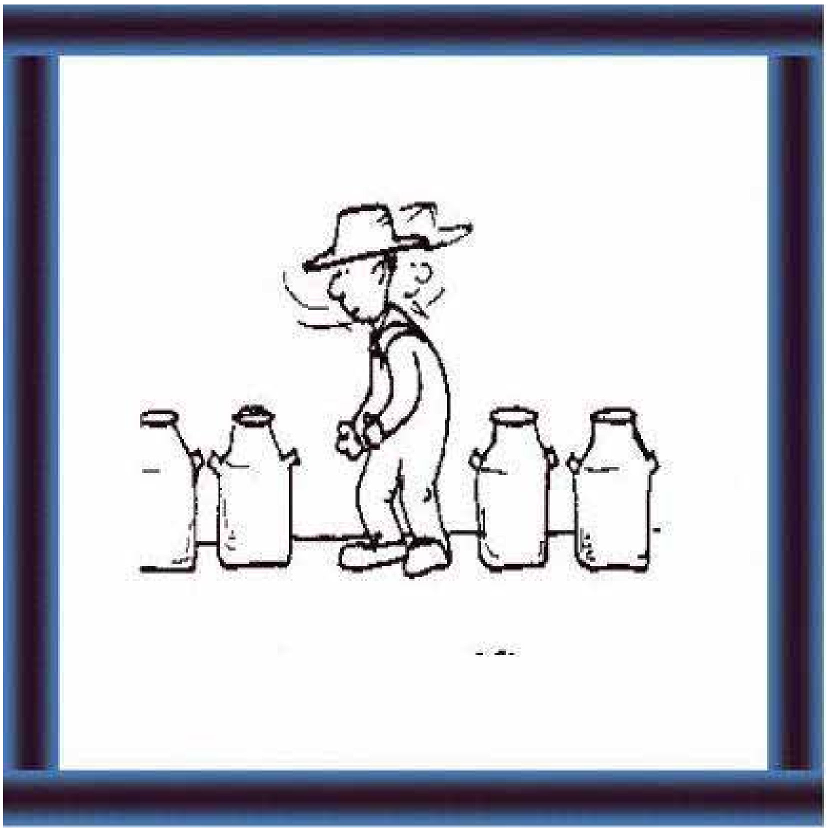


What is important ? (1-4)
Maintaining milk quality by:
- keeping your milk clean and cool
- handling your milk gently
- transporting your milk quickly.



How can we collect milk efficiently ? (5-13)

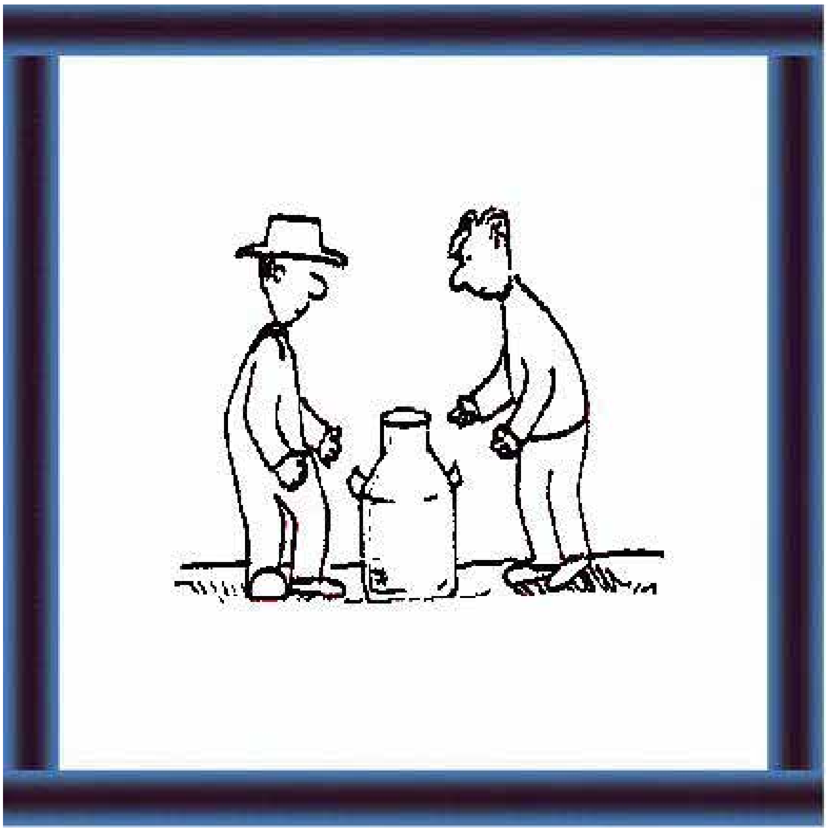
By co-operating with other farmers and the collecting centre in the timing of milk collection.



What kind of milk containers should you use ? (14-21)

Good quality can made out of good materials.What kind of milk containers should you use ? (14-21)

Good quality can made out of good materials.

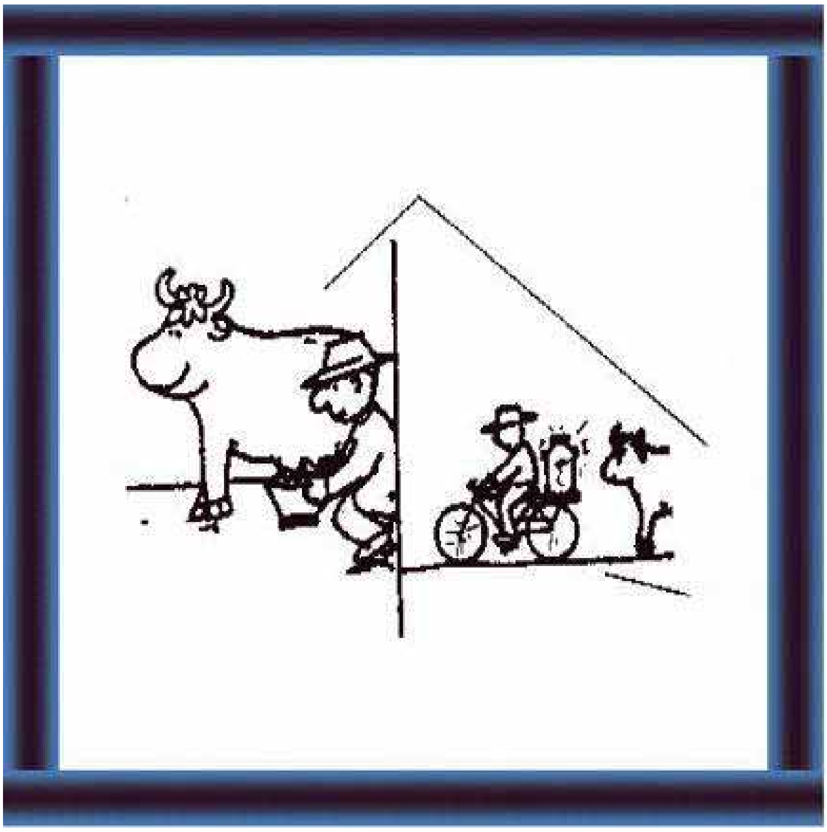


How can you avoid problems during transport ? (22 - 24)

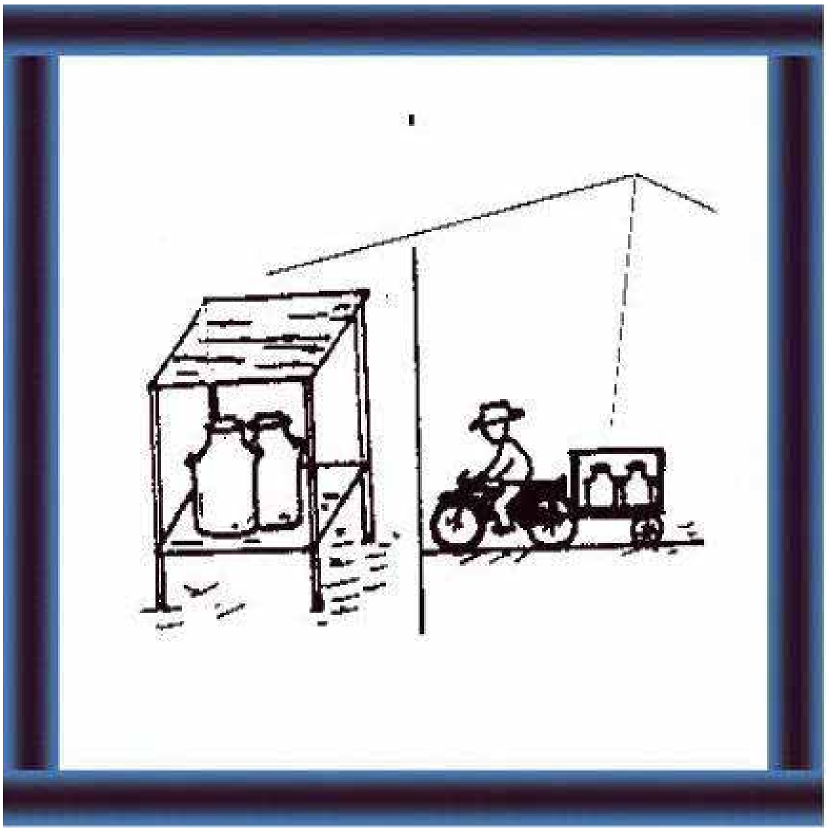
By paying attention to the above and not freezing your milk.

(The numbers in brackets refer to illustrations in the Extension Materials)

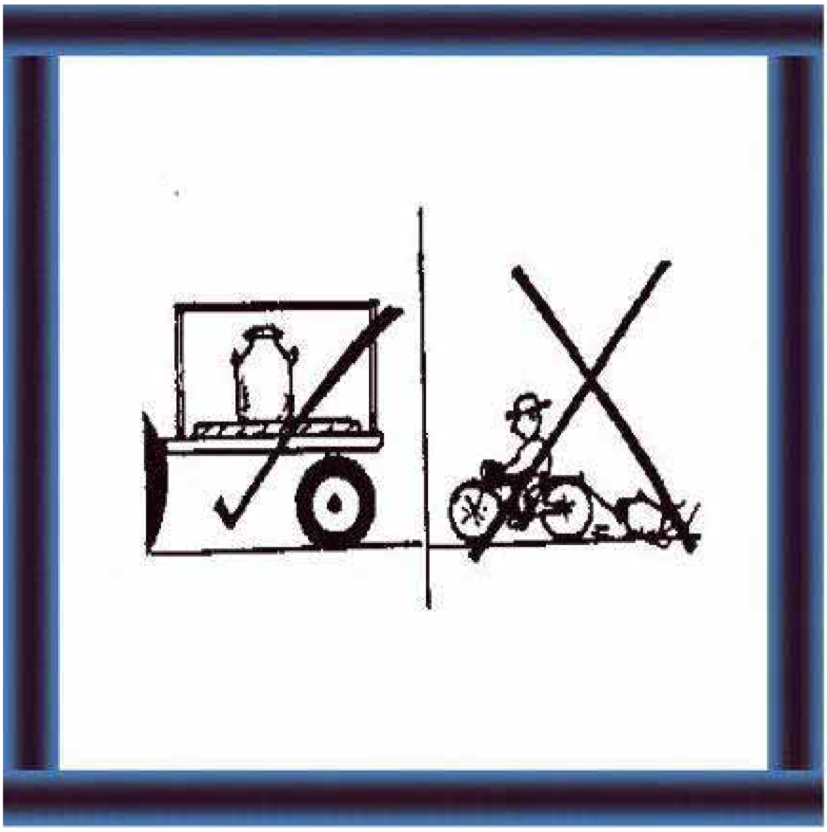
What is important in milk transport ?



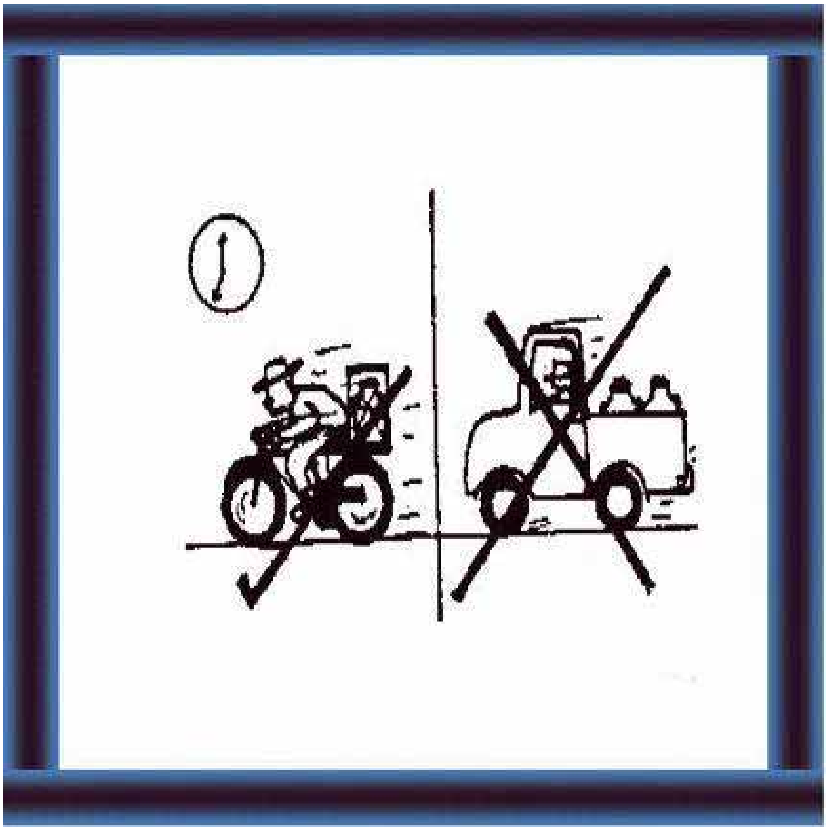
1 Anything which affects the quality of your milk.
Keep your milk clean
- during milking
- during storage
- and during transportation.



2 Keep your milk cool.

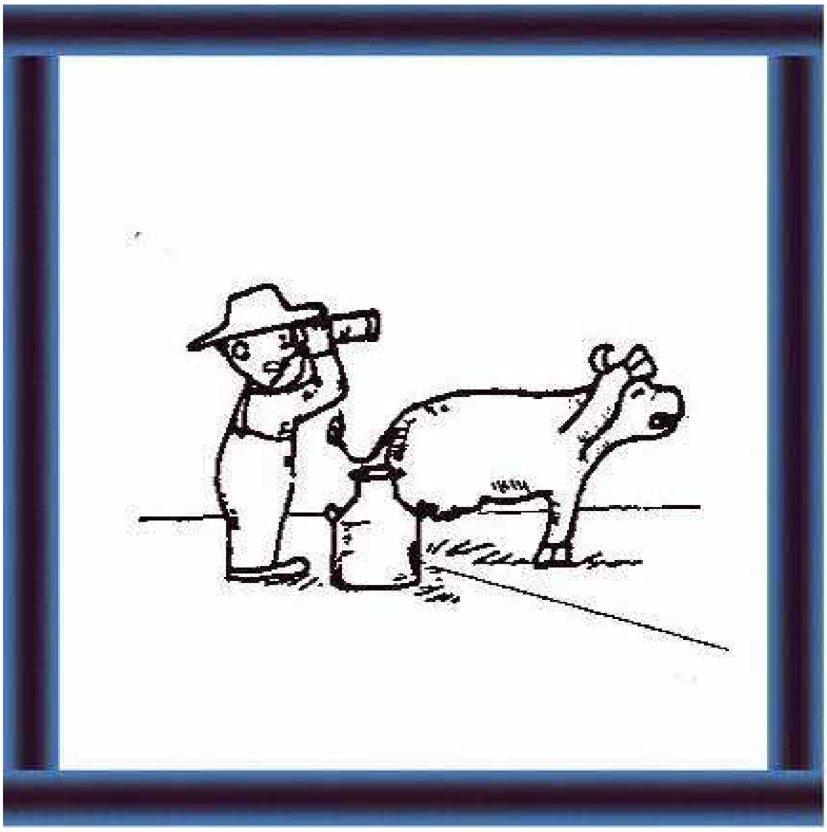


3 Handle your milk gently.

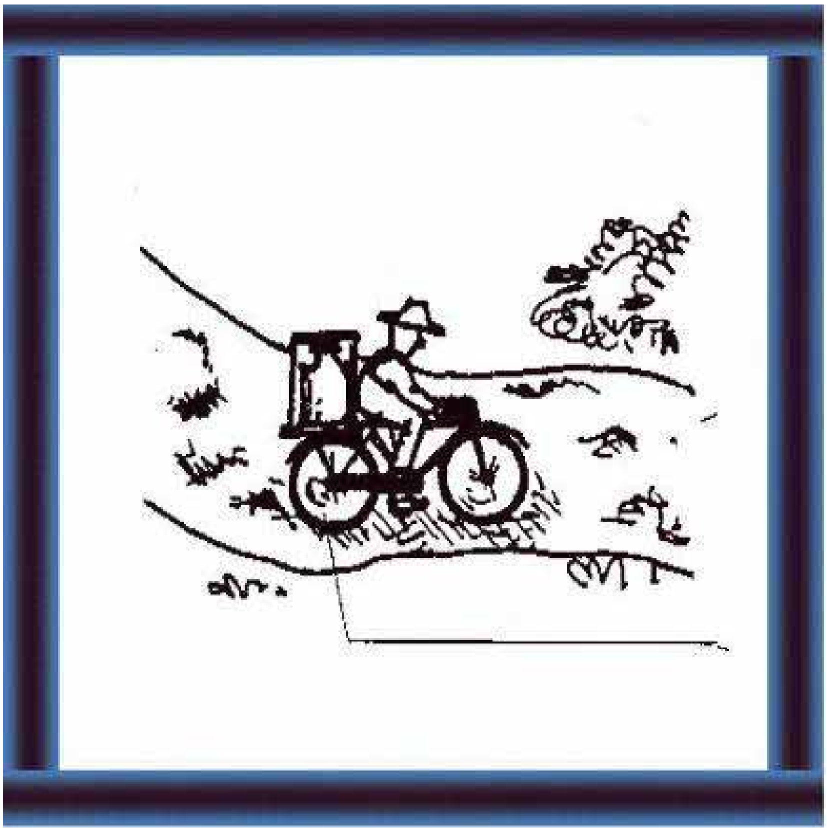


4 Transport your milk in the shortest time possible but at low cost.

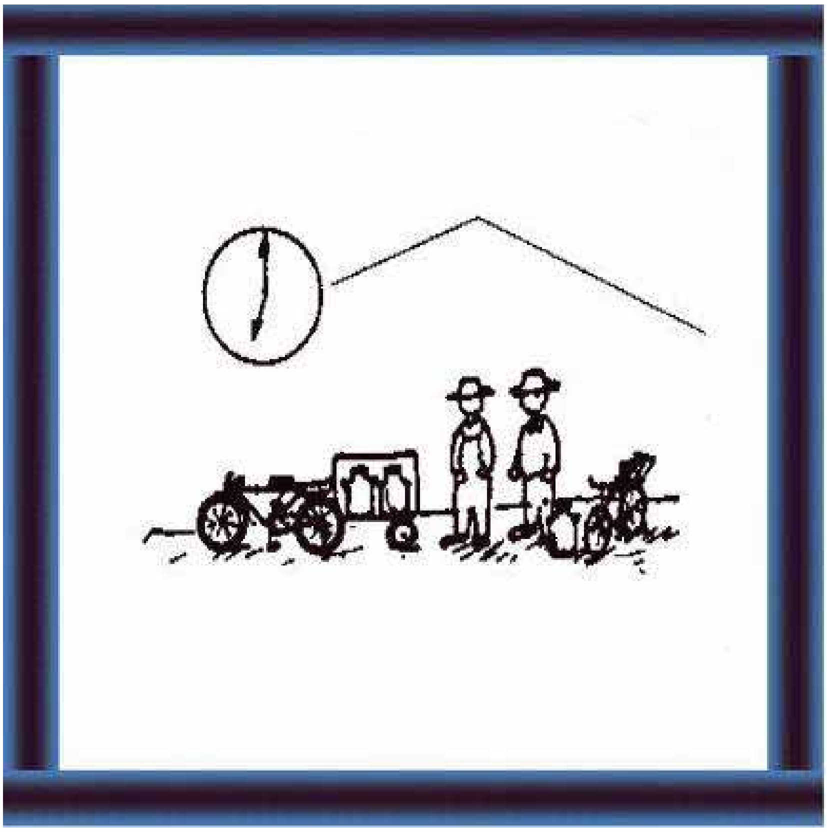
How can we collect milk efficiently?



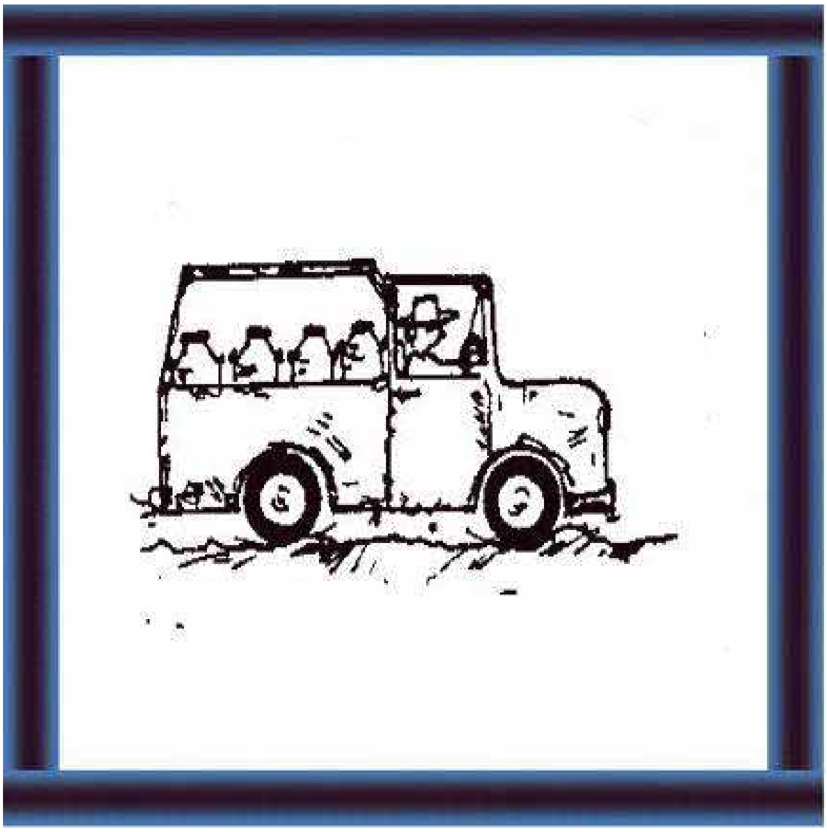
5 Many farmers produce only a small quantity of milk and the dairy plant is far away.



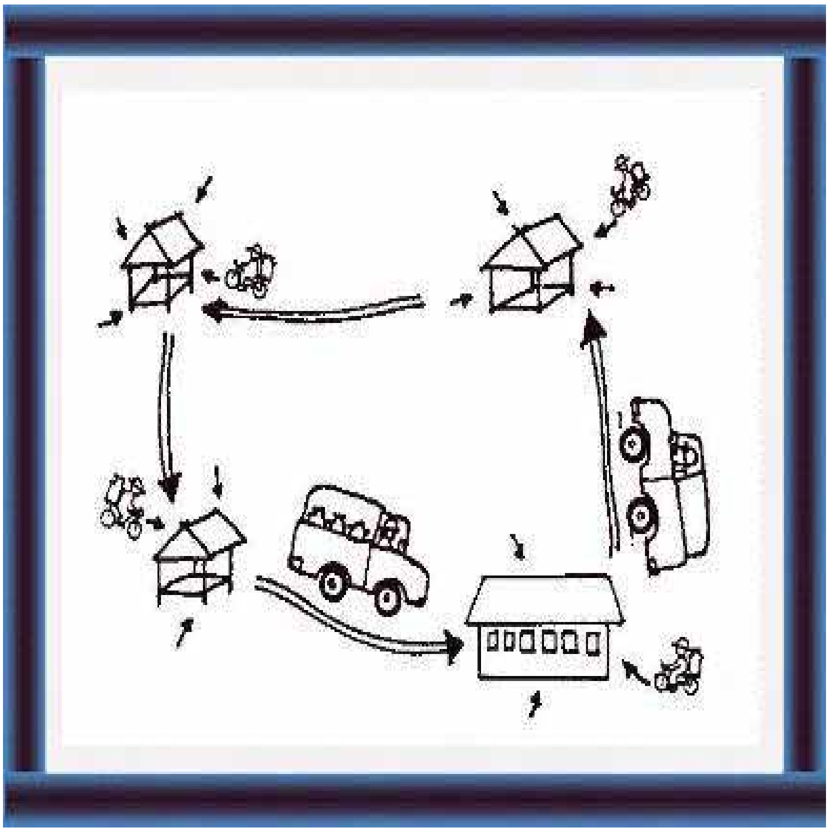
6 The roads are bad and the farmer takes his milk to the collection point by bicycle.



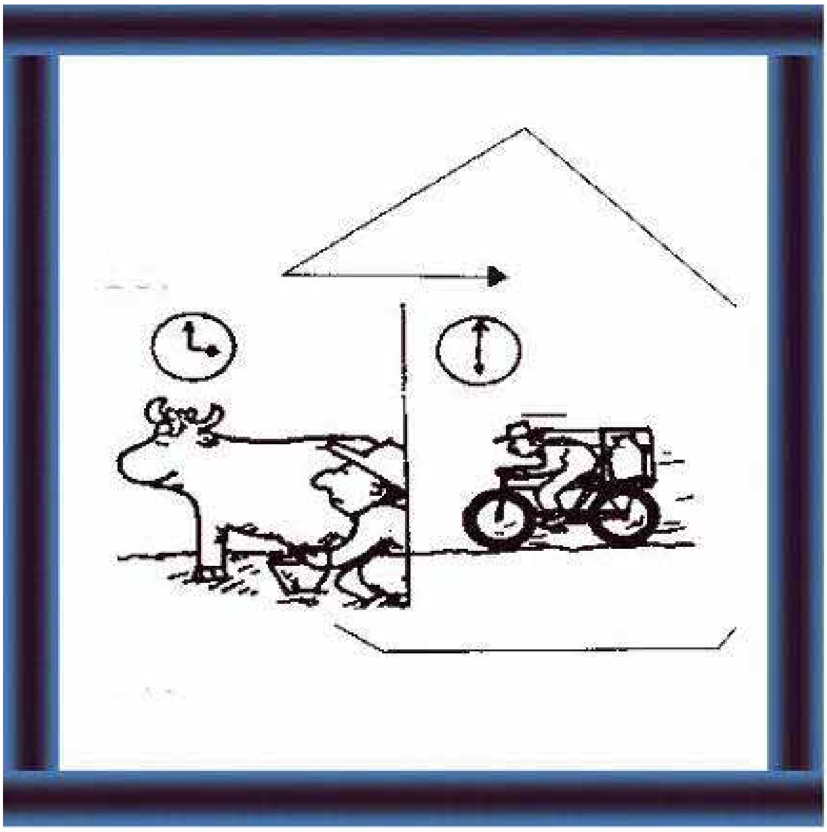
7 Farmers nearby bring their milk. They know what time the truck comes and bring their milk just before.



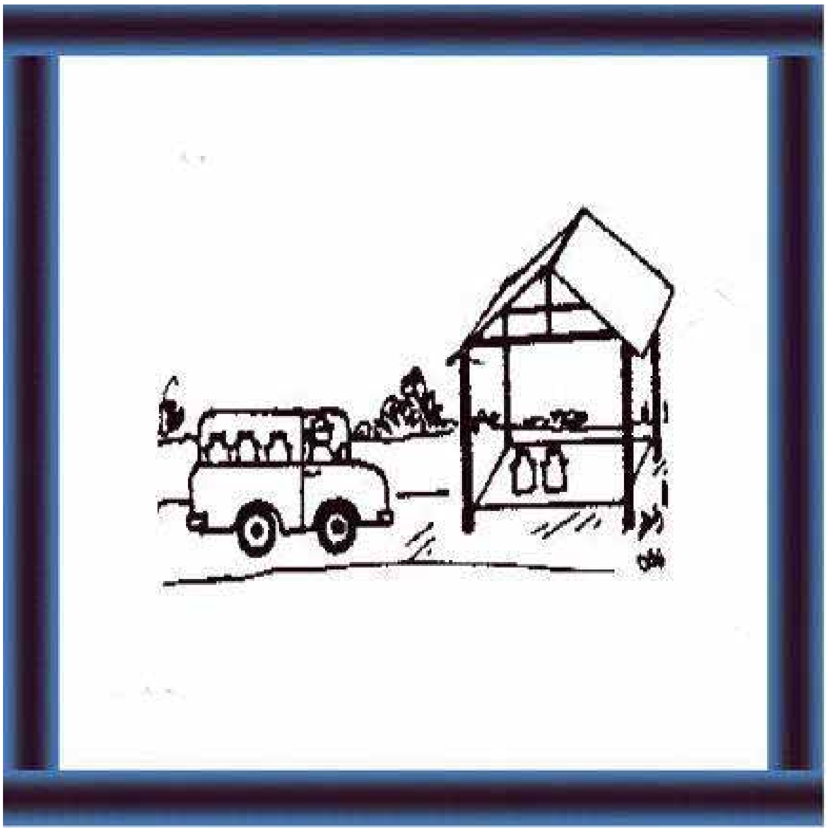
8 You can plan with the farmers in a co-operative or with the dairy so that good quality milk arrives at the dairy at low cost.



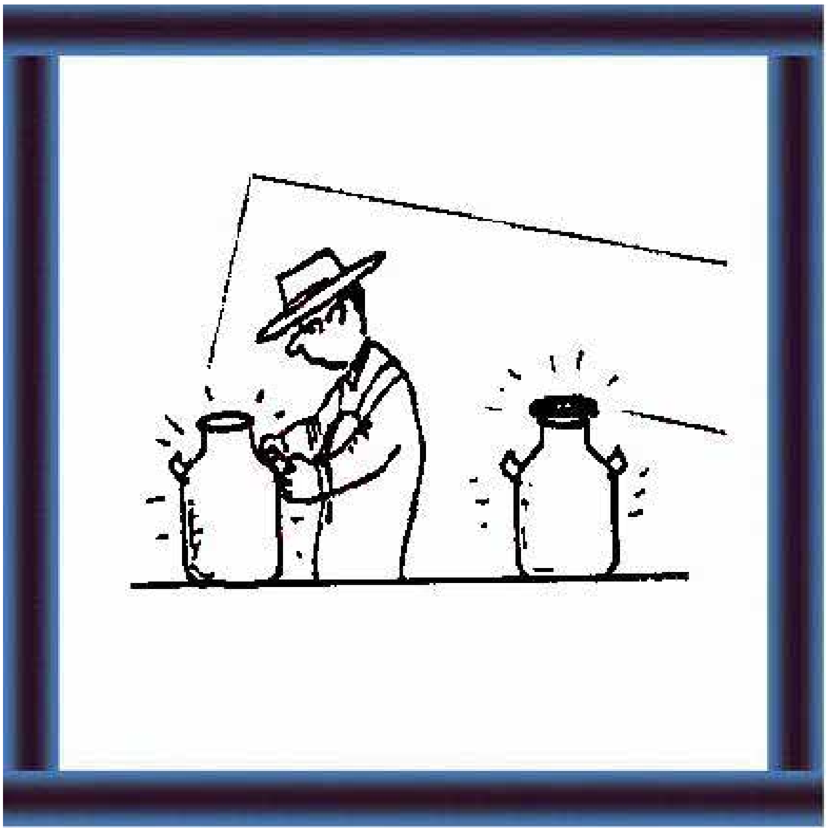
9 This milk collecting system is efficient and low cost. It makes good use of manpower and transport.



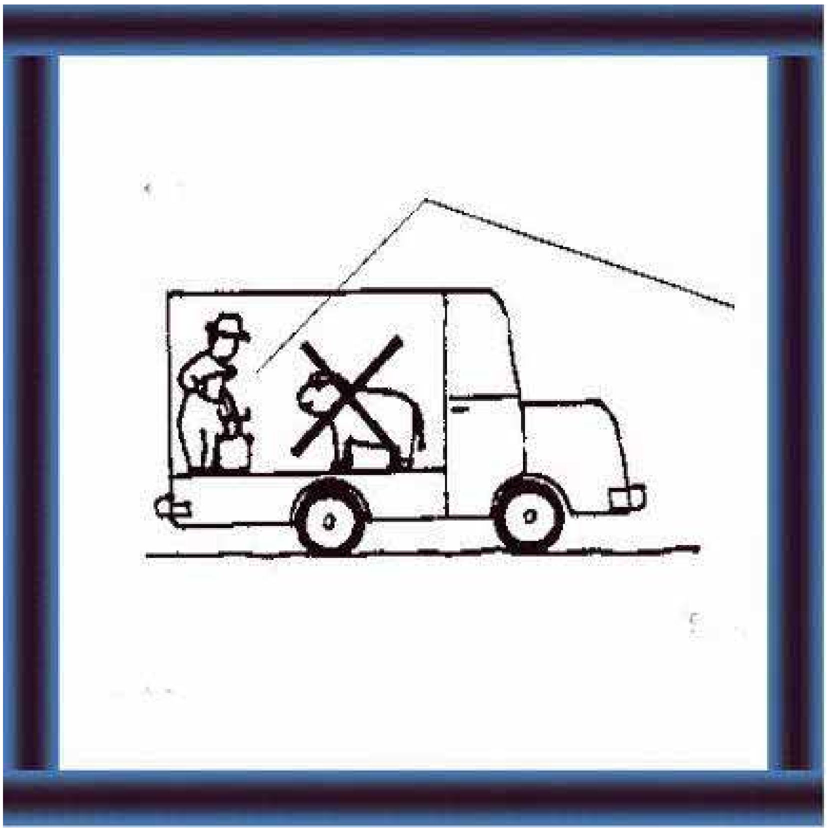
10 If you do not cool or preserve your milk, it must arrive at the dairy within 4-6 hours. milk your cow just before sending it to the collection point just before the collection by the truck.



11 Protect your milk from light and temperature. Keep it cool.

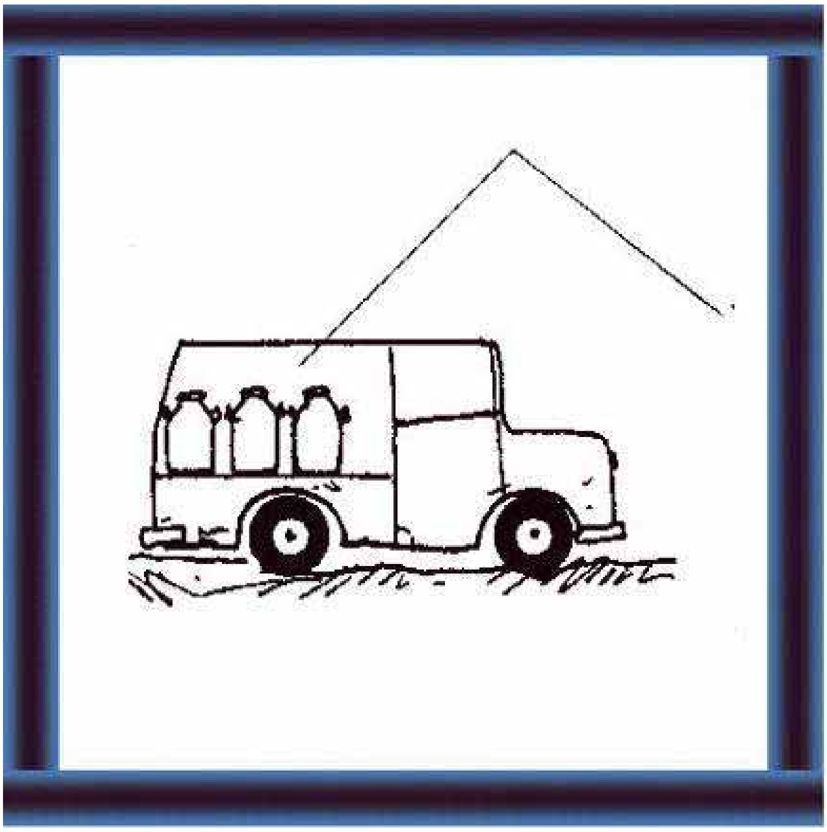


12 Keep everything clean and sanitize your equipment.

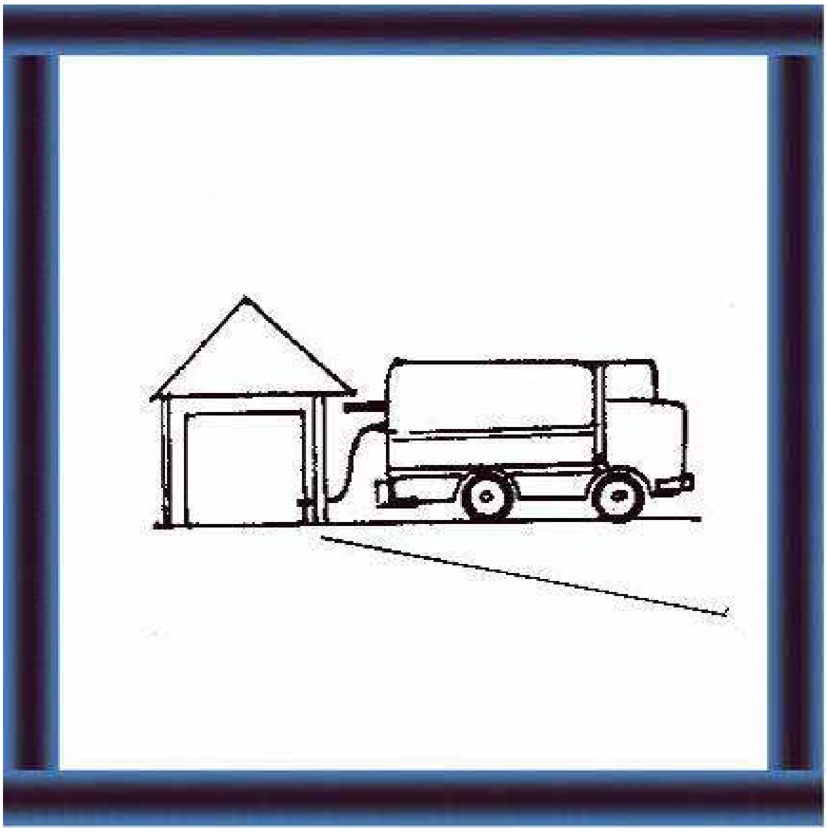


13 Always use clean, disinfected filters when you stratin milk. Never carry animals or dry things with your milk.

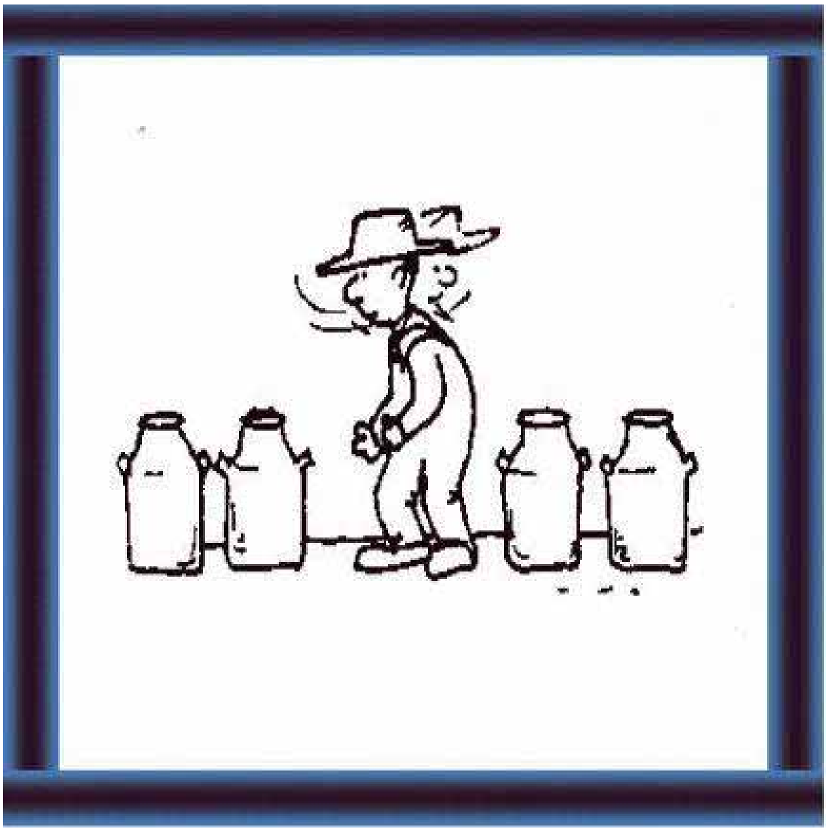
What kind of milk containers should you use ?



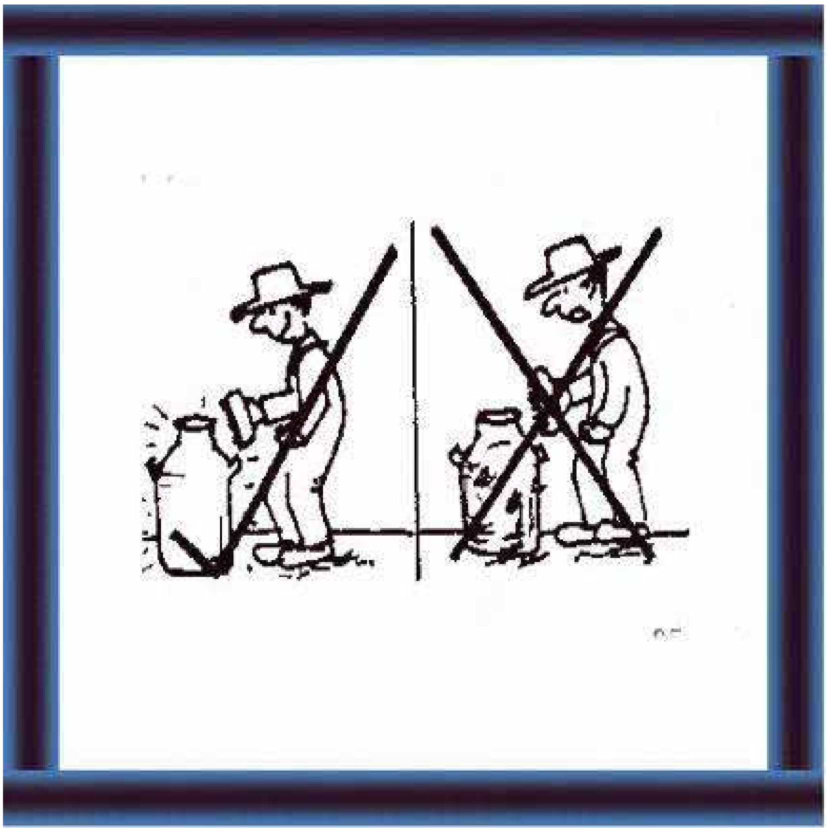
14 For small qualities of milk, you should use cans.



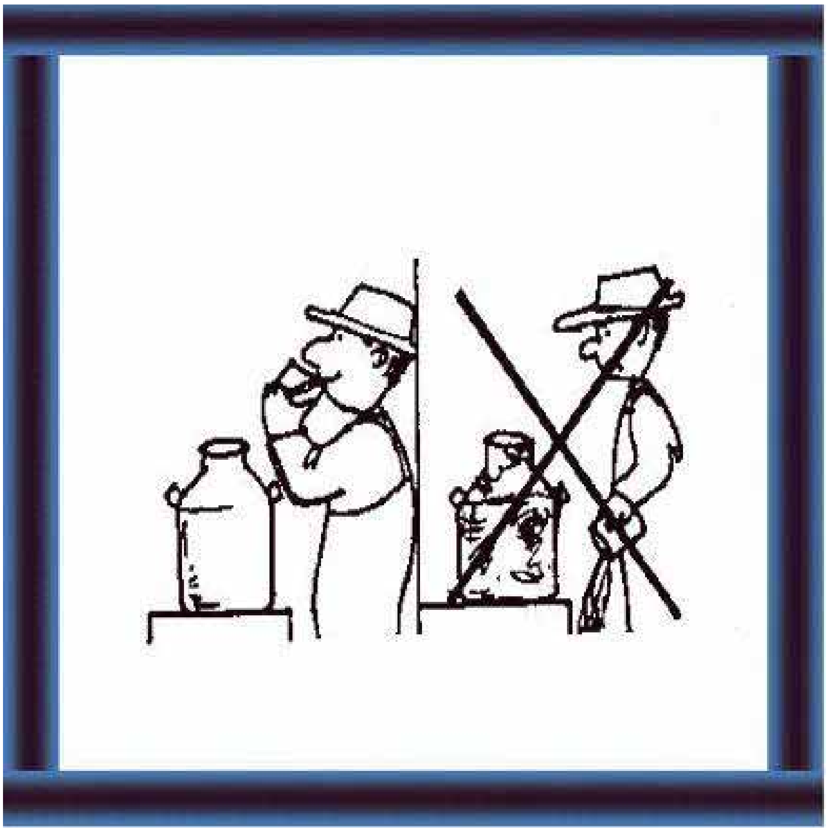
15 Bulk tanks use pumps. They are extensive and need maintenance to avoid spoilage of milk.



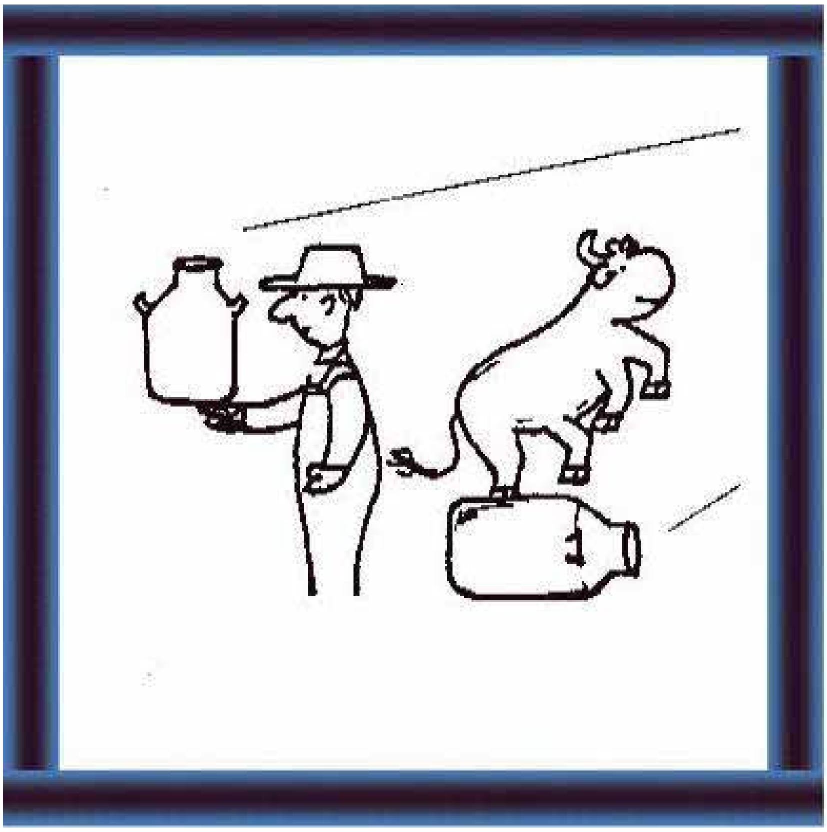
16 Choose your cans carefully.



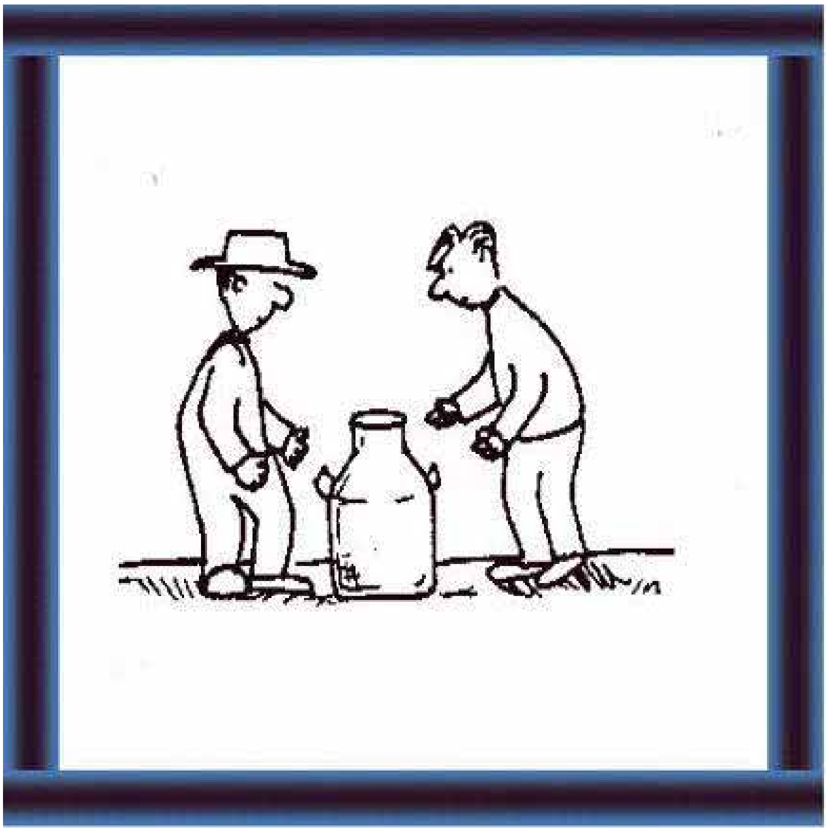
17 Materials for cans should be non corrosive such as stainless steel, aluminium or plastic.



18 They should not give any flavour to the milk. Do not use containers which have contained pesticides or other chemicals.

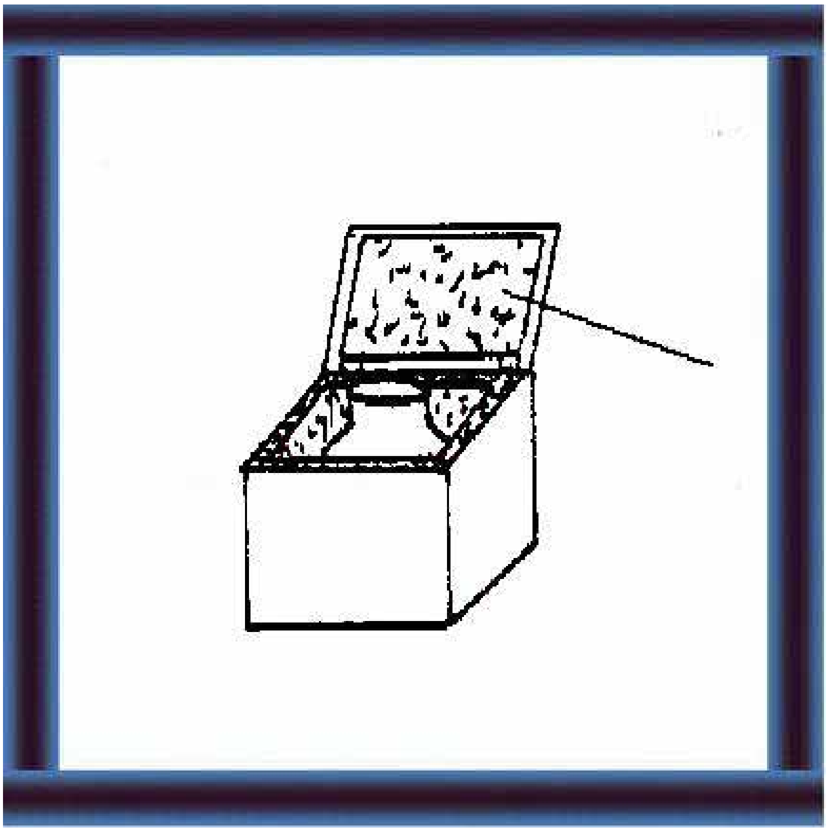


19 They should be light but strong and with a smooth surface (easy to clean).



20 Consult your extension worker about the best type of container to use.

\



21 You may construct a box with insulating foam inside (polystyrene) to avoid temperature increase during transport.

Avoiding Problems During Transport (22-24)

Rancid taste and smell in milk comes from free fatty acids, FFA (22). The enzyme Lipase is responsible for the chemical reaction (Lipolysis) that frees the fatty acids from the glycerides. However, before the enzyme is able to attack the butter fat the membrane around the fat (fat globule) has to be broken. Damage to the membrane can happen if the milk is handled roughly i.e. shaking, stirring, sloshing. Lipolysis is encouraged by high storage temperatures.

Metallic (oily, tallowy) flavour comes from acidation of the butter fat (230. The presence of iron and copper salts light and dissolved oxygen trigger the reaction. When bacteria grow in milk they use the oxygen thereby reducing the possibility of fat acidation. Milk can contain more dissolved oxygen at low temperature than at high temperatures (the solubility of oxygen is higher at low temperature). Bacteria are not so active at low temperatures. Metallic flavour, therefore, is often found in milk that has been cooled for a long time. The problem should not be solved by storing the

milk at higher temperatures so that the bacteria are more active as this will only cause more problems. see Figure 1.

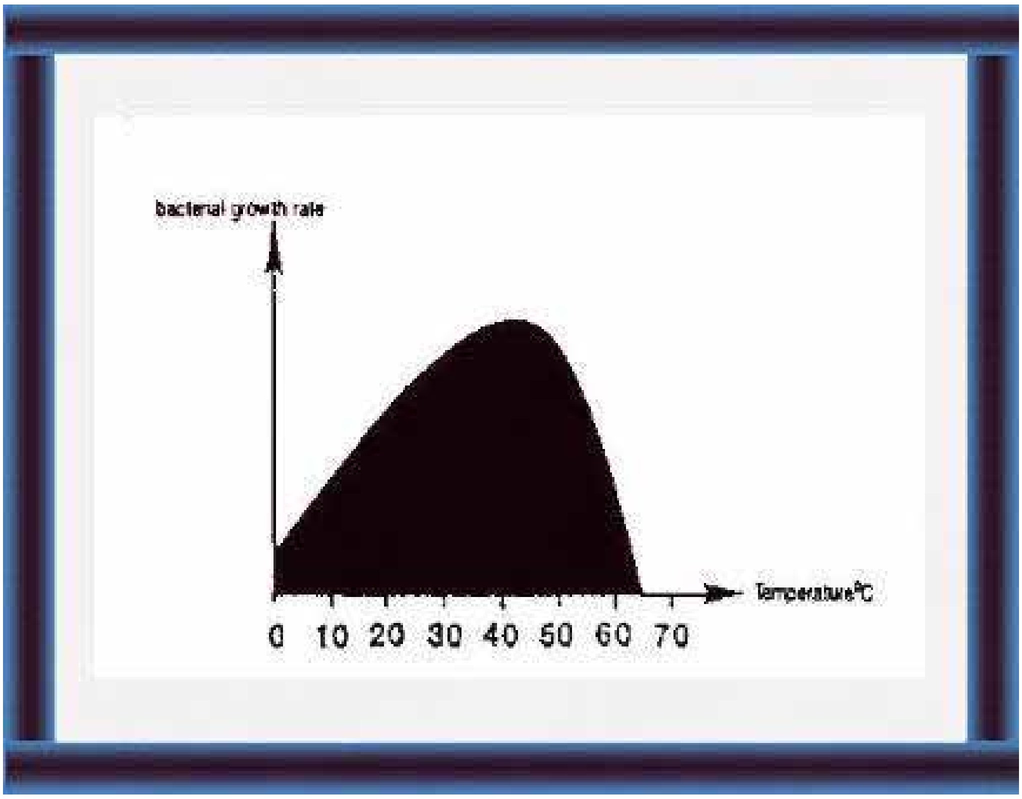
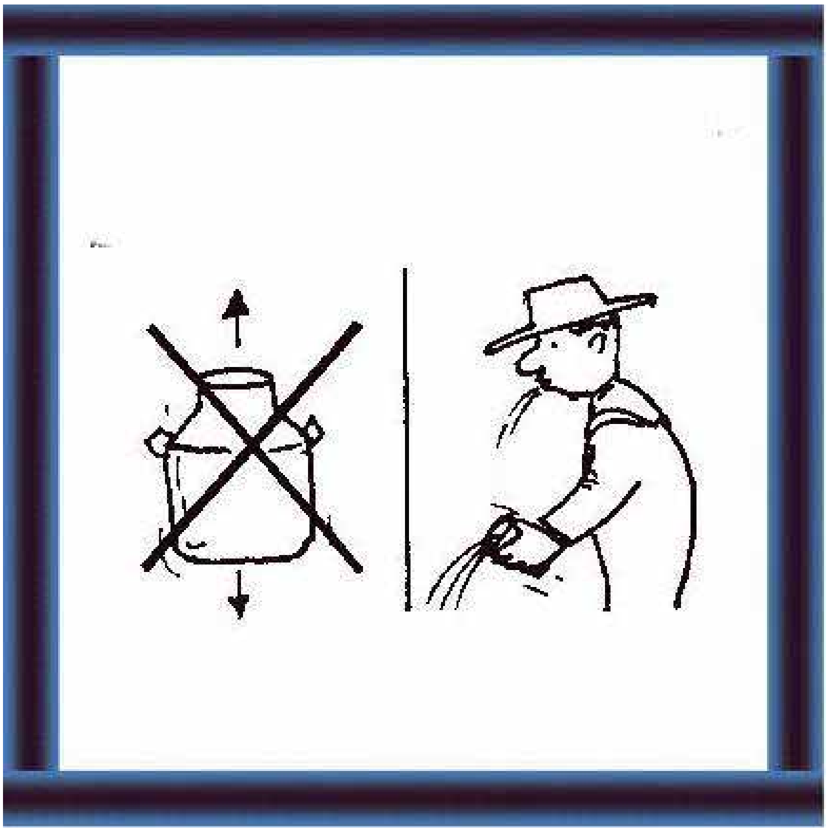


Figure 1. Bacterial growth related to temperature.

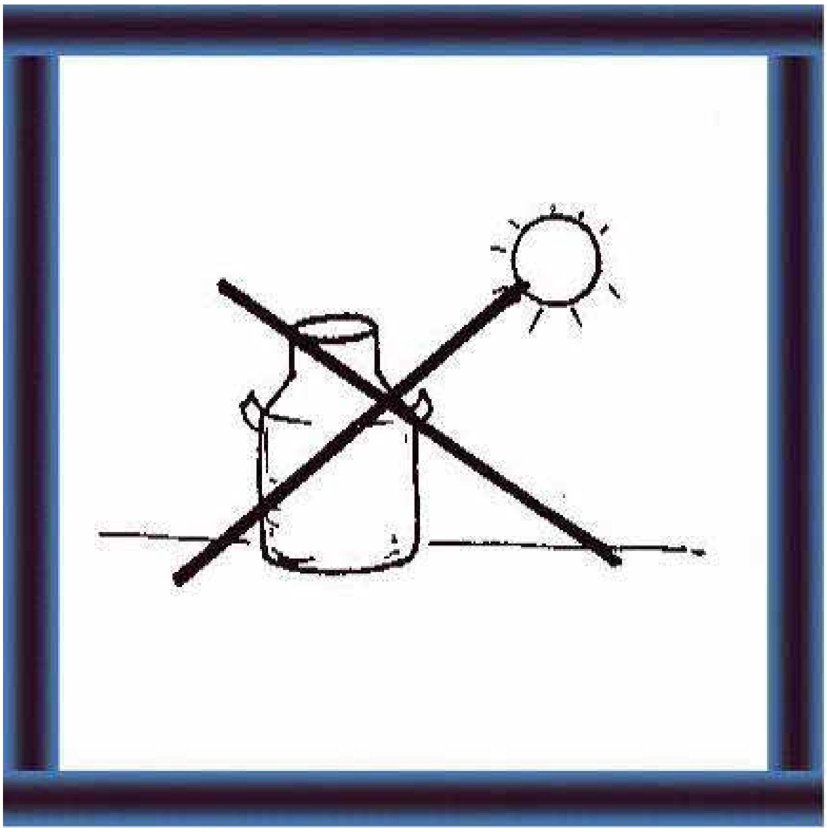
Of course controlled fermentation by lactic acid producing bacteria can be used (yoghurt, curd etc.). heating the milk to above 80 C will also prevent oxidation of fat. Contamination with heavy metals, especially copper and exposure to light must be avoided.

Sunlight flavour (cabbage, burnt protein) occurs when milk is exposed to light (sun or electric). It is a chemical reaction in the protein (oxidation of an amino acid) which gives the sweetish flavour.

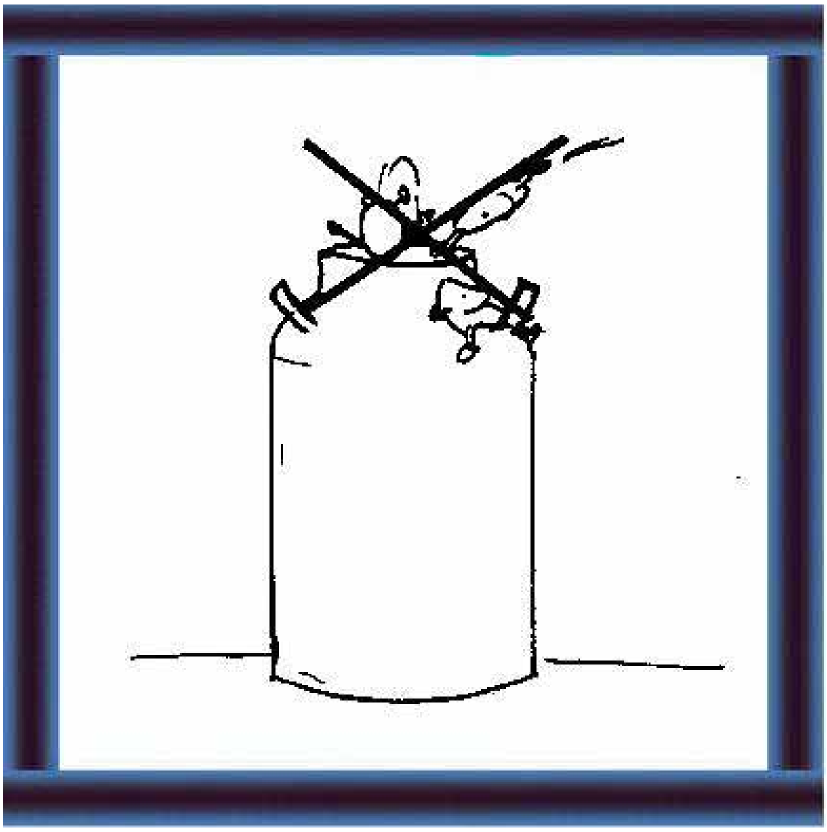
How can you avoid problem during transport ?



22 Do not
- shake up your milk
- freeze it
- expose it to rapid change in temperature (especially 15-30 C)
The fat globules may break down and your milk may get rancid flavour.



23 Do not
- use containers and any equipment with copper or iron
- leave your milk in direct light or sun light.
Your milk may get metallic or sunlight flavour.



24 Do not
- allow bacteria to develop quickly.

Keep your milk cool and clean and send it to the collecting centre quickly.

What do you know about milk transport ?

Important points in transport

1. Hygiene	(1)
2. Temperature	(2)
3. Gentle handling	(3)
4. Speed of delivery	(4)

Efficient milk collection

1. Problems of quantities and roads	(5-6)
2. Planning timing with other farmers and milk collecting points	(7-8)
3. An efficient, low cost milk collecting system	(9)
4. Timing milking	(10)
5. Light, temperature and hygiene	(11-13)

Selecting milk containers

1. Cans (14,16-20)
2. Bulk tanks (15)
3. Cool boxes (21)

Avoiding problems

1. Handling and freezing (22)
2. Containers (23)
3. Temperature and hygiene (24)

Small-Scale

Dairy Farming Manual

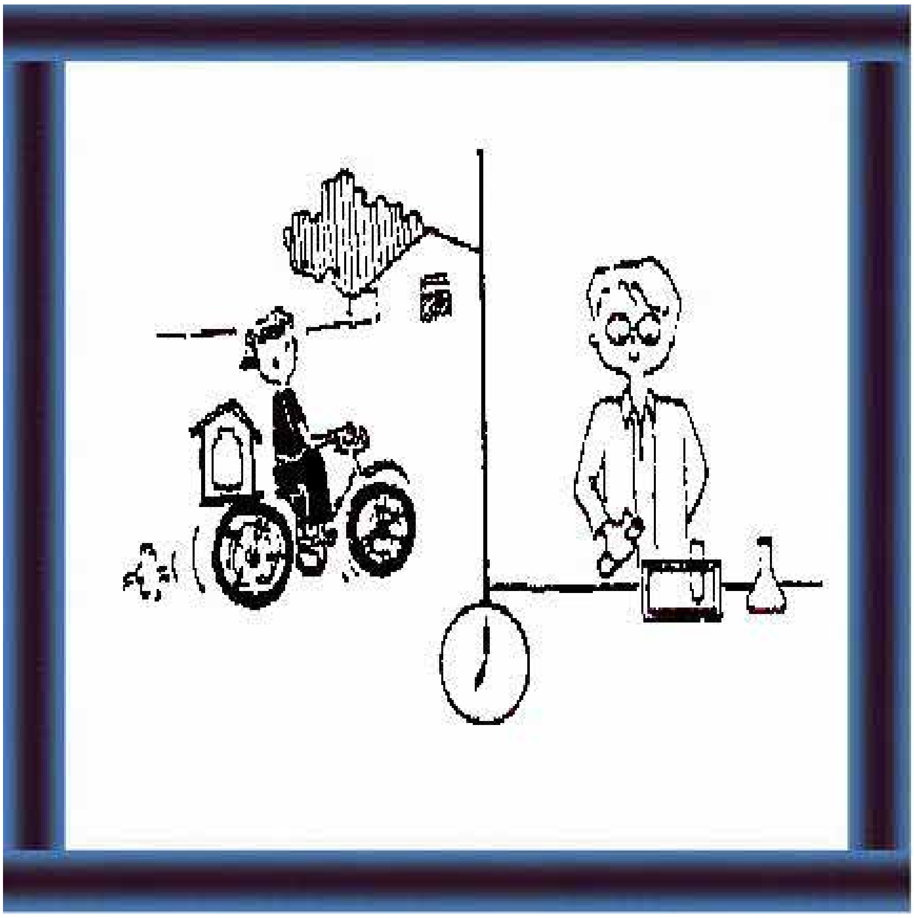
Volume 1

Technology Unit 6

Milk Collecting Centres

Extension Materials

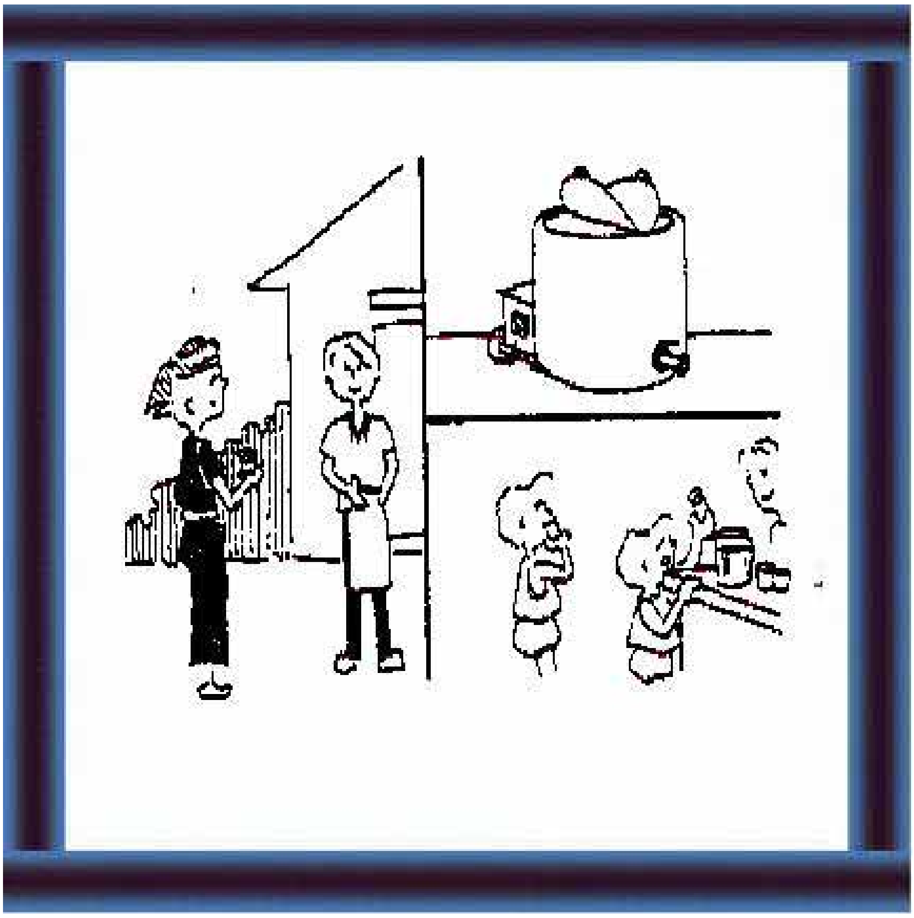
What should you know about milk collecting centres ?



1 What is important in milk collection ? (5-7)

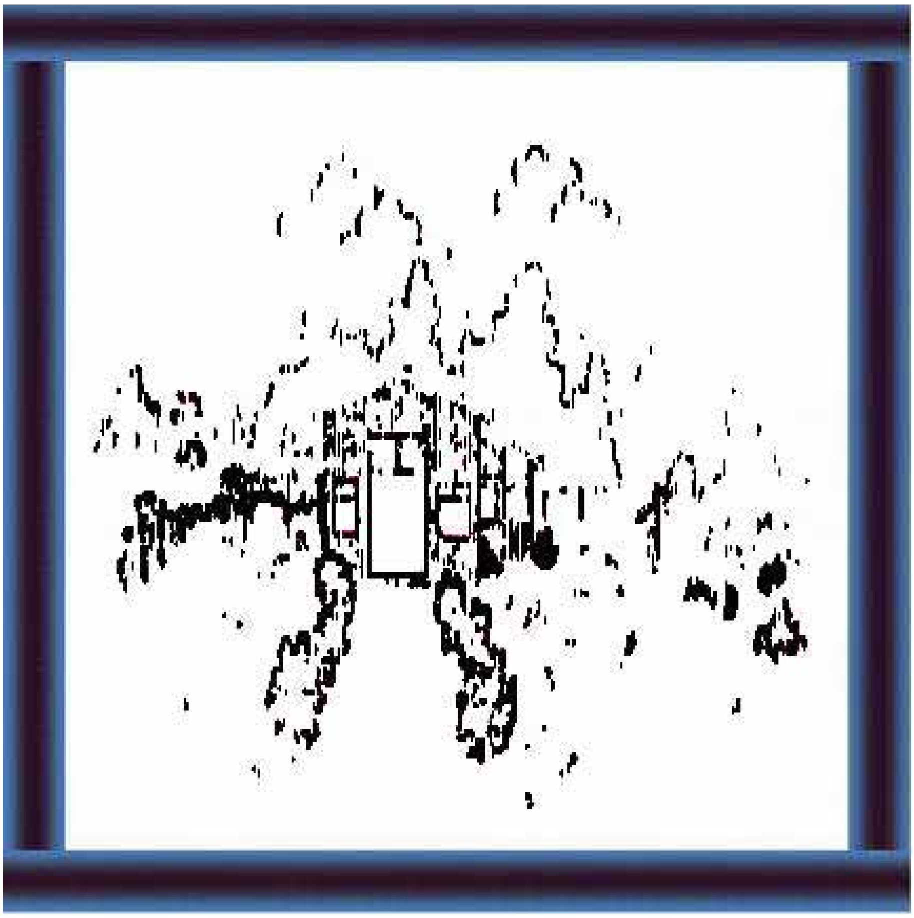
- delivering your milk quickly and at a low cost

- testing your milk.



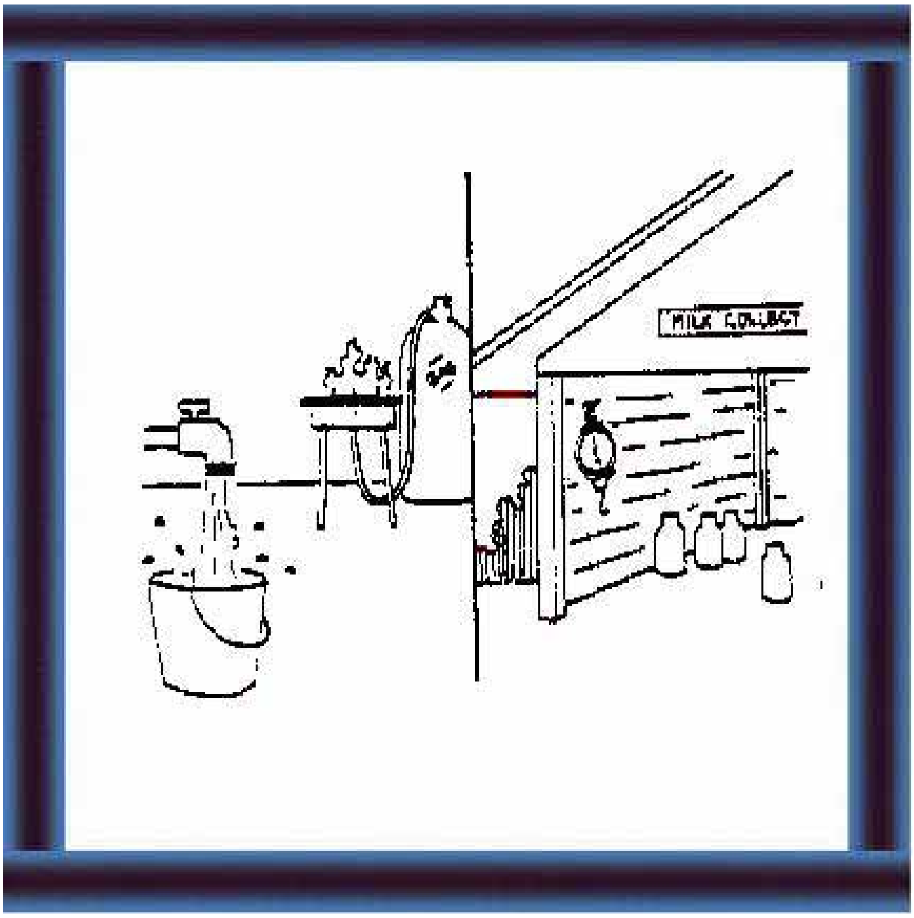
2 What does the milk collecting centres do ? (8-19)

If your milk is good quality, the centres:
- recieves your milk
- keeps it in good condition
- dispatches your milk and arranges for payment



3 What is important in the location of milk collecting centres ?

- water supply and waste disposal
- ease of transport
- no flooding and good shade.

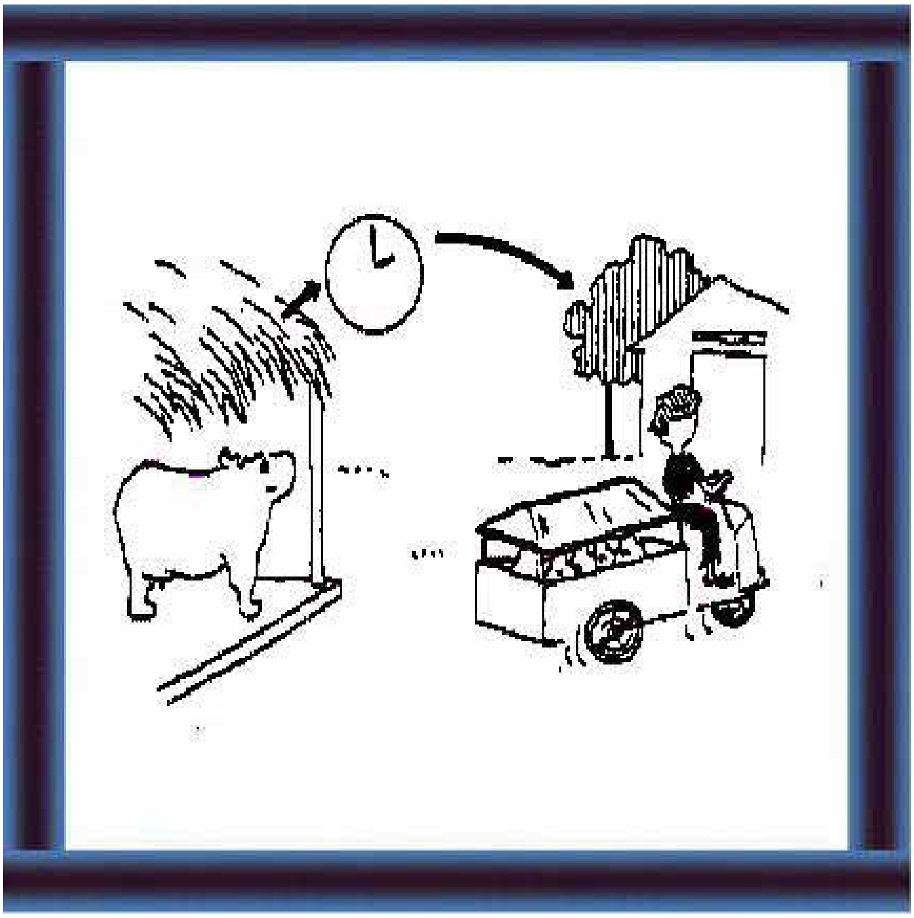


4 What type of utilities, buildings and equipment are necessory ? (21-41)

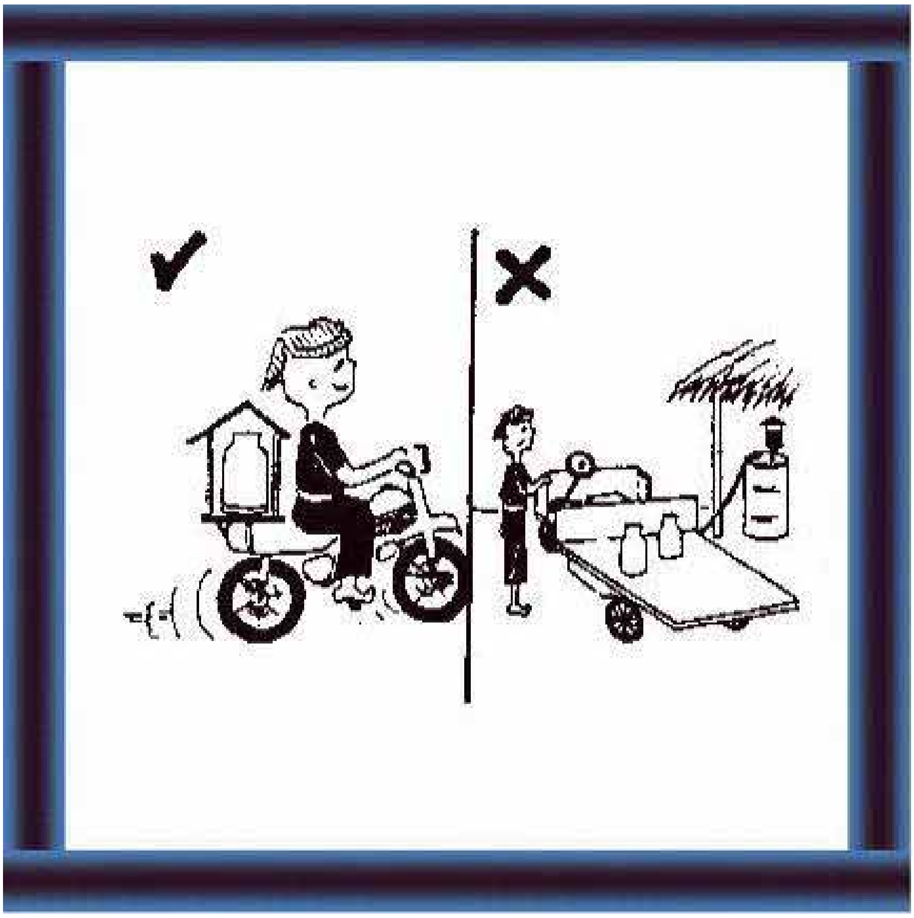
A centre needs:
- water and energy supply
-the right buildings and equipments.

Note: (The numbers in brackets refer to illustrations in the Extension Materials)

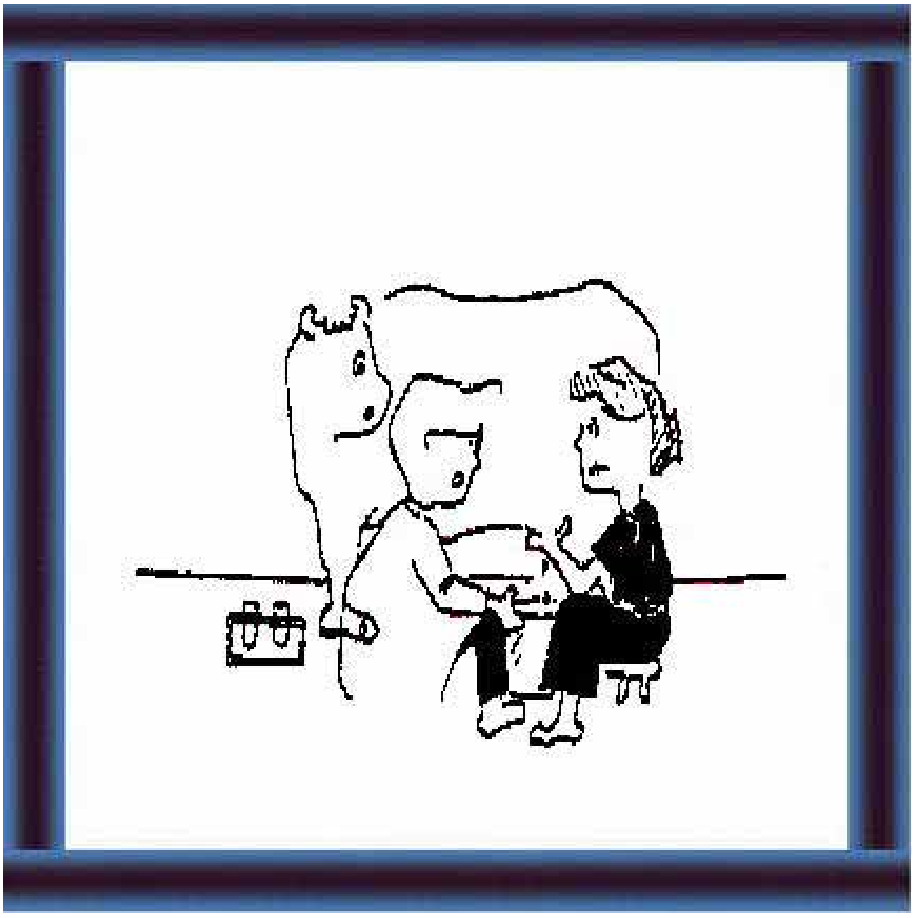
What is important in milk collecting ?



5 Getting milk to the collecting centre in the shortest time.

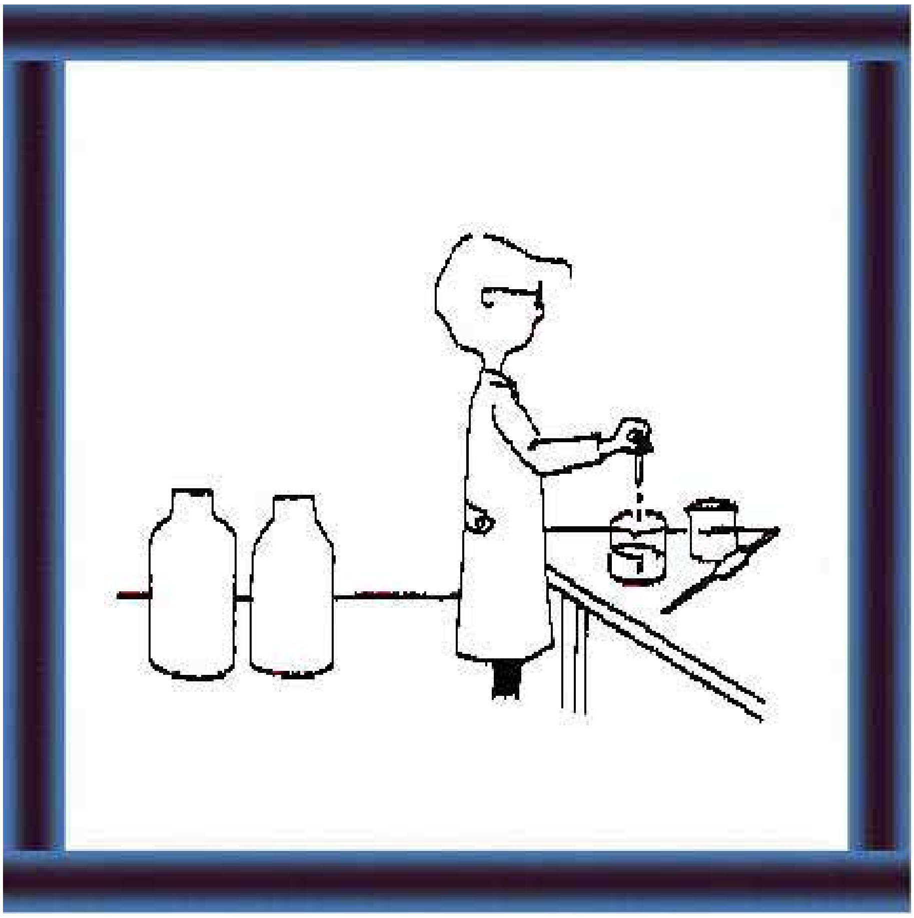


6 Getting milk to the collecting centres at low cost



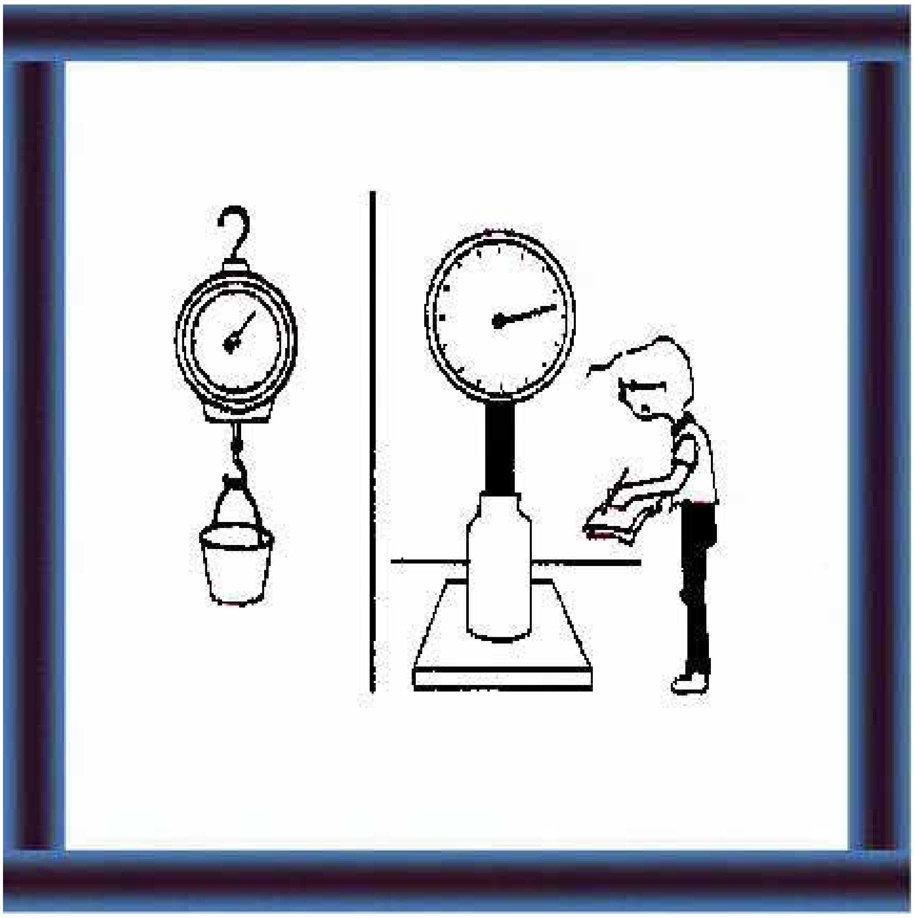
7 When and how to test the quality of milk.

What does a milk collecting centre do ?

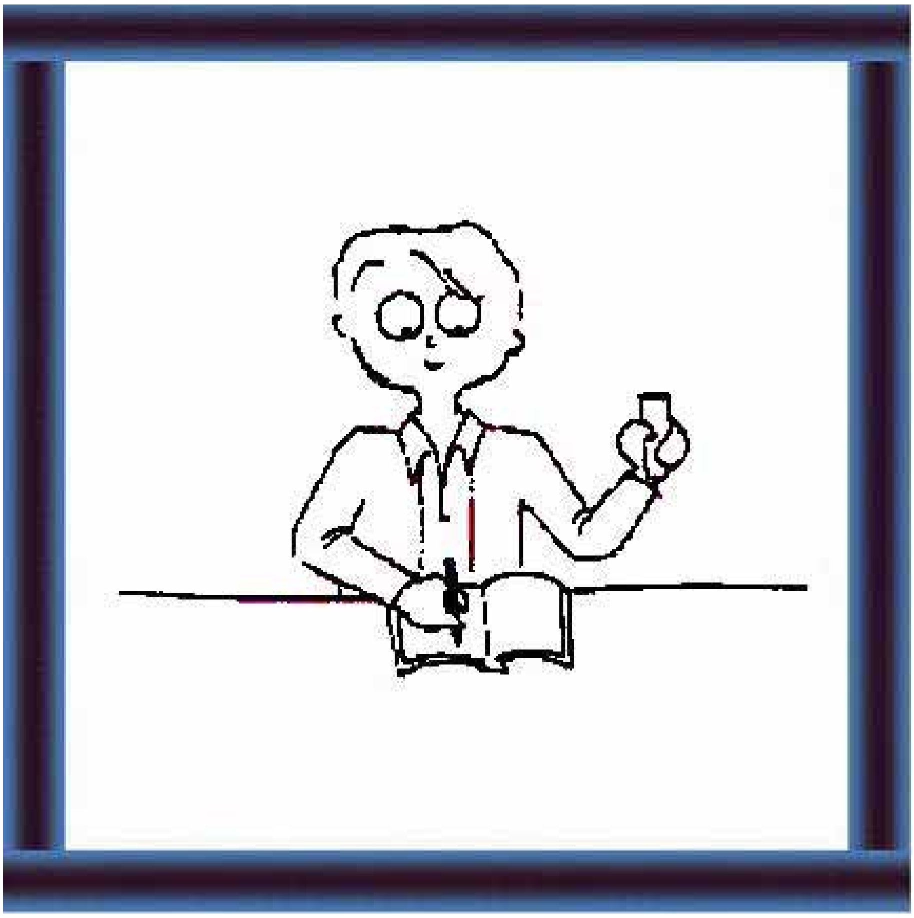


Reception

8 The centre takes samples of milk and
- tests them



9 - weighs the milk



10 - records the weights and

- tests results

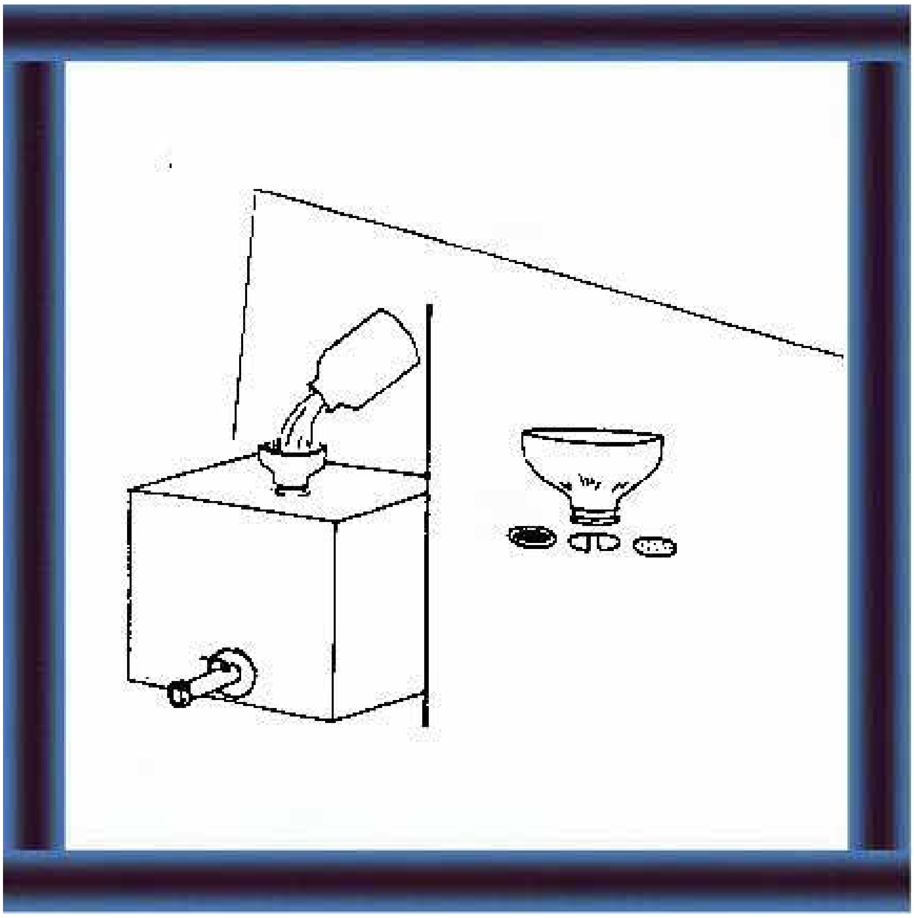
for each delivery

11 - rejects poor quality milk.

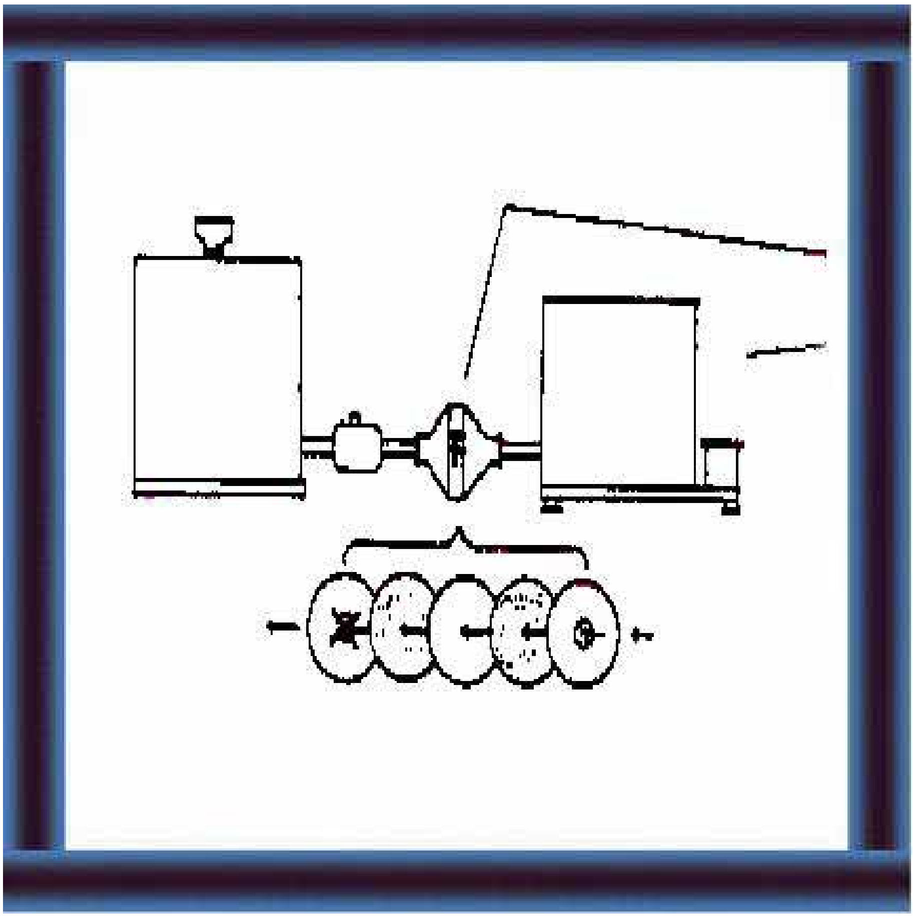
Make sure your milk is good quality.

Straining and filtering

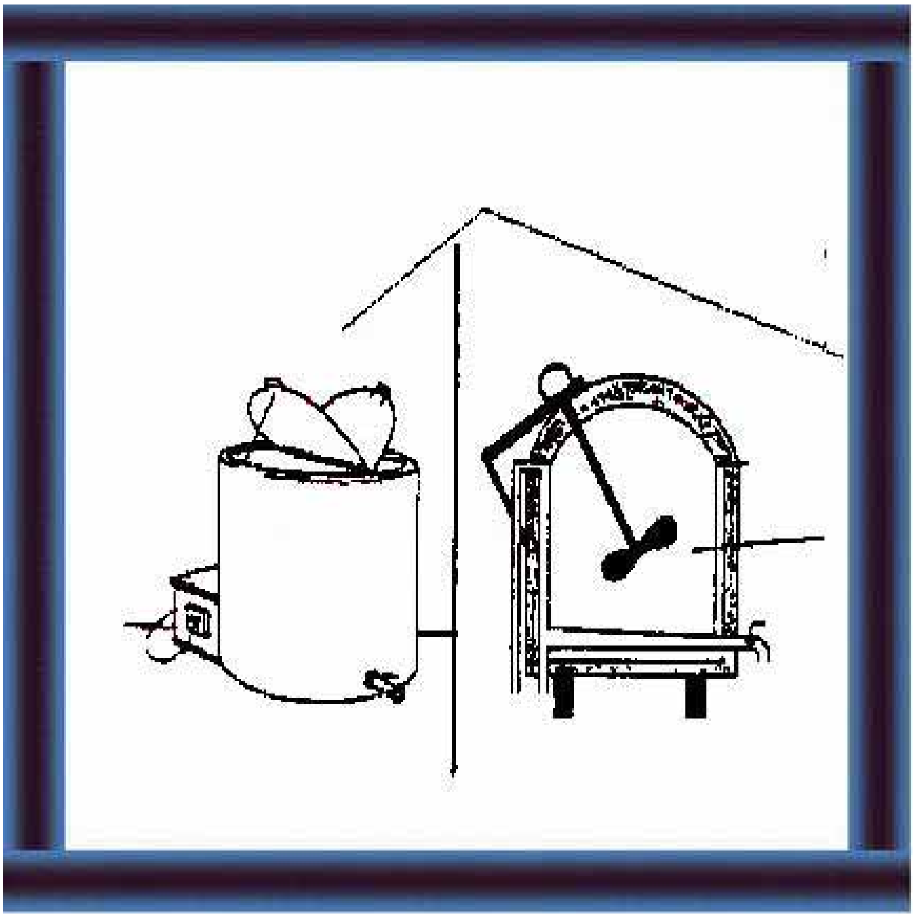
12 The



centre strains your milk into a dump tank to remove impurities.

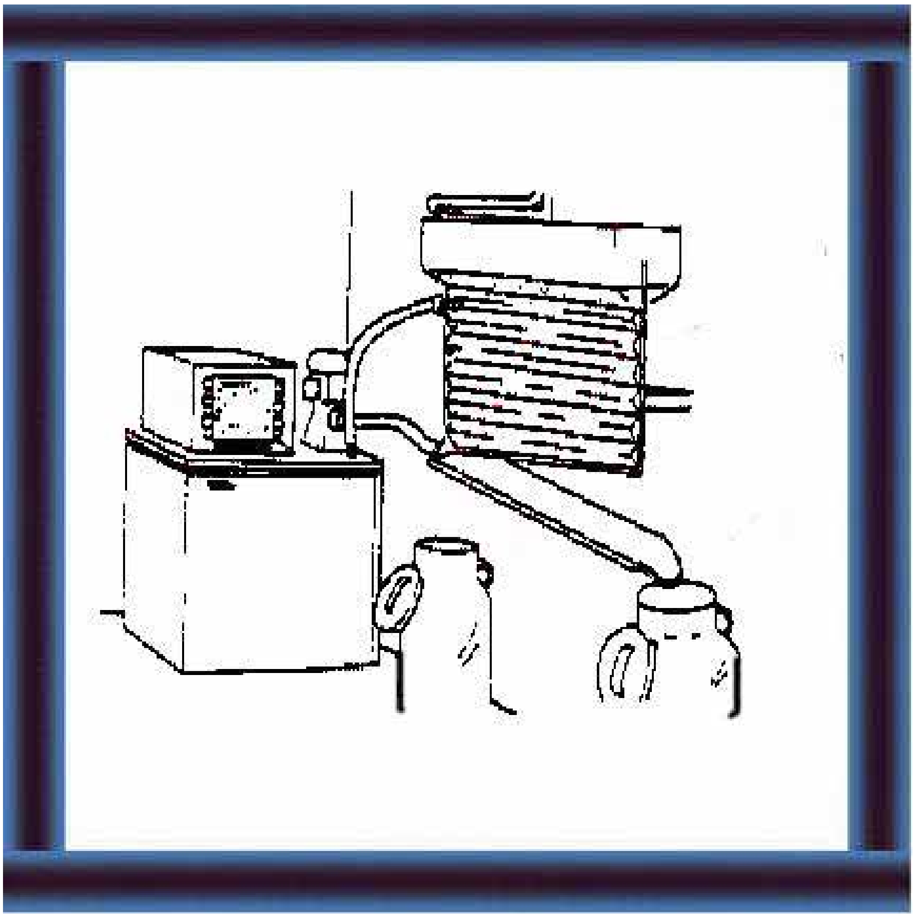


13 From the dump tank, the centre pumps the milk through a filter to a cooling tank.



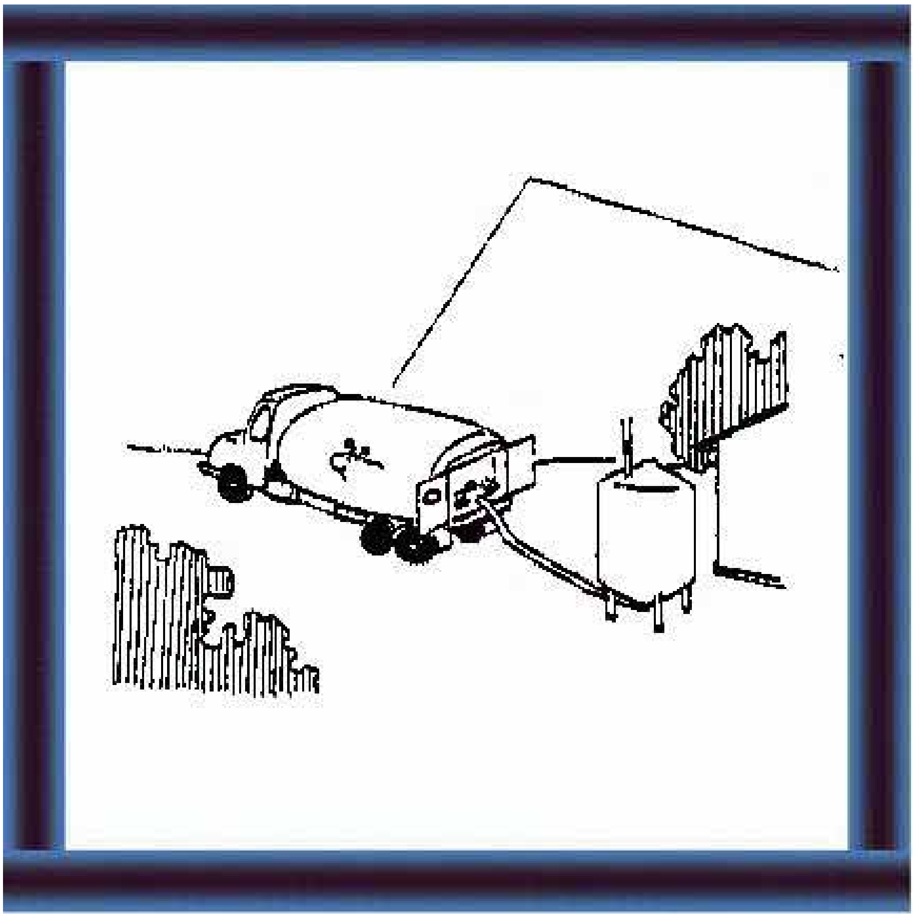
Cooling and Storing

14 The centre cools the milk and stores it in a farm-tank cooler. The cooler has an agitator to speed cooling and prevent a cream layer forming.



15 Some small centres use a surface cooler. Warm milk enters and the cool milk in cans is ready for transport.

Dispatch and Sales



16 Tanker trucks collect the milk from the centres and send it to the dairy.

17 The centre may sell milk locally

18 and also supplies for the farm such as:

- concentrates

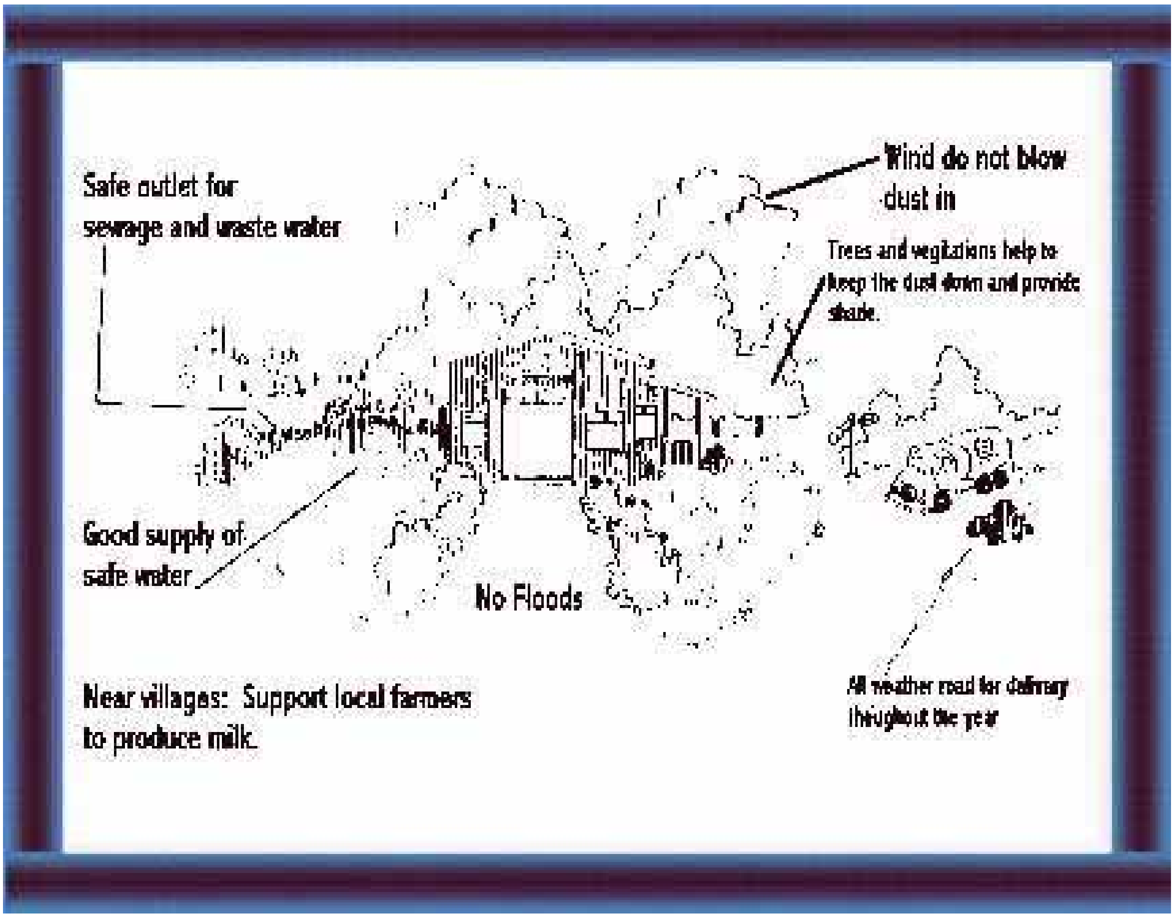
- chemicals

- equipment.

Payment

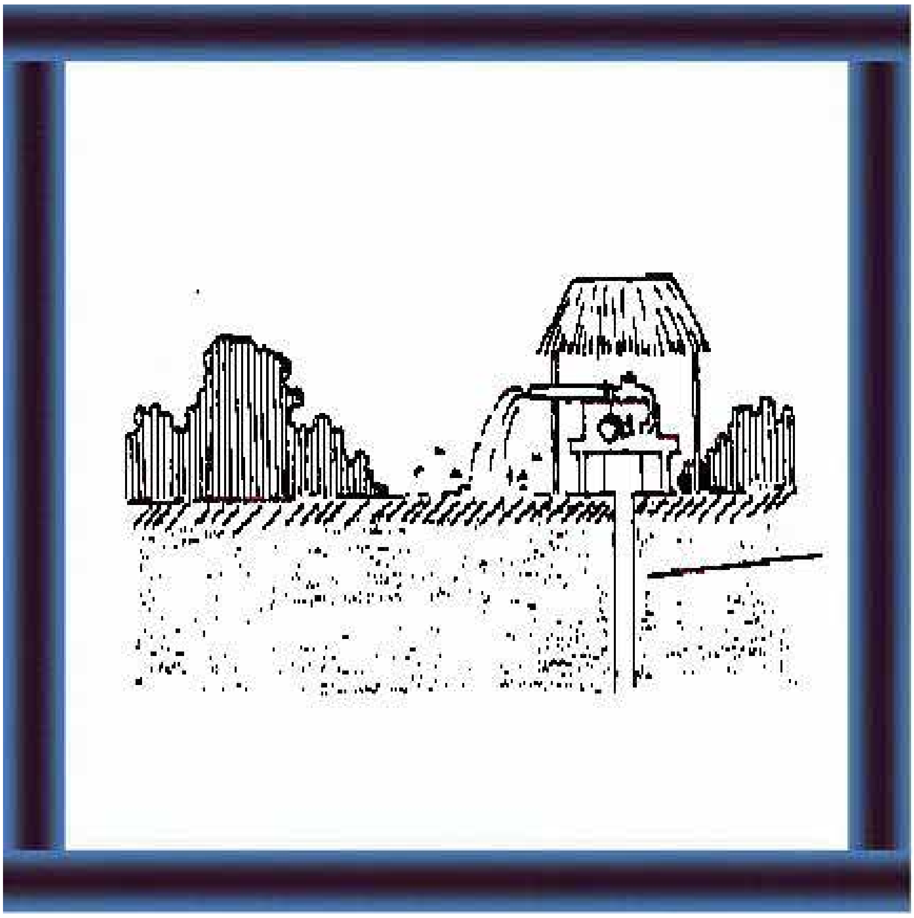
19 The centre will keep records and accounts and arrange payment for your milk.

20. What is important in the location of a milk collecting centre ?



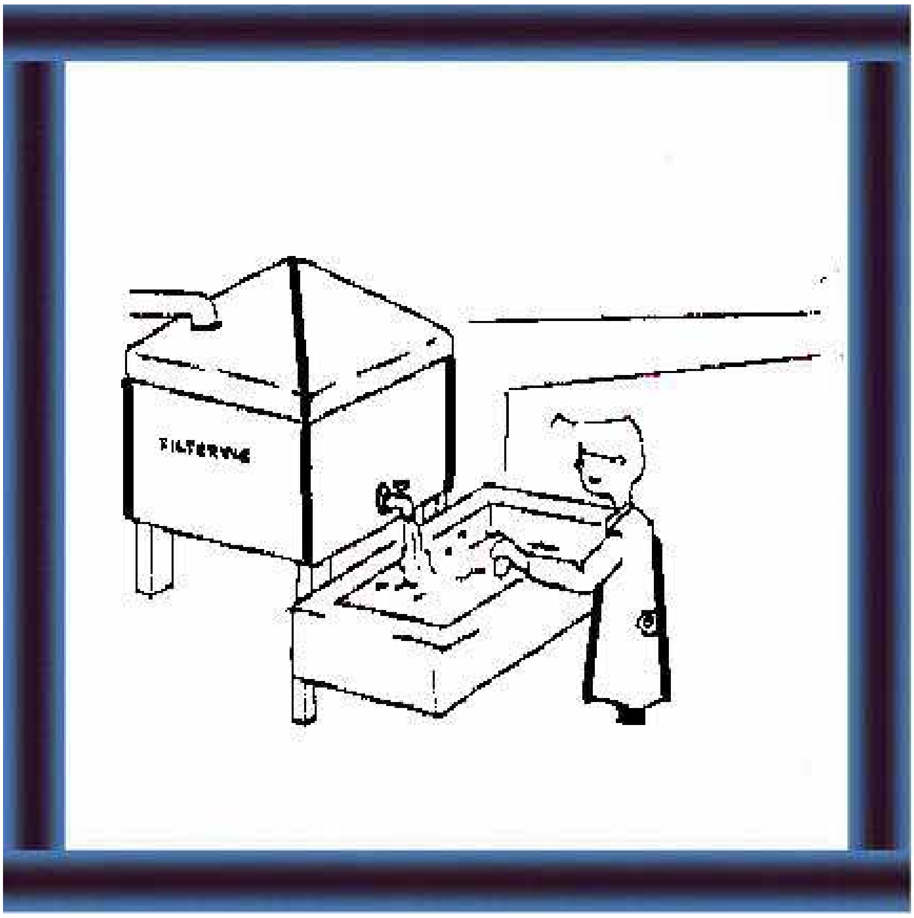
What utilities are necessory for a milk collecting centre ?

Water

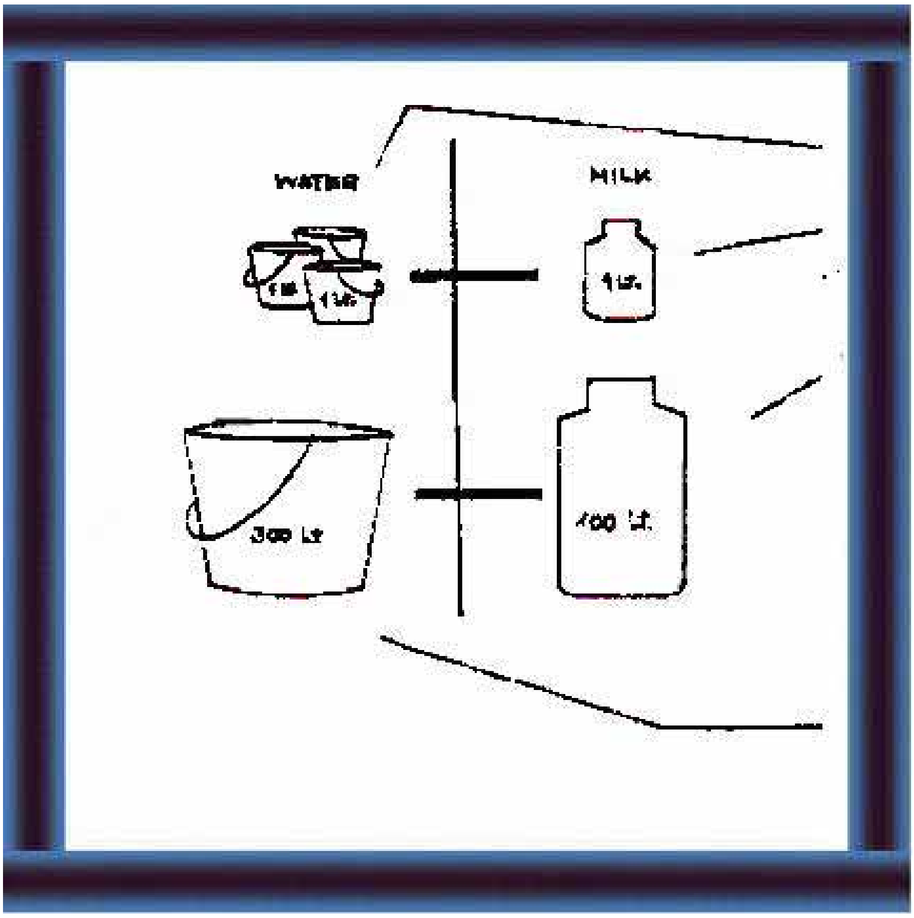


21 If there is no town supply, drill a borehole and use a pump.

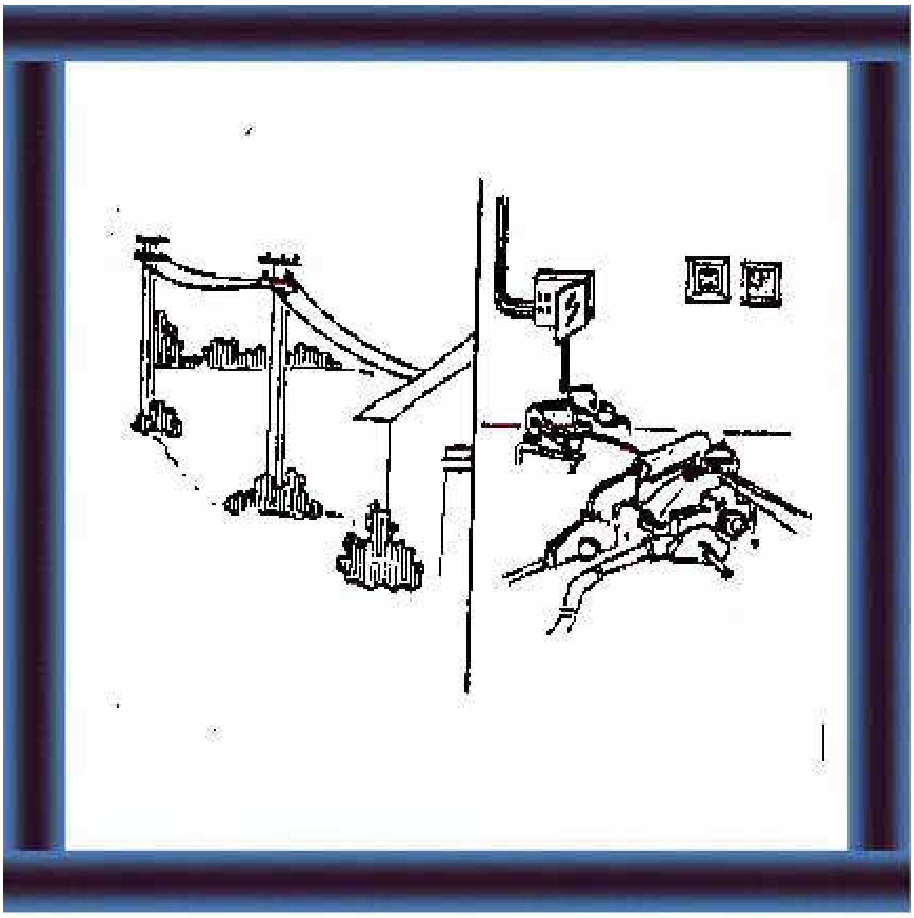
22 If a borehole is not possible, use a shallow or rain water attachment.



23 Make sure the water is safe by filtering and adding chlorine.



24 A centre needs 3 litres of water for every 1 litre of milk produced. So for 100 litres of milk, the centre needs 300 litres of milk.

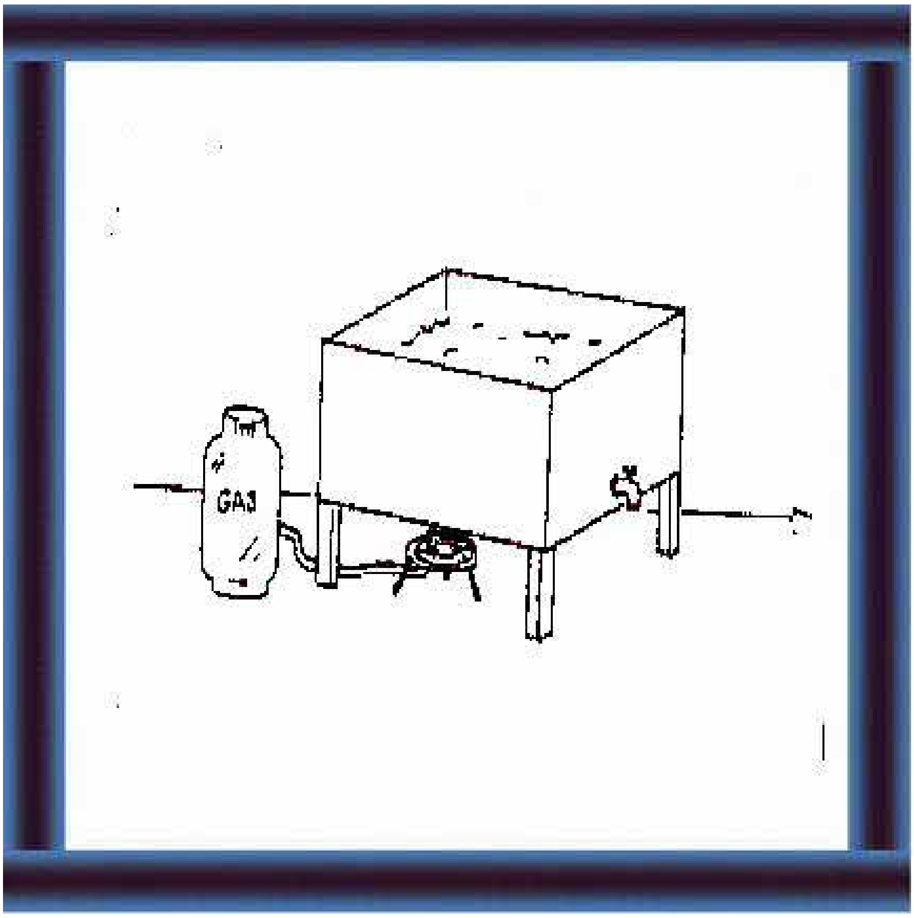


Electricity

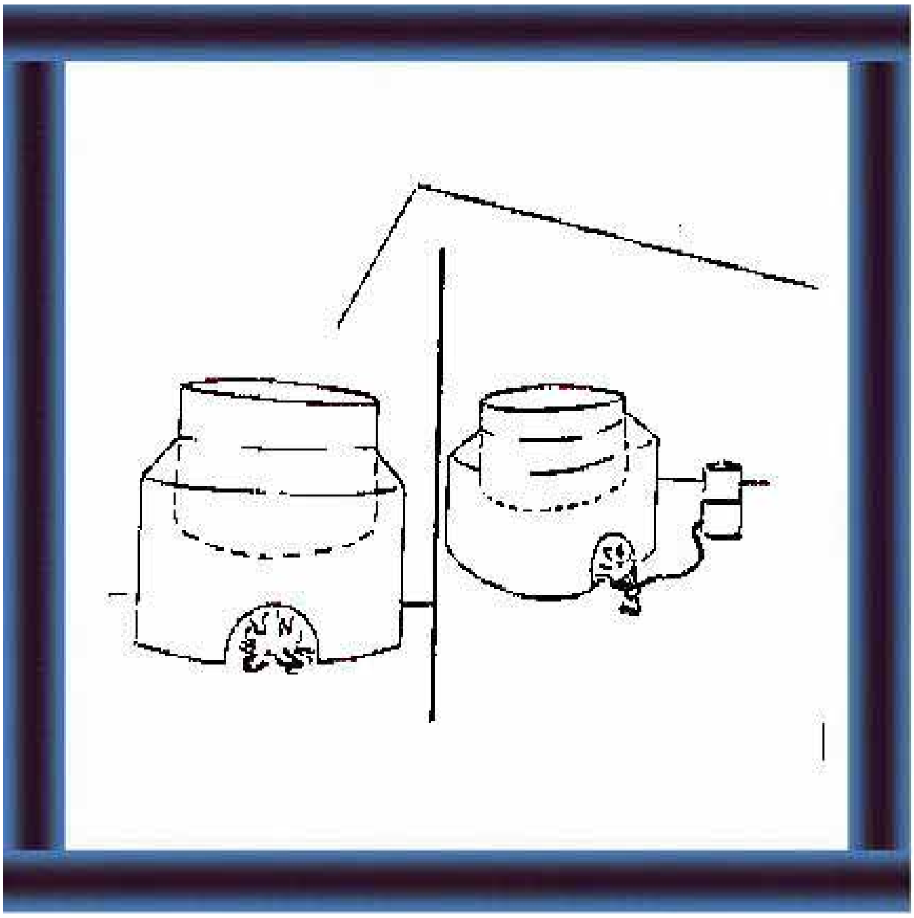
25 The centre needs electricity to cool and pump the milk.
If there is no mains supply, the centre can use a diesel generator.

Gas

26 The centre can use gas



for heating water to clean and sterilize dairy equipment.



27 If no gas is available, the centre may use wood-fired or drip oil-fired boilers.

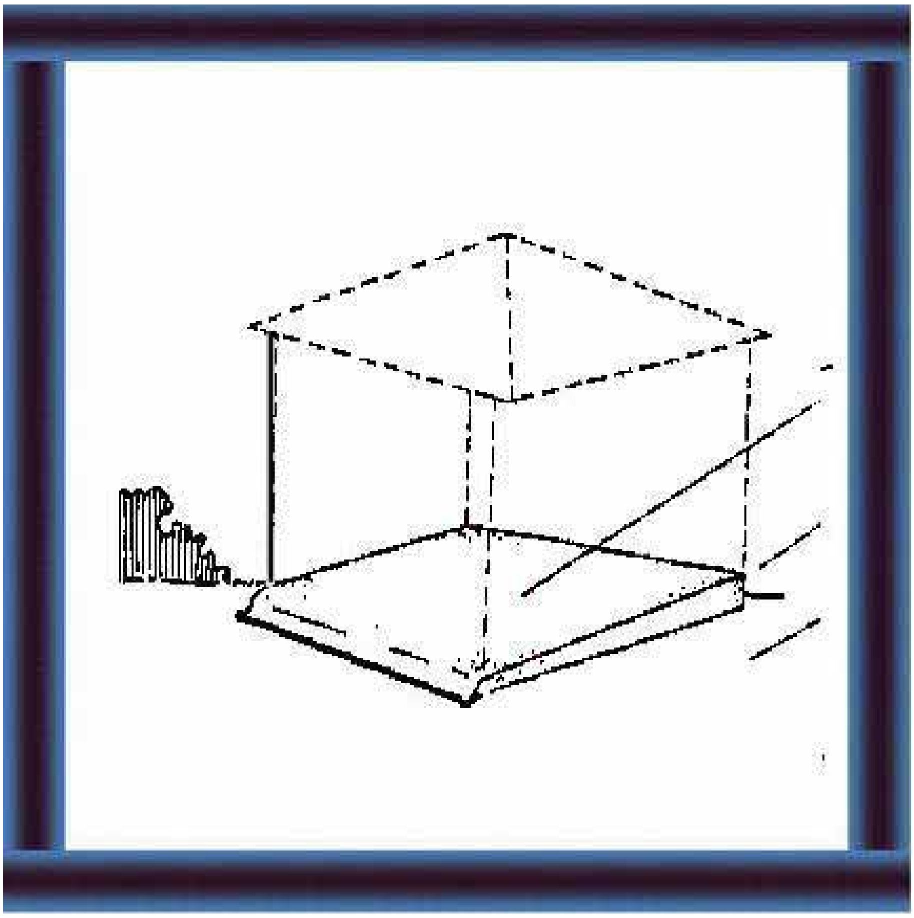
Solar heating

28 This centre collects the sun's rays to heat water in the tank.

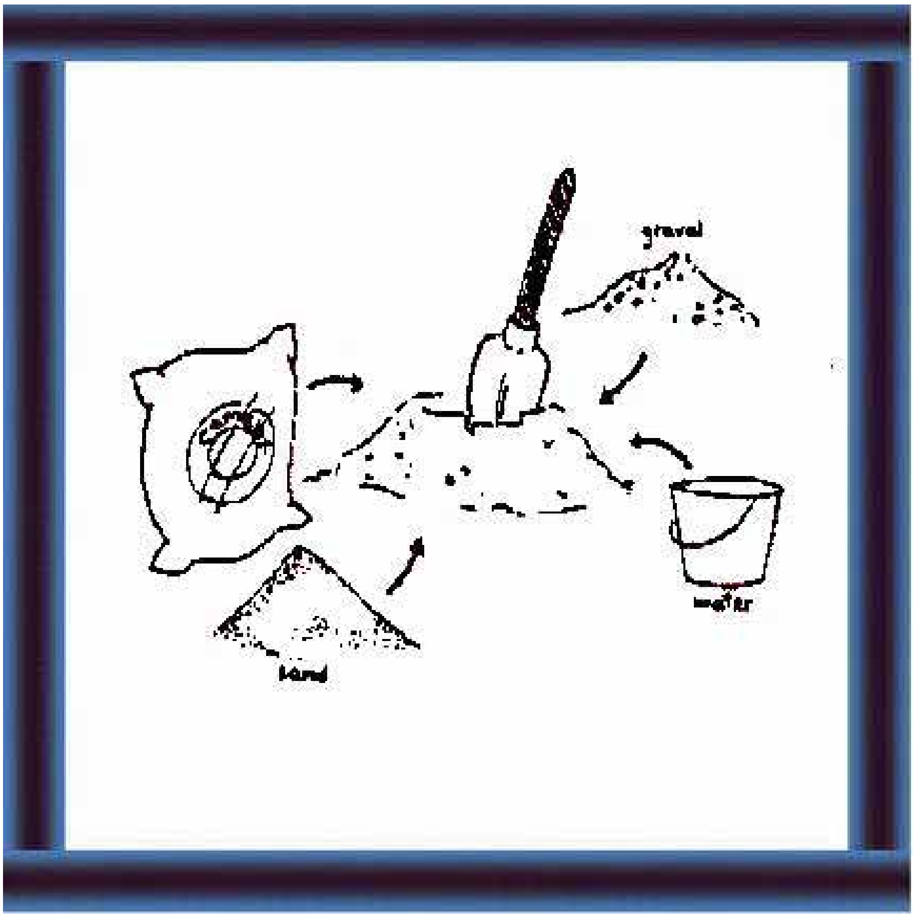
What type of building is necessory ?

Floor

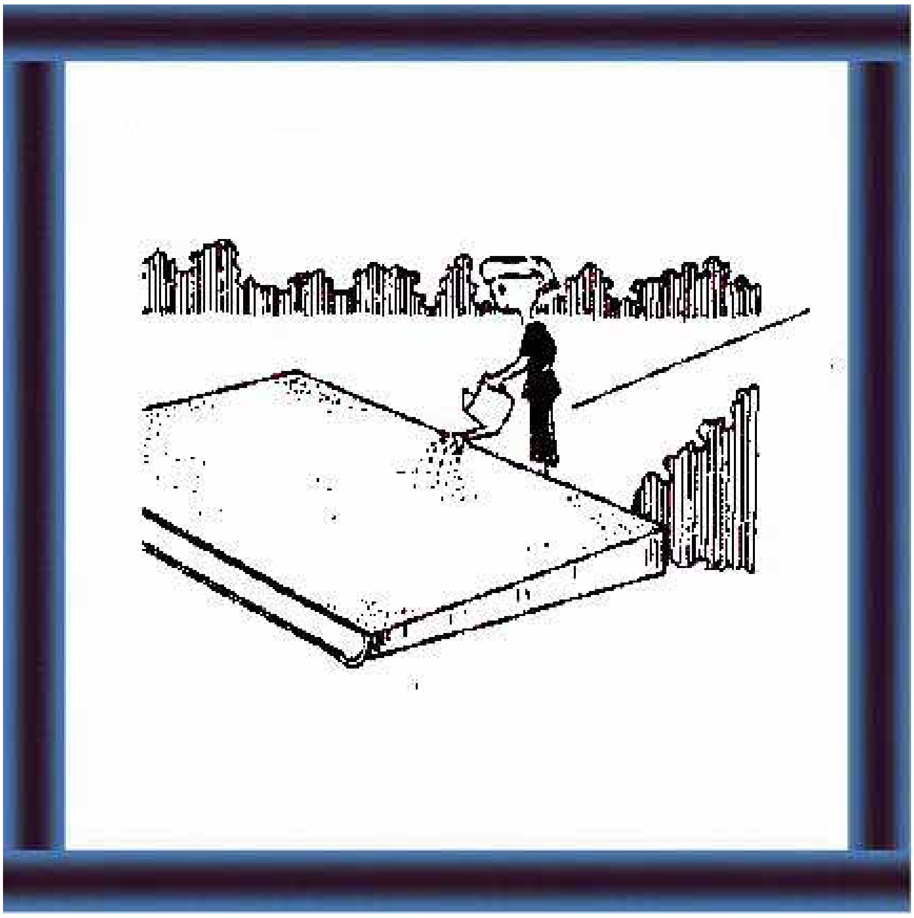
29 The floor should be:
- hard and flat, so that



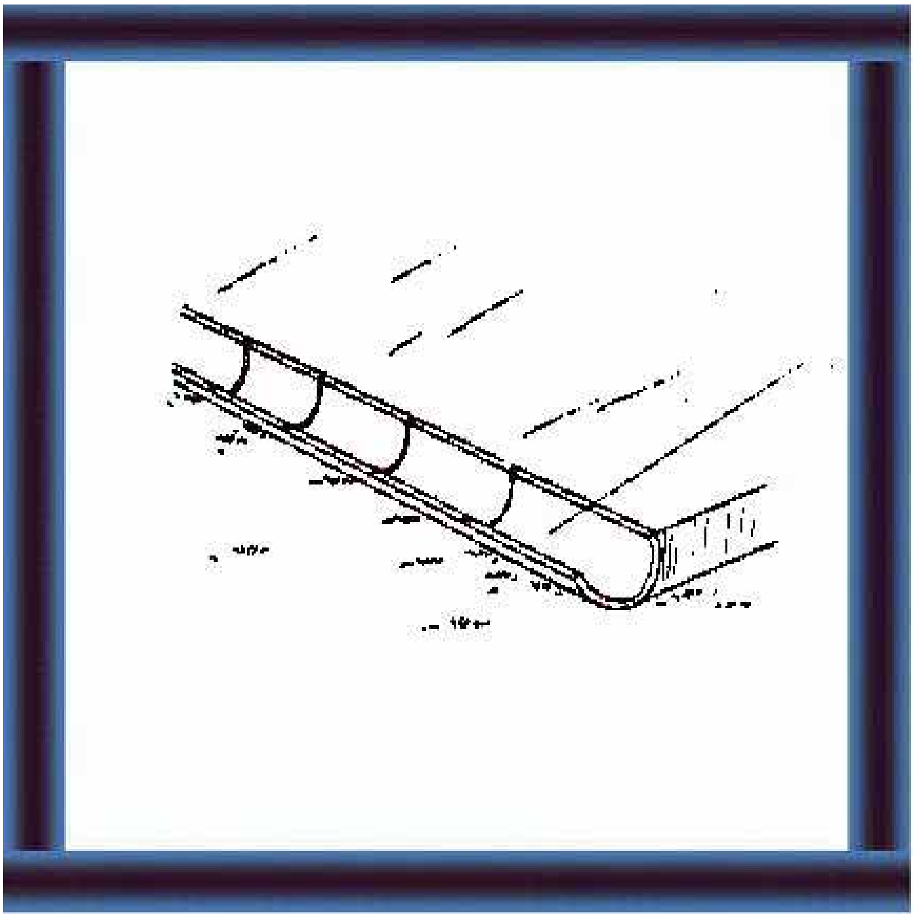
water does not pool - angled to the drain, so that water runs away Surroundings should be dry and solid - not muddy.



30 Mix concentrate correctly using cement, sand, gravel and water.



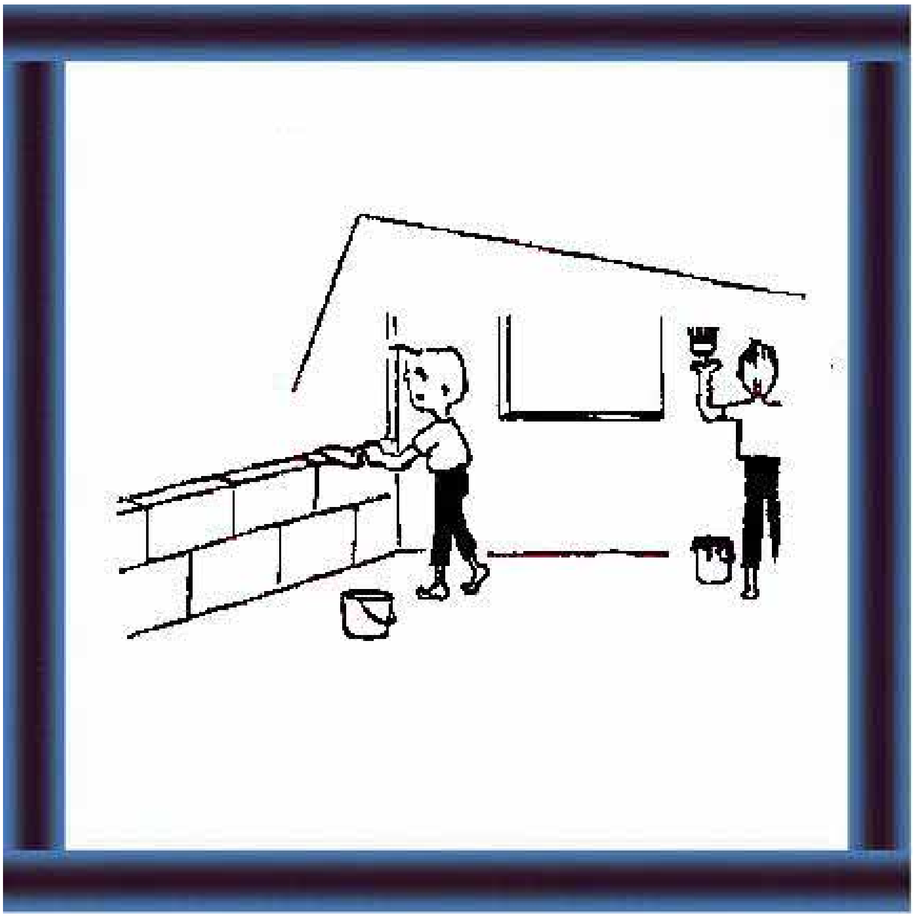
31 Let the concentrate dry slowly and sprinkle with water regularly for 3-4 days to prevent cracks.



Drains

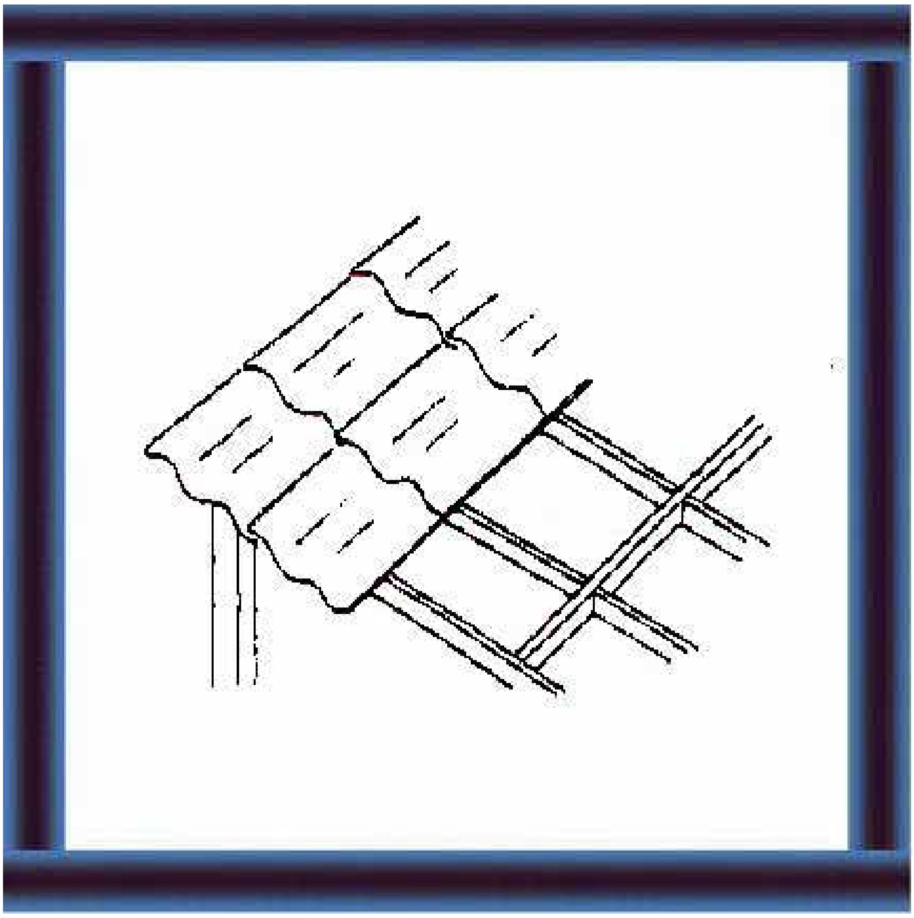
32 Make drains from half sections of glazed tiles.

Walls and Windows



33 Use clay, stone or concentrate blocks for the walls and white wash or tile.

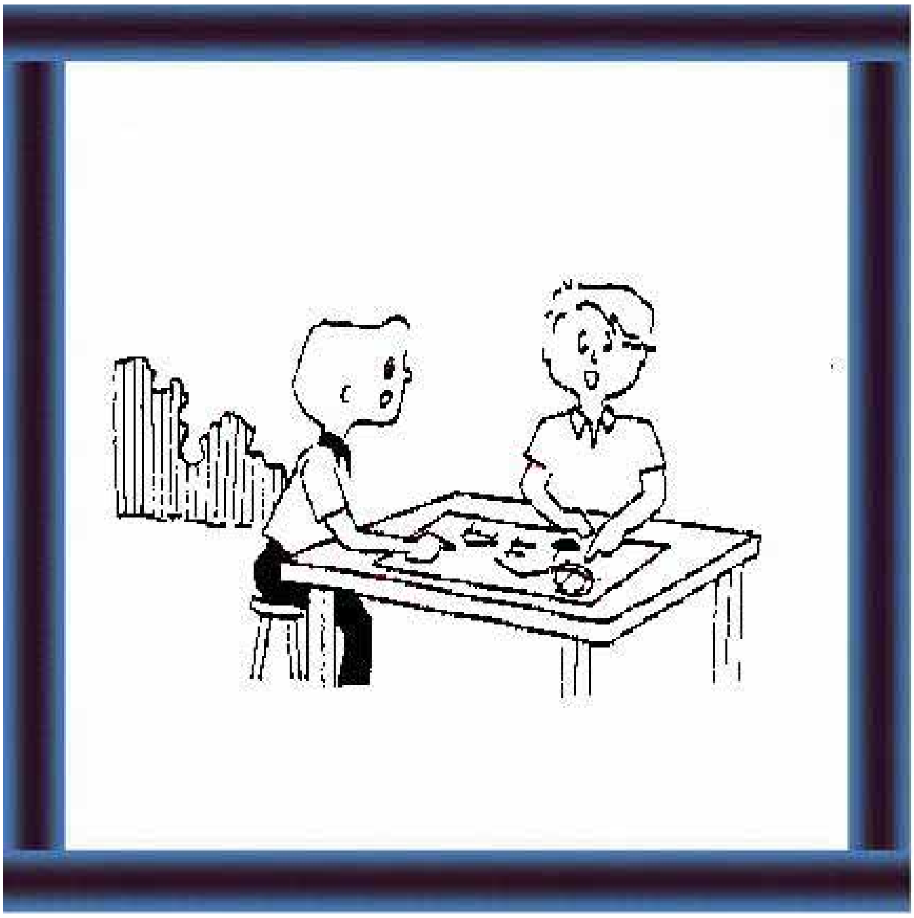
Roof



34 Use corrugated iron.

Design

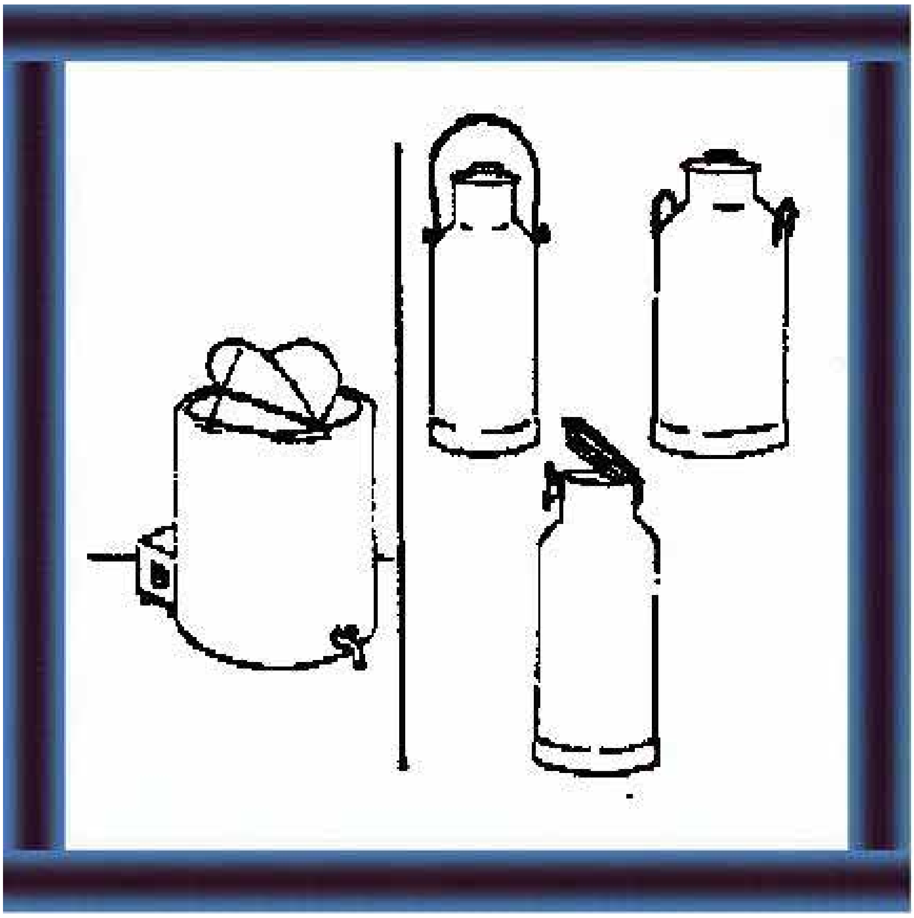
35 Ckeck the design carefully - with the architect, make sure your building is low cost and safe - with



extension worker, a good layout saves you work
- with the health authorities, good planning for hygiene yields high quality milk.

What type of equipment is necessory ?

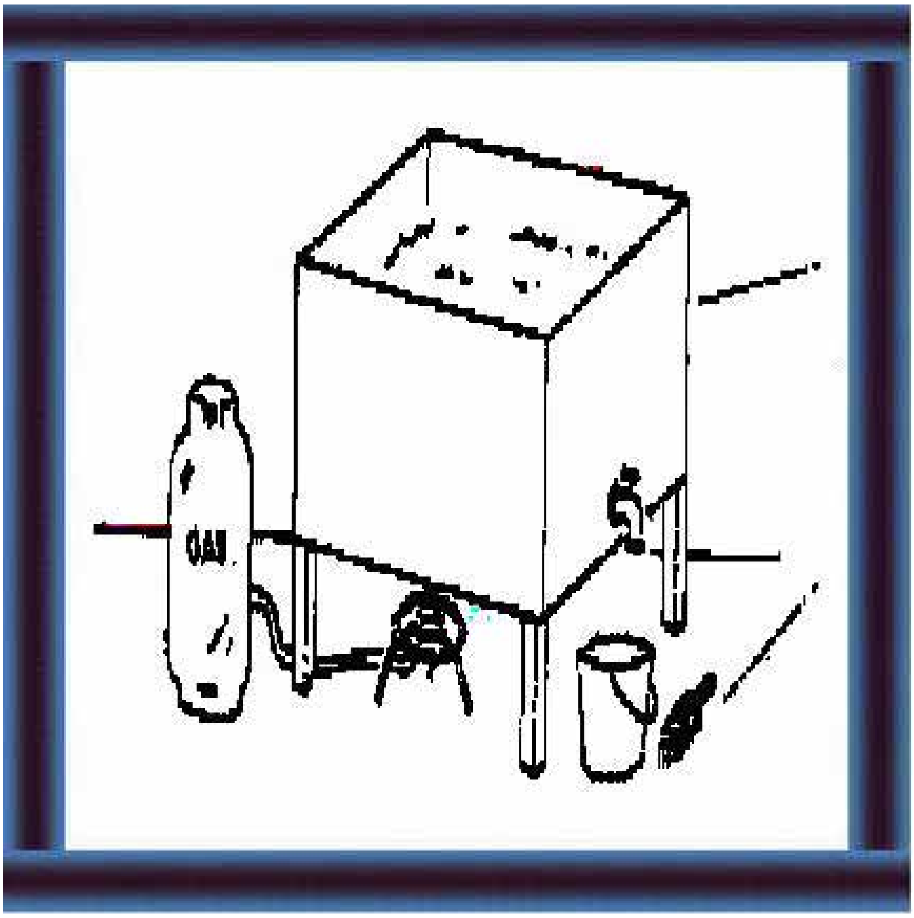
Cooling and



Storage

36 coolers

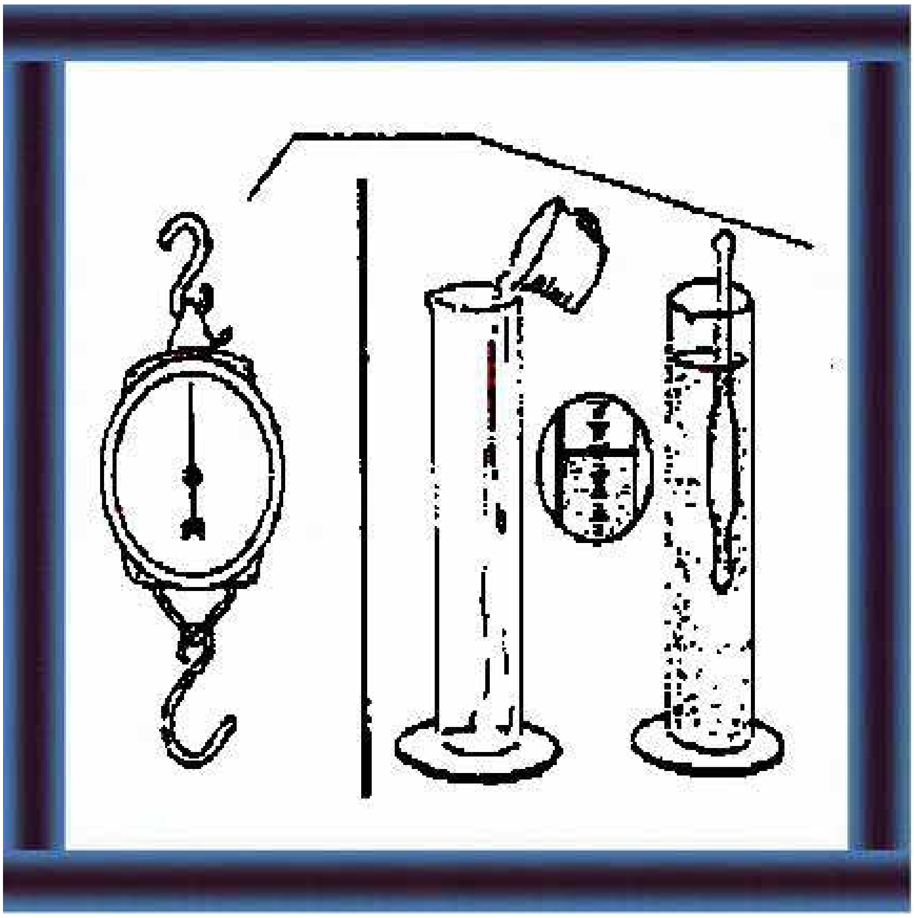
- cans



Cleaning

37 boilers

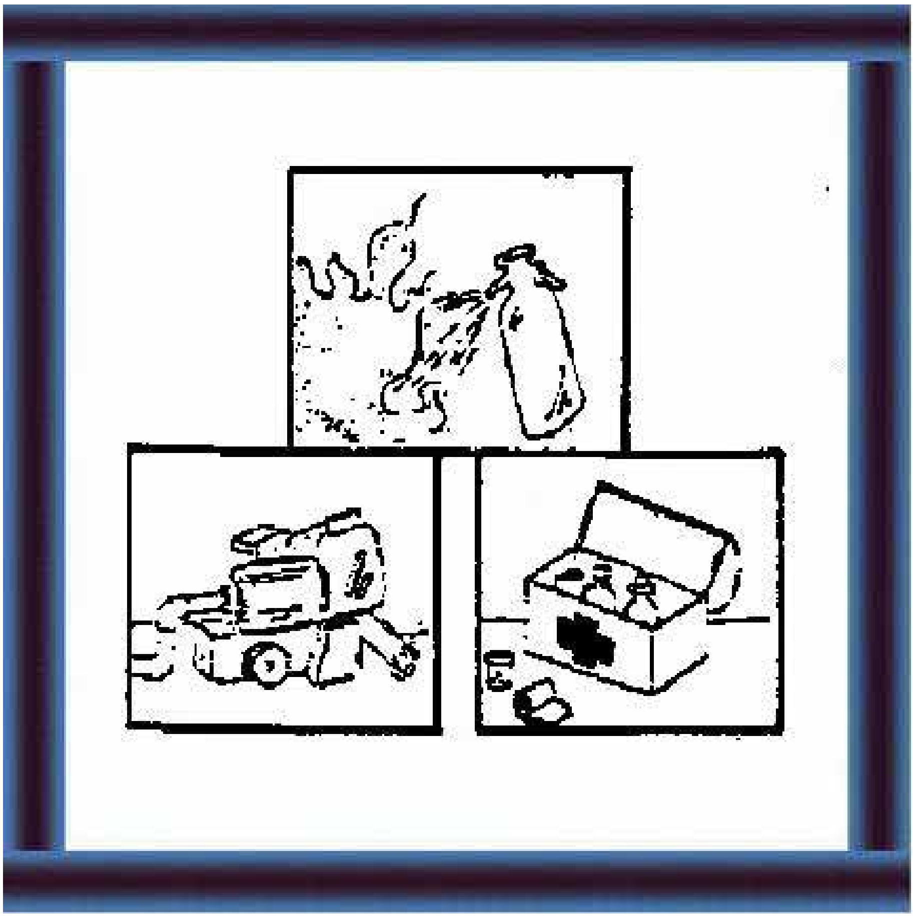
- brushes



Testing and Measuring

38 scales

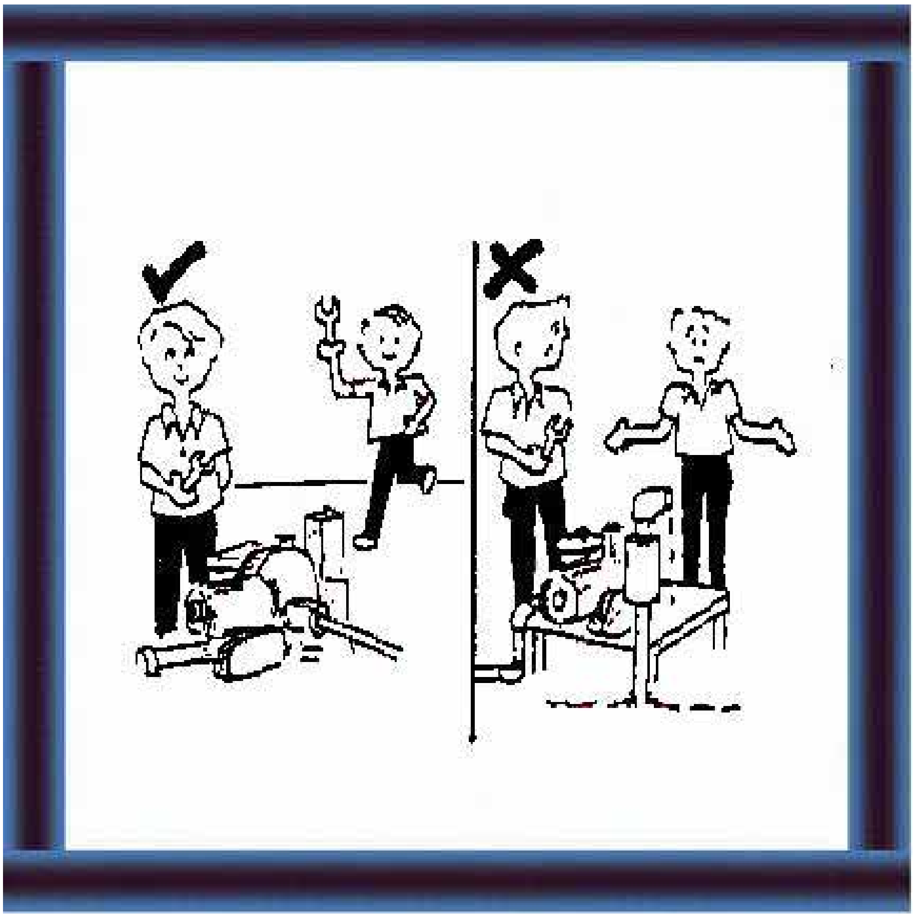
- laboratory equipment



Safety

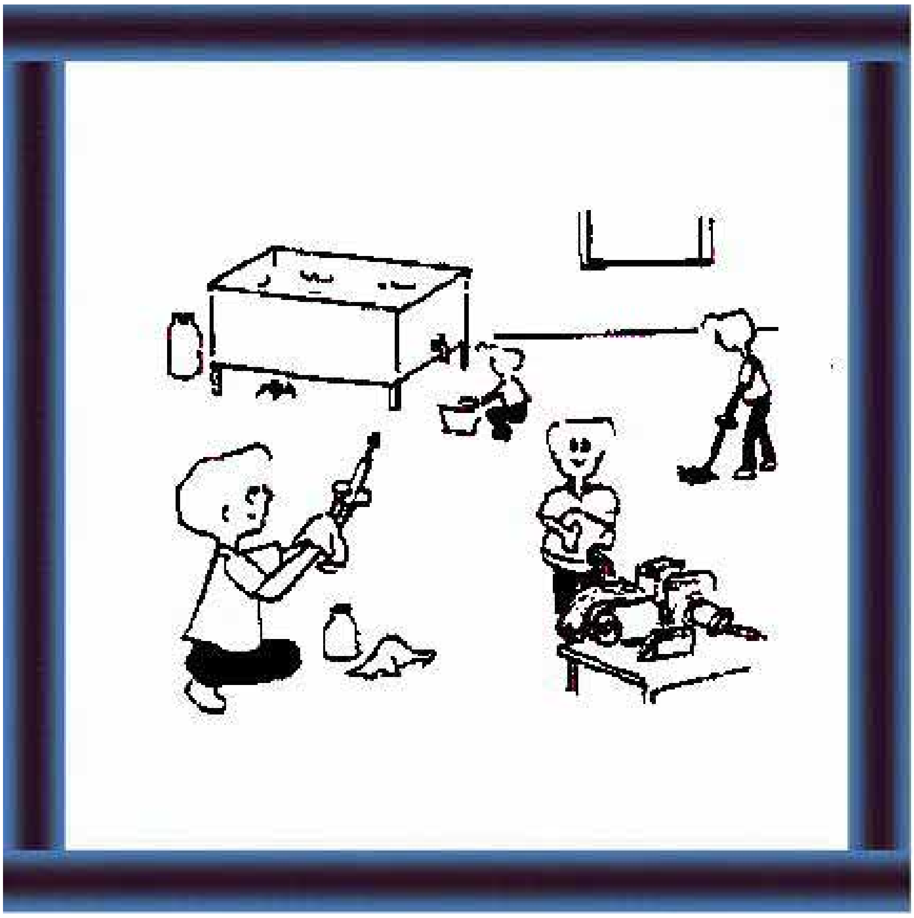
39 fire extinguishers
- emergency generators
- first aid kit

How to get the best from equipment ?



40 make sure spare parts are easily available.

41 Maintain equipment regularly



- clean everything
- grease bearings
- change oil.

What do you know about milk collecting centres ?

What is important ?

1. Short delivery time (5)
2. Low cost delivery (6)
3. Method and timing of tests (7)

Functions of milk collecting centres

1. Reception
   - sampling and testing (8)
   - weighing (9)

	- recording	(10)
	-ensuring quality	(11)
2.	Straining and filtering	(12-13)
3.	Cooling and storage	(14-15)
4.	Despatch and Sales	
	- transport to dairy	(16)
	- local sales	(17)
	-farm supplies	(18)
5.	Payment	(19)

Important points in location (20)

1. Water supply
2. Safe sewage and waste disposal
3. Good roads
4. Shade and little dust
5. No floods

Utilities

1.	Water	(21-24)
2.	Electricity	(25)
3.	Gas or wood	(26-27)
4.	Solar Heating	(28)

Building

1.	Floors	(29-31)
2.	Drains	(32)
3.	Walls and windows	(33)
4.	Roof	(34)
5.	Design	(35)

Equipment

1.	Cooling and Storage	(36)
2.	Cleaning	(37)

3. **Testing, measuring** (38)
4. **Safety** (39)
5. **Spare parts** (40)
6. **Maintenance** (41)

Small-Scale

Dairy Farming Manual

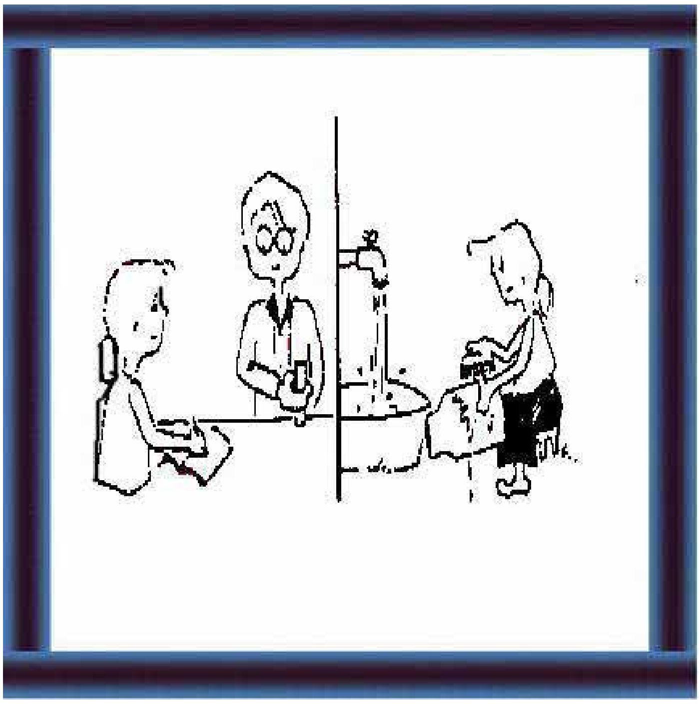
Volume 1

Technology Unit 7

Milk Reception

Extension Materials

What should you know about milk reception ?



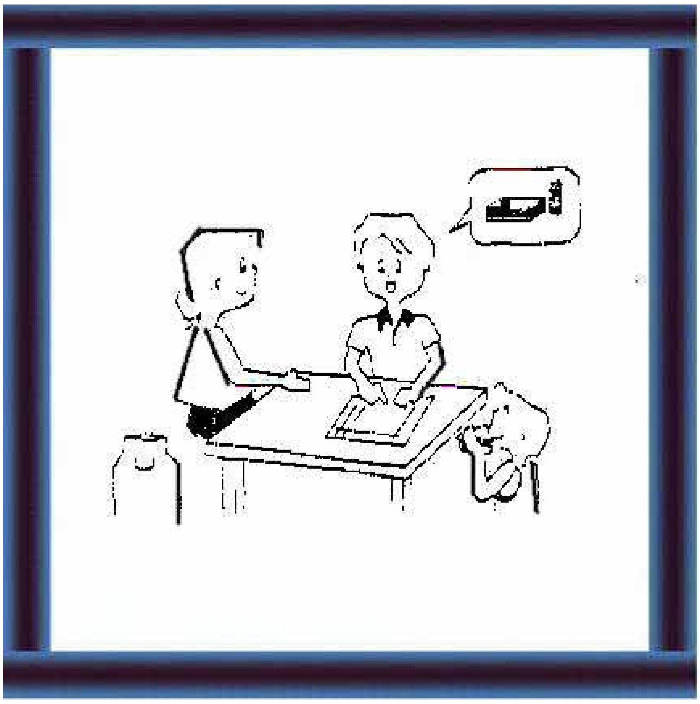
1 What is important in milk reception ? (5-9)

- organize well and keep records
- understand what makes good quality milk
- keep everything clean

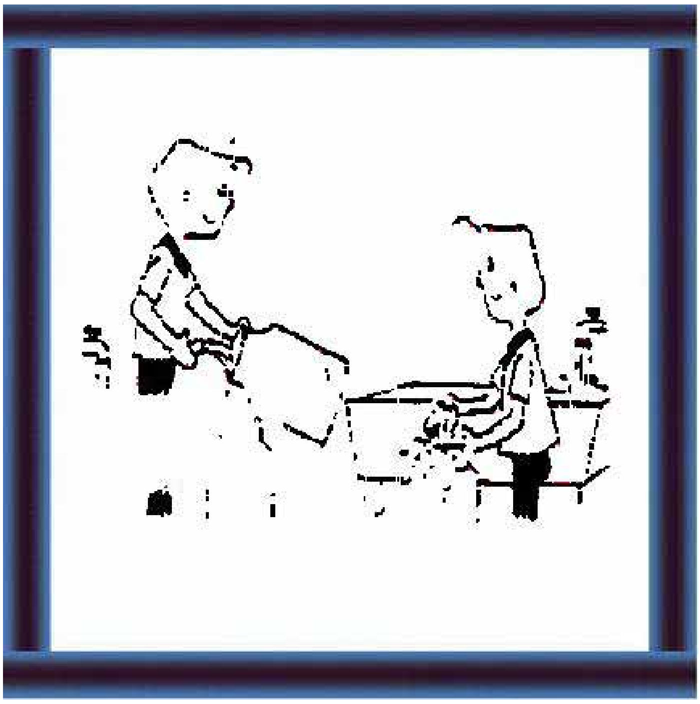
2 How does the centre organize reception and advise farmers? (9-12)

The centre:

- plan the timing of milking and transport
- advise on husbandary and any problems you have



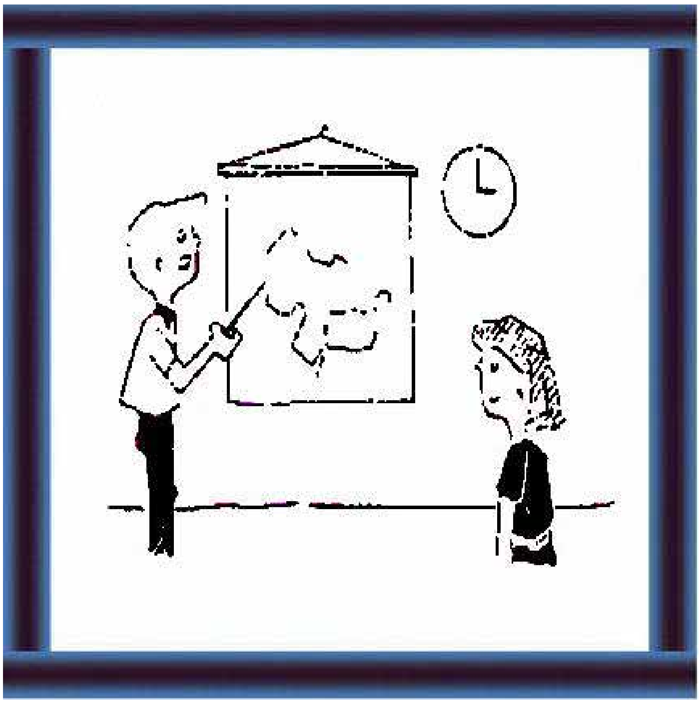
3 How does the centre keep records and make payments ? (13-24)
The centre:
- helps you to keep daily and monthly records
- pays you according to milk quality/ quantity and transport costs.



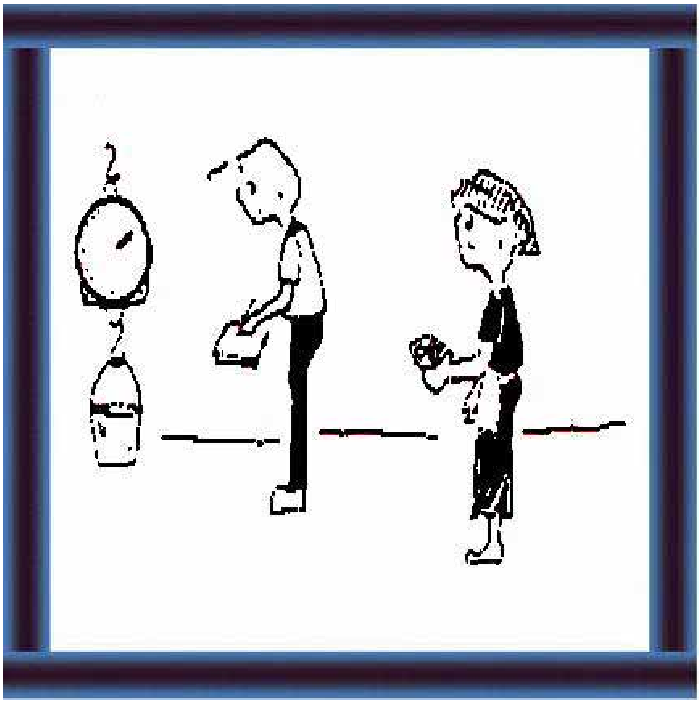
4 How does the centre clean equipment ? (25-31)
The centre cleans equipment by careful:
- rinsing
- sanitizing
- drying

(The numbers in brackets refer to illustrations in the Extension Materials)

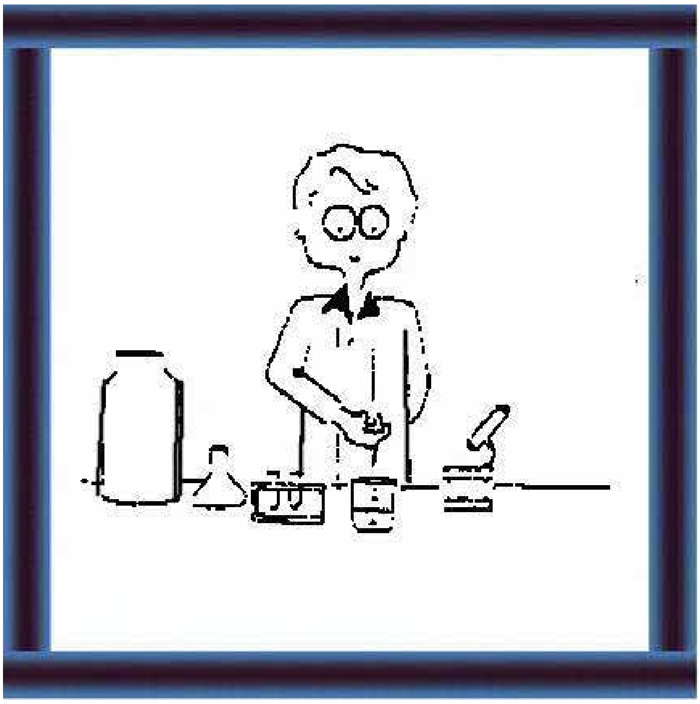
What is important in milk reception ?



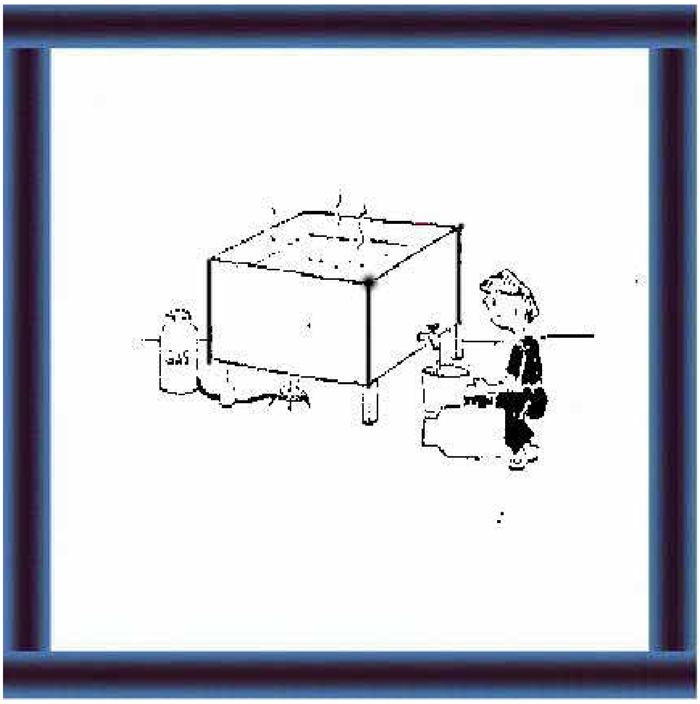
5 Organizing milk collection routines for farmers and giving them advice.



6 Keeping records and accounts and making payments.

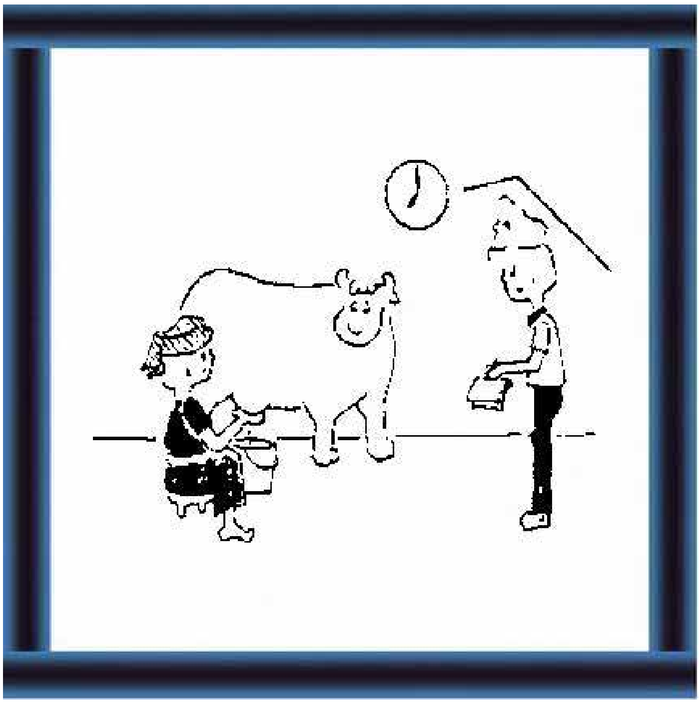


7 Sampling and testing milk quality

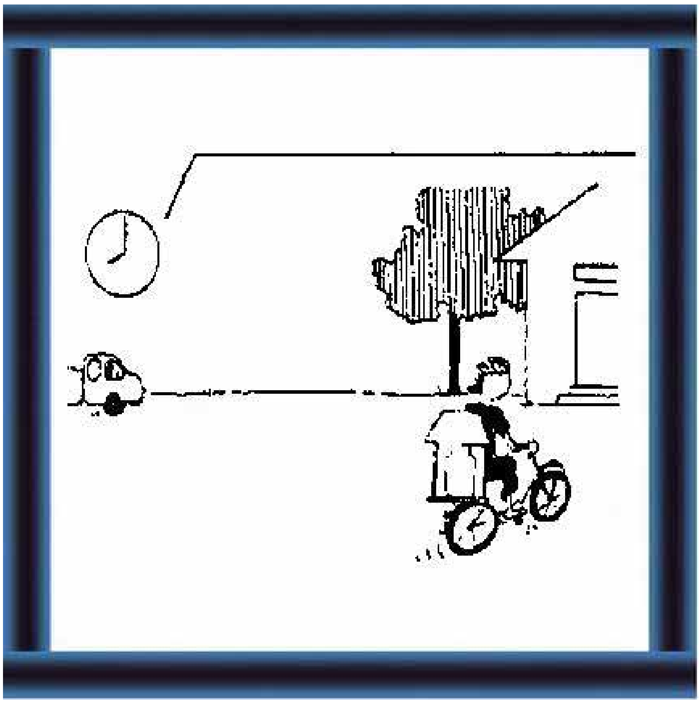


8 Cleaning and sterilizing buildings and equipment.

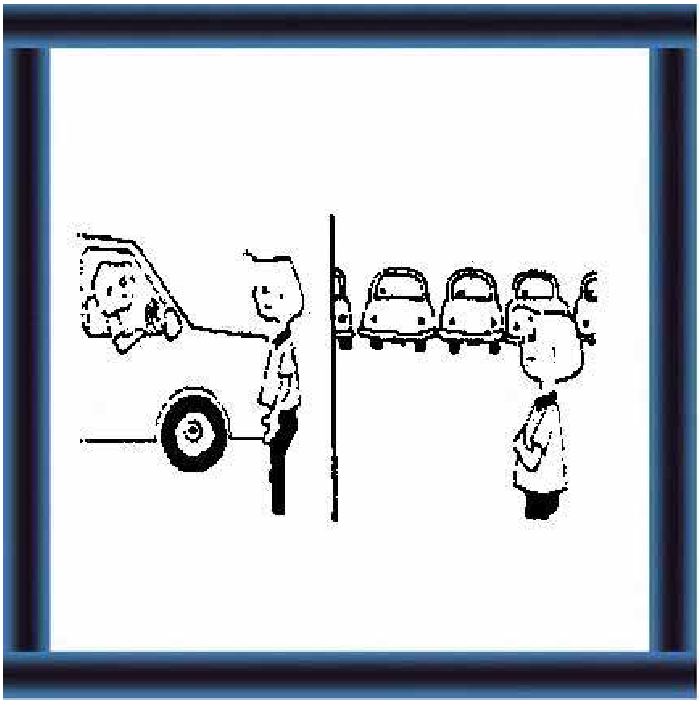
How does the centre organize reception and advise farmers ?



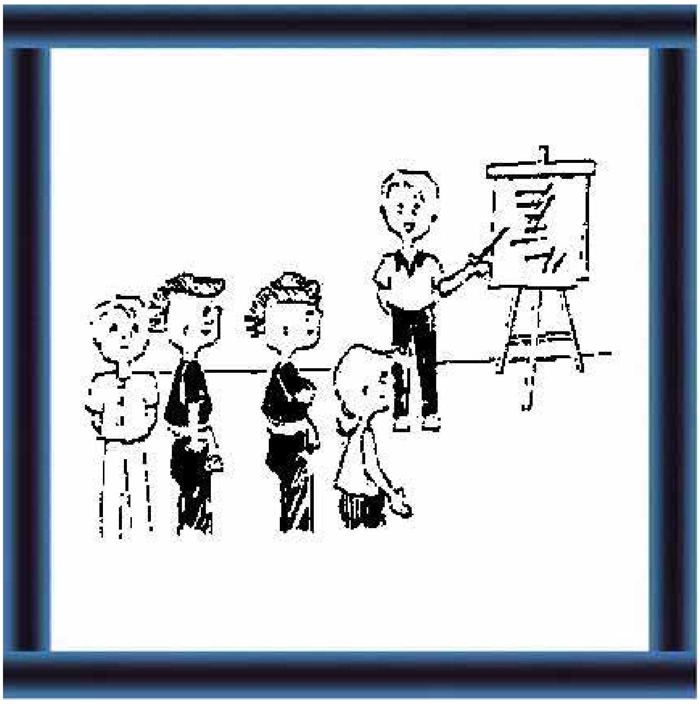
9 The centre agrees with each farmer on when to milk according to the number of his cattle and the distance from the collection point...



10 ... so that all farmers in that area bring their milk to the collection point just before the truck arrives.



11 The centre agrees with the truck drivers so that the centre can recieve the milk from one truck before the next truck arrives.

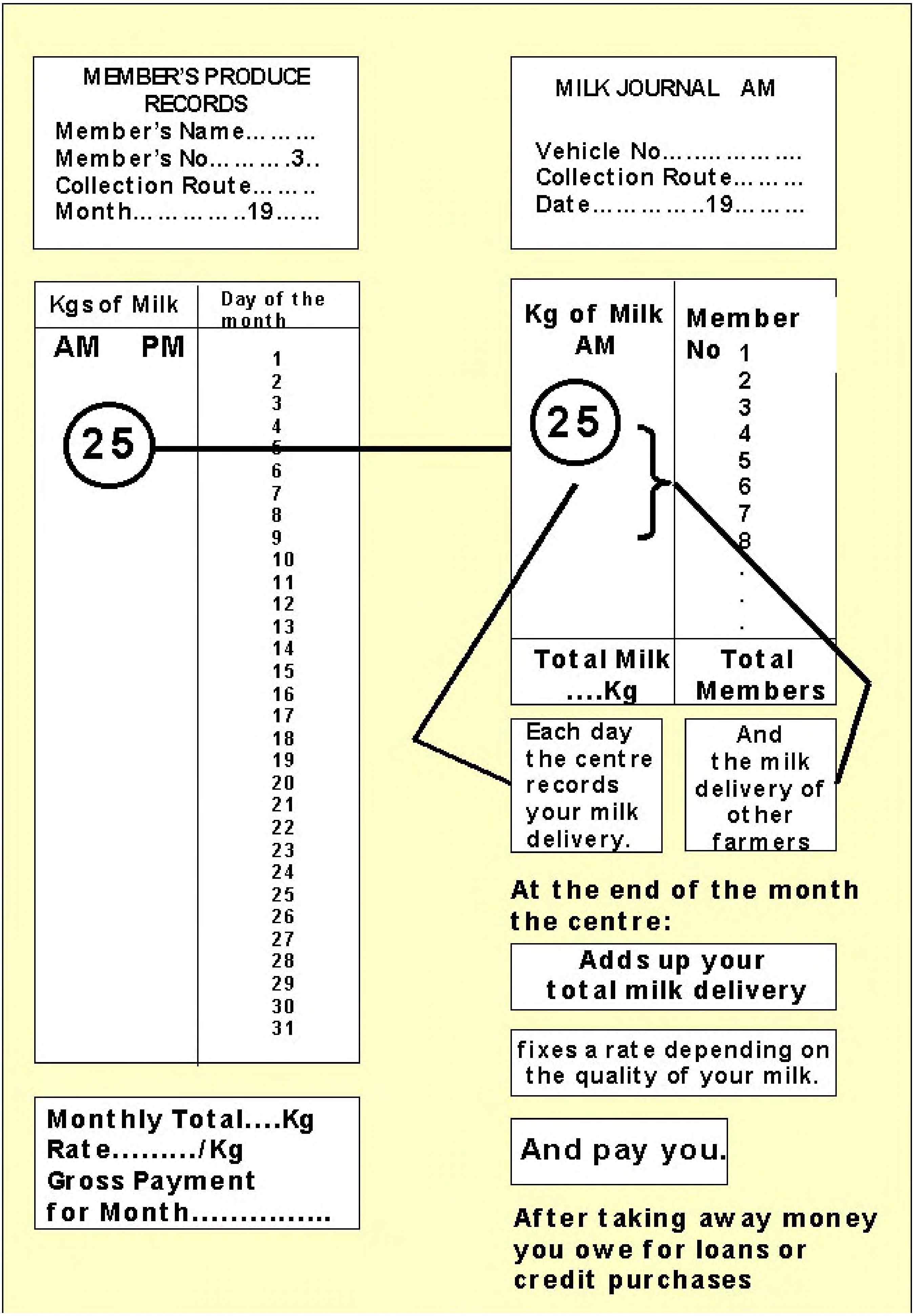


12 The centre makes sure the farmers understand about:

- hygiene
- animal health
- correct use of chemicals
- how to overcome problems if the centre rejects milk.

How does the centre keep records and make payments ?

13 You have a record for each month: 14 The centre has a record for each day:


MEMBER'S PRODUCE RECORDS
Member's Name.........
Member's No..........3..
Collection Route........
Month...............19.......
Kgs of Milk
Day of the month
AM
PM
25
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
Monthly Total....Kg
Rate........./Kg
Gross Payment for Month...............
MILK JOURNAL AM
Vehicle No.......................
Collection Route.........
Date...............19.........
Kg of Milk AM
25
Member No
1
2
3
4
5
6
7
8
.
.
.
Total Milk ....Kg
Total Members
Each day the centre records your milk delivery.
And the milk delivery of other farmers
At the end of the month the centre:
Adds up your total milk delivery
fixes a rate depending on the quality of your milk.
And pay you.
After taking away money you owe for loans or credit purchases

credit purchases

page 122

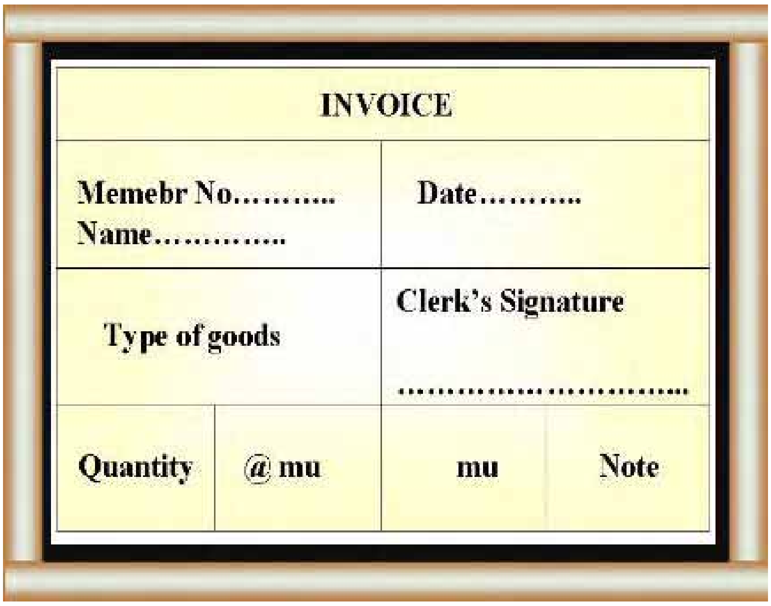
If you buy goods for cash:
15 the centre gives you a receipt.

CASH SALES RECEIPT			
Memebr No.......... Name.............		Date..........	
Type of goods		Clerks Signature	
Quantity	@ mu	mu	Note

16 and records the cash sale in a journal

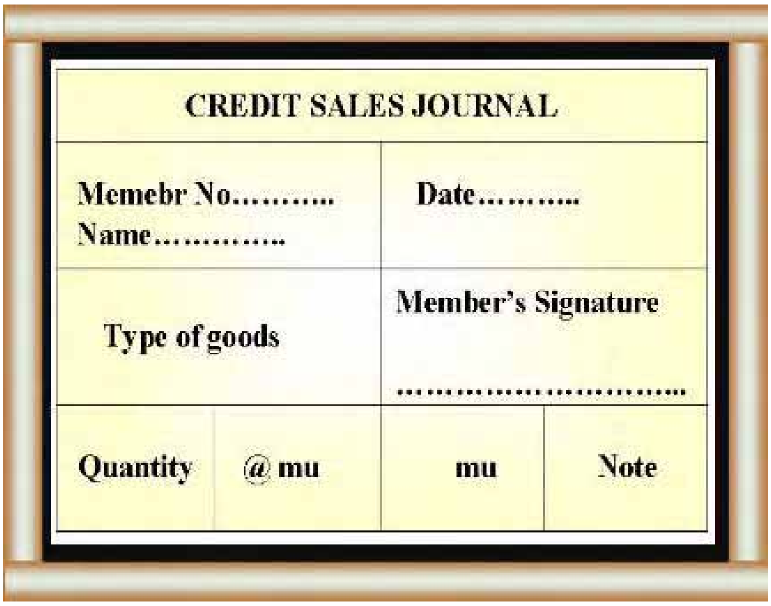
CASH SALES RECEIPT			
Memebr No.......... Name.............		Date..........	
Type of goods		Member Signature	
Quantity	@ mu	mu	Note

If you buy goods on credit:
17 the centre gives you an invoice



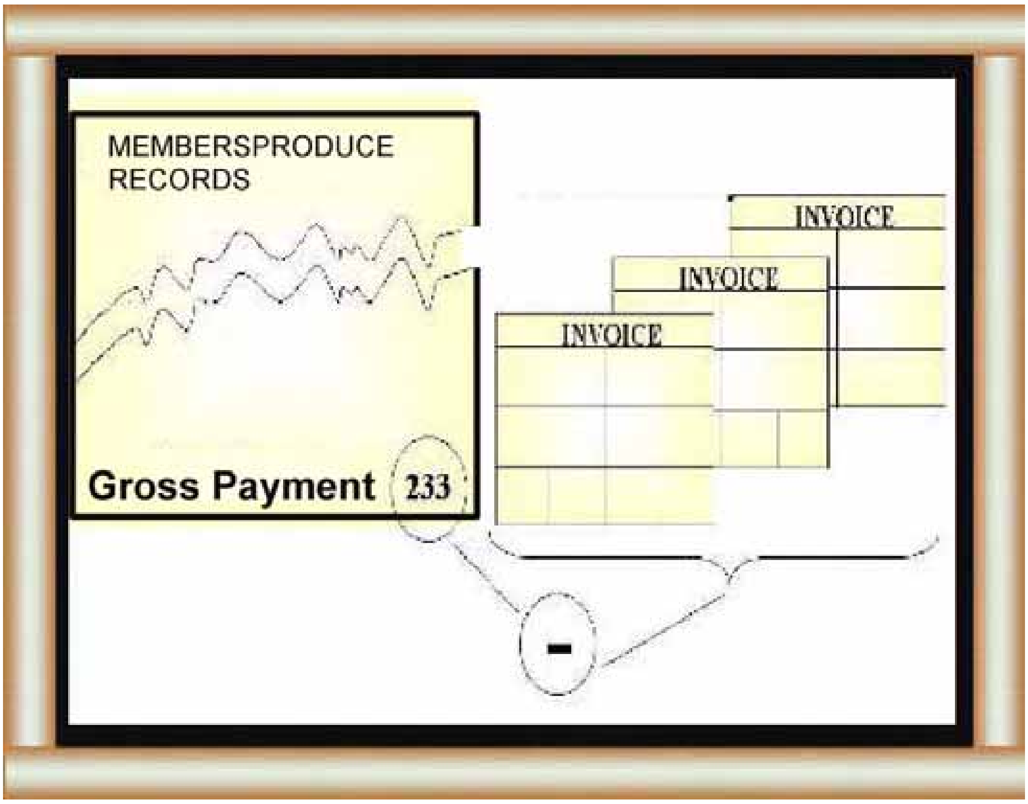
INVOICE			
Memebr No.......... Name.............		Date..........	
Type of goods		Clerk's Signature	
Quantity	@ mu	mu	Note

18 and records the credit sale in another journal



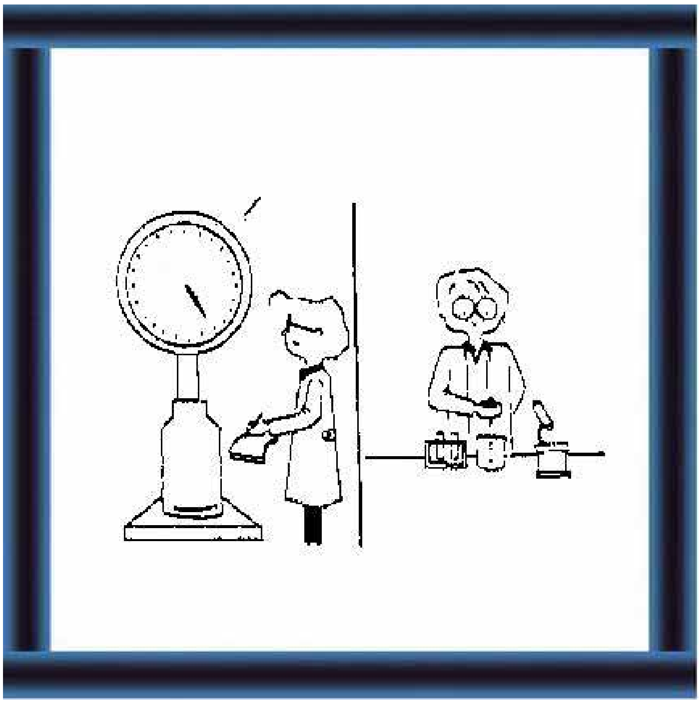
CREDIT SALES JOURNAL			
Memebr No.......... Name.............		Date..........	
Type of goods		Member's Signature	
Quantity	@ mu	mu	Note

19 At the end of the month:
The centre adds your invoices

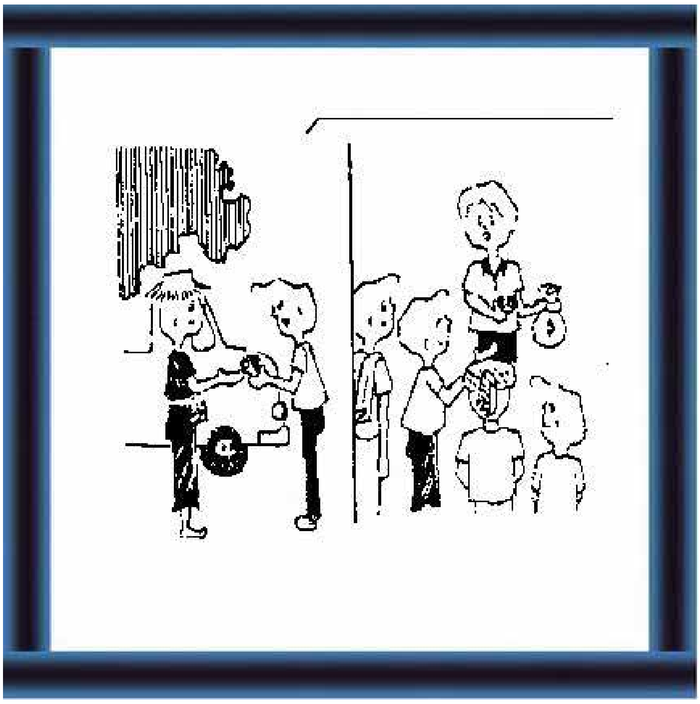


and takes them away from your payment.

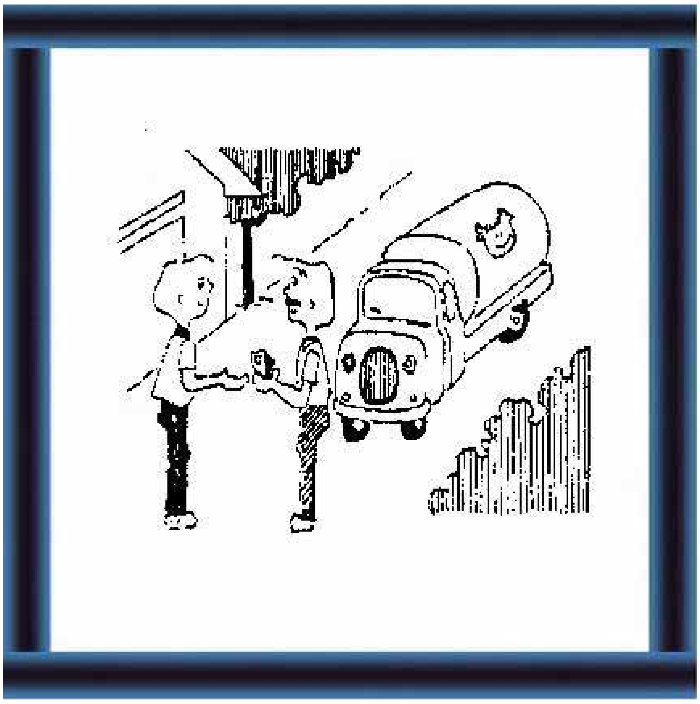
How much does the centre pay you?



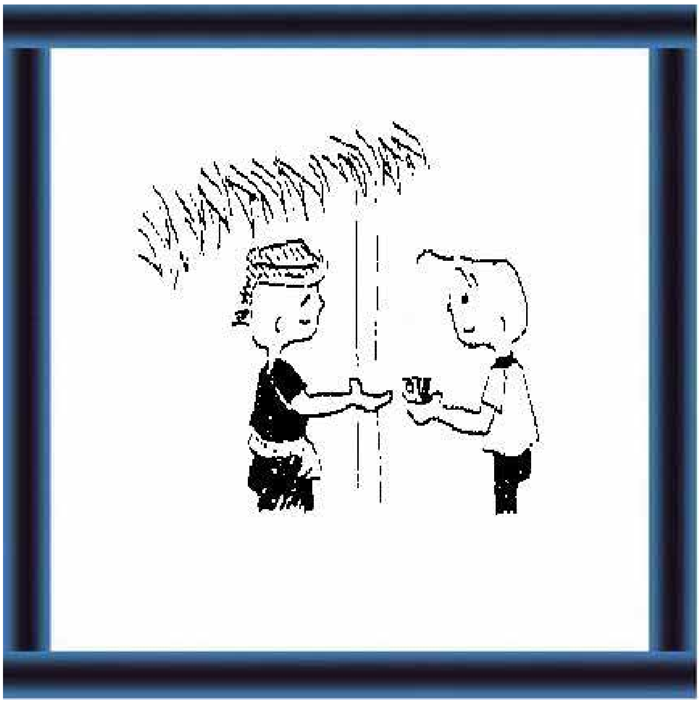
20 The centre pays you for the quantity and the quality of your milk.



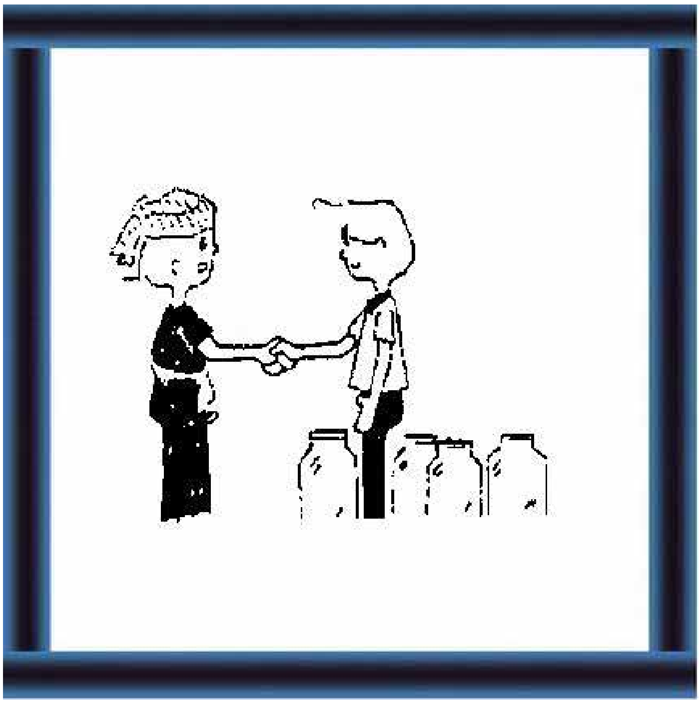
21 The centre pays for transport costs and for operating costs such as staff wages and electricity.



22 The centre earns money by delivering good quality milk to the dairy.



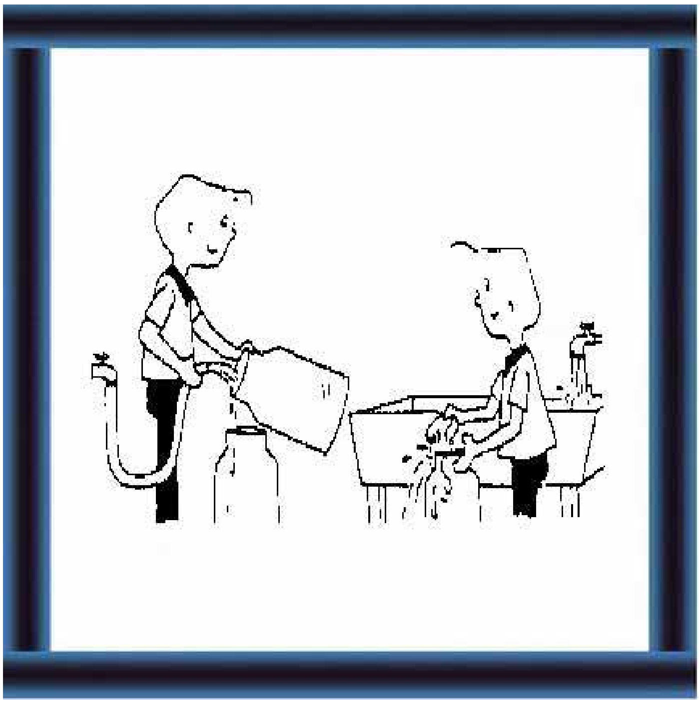
23 You get more money from the centre if:
- you deliver more milk
- you deliver better quality milk
- you help the centre keep transport costs low.



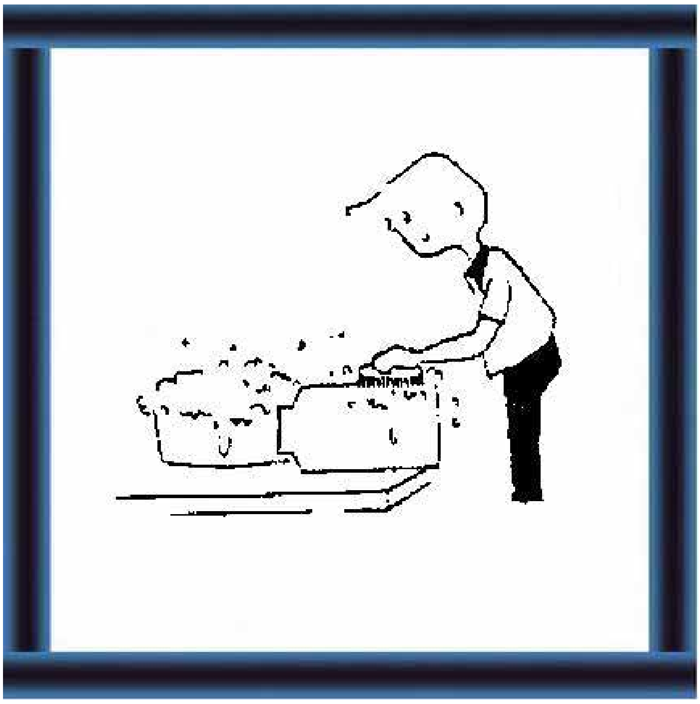
24 The centre wants to accept your milk, not to reject it.

Consult your centre about how to produce the best quality milk.

How does the centre clean equipment ?



25 They rinse with cold water.



26 They scrub inside and out with a brush, warm water and a cleaning agent, then they clean again with a sanitizer.

The centre may let you clean your own milk cans.
Cleaning agents you can use are:

Detergents Quick and effective action against fat and protein matter.

Soaps Do not use perfumed soaps.

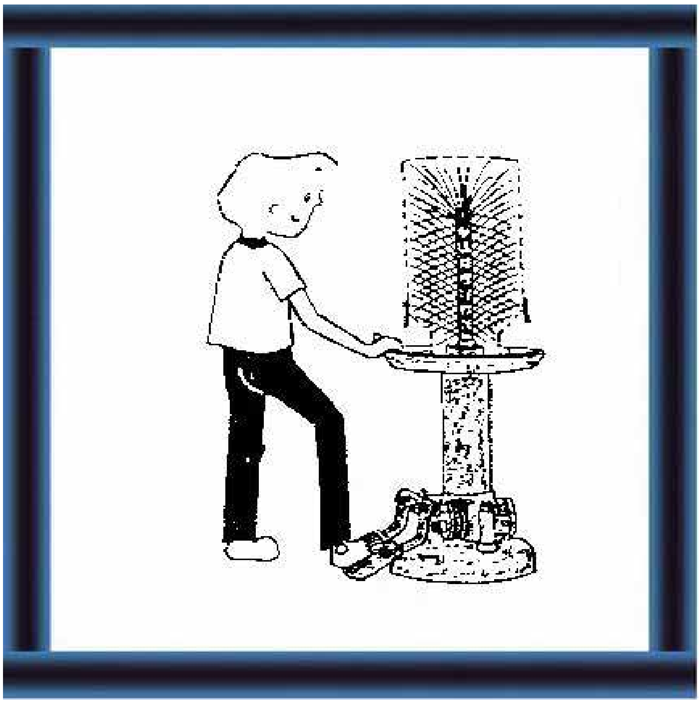
Caustic Soda Effective, especially if mixed with suitable phosphates.
(Sodium Hydroxide)
Note:
1 Use only weak solutions for hard washing.
2 Corrosive for tinned surfaces and aluminium.

Washing Soda (Hydrated Sodium Carbonate)

Cheaper and less corrosive than caustic soda for manual washing, use 5 cc in 10 l of water.

Wetting Agents Effective but expensive.

How does the centre sanitize (disinfect) equipment?



27 Bigger centres use steamto kill micro-organisms left after cleaning

28 but you can also use boiling water

29 or chemicals.
Make sure:

- they are not toxic
- they do not bring taste or smell to the milk
- they are effective and cheap
- you follow the directions
- you rinse thoroughly with clean water.

Chemicals you can use are:

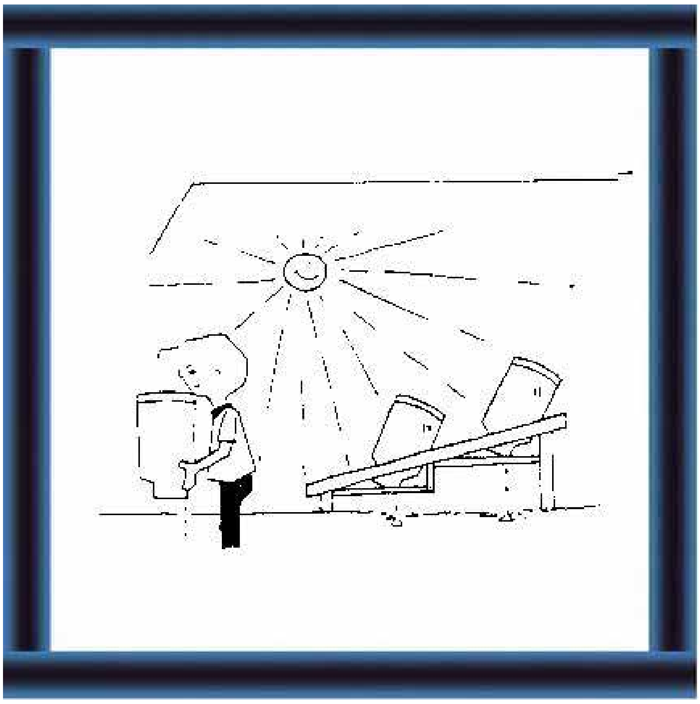
Chlorine

Follow the directions on the packet of sodium or calcium hypochlorite. The strength of the solution should be 1 cc per 5 litres of water.

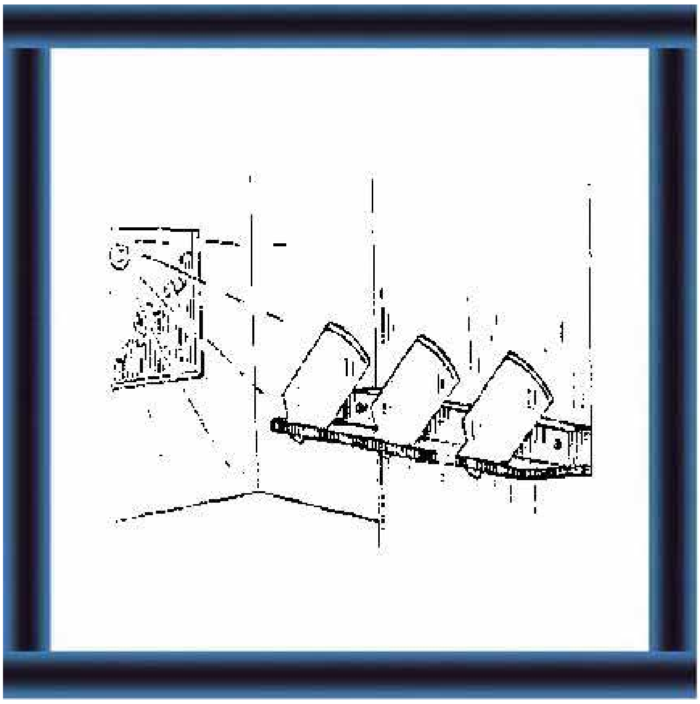
Quaternary Ammonium Compounds

These dairy sterilizers are effective and easy to use. Follow the directions on the packet or bottle.

Note: Residues of quaternary ammonium compounds in milk will make it unsuitable for making fermented products e.g. yoghurt and cheese.



30 After cleaning and sanitizing, drain the equipment and dry it in sunlight.



31 Store up-side-down without lids on racks in a dust-free, well-ventilated room.

Disinfect just before use.

What do you know about milk reception?

Important points

1.	Organization and advice for farmers	(5)
2.	Records, accounts and payments	(6)
3.	Sampling and testing	(7)
4.	Cleaning and sterilizing	(8)

Providing organization and advice

1.	Planning timing of milking and transport	(9-11)
2.	Advising on: - hygiene - animal health - correct use of chemicals - problems	(12)

Record keeping

1.	Monthly Members Produce Records	(13)
2.	Daily Milk Journal	(14)
3.	Cash Sales Report	(15)
4.	Cash sales Journal	(16)
5.	Invoice	(17)
6.	Credit Sales Journal	(18)
7.	Member's Produce Record	(19)

Payments

1.	The centre pays:	
	- farmers for good quality milk	(20)
	- transport and operating costs	(21)
2.	The centre pays you more for:	(22-24)
	- more milk (of good quality) - better quality milk - lower transport costs	

Hygiene

1.	Cleaning equipment	
	- rinsing	(25)
	- scrubbing with cleaning and sanitizing agents	(26)
2.	Sanitizing	
	- steam and boiling water	(27-28)
	- chemicals	(29)
3.	Drying	
	- draining	(30)
	- storing	(31)

Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 8

Milk Payment

Extension Materials

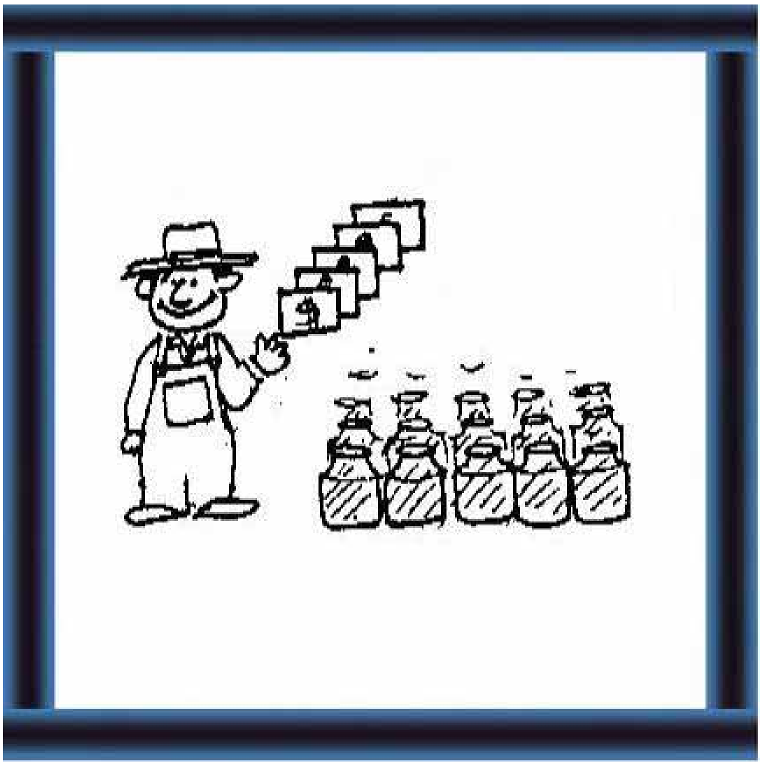
What should you know about milk payment?

How much money does the dairy pay for your milk? (1 - 6)

The dairy pays according to:

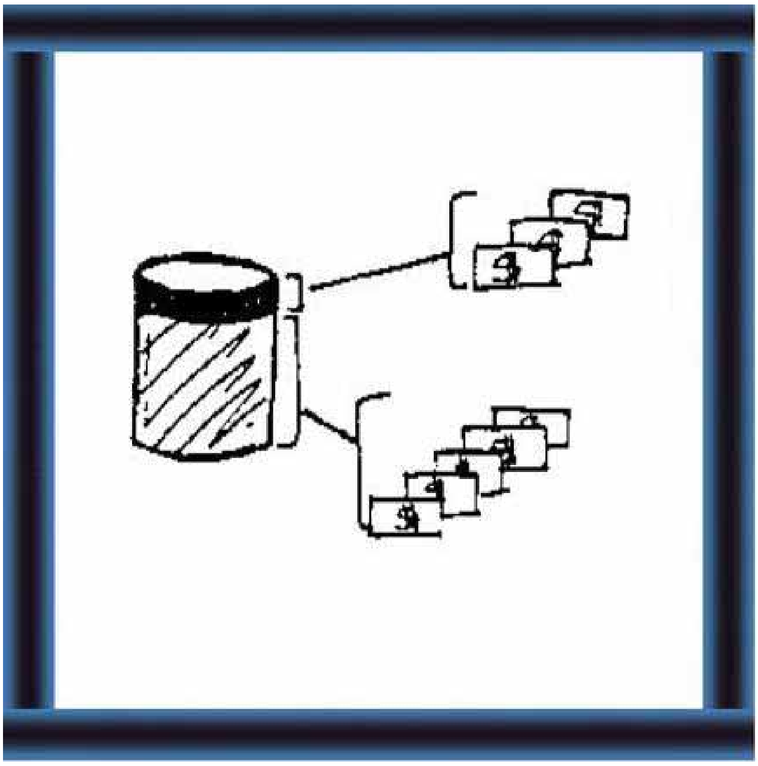
- quality

- quantity.



How does the dairy pay for quantity? (7 - 11)

The dairy pays for quantity **if** your milk is **high quality.**



How does the dairy pay for quality? (12 - 35)

The dairy pays according to:

- **composition** quality

- **physical** quality and **hygiene.**

Milk Payment

(Numbers in brackets refer to illustrations in the extension materials)

Payment for Quantity and Quality (1-6)

The basic points to be considered in a milk payment system are

Quantity of the milk

- Volume
- Weight

Quality of the milk

- Compositional
- Microbiological
- Physical
- Hygienic

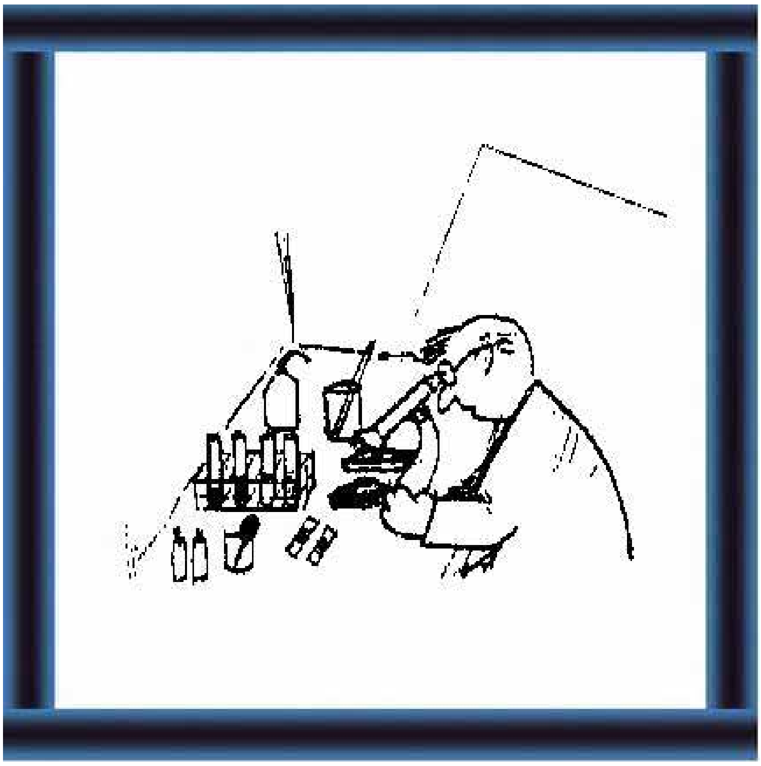
Dairies use one or more of these for milk payment all over the world. Other conditions such as quotas, contracts or subsidies fit into milk payment systems to satisfy interest groups of dairy farmers or national dairy policies.

If only the quantity payment is used, milk producers may adul-terate the pure milk. If quantity payment goes with quality payment, adulteration does not pay back the transportation cost of the extra volume and the inferior quality. This, and fines or punishment, make adulteration tests unnecessary in countries with quality payment.

Milk of poor quality makes poor quality dairy products, even with heat treatment or other quality preserving operations. It is advisable to lay down regulations for a premium/deduction system based on tests such as the resazurin test, the methylene-blue test or the alcohol/alizarin test.

1 How much money does the dairy pay for your milk?

2 The dairy tests your milk



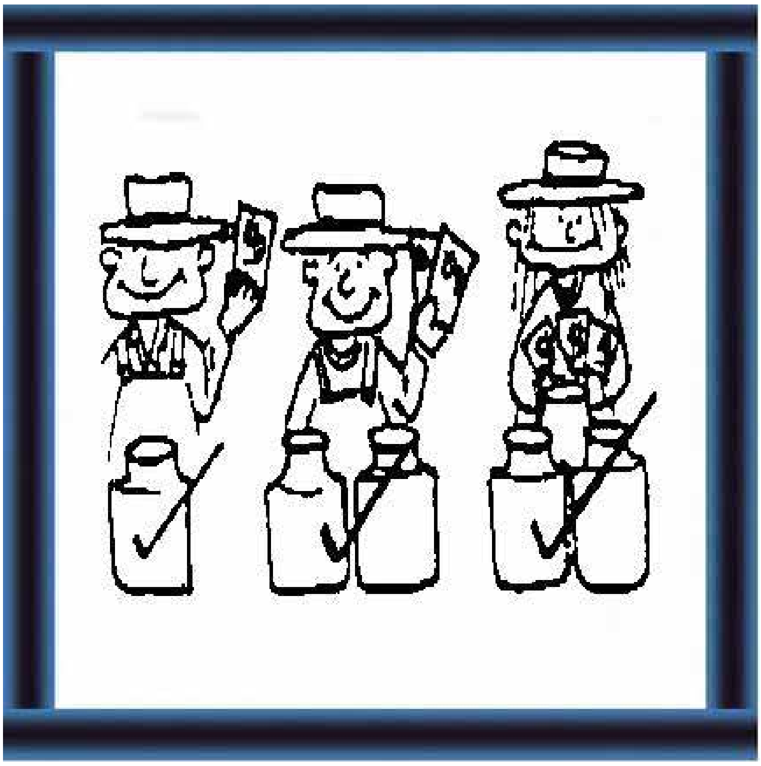
and pays you according to the **quality.**

3 If your milk is **high quality** the dairy pays you more money.

4 If your milk is **low quality** the dairy pays you **less money.**

A payment system based on microbiological quality encourages dairy hygiene on the farm. Tests of foreign matter in milk are unsuitable as a basis for milk payment. The sediment test can, however, be used as a valuable advisory test. Special conditions require quality tests, for example, in countries where low cooling on the farm and 2-3 times weekly milk deliveries per farm encourage a microflora of psychrophilic protein digesting bacteria. A normal resazurin or methylene-blue test would give false results if carried out on such deep cooled milk samples. To sort out inferior deep cooled milk the organoleptic test is used and for payment purposes individual milk samples are grown on selective substrates. The number of colonies counted after a predetermined period gives the basis for a payment premium or deduction.

5 If your milk is **very** low quality the dairy **rejects** it.



6 These farmers all produce **high quality milk**.

The dairy pays the **same** for each can according to **quantity.**

Payment for Quantity

There are in general two different ways of measuring milk.

1. Volumetric measurement (litres/gallons)

(1) Dipstick method

The dipstick method uses a graduated stick which can only measure the content in containers of equal size. One dipstick with graduations can measure the content of 40 litre cans, but the same stick cannot be used for measuring the content of other types of containers.

The most secure method has a special matching container. Measure all milk with the dipstick in the special con-tainer.

The dipstick method is mainly used for large quantities of milk in containers such as stationary tanks, rail tankers and road tankers.

(2) Container method

The container method is mainly used for sales of milk to consumers and for internal work in the dairy.

Containers are made either to hold definite quantities of milk such as 1/2 litre, 1 litre or they are made with inside graduations, from which the milk level in the container can be read.

(3) Flow-meter method

In modern road tankers the milk is measured by a flow-meter i.e. volumetric measurement. The tanker is usually equipped with a deaerator which removes air that may have entered the milk during pumping etc. High air content will result in increased milk volumes. Before payment to the farmer litres can be converted into kilos : litres x specific gravity = kilos.

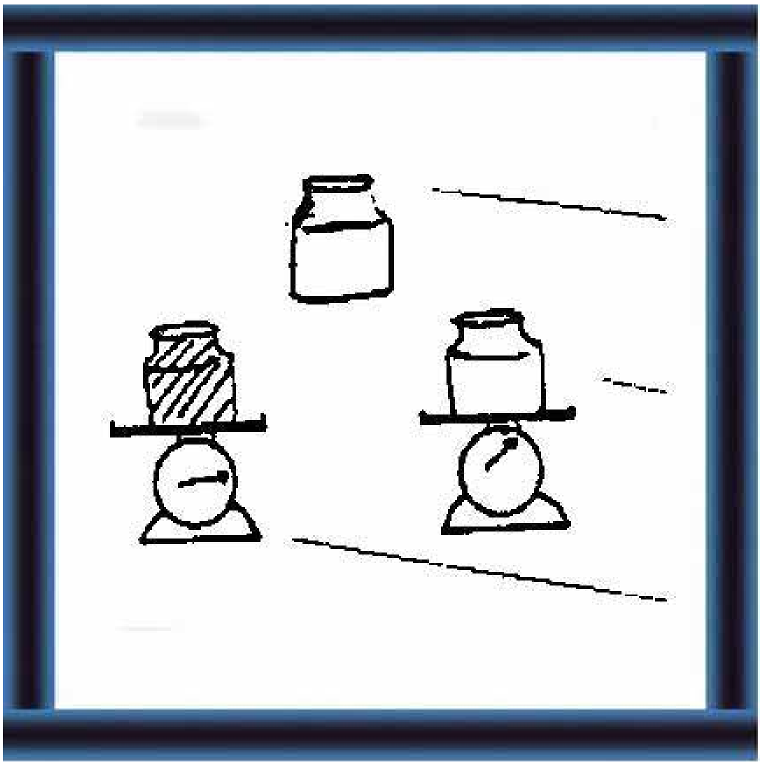
2. Gravimetric measurement (kilos/pounds)

The most common method for measuring milk from farmers is the gravimetric method. A wide variety of weighing machines and scales are used for this purpose.

Small cooperative societies usually use a spring balance. This is not completely reliable and can easily give wrong readings. Frequent adjustments even on the same day may be necessary. As all farmers are treated equally and have their milk quantities weighed by the same scale, this method is good enough in the early stages of dairy development. Later on, better weighing equipment is necessary. Milk reception plants normally have suitable weighing scales, weighing exactly the quantities of milk received.

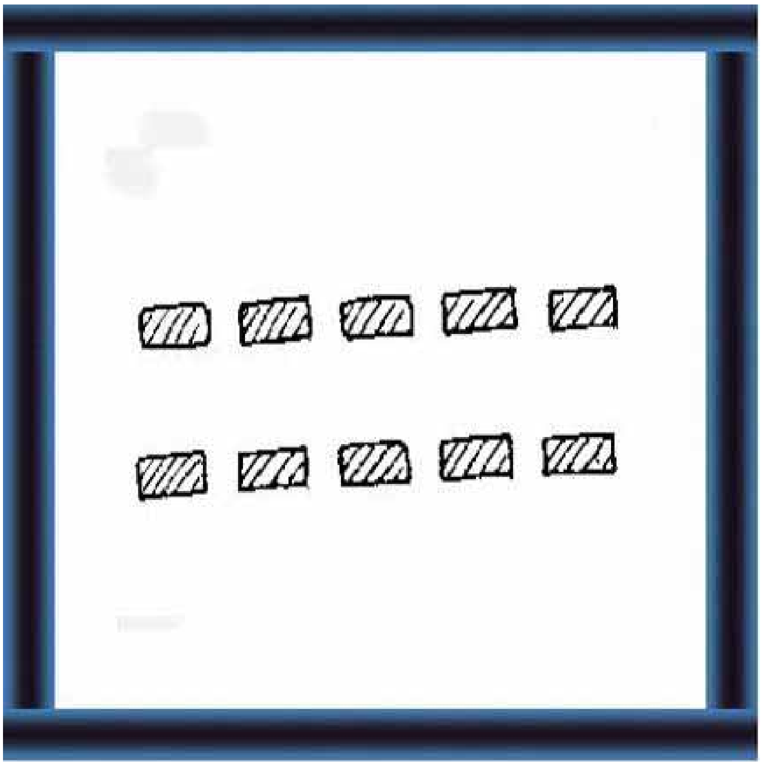
How does the dairy pay for quantity?

7 If your milk is high quality the dairy pays you for the **quantity** you deliver.



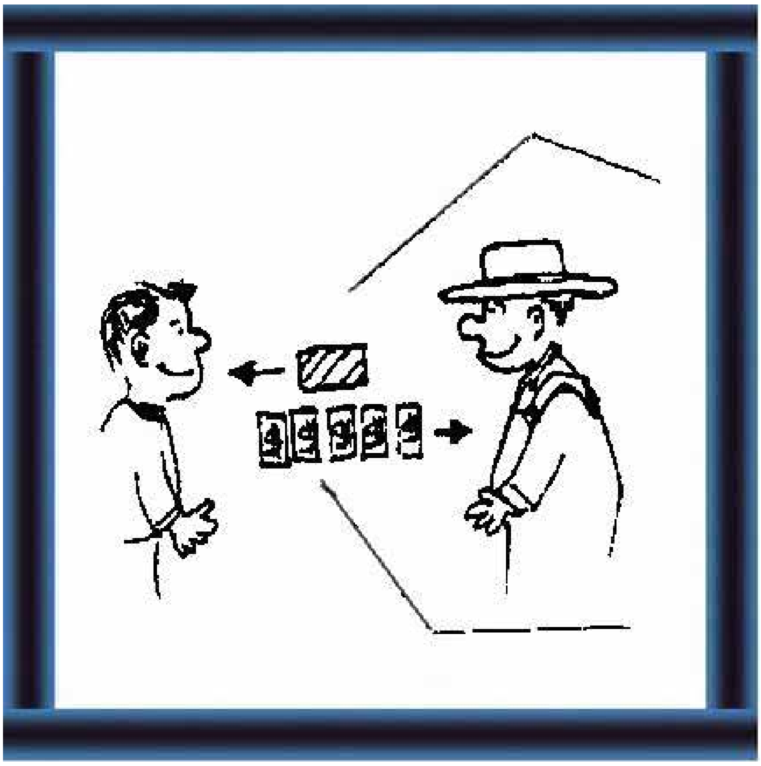
8 This farmer's milk can contains about **10 L.**

Full of milk it weighs 12 kg.
Empty, it weighs 2 kg.



9 The **quantity** of milk is

12 - 2 **= 10 kg**



10 For **each kg** of high quality milk he receives **5 mu.**

Therefore, for 10 kg he receives:
10 x 5 **= 50 mu**

In the following methods, 2 farmers delivering similar amounts of milk with differing composition and microbiological quality are paid according to different payment methods.

INFORMATION **METHODS**
(see descriptions below)

		1 to 6A	6B
Farmer 1	**:100 kg milk 6 % fat**	**1st class**	**3rd class**
Farmer 2	**:100 kg milk 3 % fat**	**3rd class**	**1st class**

Price **: Butter price : 60 mu/kg**
Fat consumption : 85 fu/kg of butter

(fat units)

Skim milk price : 2 mu/kg
Whole milk price : 5 mu/kg
Premium for 1st class milk : 1 mu/kg
Deduction of 3rd class milk : 1 mu/kg

Fat price : $\dfrac{\text{Butter price x 100}}{\text{Fat consumption}}$ = **Fat price**

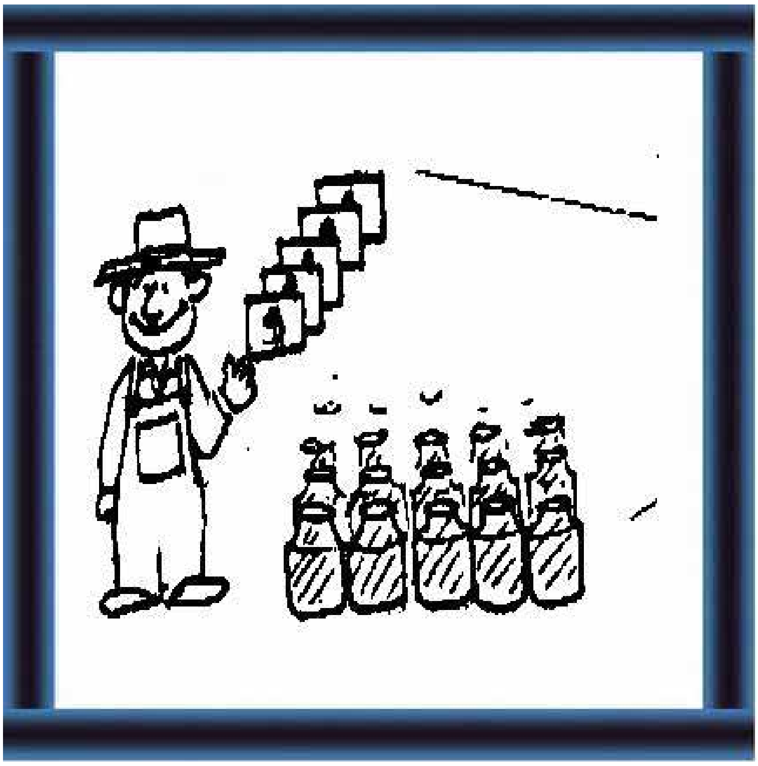
: $\dfrac{60 \times 100}{85} = 70.5 = 70$ **mu/kg**

1st Method: Payment according to quantity

Farmer No.	Kg milk	mu/ kg	Total price
1	100	5	500
2	100	5	500
Total	200	10	1000

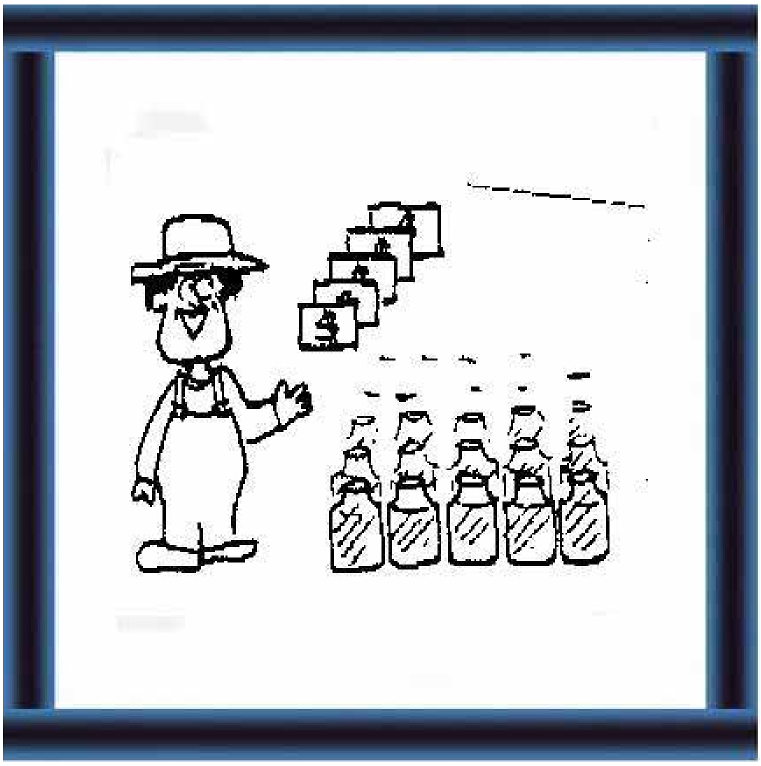
Example

11 Two farmers produce 100 kg of milk each. If the dairy pays them by **quantity only,** they get the **same** money.



100 kg milk @ 5 mu/kg

= 500 mu

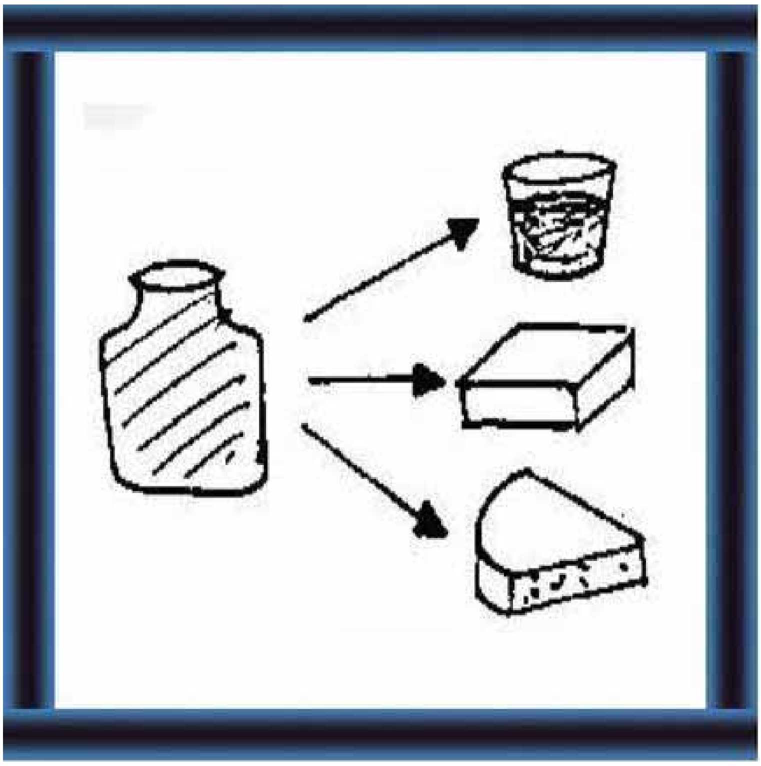


100 kg milk @ 5 mu/kg

= 500mu

How does the dairy pay for quality?

They use fat for making cream, butter, cheese and other products.



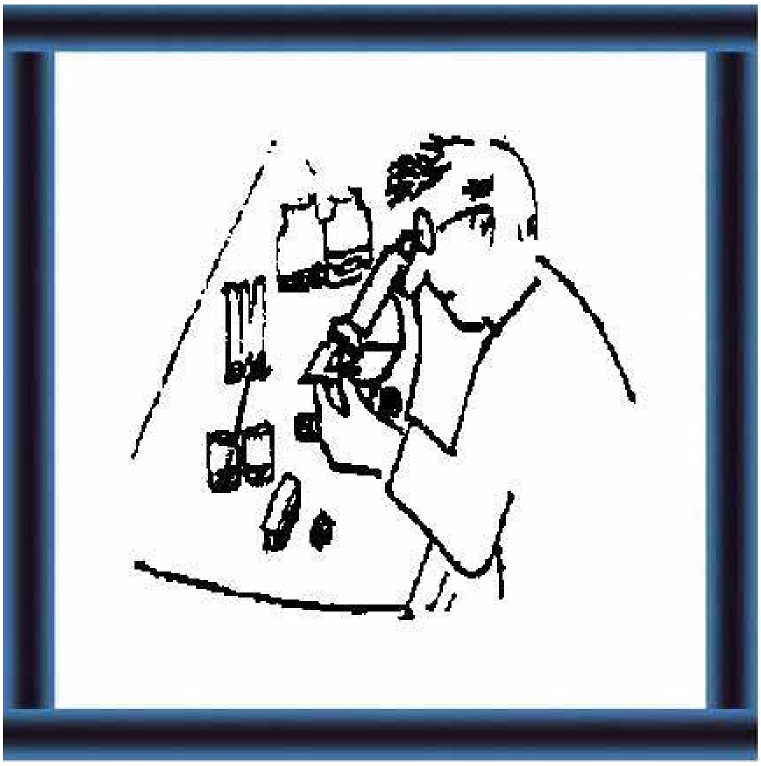
12

The dairy pays according to **three** kinds of quality.

Composition
The dairy pays you for the **fat** in your milk.

Physical appearance

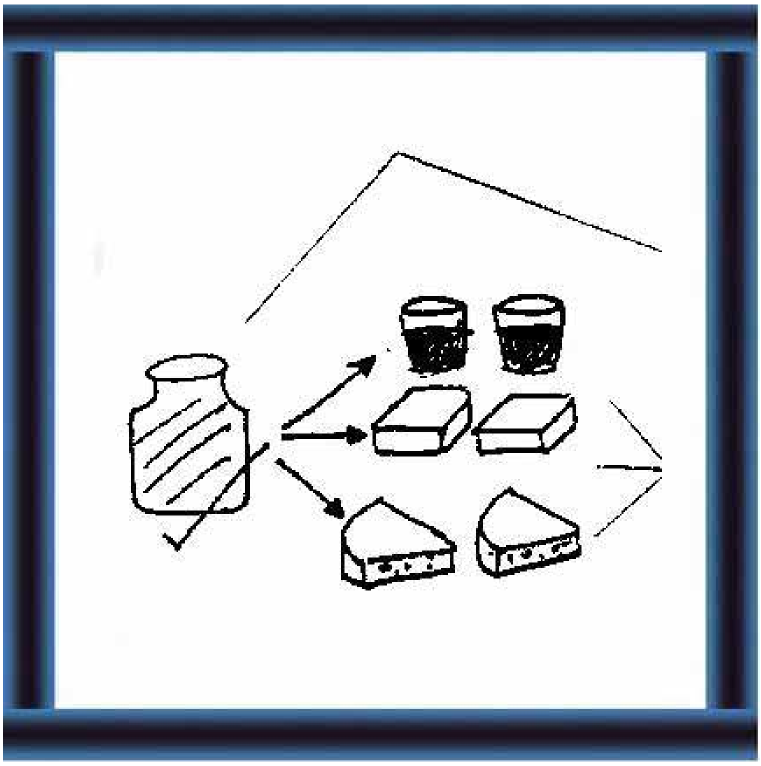
13 The dairy pays you more for milk which has a **good** appearance and **taste.**



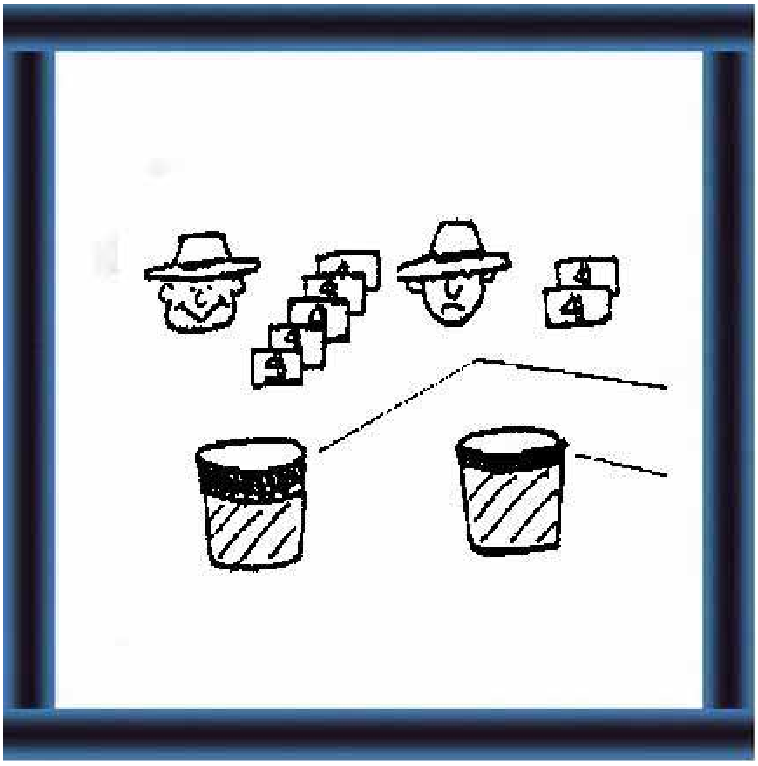
Cleanliness

14 The dairy pays you more for milk which is **clean** and contains **few** bacteria.

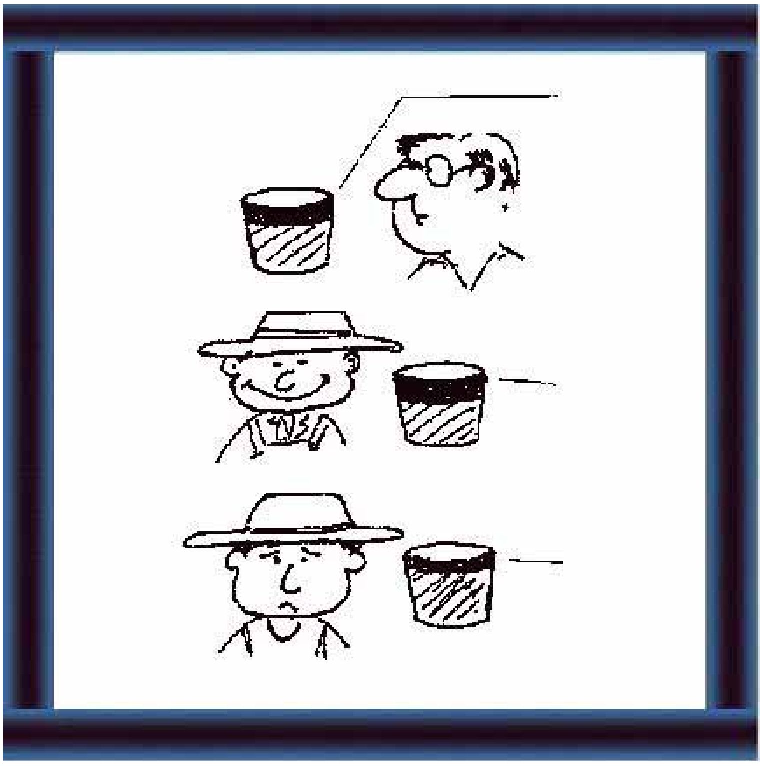
How does the dairy pay for composition quality?



15 If your milk has **high fat** content the dairy can make more milk products.



16 The dairy pays **more** for milk with **high fat content** than for milk with **low fat content.**

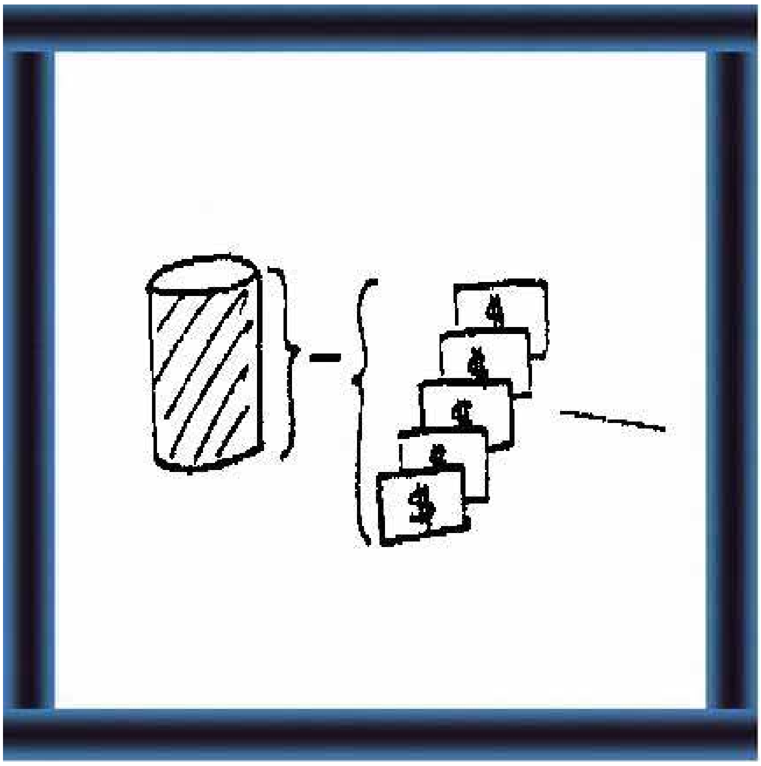


17 The dairy may set a **minimum fat content** e.g. 3 % fat.

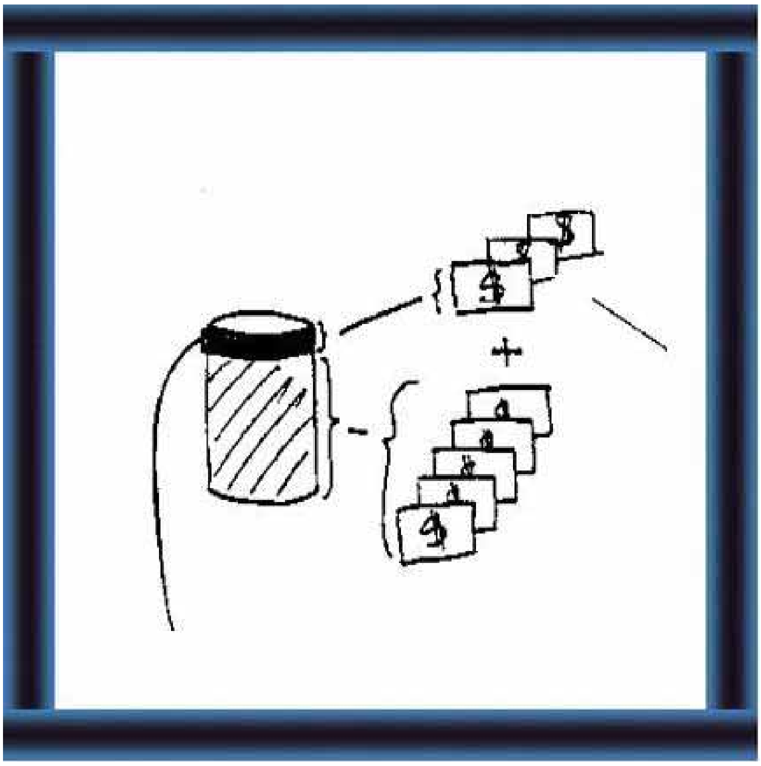
If the fat content is **above the standard** you get **more money.**

If the fat content is **below the standard** you get **less money.**

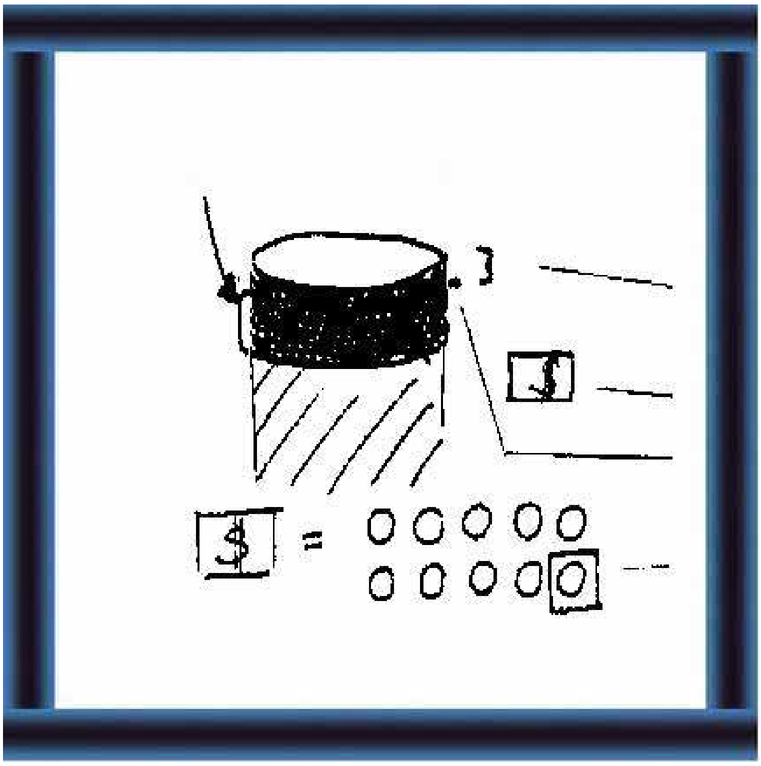
Here is an example from one country



18 This farmer receives 5 mu/kg milk.

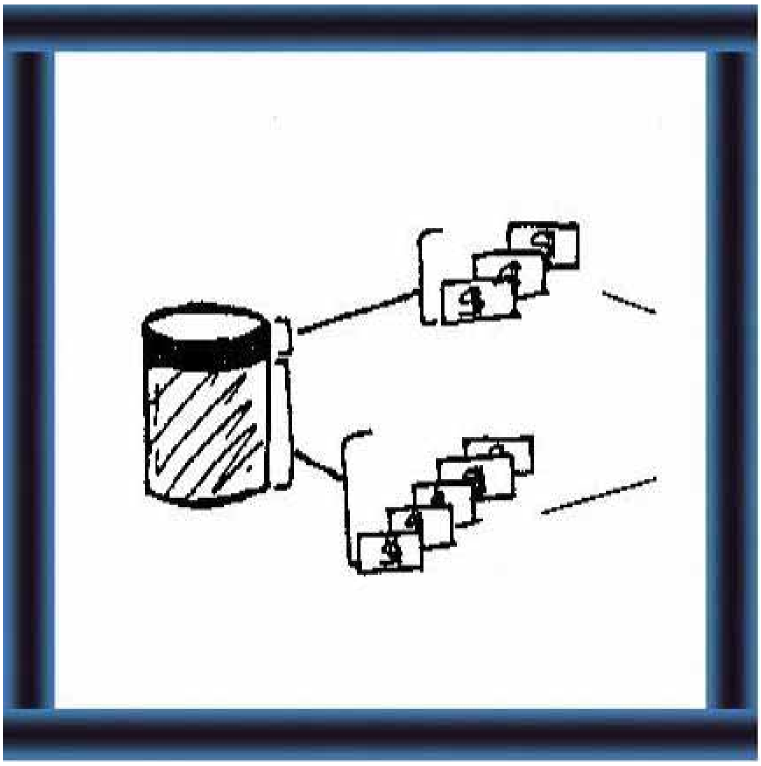


19 For the minimum of 3 % fat, he receives **3 mu/kg milk.**



20 For each 1 % **of fat** over the 3 % minimum, he receives **1mu.**

For **each 0.1 % fat** over the 3 % minimum he receives **$^{1}/_{10}$ mu.**

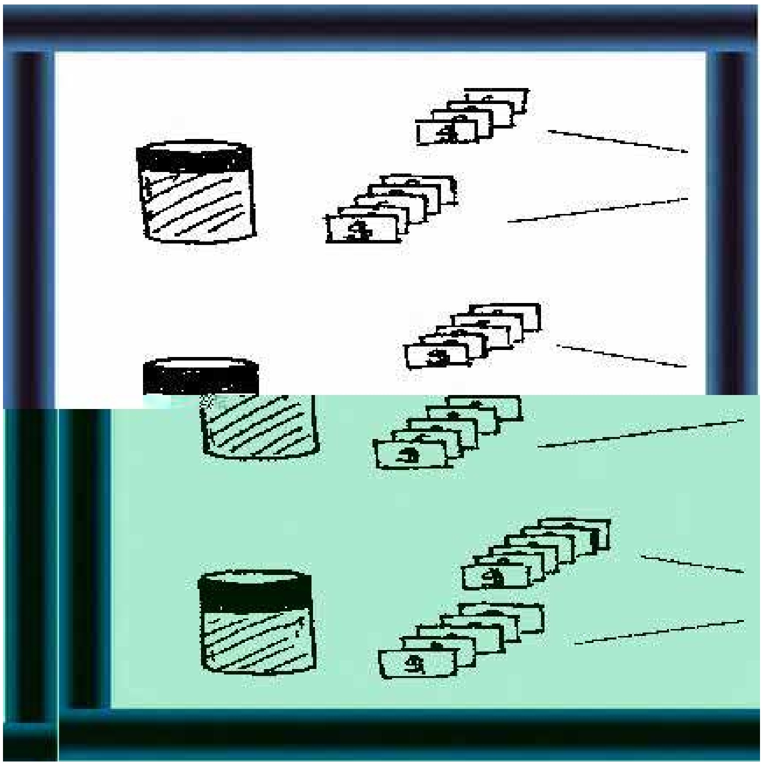


21

For 3 % **fat milk,** he receives:
3 mu for the fat

5 mu for the milk

= **8 mu**



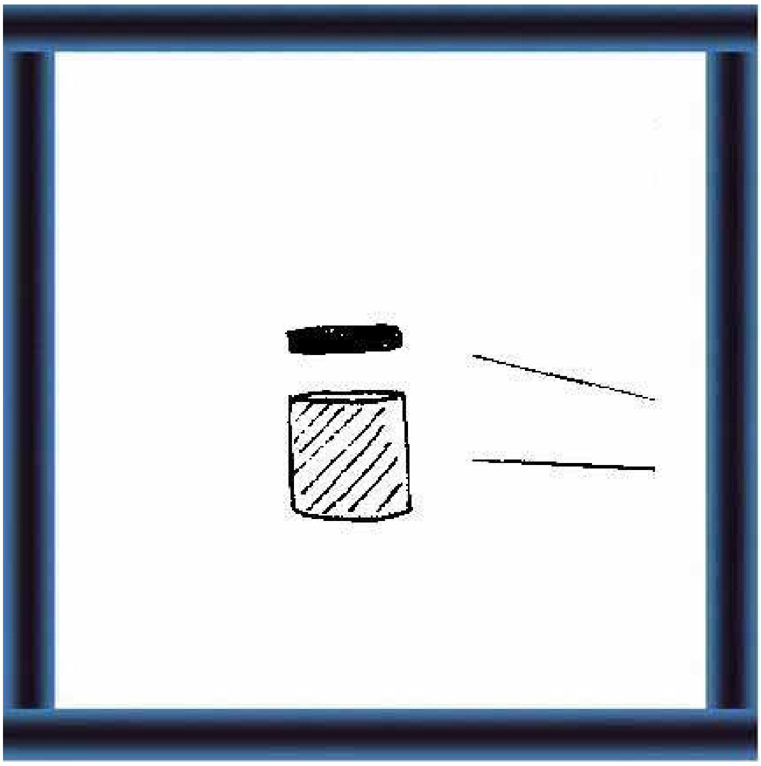
22

For 4 % fat, he receives:
4 mufor the fat
5 mu for the milk = **9 mu**
For 5 % fat, he receives:
5 mu for the fat
5 mu for the milk = **10 mu**
For 6 % fat, he receives:
6 mu for the fat
5 mu for the milk = **11 mu**

More fat gives more money.

Example:

These two farmers produce 100 kg milk each. The dairy pays them by **quantity** and **composition.**



23 The dairy pays

70 mu/kg for fat and

2 mu/kg for skim milk.

2nd Method: Payment according to quantity and composition. Fat paid according to the above information and skim milk according to skim milk supplied

Farmer	Kg milk	Fat %	Fat units (fu)	Kg fat	Fat price (mu)	Fat pay	Kg skim left	Skim price (mu)	Skim pay (mu)	Total pay (mu)
1	100	6.0	60	6.0	70	420	94	2.0	188	608
2	100	3.0	30	3.0	70	210	97	2.0	194	404

3rd Method: Payment according to quantity and composition. Fat paid according to the above information and skim milk according to whole milk supplied

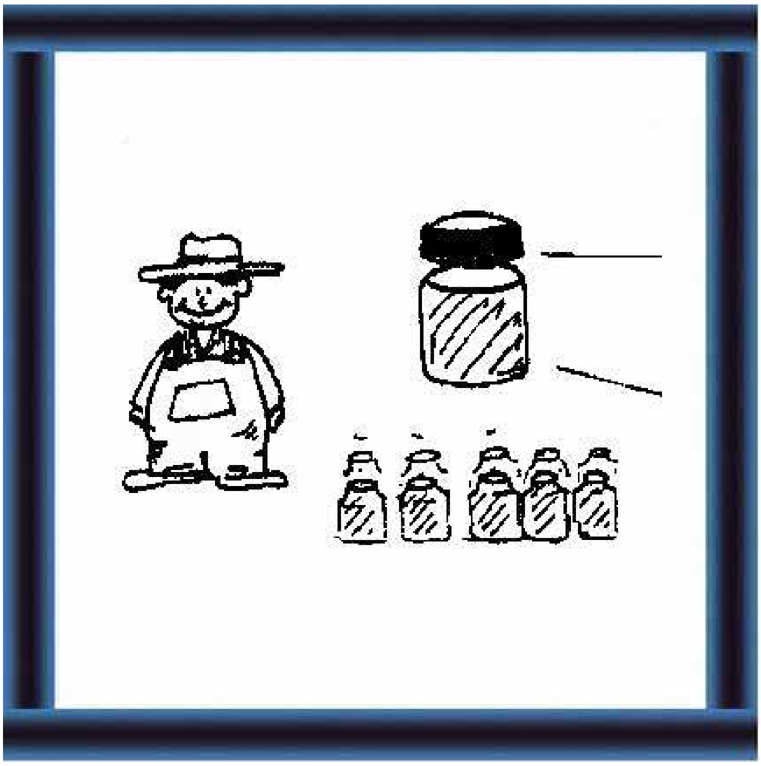
Farme	Kg milk	Fat %	Fat units (mu)	Kg fat	Fat price (mu)	Fat pay	Skim price (mu)	Skim pay (mu)	Total pay (mu)
1	100	6.0	600	6.0	70	420	2.0	200	620
2	100	3.0	300	3.0	70	210	2.0	200	410

4th Method: Payment according to quantity and composition. Fat paid according to the above information and skim milk according to whole milk supplied

	1 kg 6 % milk	1 kg 3 % milk
Fat pay (mu)	4.2	2.1
Skim milk pay (mu)	2.0	2.0
Total price (mu)	6.2	4.1

Farmer	Milk Kg	Fat %	Price/kg (mu)	Total pay (mu)
1	100	6.0	6.2	620
2	100	3.0	4.1	410

Farmer with 6 % fat milk:



24
6 % fat
so 100 kg of milk contains
6 kg fat @ 70 mu/kg = **420 mu**
+
94 % skim milk
so 100 kg of milk contains
94 kg skim milk @
2 mu/kg = **188 mu**

The dairy pays him
for 100 kg milk. **608 mu**

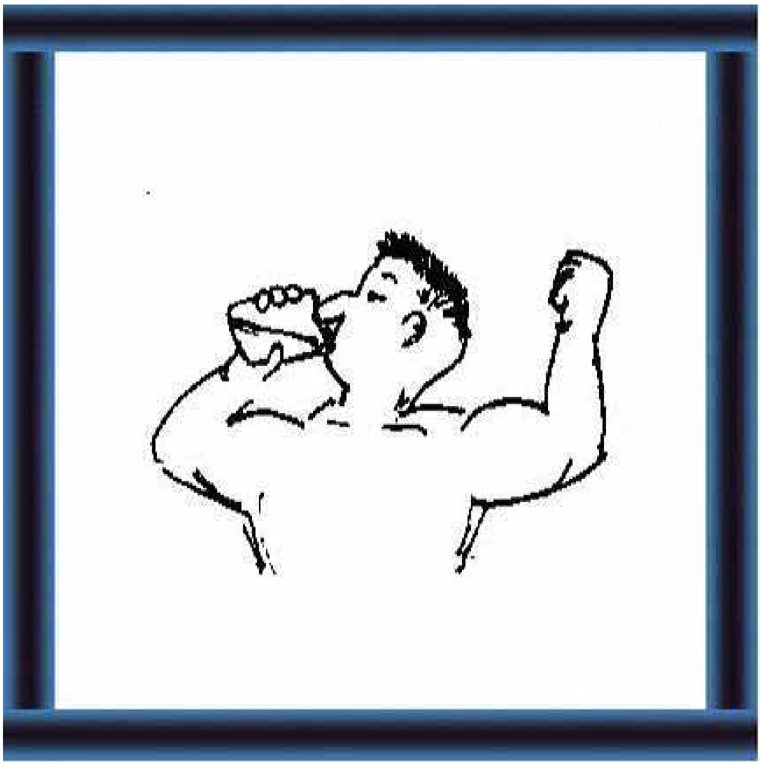
Farmer with 3 % fat milk

25
3 % fat
so 100 kg of milk contains3
kg of fat @
70 mu/kg = **210mu**
+
97 % skim milk
so 100 kg of milk contains 97
kg of skim milk @
2 mu/kg = **194mu**

The dairy pays him
for 100 kg of milk **404mu**

The density of milk normally varies between 1.028 and 1.034 kilos per litre, but it is wise to test the density locally over a period to find the correct conversion value for that particular area.

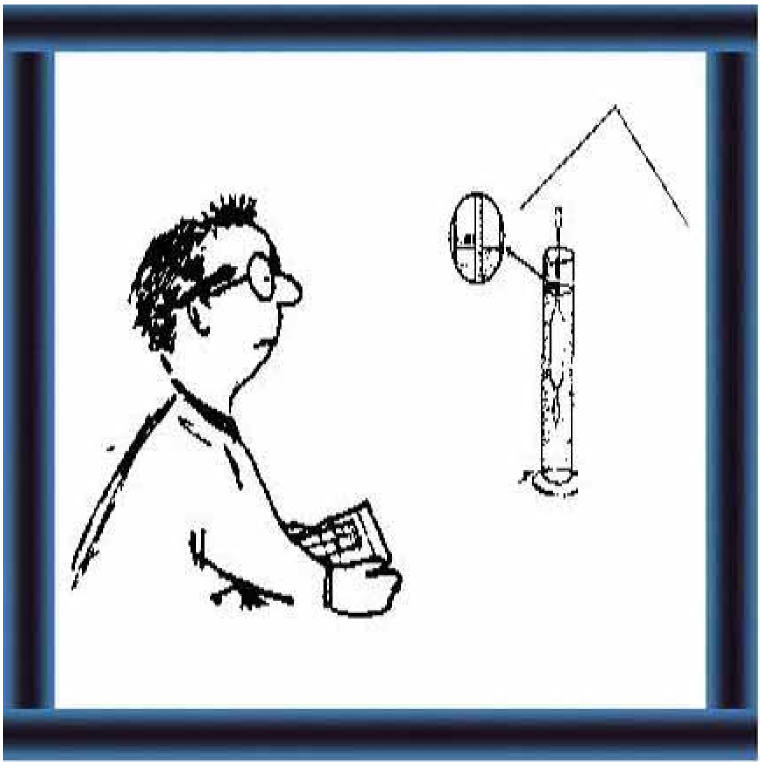
The density depends on the content of water, fat and dry matter. If fat is removed from the milk the density will go up. If the milk contains extraneous water the density will go down. This fact can be used as an indicator for adulteration.



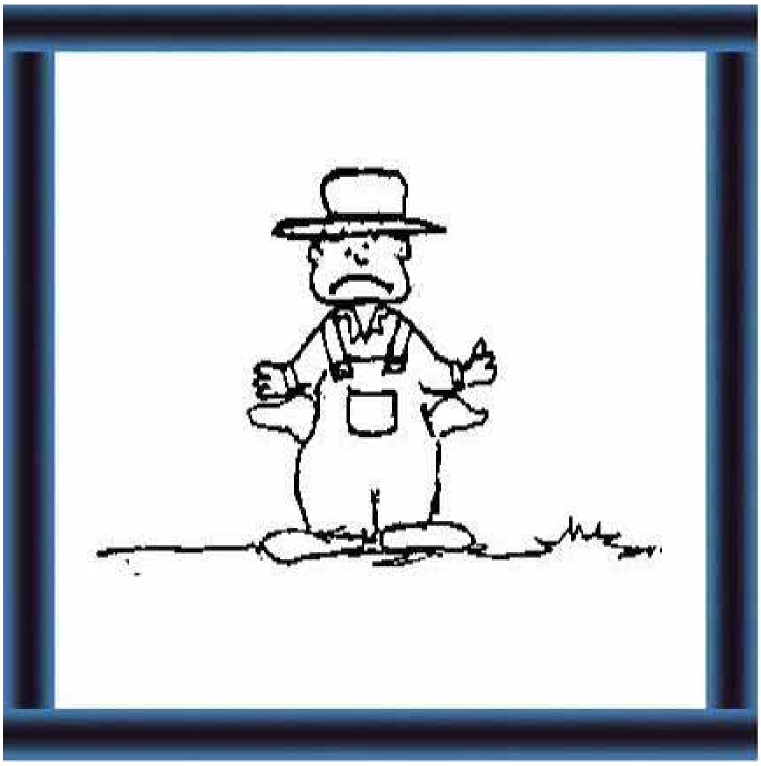
26 Milk also contains protein which makes your body strong.

Some modern dairies pay according to the protein content of the milk.

27 Never add anything to your milk.

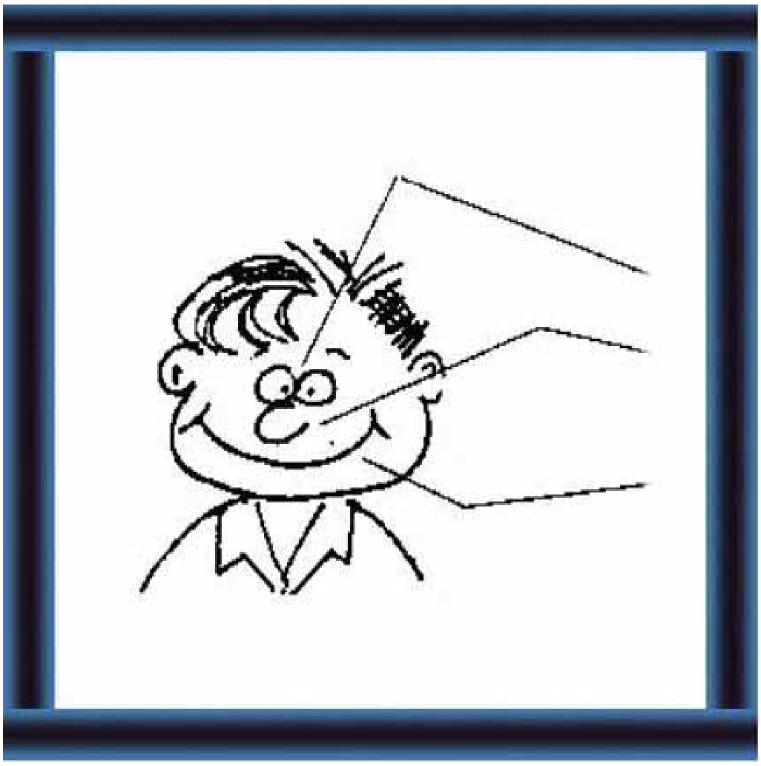


28 The dairy will check the density of your milk.



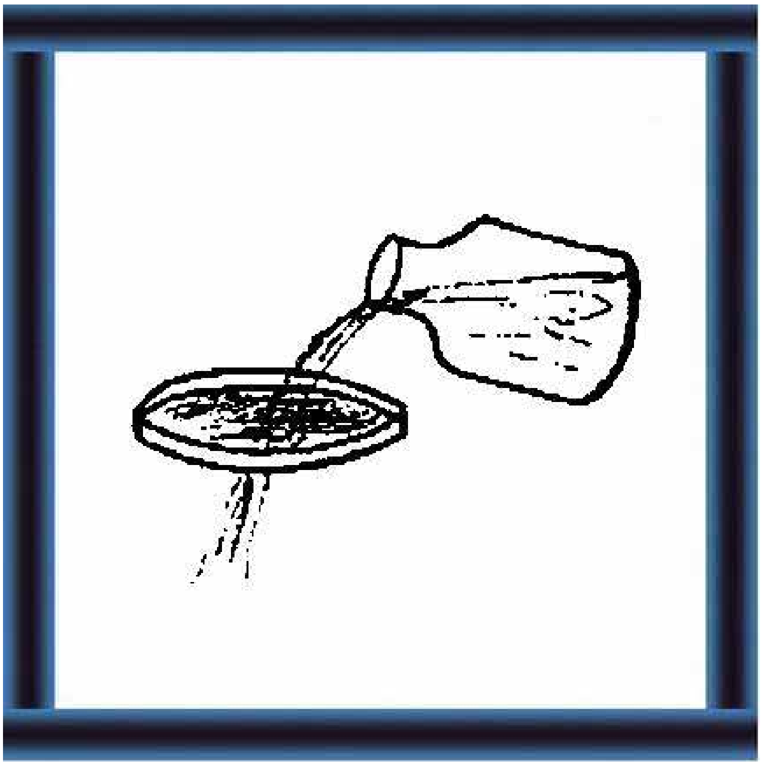
29 If it is not correct, you will get less or no money for your milk.

How does the dairy pay for physical quality and hygiene?



30 The dairy will grade your milk in the following way:
- colour
- smell
- taste.

Your milk should look, smell and taste **good.**



31 Dirt

There should be no dirt.

32 Bacteria Count**.**

Cell count

The fewer bacteria and cells in your milk the better.

5th Method: Payment according to quantity and microbiological quality

Farmer	Milk kg	Price /kg	Total Price (mu)	Class	Deduct -ion kg	Premium kg	Pay (mu)	Total pay (mu)
1	100	5	500	1st	-	1	+100	600
2	100	5	500	3rd	1	-	-100	400

6th Method: Fixed kg price as Method 4 and microbiological quality

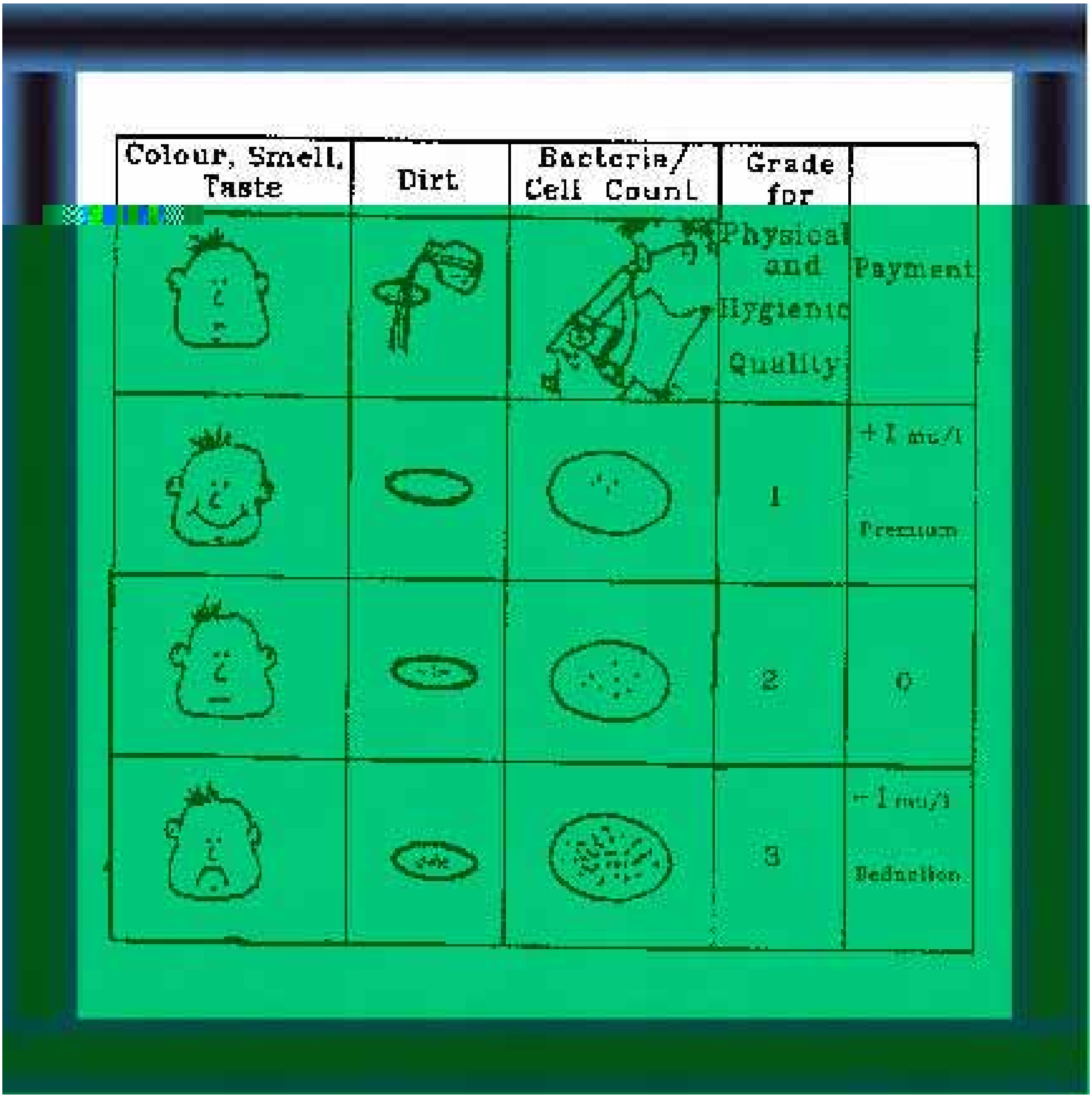
A: Farmer 1 1st class milk; Farmer 2 3rd class milk

Farmer	Milk kg	Fat %	Price /kg	Total Price (mu)	Class	Deduct -ion kg	Premium kg	Total pay (mu)
1	100	6.0	6.2	620	1st	-	100	720
2	100	3.0	4.1	410	3rd	100	-	310

B: Farmer 1 3rd class milk; Farmer 2 1st class milk

Farmer	Milk kg	Fat %	Price /kg	Total Price (mu)	Class	Deduct - ion kg	Premium kg	Total pay (mu)
1	100	6.0	6.2	620	3rd	100	100	520
2	100	3.0	4.1	410	1st	-	100	510

33 The dairy puts the grades together and pays you **more** for milk with **high** physical and hygienic **quality.**



Colour, Smell, Taste	Dirt	Bacteria/ Cell Count	Grade for Physical and Hygienic Quality	Payment
			1	+1 mu/l Premium
			2	0
			3	-1 mu/l Reduction

In the above payment methods no expenditures, depreciation costs, bonuses, or other deductions are considered. Before paying the milk producer for his deliveries, it is very important, especially in a cooperative, to make these deductions. When the farmer is paid for his milk, it is very difficult to extract any funds from him to pay eventual overspending again.

7th Method: Fixed kg price including some general deductions

Item	100 kg 6 % milk	100 kg 3 % milk
Fat pay	420.0 +	210.0 +
Skim milk pay	200.0 = 620.0	200.0 = 410.0

Less

Expenditures and running costs	5.0 +	5.0 +
Depreciation of equipment and buildings	0.5 +	0.5 +
Deduction of bonus payment	1.5 +	1.5 +
Extension fund	5.0 +	5.0 +
Deduction for price pool	1.0--> **13.0**	1.0--> **13.0**
Milk price per 100 kg	**607.0**	**397.0**

Farmer	Milk kg	Fat %	Price / kg (mu)	Total Price (mu)	Class	Deduct -ion (mu)	Premium (mu)	Total pay (mu)
1	100	6.0	6.07	607	1st	-	100	707
2	100	3.0	3.97	397	3rd	100	-	297

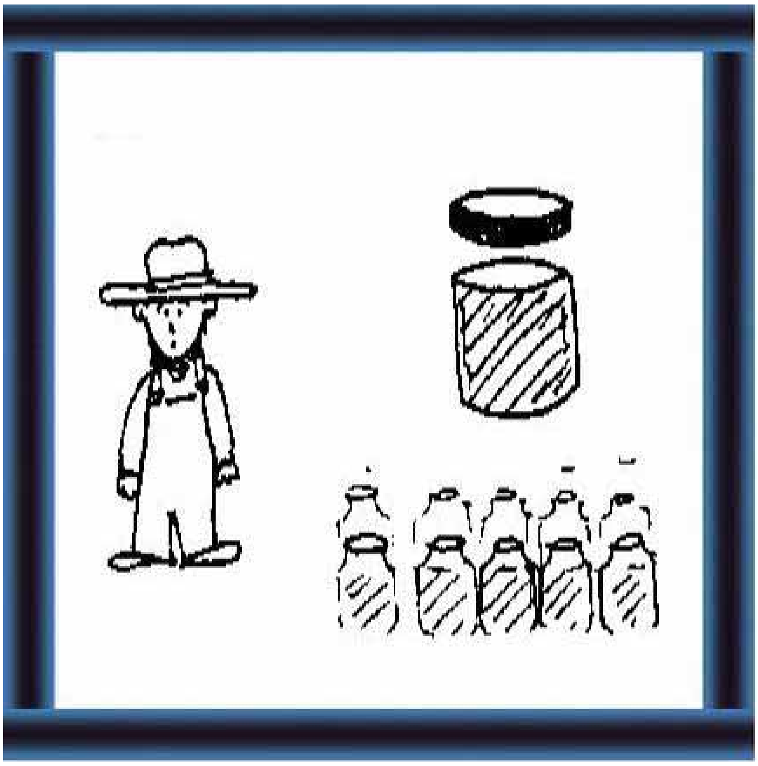
Example:

The dairy pays the two farmers for:
- **quantity and composition**
- **physical/hygienic quality**

34 Farmer with 6 % fat milk:

100 kg	6% Fat 94% skim milk 608 mu	+	Grade 1 100 mu premium

= 708 mu



35 Farmer with 3 % fat milk:

100 kg	3% Fat 97% skim milk 404 mu	+	Grade 3 100 mu deduction

= 304 mu

The first farmer gets **more than double** for the **same quantity** of milk because his milk has:
- **higher** compositional quality (fat content)
- **higher** physical and hygienic quality (cleaner, **fewer** bacteria).

What do you know about milk payment?

Payment for your milk

1. Payment according to milk quality	**(1-4, 6)**
2. Rejection of low quality milk	**(5)**

Payment for quantity

1 Payment according to quantity if quality high	**(7-10)**
2 Example	**(11)**

Payment for quality

1 Types of quality	**(12-14)**
2 Composition quality	
- Fat content	**(15-17)**
- Examples of payment according to fat content	**(18-25)**
- Protein content	**(26)**
- Adulteration	**(27-29)**
3 Physical quality and hygiene	
- Grading according to:	**(30)**
- colour	
- smell	
- taste	
- Dirt	**(31)**

- Bacteria/cell counts	**(32)**
- Overall grading	**(33)**
- Example	**(34-35)**

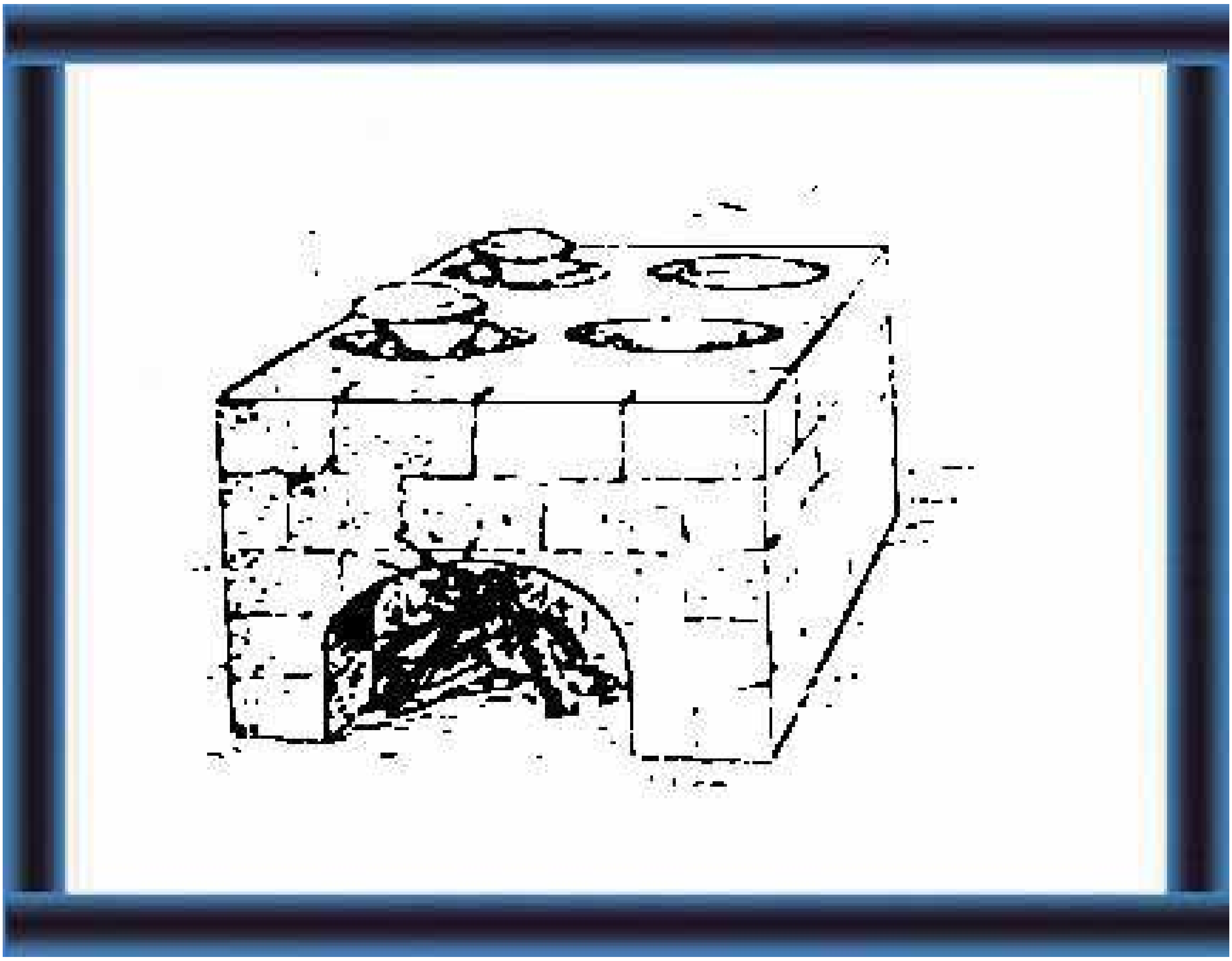
Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 9

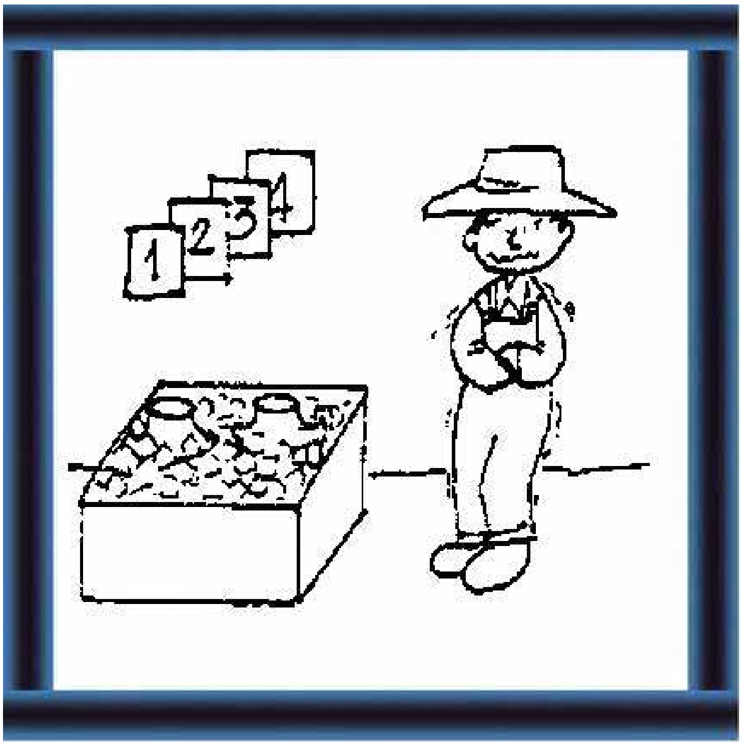
Milk Treatment



>Extension Materials

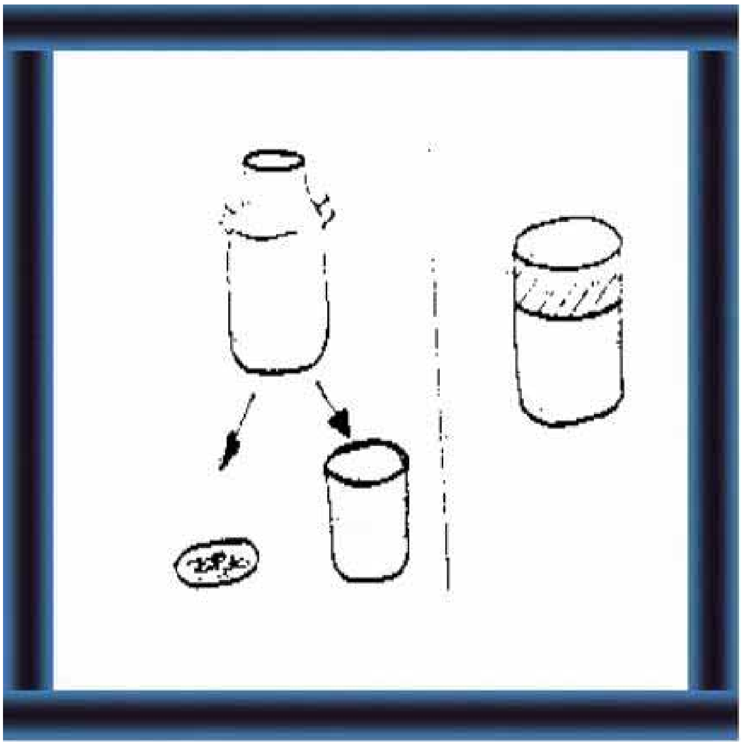
What should you know about milk treatment?

You should know about the four main methods:



1 **Cooling**

- to **store** the milk **longer** before further treatment (see T.4)



2 **Separation (5-8)**

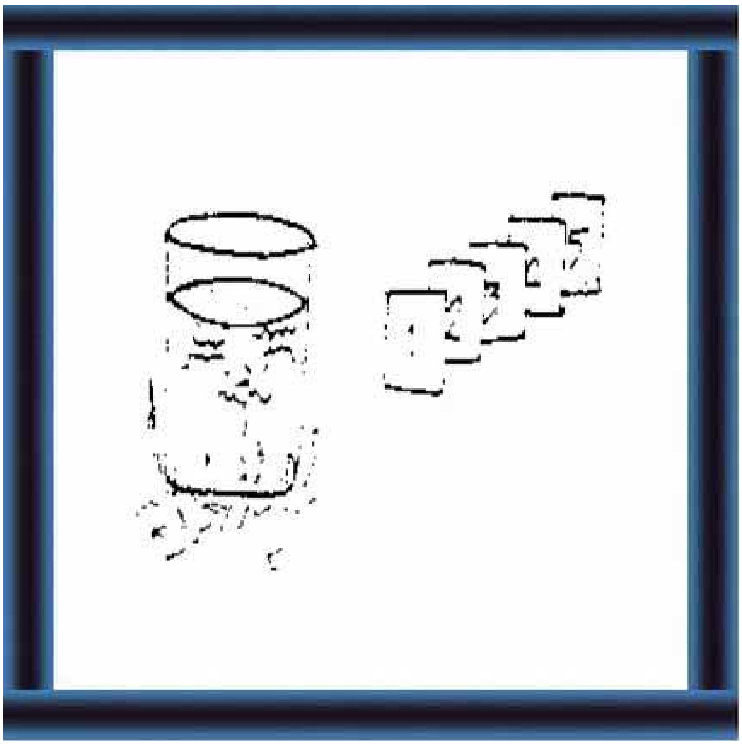
- to **remove dirt**

- to **separate** cream from skim milk.

3 **Standardization (9-21)**

- to obtain the **correct percentage** of **fat**

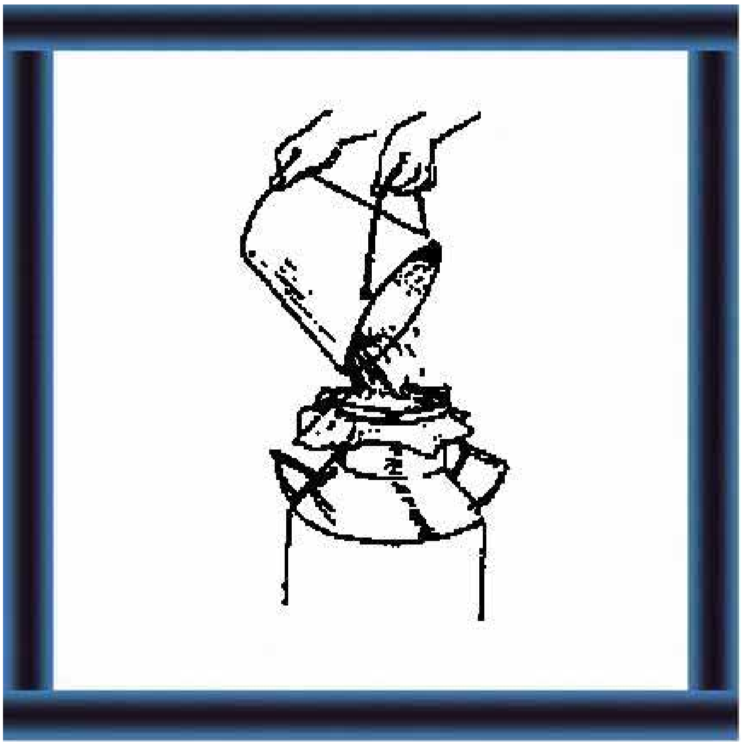
- to obtain the **correct percentage** of **total solids**.



4 **Heat treatment (22-42)**

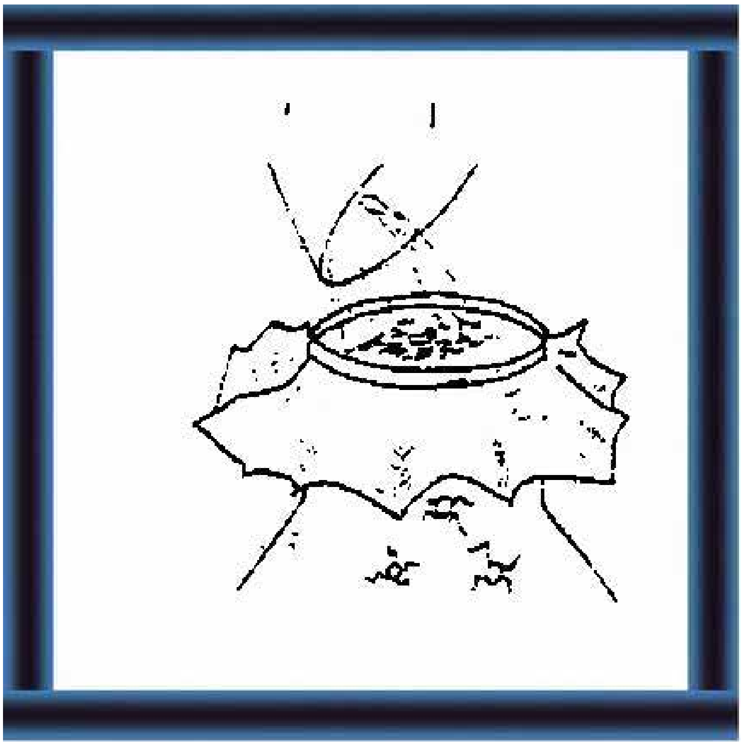
- to **kill bacteria** which spoil the milk (see 43-58 for large scale heat treatment).

How can you treat milk on a small scale?

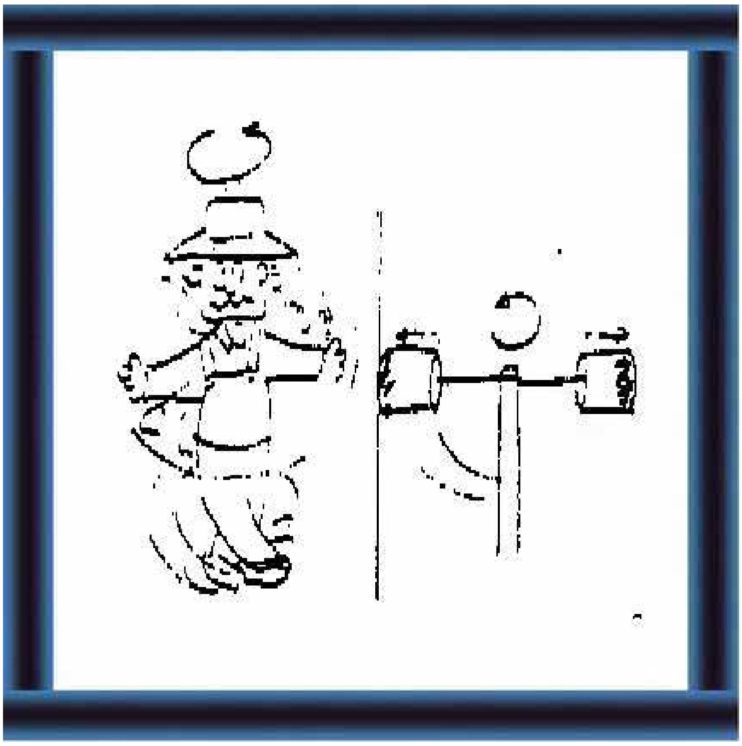


Separation

5 You can **filter** milk to remove **large dirt particles**



6 but more milk passes **through the dirt** and dissolves some of it and **carries bacteria** to the milk already filtered.

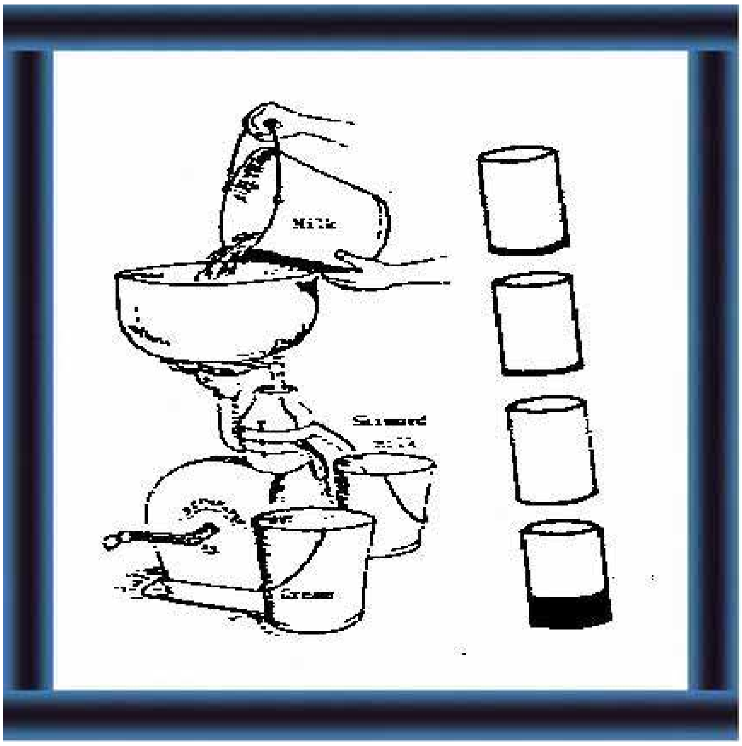


7 By using a **separator** you can separate cream from skim milk. **Heavier particles** (skim milk) move to the **outside**.

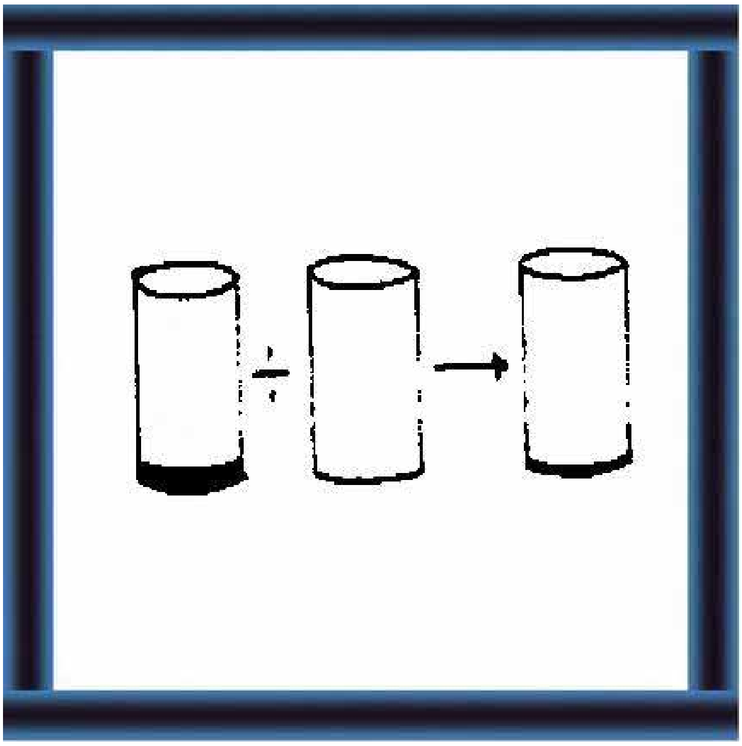
8 You can work this separator **by hand**.
It treats 60-200 l of milk per hour.

Standardization

What is standardization?



9 Standardization is a method of **controlling** the **fat content** of milk.
Whole milk has a fat content of **3-5 %** (buffalo milk may have 7-8 % fat).
Low-fat milk has a fat content of **1.5-1.8 %**.
Skim milk has **less than 0.1 % fat**.
Cream has **35-70 % fat**.

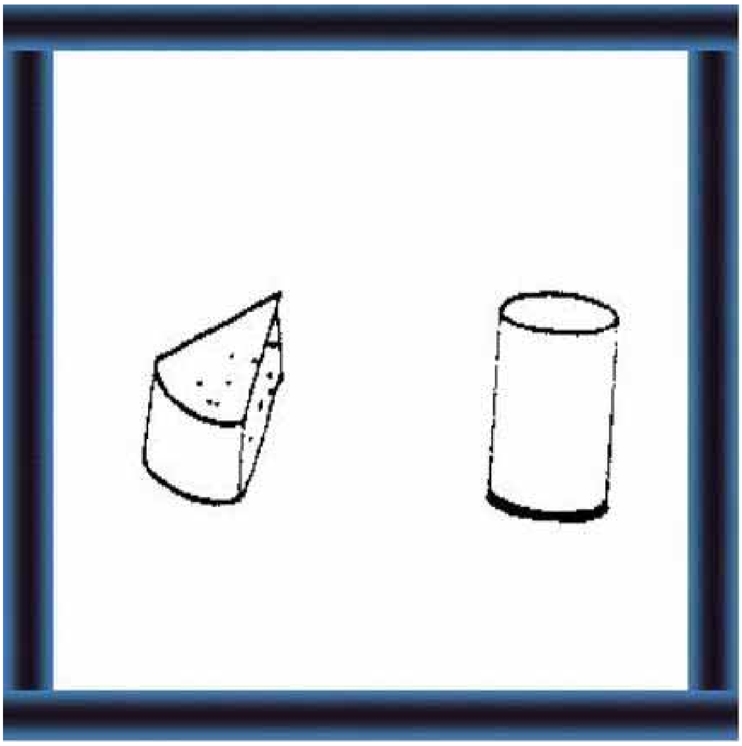


10 After separation, you can mix:

- whole milk with

- skim milk to get

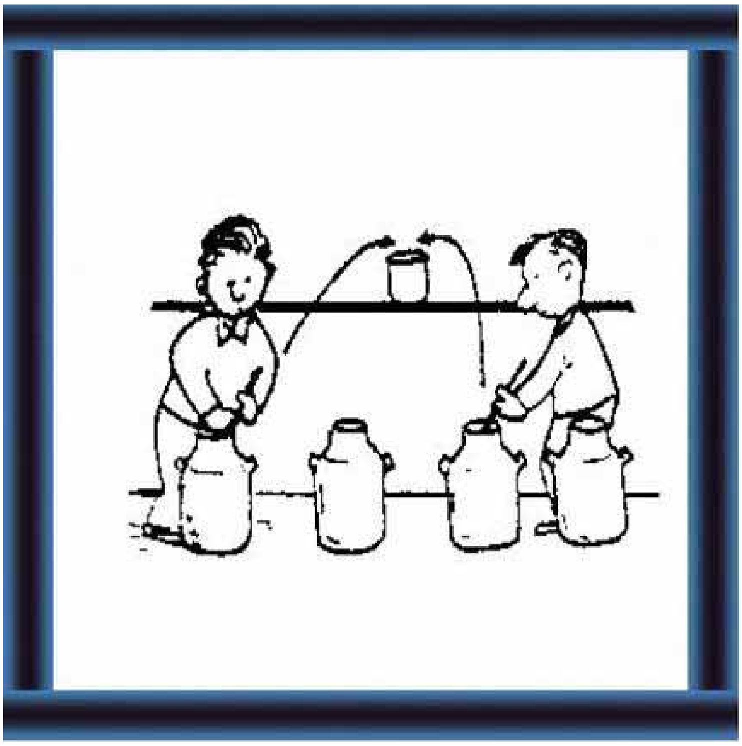
- milk with a fat content between 0-4 %.



11

For example, to make a certain cheese, you may need milk with a fat content of 2.6 % (see T 12 Standardization and Production Costs).

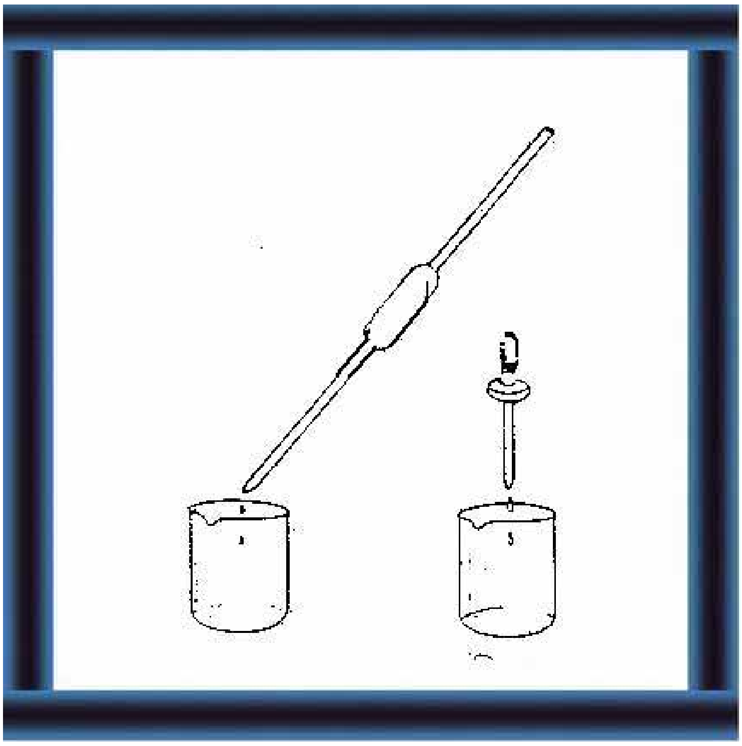
How do you sample and test milk for standardization on a small scale?



12 In milk reception, you weigh, filter, test the density of your milk.

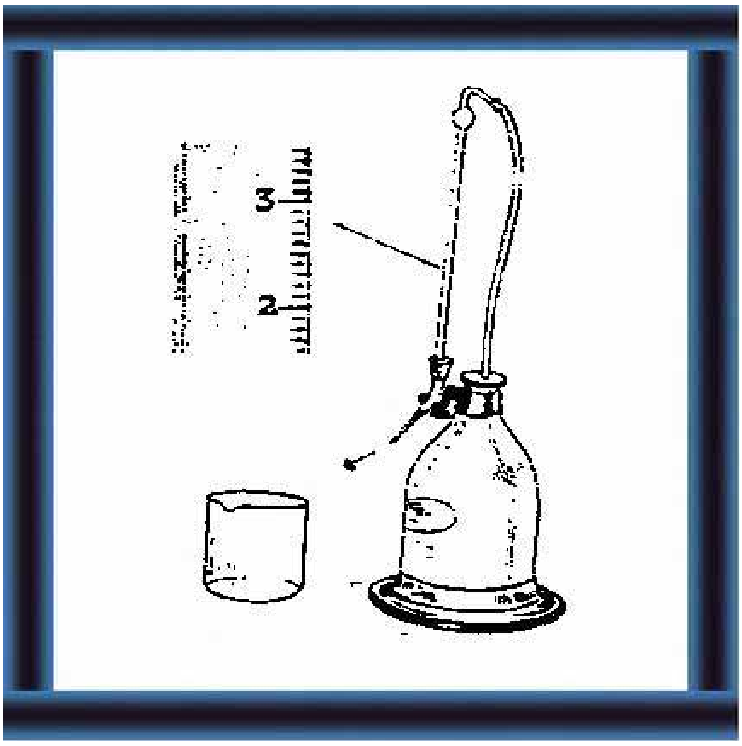
You may make other tests.

Then you take a **sample** of milk from **each can** and **mix together**.



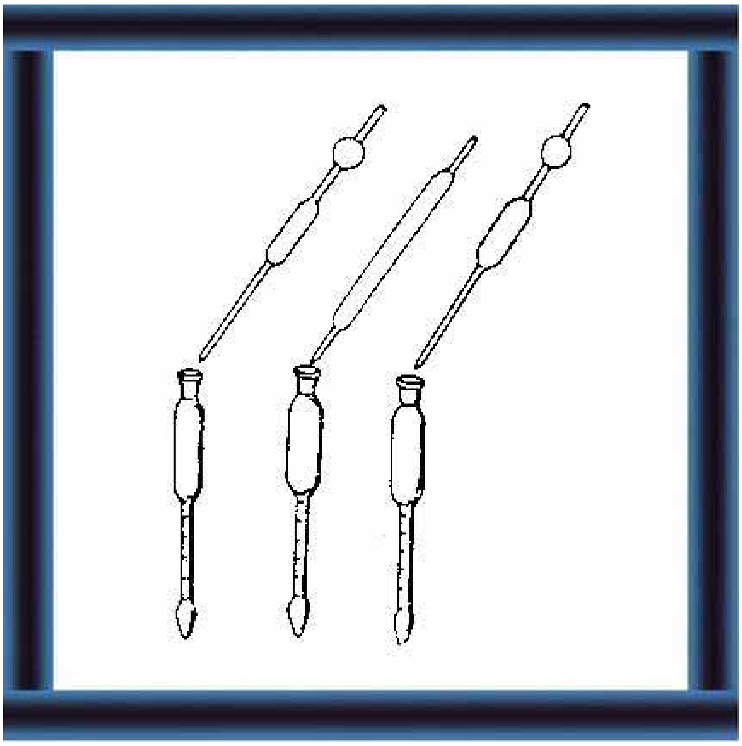
13 You test the mixed sample for **milk acidity**.

You:
- put **20 ml** of the **milk sample** into a glass with a pipette
- add **8-10 drops** of **phenolphthalein** with a dropper.

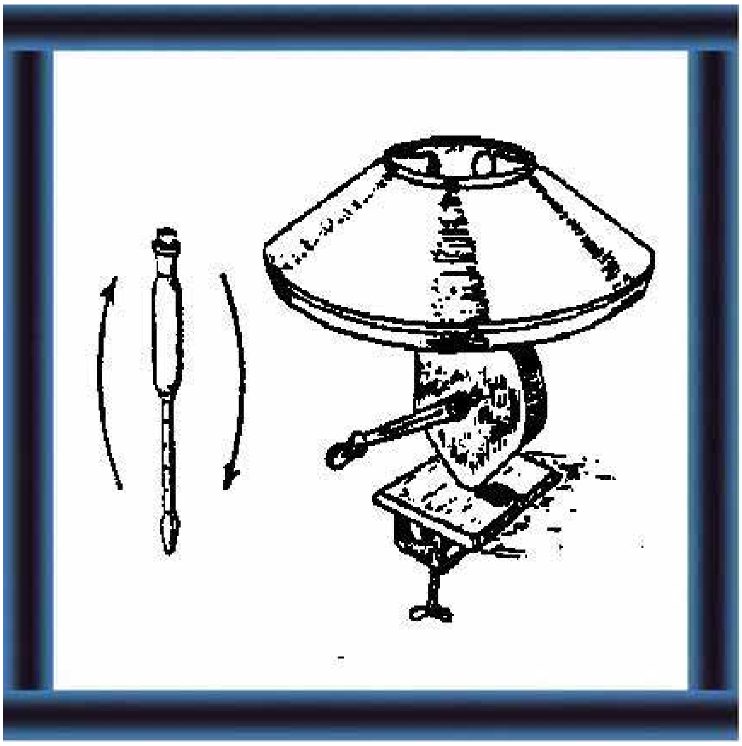


14 With the burette, you:
- add NaOH 0.1N solution drop by drop into the glass until the solution has a stable pink colour.

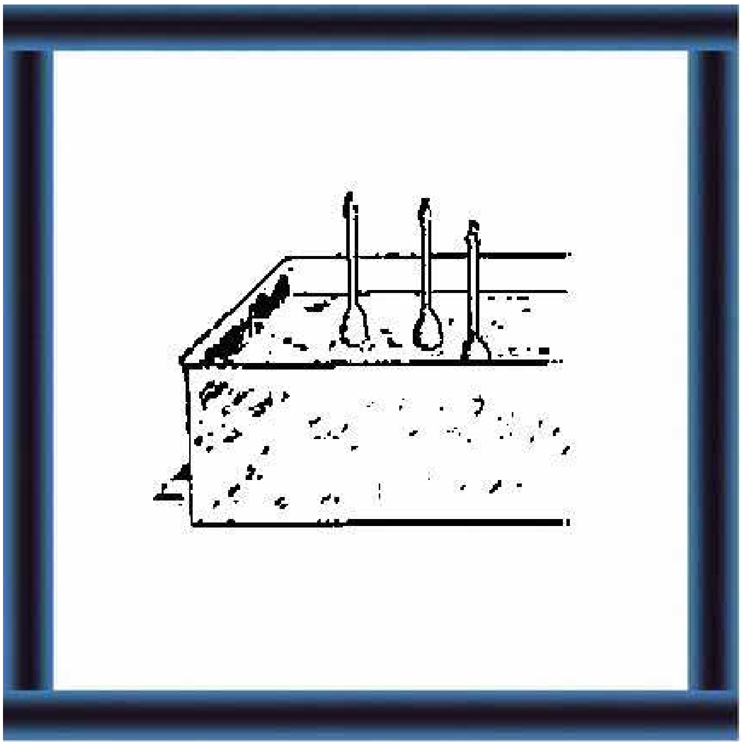
The number of 0.1N NaOH used is multiplied by 5 to give ml per 100 ml of milk.
Normal milk will have a value between 17 and 21 ml per 100 ml milk. If higher the milk is sour.



15 You also test the mixed sample for **fat content**.
You:
- put **10 ml** of **sulphuric acid** in the **butyrometer**
- add **11 ml** of **milk** from the **average sample**
- add **1 ml** of amyl **alcohol**

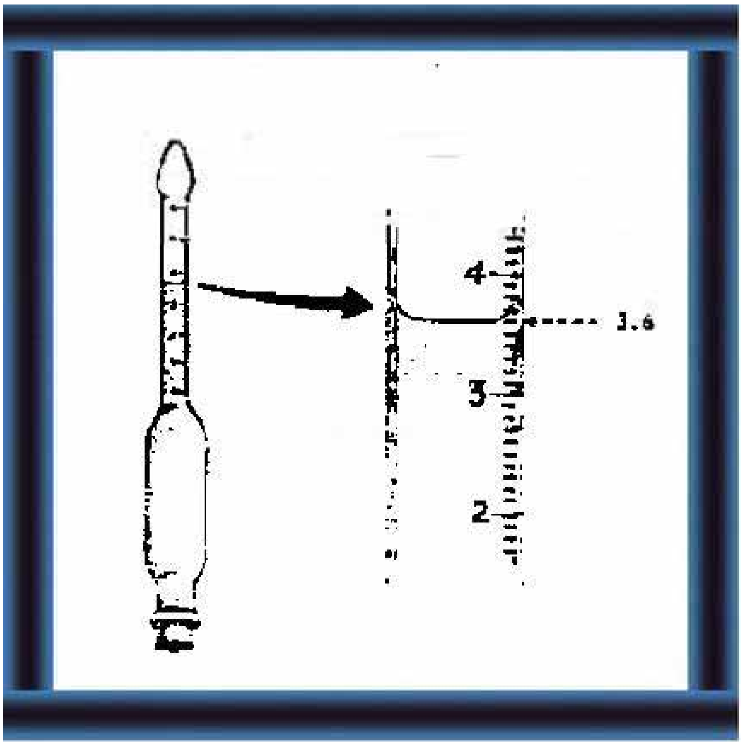


16 - **cork** the **butyrometer** and **shake well** to dissolve the milk elements (use a cloth to hold - hot!)
- put the butyrometer in the **centrifuge**
- centrifuge for **5 minutes**



17 - put the butyrometer **cork down** into a **water bath** (60 - 70 C)

- leave for **5 minutes**.



18 **Make sure**:

- the butyrometer is **vertical**

- You read at **eye level**.

The sample here contains **3.6 % fat**.

19 You record the results in a **milk analysis note book**:

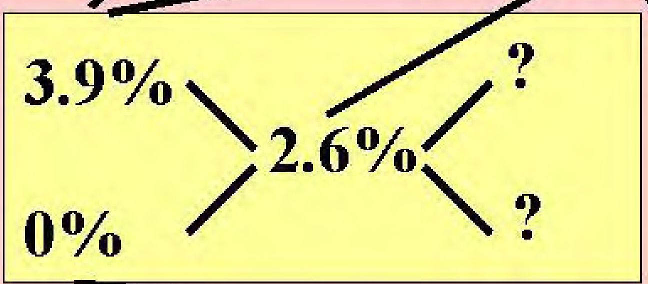
Date	Quantity of Milk Received	Acidity 0.1 N ml NaOH per 100 ml milk	Fat Content %	Obser-vation
12February	385	22	3.6	-
13 February	405	21	3.7	-
14 February	395	21	3.6	-
15 February	372	20	3.8	-
16 February	387	20	3.7	-
17 February	384	21	3.9	-

How do you calculate the quantities for standardization?

Suppose, to make Edam cheese, you need milk with a fat content of 2.6 %.

16 You can use the Pearson Square method.

Write down the fat contents of:



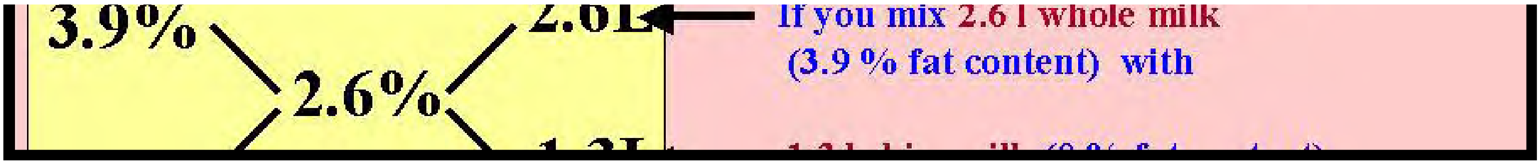
Your whole milk

The milk you want

skimmilk

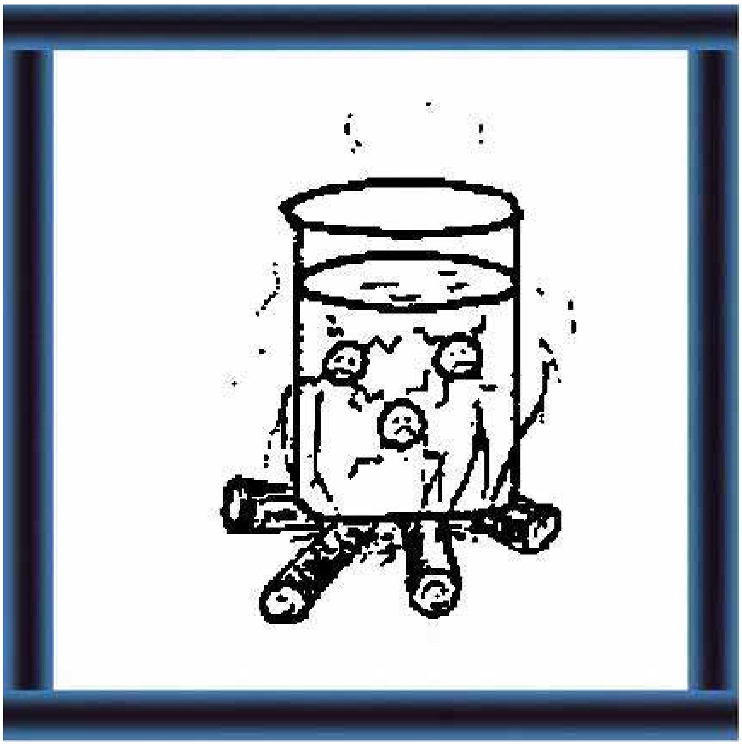
17 Subtract along the diagonals.

If you mix 2.6 l whole milk



Small scale heat treatment

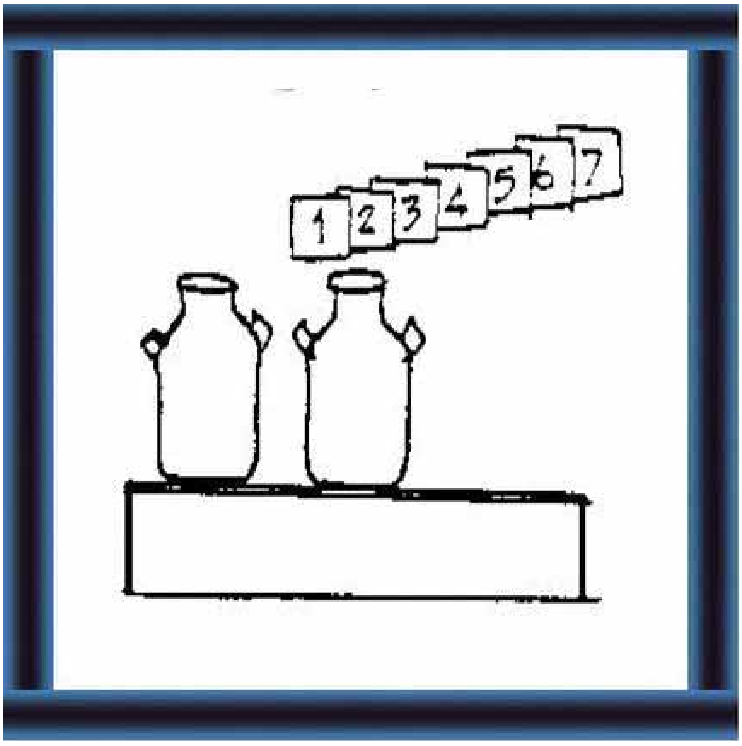
Why heat milk?



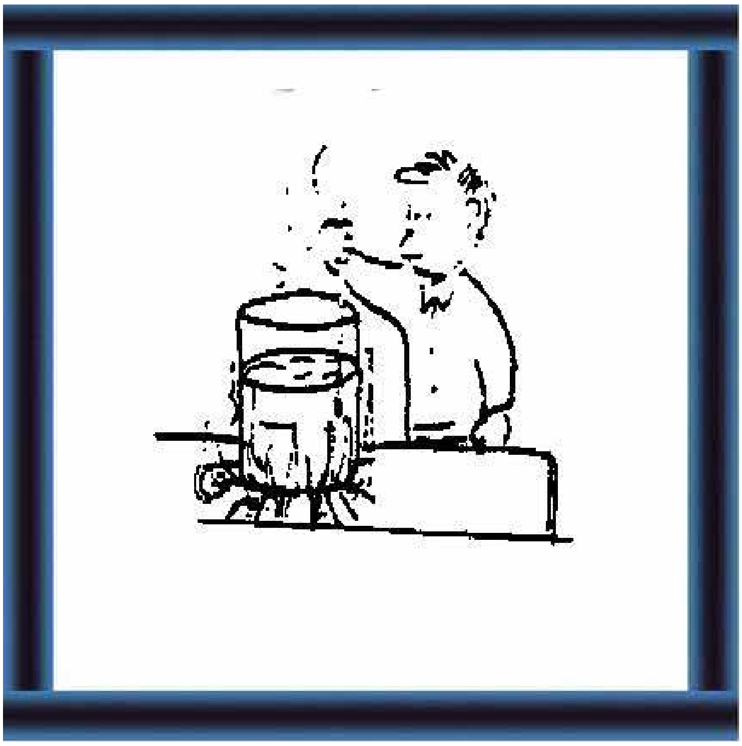
22 **Heating** milk **kills** most **bacteria** and other **micro-organisms**.

Pasteurization is heating with **controlled temperature** and **time**.

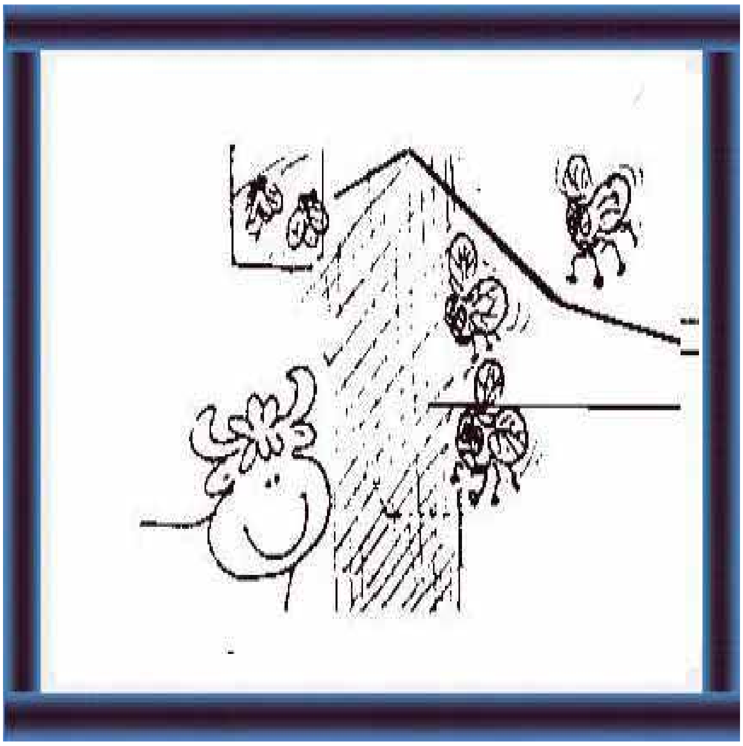
There are different combinations of temperature and time.



23 After you **cool** the milk you can **keep it longer**.



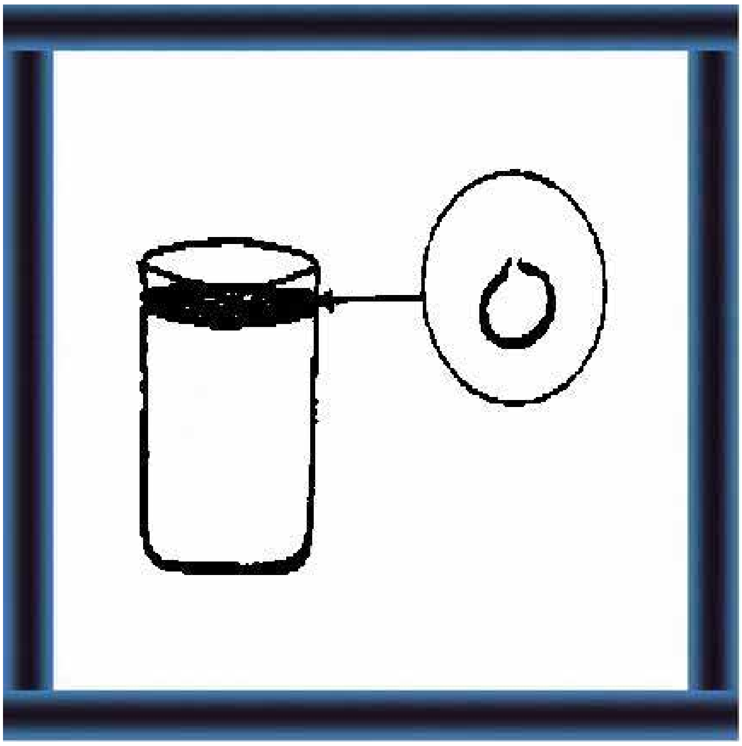
Important
24 Use a **thermometer** to heat to the **correct temperature**.
For **small scale processing**, heat to **65 C** and keep for **30 minutes**.
Stir the milk **regularly** to keep **even temperature throughout** the milk.



25 **Never drink milk which has not been heated**.

It can make you **sick**.

What are the effects of heat treatment on milk?



Fat

26 Only **high** temperatures change fat, but pasteurization **melts fat** so that rough treatment easily **breaks** the **membrane**. Then, **enzymes** can **oxidize** the **fat**.

Proteins and enzymes

27 If milk is **good quality**, **normal** pasteurization:
- does n**ot change proteins**
- **does not usually change enzymes** from bacteria.

Pasteurization **coagulates sour milk**.

Lactose

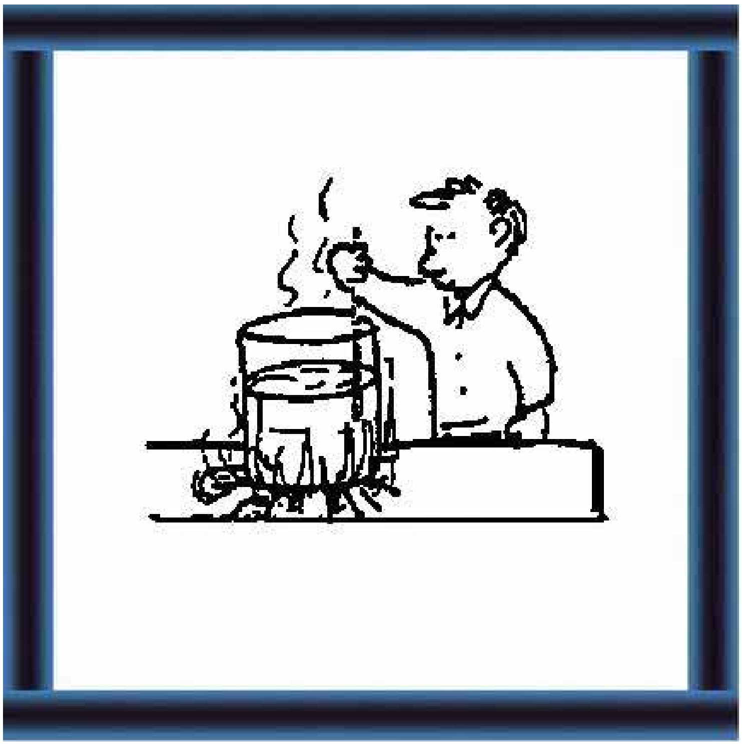
28 **Very high** temperatures cause:
- **browning** of milk
- **change** in **flavour**.

Normal pasteurization does **not** cause browning.

Minerals and vitamins

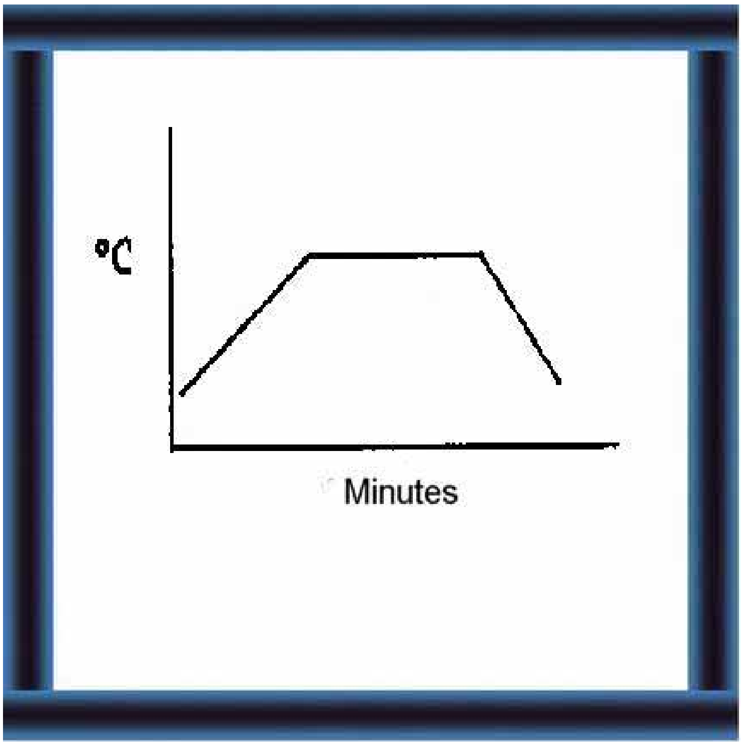
Normal pasteurization does **not** change minerals.
Heat treatment can **destroy water soluble vitamins**. **Normal** pasteurization **destroys** about **5-20 % Vitamin C**.

What is important in heat treatment?



29 **Make sure you**:
- **measure temperature accurately**

- **stir** the milk **throughout** the heat treatment

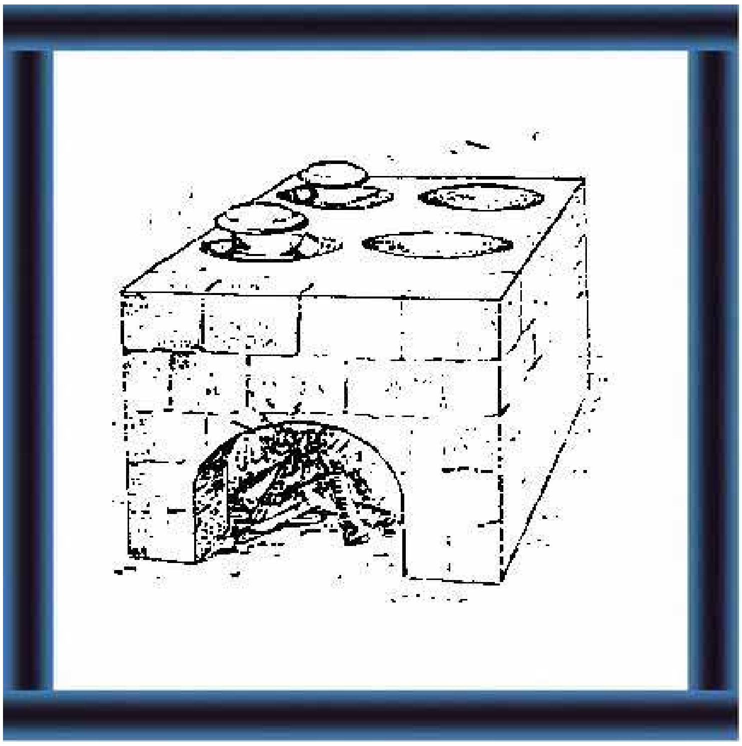


30
- **heat** the milk up to a **certain** temperature

- **maintain** the temperature for a **fixed** time

- **cool** the milk (stirring until cool).

How do you treat milk on a small scale?



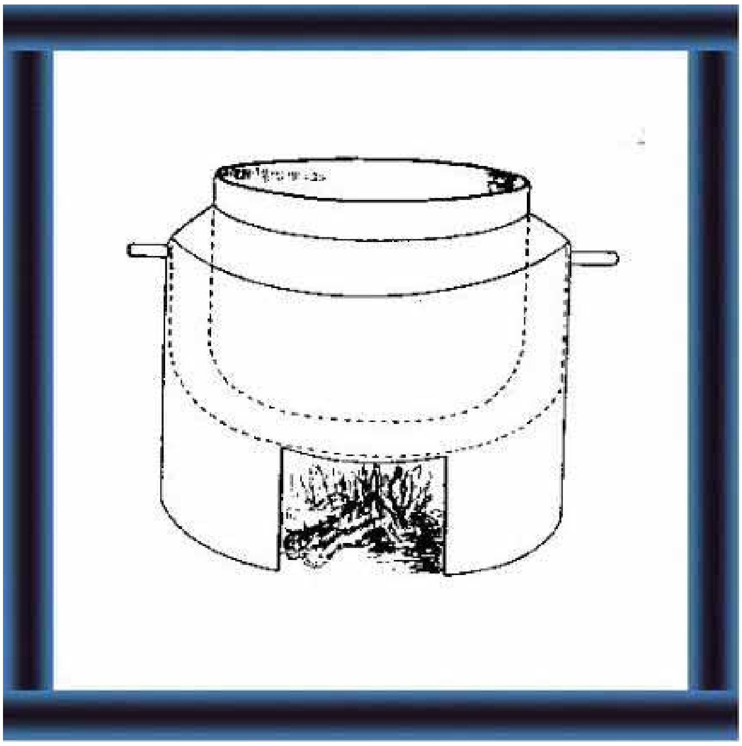
Thermatization

31 Thermatization is a **soft heat treatment**, for example, 65 C for a short time.

This **boiler/water bath** uses peat or wood for energy.

Important

Use thermatization **only** if you **cannot** pasteurize the milk **within 24 hours** of delivery to the plant.

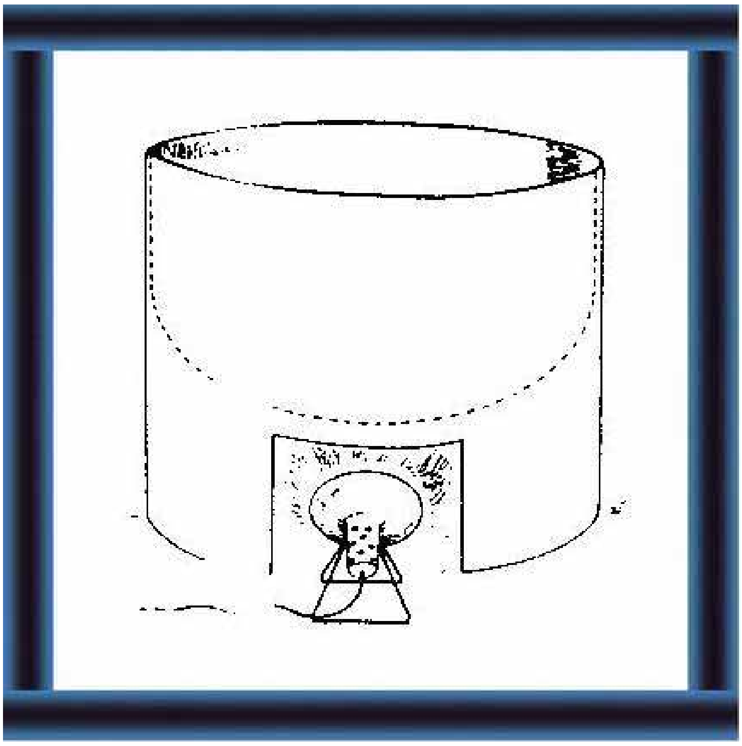


Pasteurization

32 The temperature range for pasteurization is 63 C to 100 C.

This **kills most harmful bacteria**.

This is a **wood-fueled metal boiler** with a **jacket**.

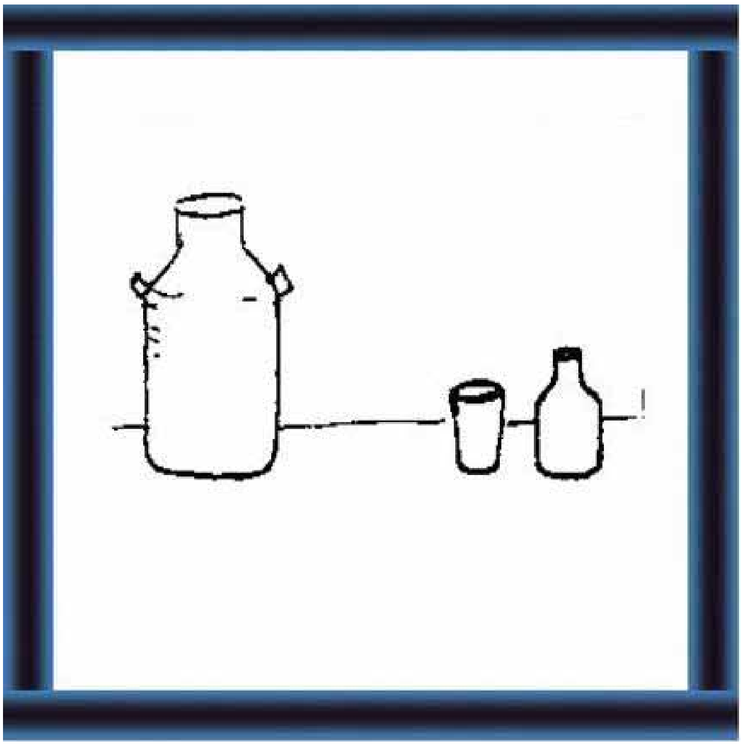


33 This is a **gas-fuelled metal** boiler.

You can pasteurize at **different times** and **temperatures**.

Time	Temperature
30 minutes	**63ºC**
3 minutes	68ºC
20 seconds	73ºC

34 Use:
- lower temperatures for market milk

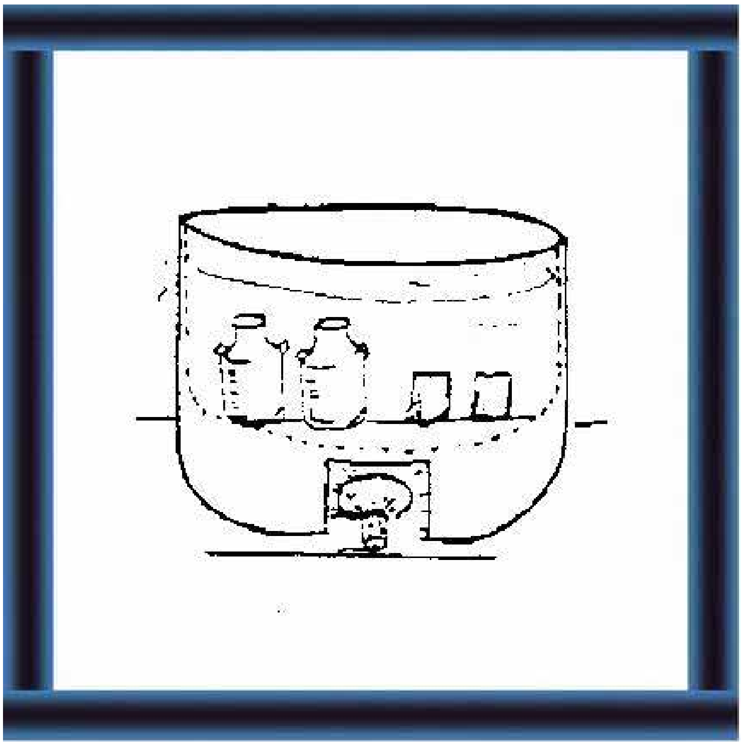


- higher temperatures for yoghurt and fermented products.

Important

Sanitize the **stirrer before use**.

Stir continuously.



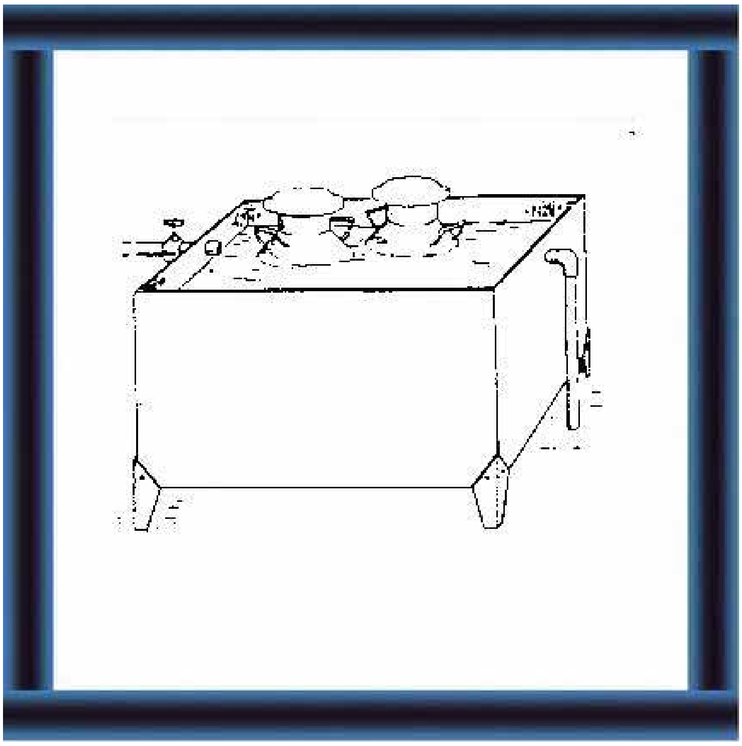
35 You can also heat treat in **containers**, **bottles** or **packets** of milk**under water**.

This **reduces** the chances of **reinfection** after treatment.

Important

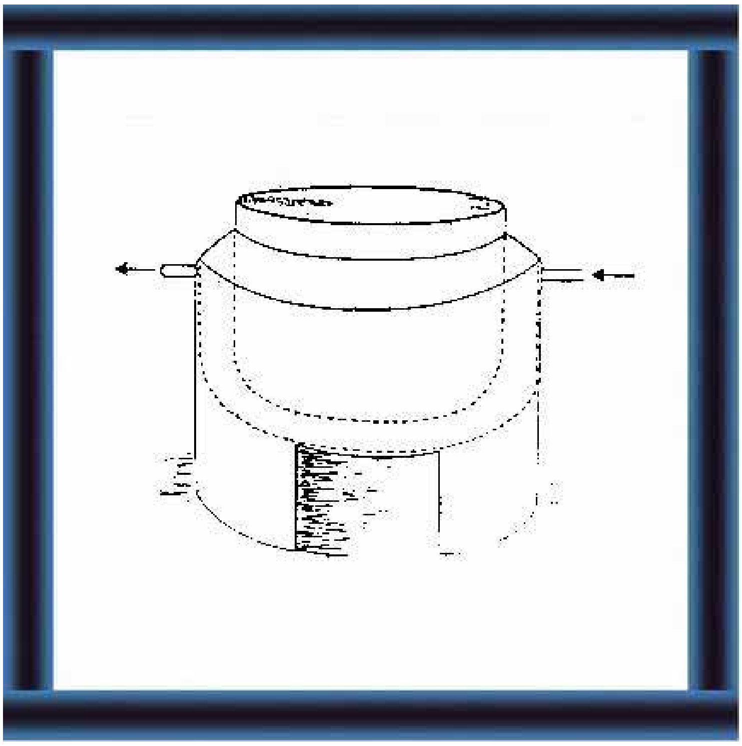
Allow **longer times** than above to **warm up** the containers.

Bottles : 80 C for 10 minutes
Bags : 80 C for 5 minutes.

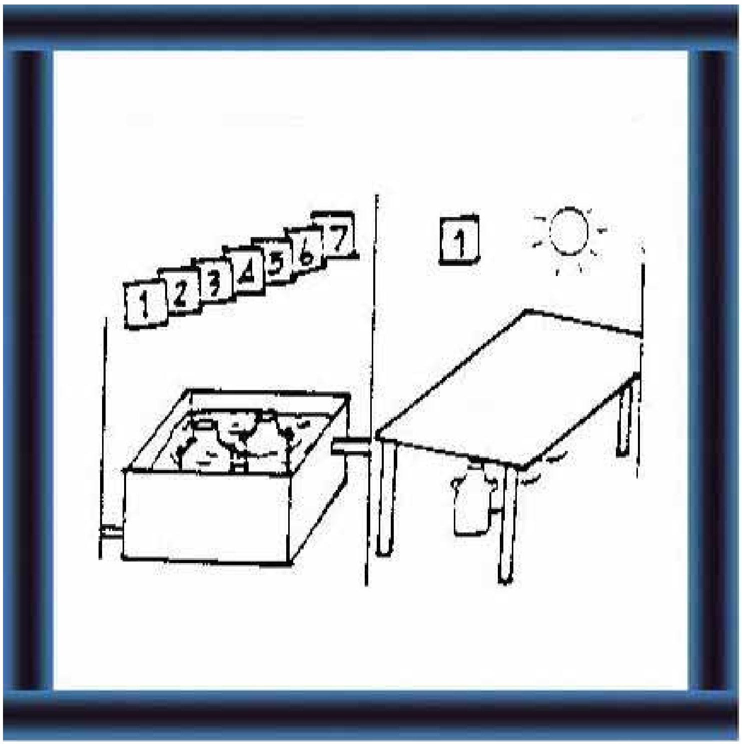


36 You can cool the milk with **running water** in a **vat**.

Use **ice** if available, in the **water** **not** in the milk!

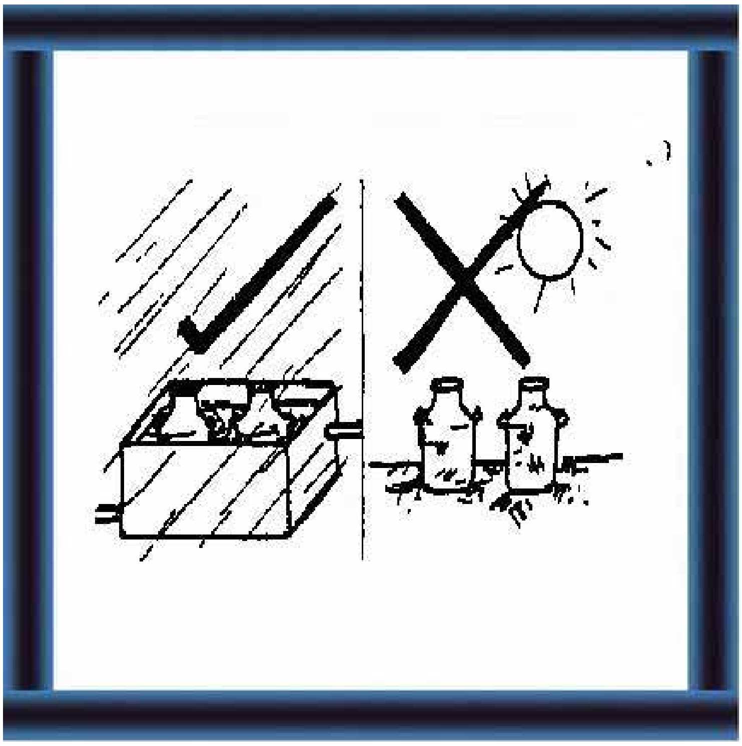


37 You can also cool the milk by running water through a **jacket**.



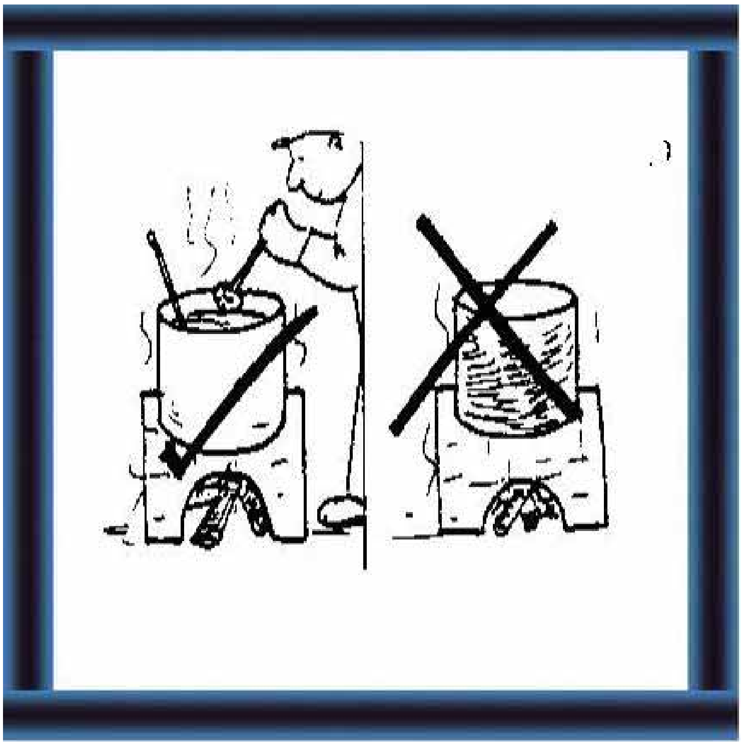
38 You can keep pasteurized milk for **up to a week** if you keep it **cool** and **not reinfected**.
If your milk is **not** cool, keep it for **only 1 day**.

Important in all milk treatment:



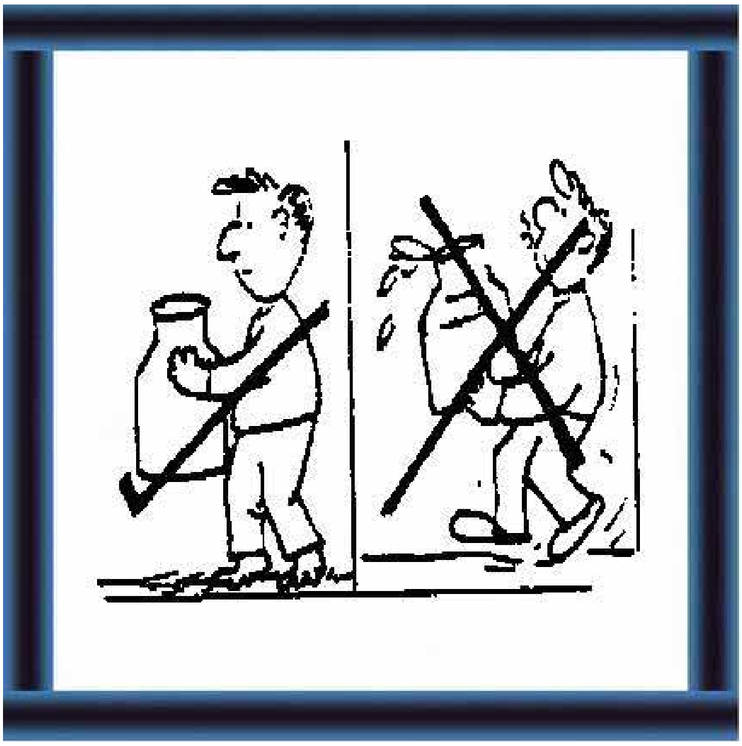
39 - keep everything **clean**

- store milk in a **cool place away from sunlight**.



40 - use a **thermometer** and **stirrer**

- **do not** use copper equipment, it may start **unwanted chemical reactions** in the milk

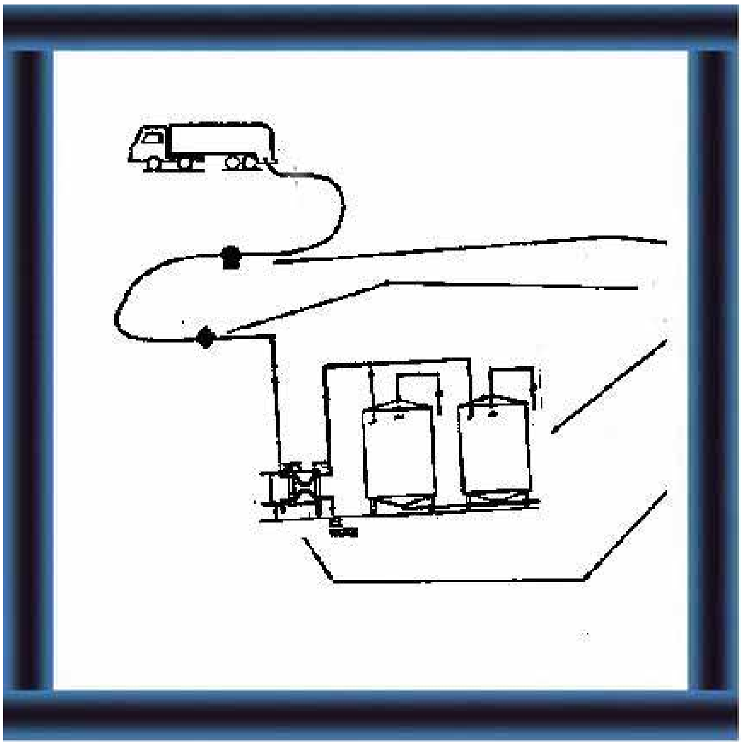


41 - treat milk **gently**

- **do not** whip air into it

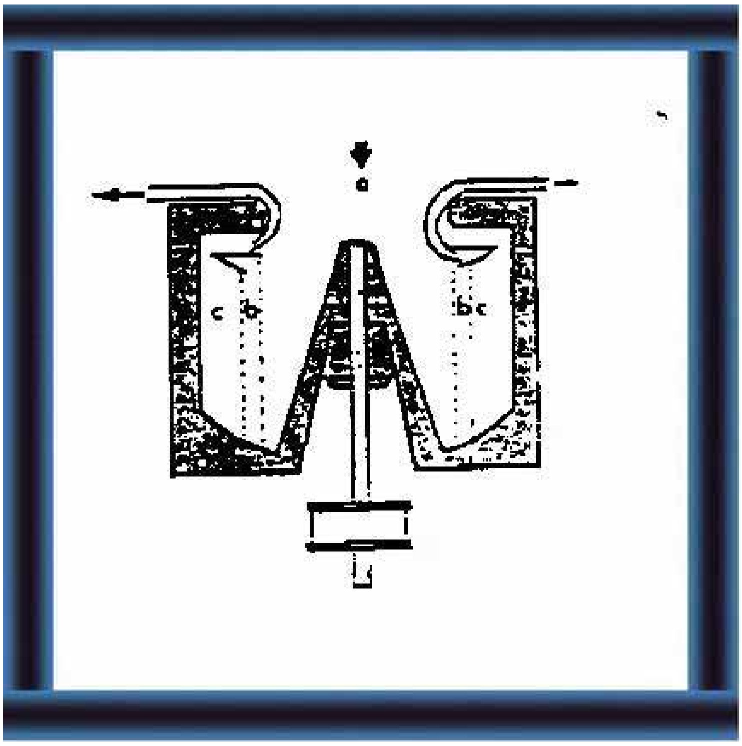
42 - **never** drink milk or products which you do **not heat treat**.

How does the dairy plant treat milk on a large scale?



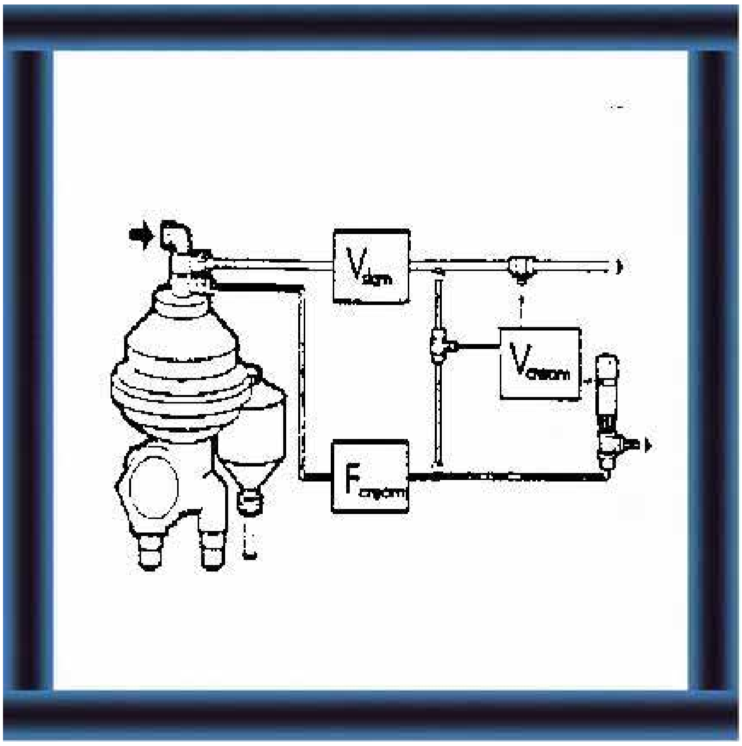
Pre-treatment

43 The plant **pumps** the milk through a **filter** and a **plate cooler** to a **storage tank**

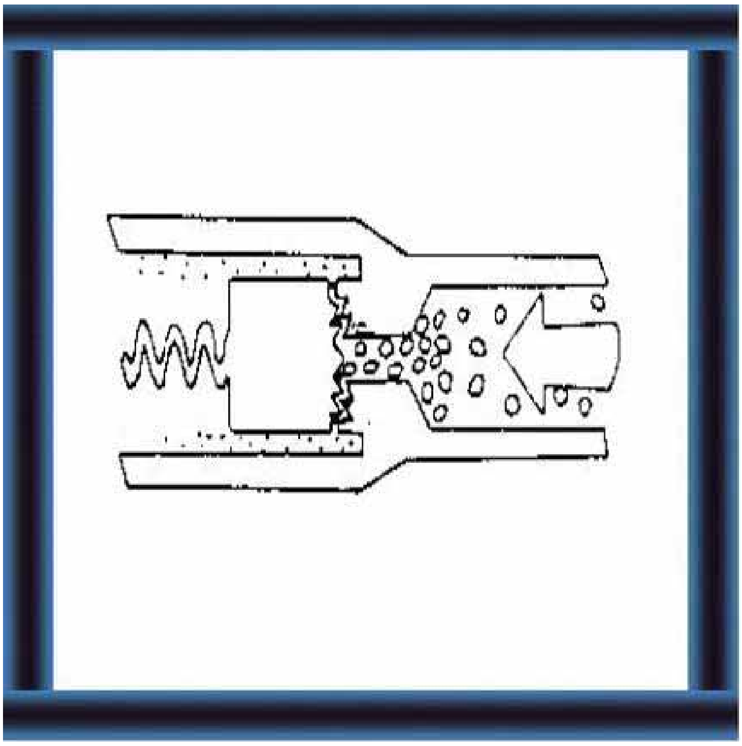


44 A **centrifuge separates** the cream from the skim milk.

Some separators also **remove dirt**.



45 The plant automatically **standardizes** the milk by **adding** part of the **cream** to the **skim milk** flow.

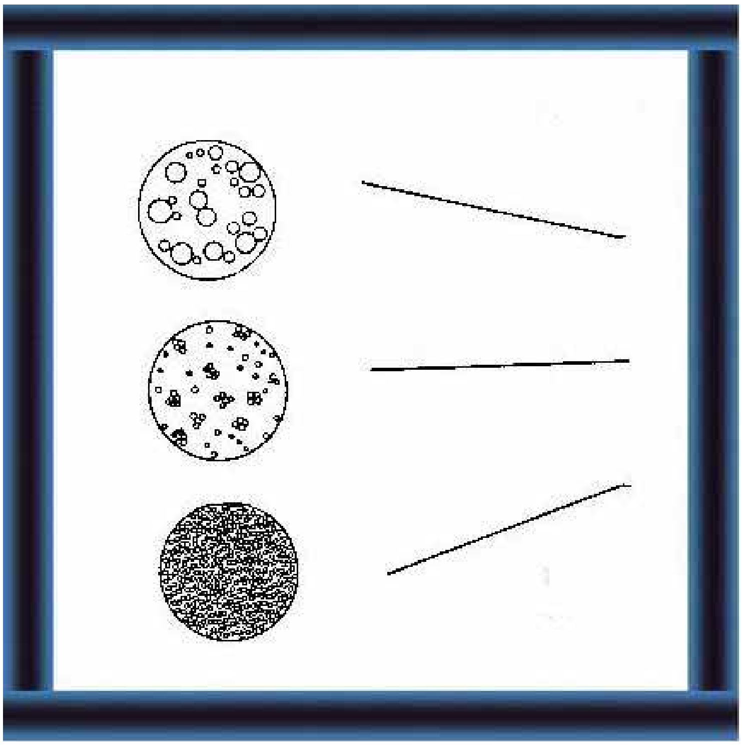


46 Next, the plant **homogenizes** the milk.
This changes the milk to have:

- **smaller** fat globules
- **lower** creaming ability

so the milk has:

- **no** cream line
- a **whiter**, more **appetizing colour**
- **less** oxidation.



47 At **different degrees** of homogenization, the fat globules are **different sizes**:

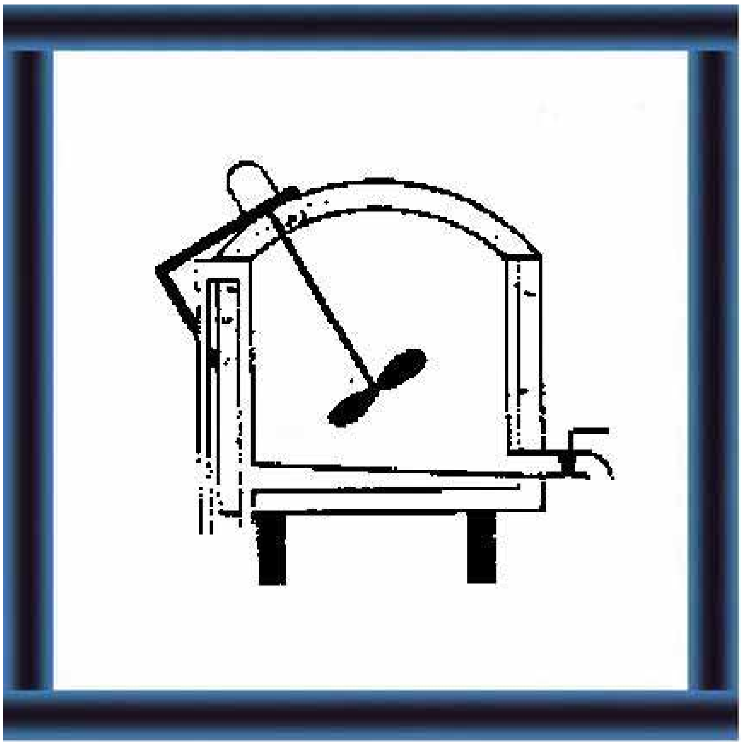
- **not** homogenized
- **partially** homogenized (viscolized)
- **totally** homogenized (micronized).

Homogenization may also have some disadvantages:

- cannot separate easily
- flavour becomes metallic quickly in sunlight
- lipase attacks easily
- low protein stability.

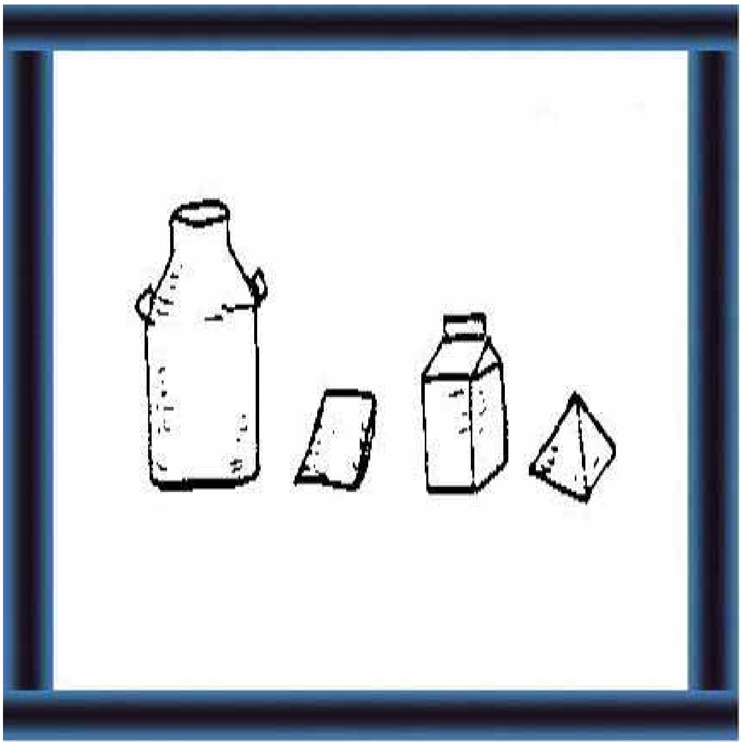
Important
Heat treat immediately after homogenization.

Large-scale heat treatment systems
What large-scale heat treatment systems are there?



Holder system
There are two types of holder system.

48 This plant heat treats and cools milk in a **vat** (batch pasteurizer)



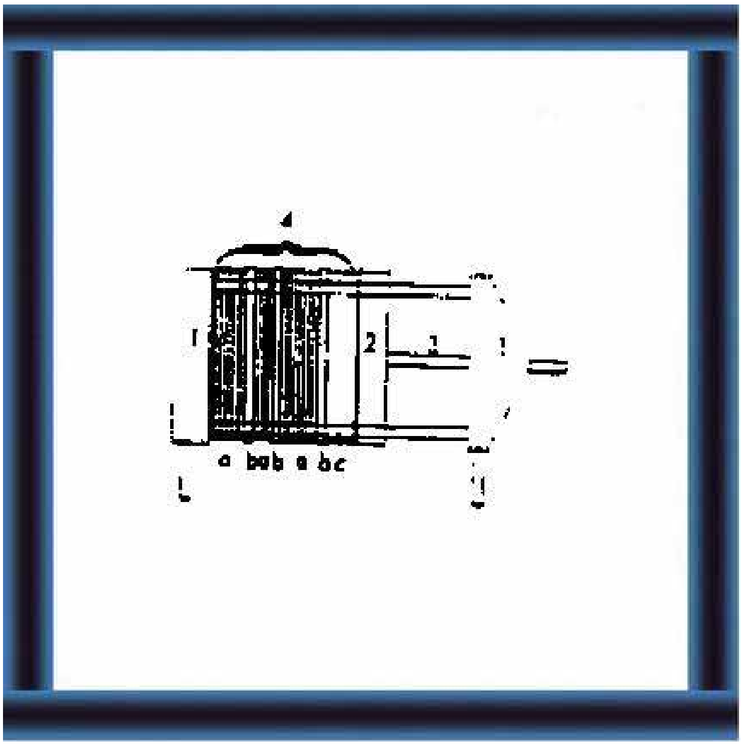
49 and then puts the milk in:

- bottles

- sachets

- cartons.

Some plants put the milk in bottles, sachets or cartons first and then heat treat the milk.



Continuous flow system

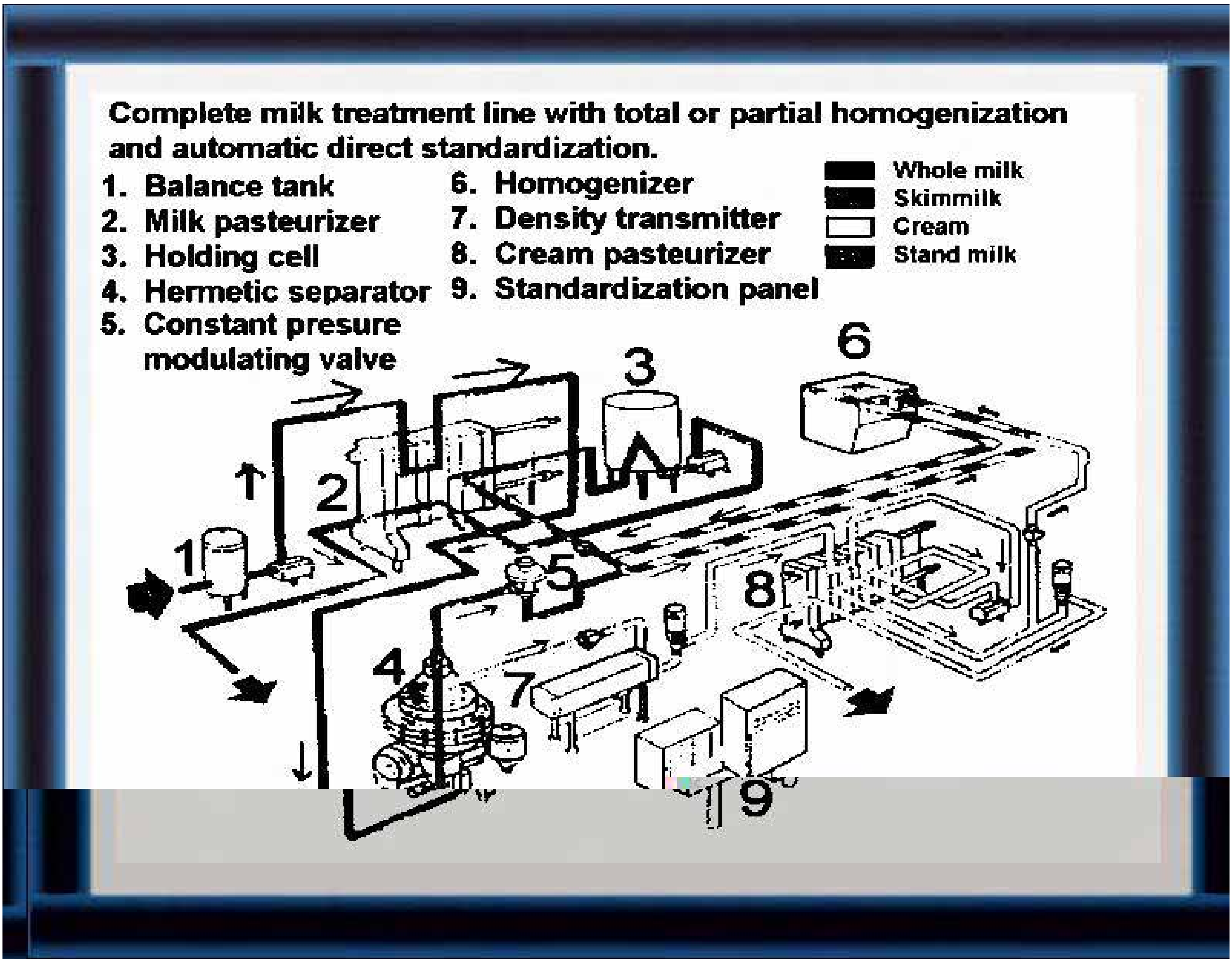
50 This **plate heat exchanger** can heat treat milk and then cool it.

Advantages
- strict control over large volumes
- little effect on taste
- low processing cost
- automatic cleaning
- uses little space to another
- fixed heat treatment time

Disadvantages
- minimum economic use:
  3 hours/day
- high investment cost
- cannot add flavour or other
  ingredients
- cannot change easily from one product

Continuous flow pasteurization

51 In the **HTST** (high-temperature short-time process) the plate heat exchanger heats the milk to 72 C for 15 seconds:

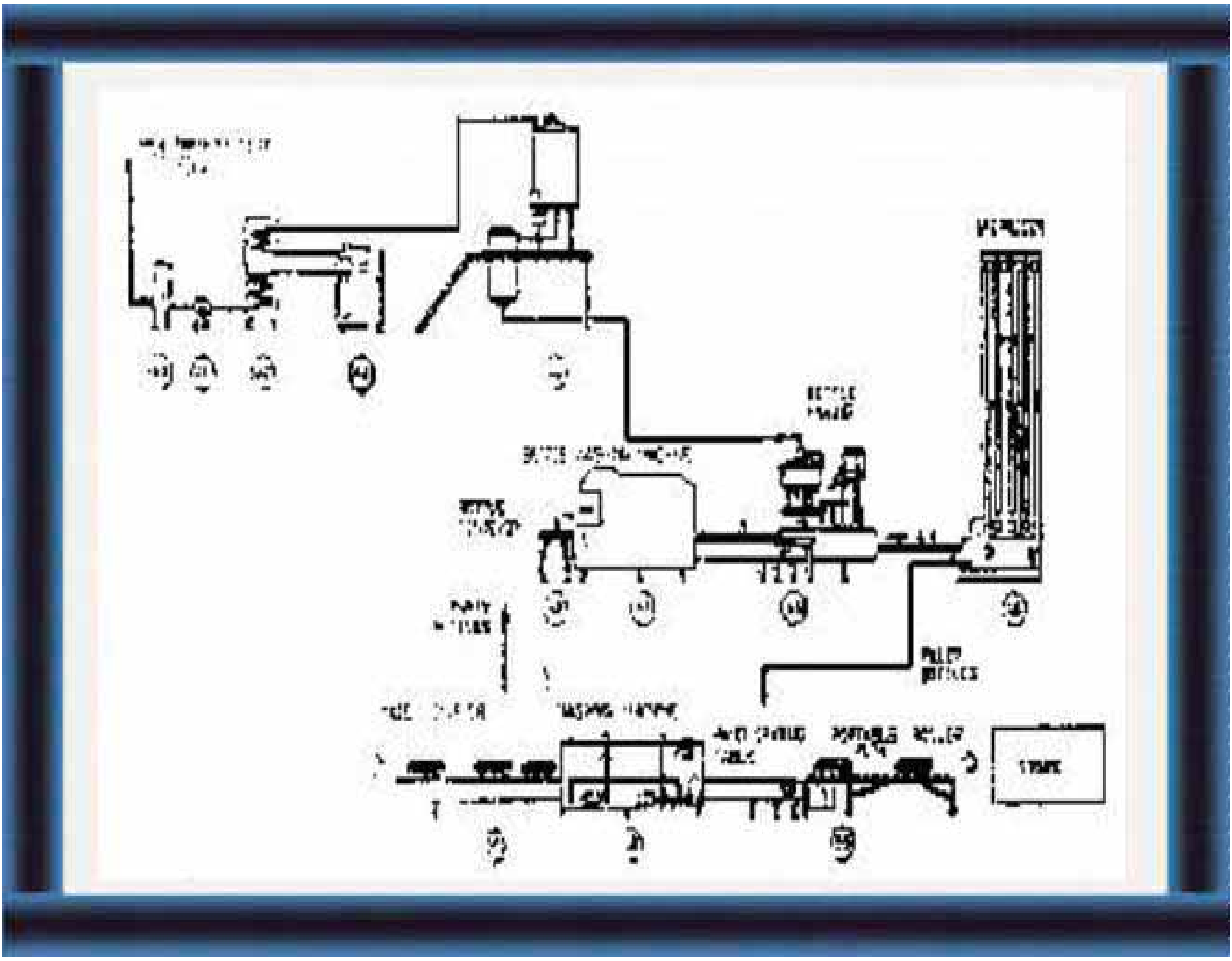


Sterilization

Sterilization is a heat treatment which kills **almost all** cells. There are various methods:

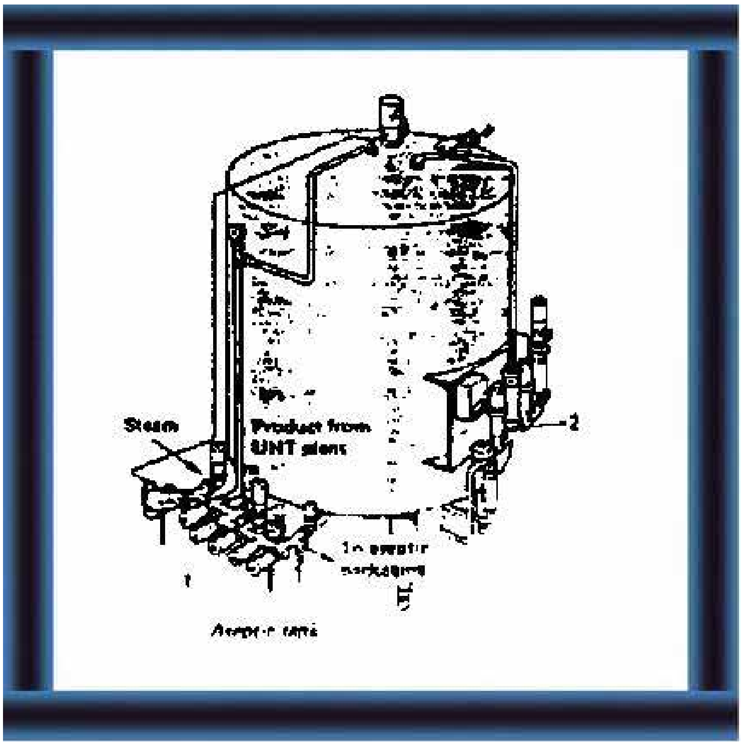
In-bottle sterilization

52 The plant **pre-heats** milk to 70-75 C and **bottles** it. The plant then heats the **sealed bottles** to 110 C for about 30 minutes.



Two-stage sterilization

The plant heats the milk to 75 C to **stabilize** it and then to 130-140 C for 20 seconds to **sterilize** it.
The plant then cools the milk to 80 C and bottles it.



Continual sterilization

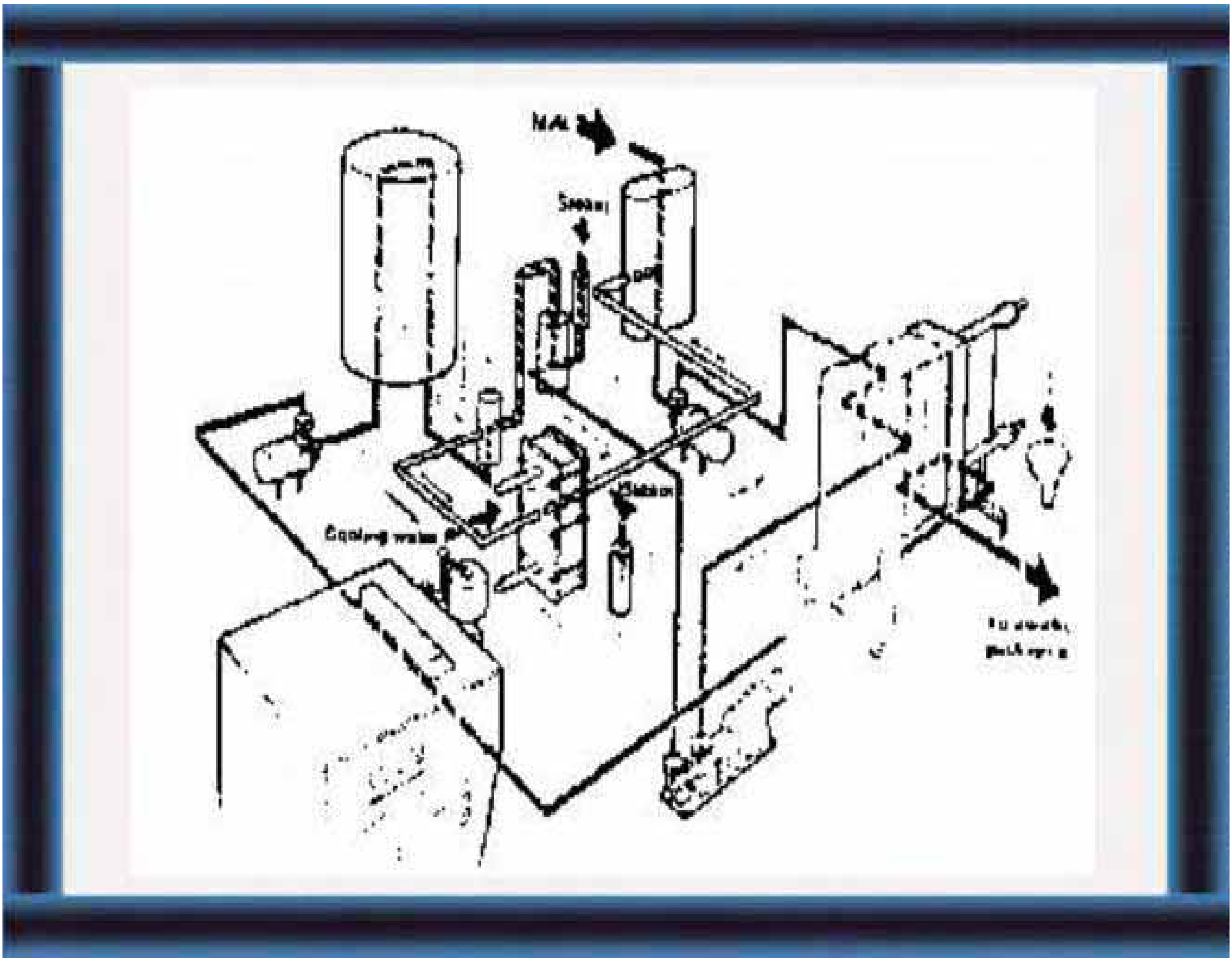
53 Equipment used for continual sterilization.

UHT treatment

There are two main methods of UHT treatment:

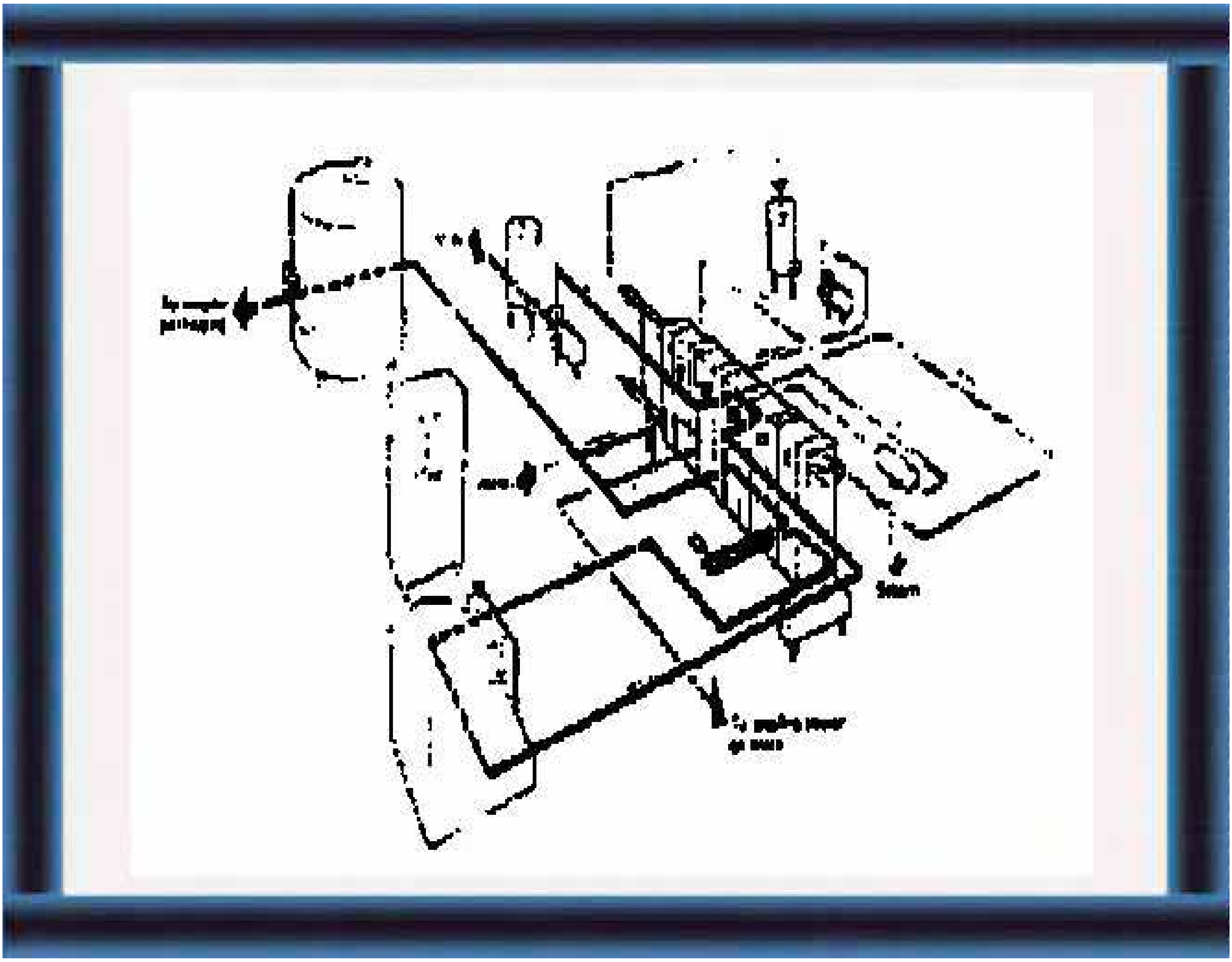
Direct heating

54 The steam passes into the milk and **directly** heats it to 140 C. Remove excess water by evaporation. You can also use electricity for direct heating.

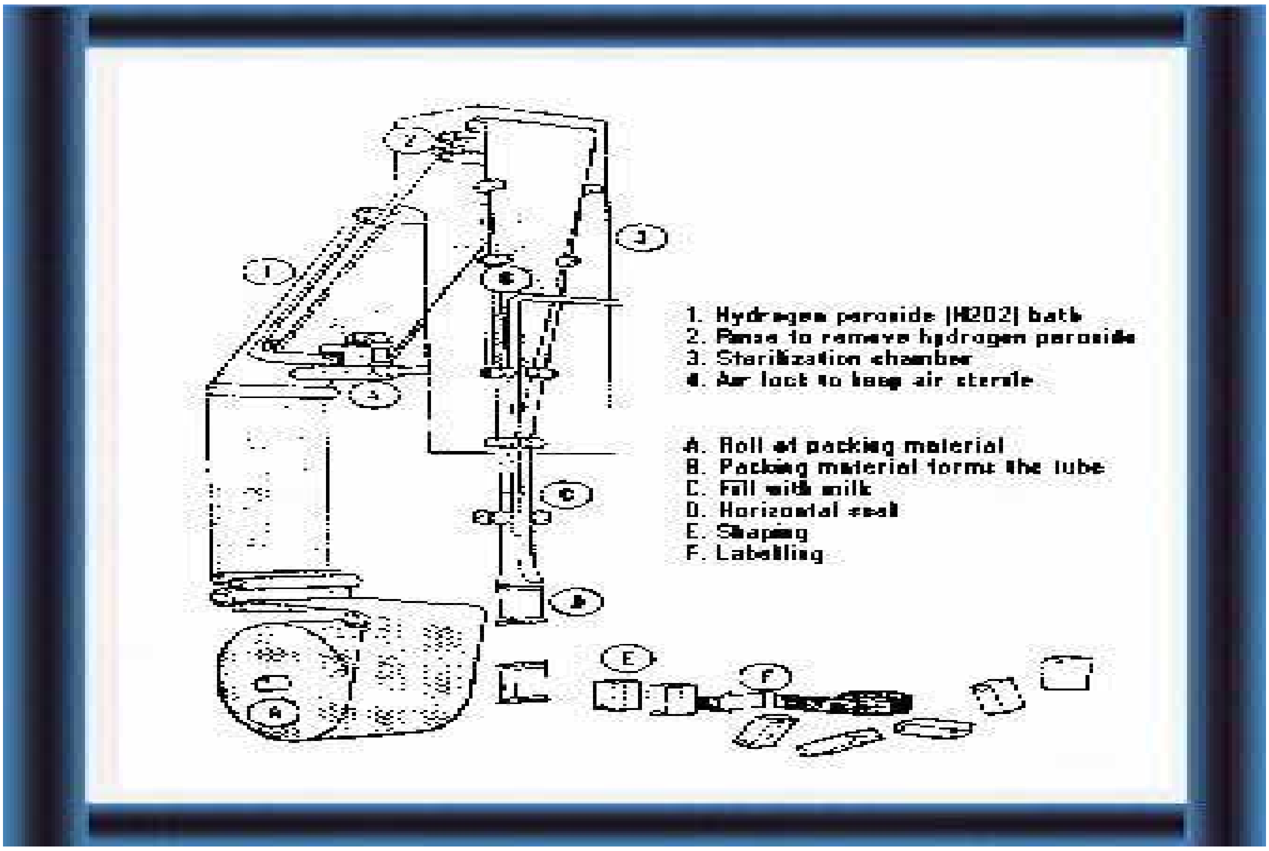


Indirect heating

55 Steam heats water which passes through a **plate heat exchanger**. The water indirectly heats the steam to 137 C



Packaging
56 A modern packaging machine.



What do you know about milk treatment?

Small scale milk treatment

1. **Separation**
   - dirt from milk (5-6)
   - cream from skimmilk (7-5)
2. **Standardization**
   - Adjusting fat contents of
   - milk (10)
   - cheese (11)
   - Sampling and testing for
   - milk acidity (13-14)
   - fat content (15-19)
   - Calculation quantities (20-21)
3. **Heat treatment**
   - Reasons for heat treatment (22-23)
   - Important points (24-25,29-30,39-42)
   - Effects of heat treatment on
   - fat (26)

- proteins and enzymes (27)
- lactose (28)
- minerals and vitamins
4. Methods
- thermatization (31)
- pasteurization (32-38)

Large scale milk treatment

1 Pre-treatment (48-49)
2 Heat treatment
- Holder systems
- Continuous flow systems (50-51)
3 Sterilization (52-53)
4 UHT treatment (54-55)
5 Packaging (56)

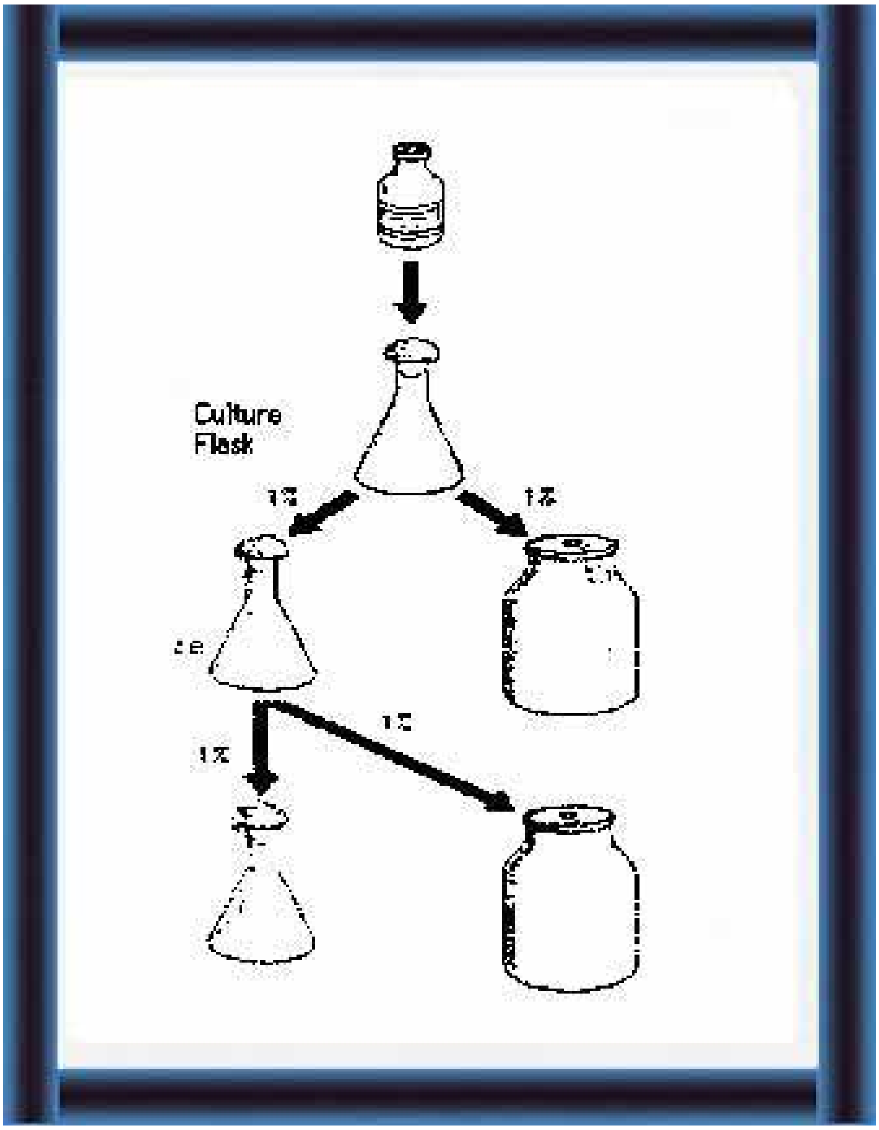
Small-Scale

Dairy Farming Manual

Volume 1

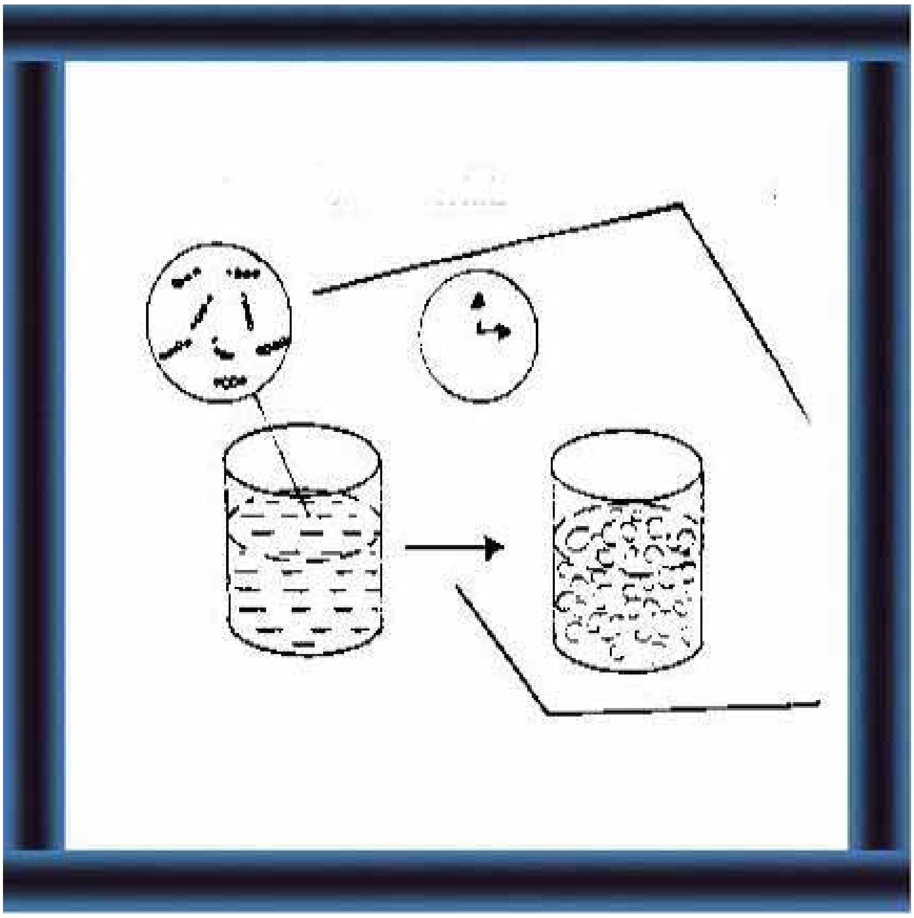
Technology Unit 10.1

Starter Cultures



Extension Materials

What should you know about starter cultures?



What is a starter culture and why use it? (5-11)

1 A starter culture is a milk product which:

- contains **lactic acid bacteria**

- **controls** the **souring** of milk.

What types of starter culture are there? (12-20)

2 There are many types. Choose one for your:

- **local conditions**

- the **product** you want to make.

How do you prepare and maintain a starter culture? (21-36)

3 You need:

- **clean** and **disinfected equipment**

- the **correct** starter culture and **high quality** milk

- to do the **right things** at the **right time**.

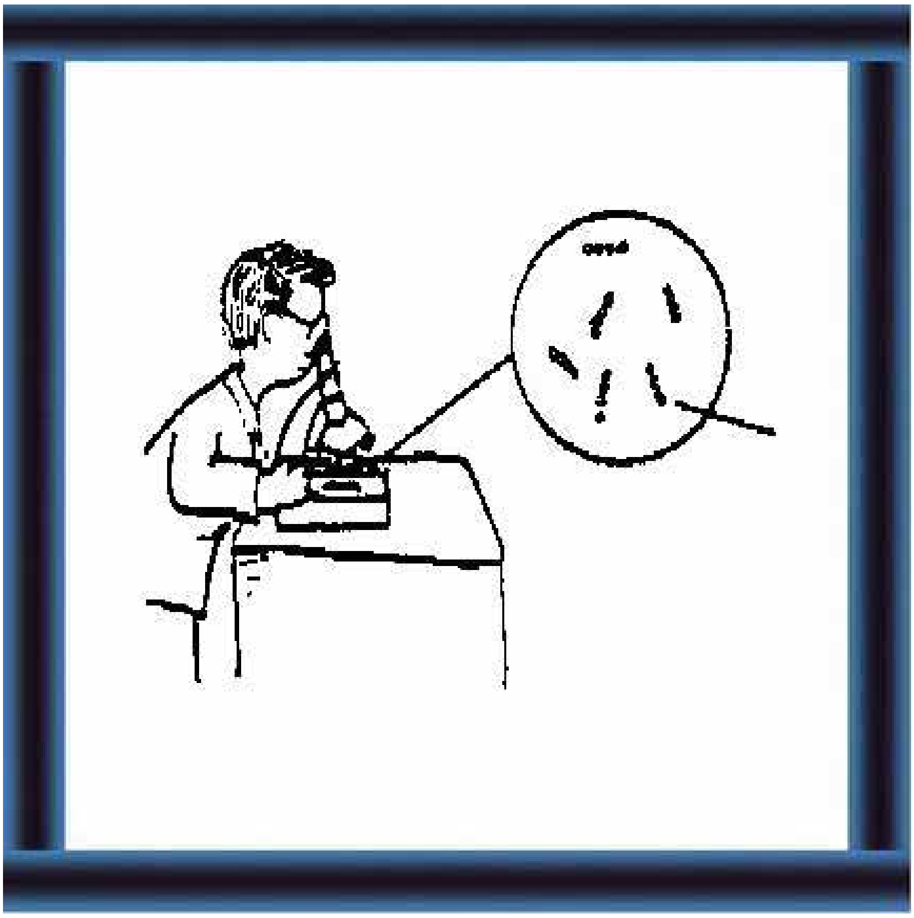
How can you prepare mother cultures for making cheese and yoghurt? (37-

38)

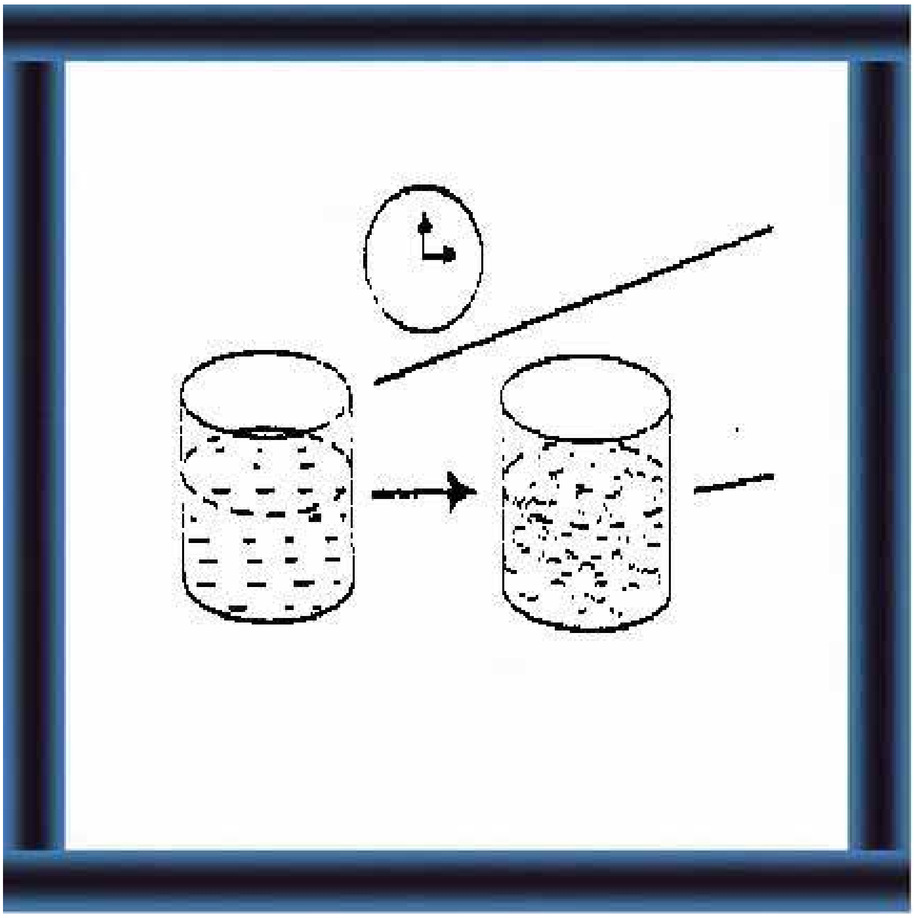
4 By using **different starter cultures** at **different temperatures**.

What is a starter culture?

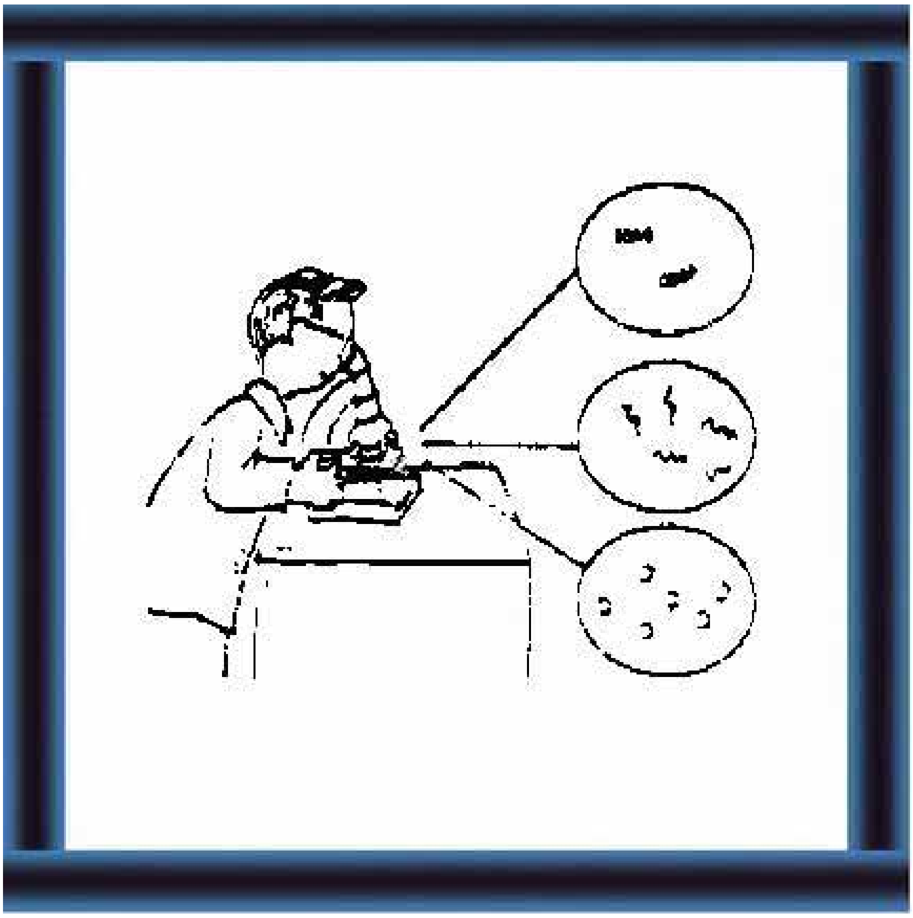
5 A starter



culture is milk which contains **lactic aid bacteria**.

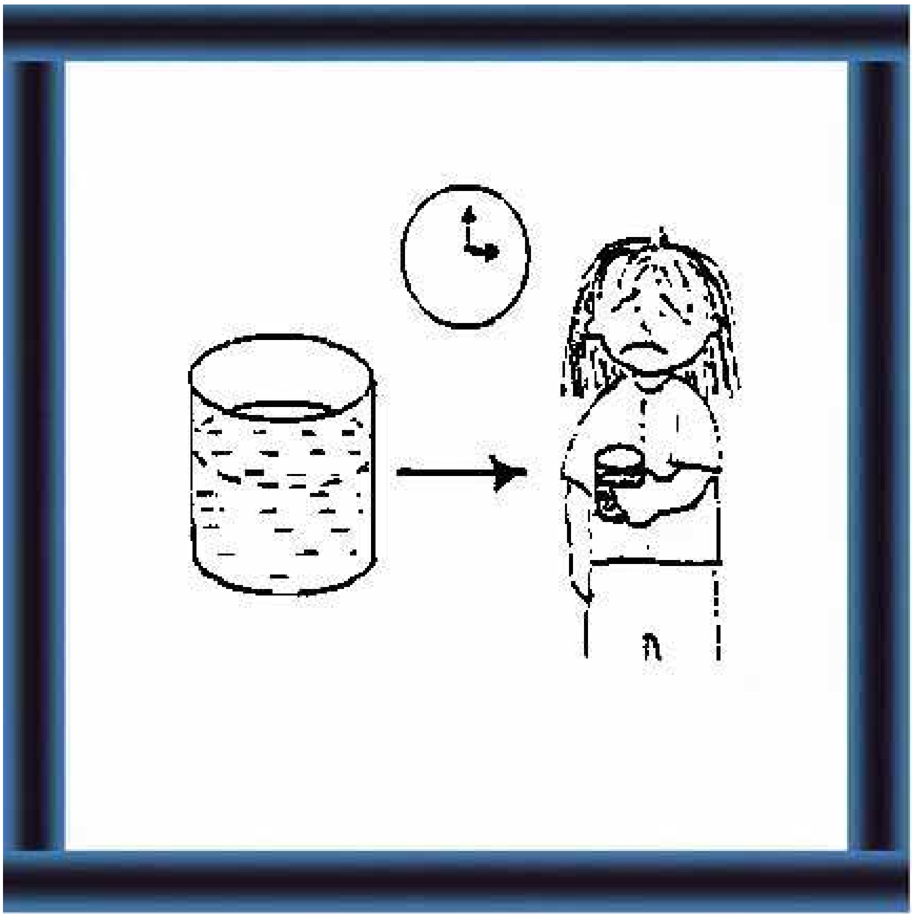


6 It **changes** the **milk sugar** (lactose) into **acid** (lactic acid) so that the milk becomes **sour** (fermented or cultured).



Why use a starter culture?

7 To **control fermentation**. Raw milk always contains **different microorganisms**.

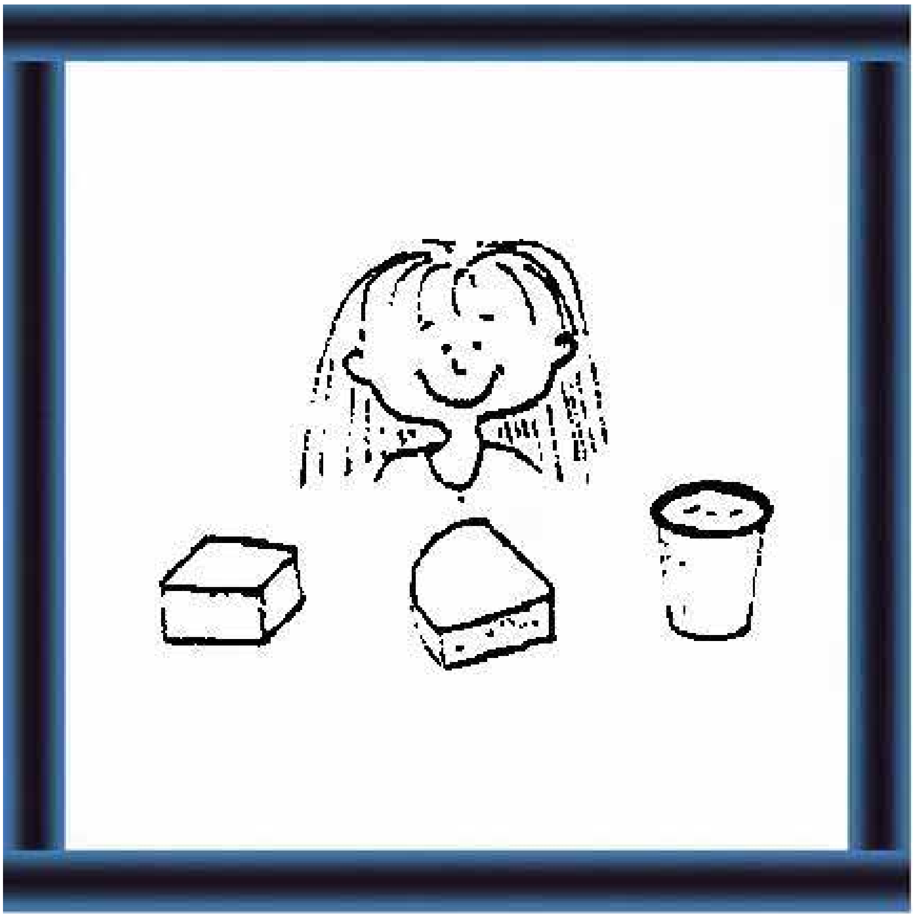


8 These microorganisms turn your milk sour but you **cannot control** the fermentation.

9 Pasteurization kills **most** of these microorganisms.

10 By using a commercial starter culture

with pasteurized milk, you can **control** the souring of milk



11 and make:

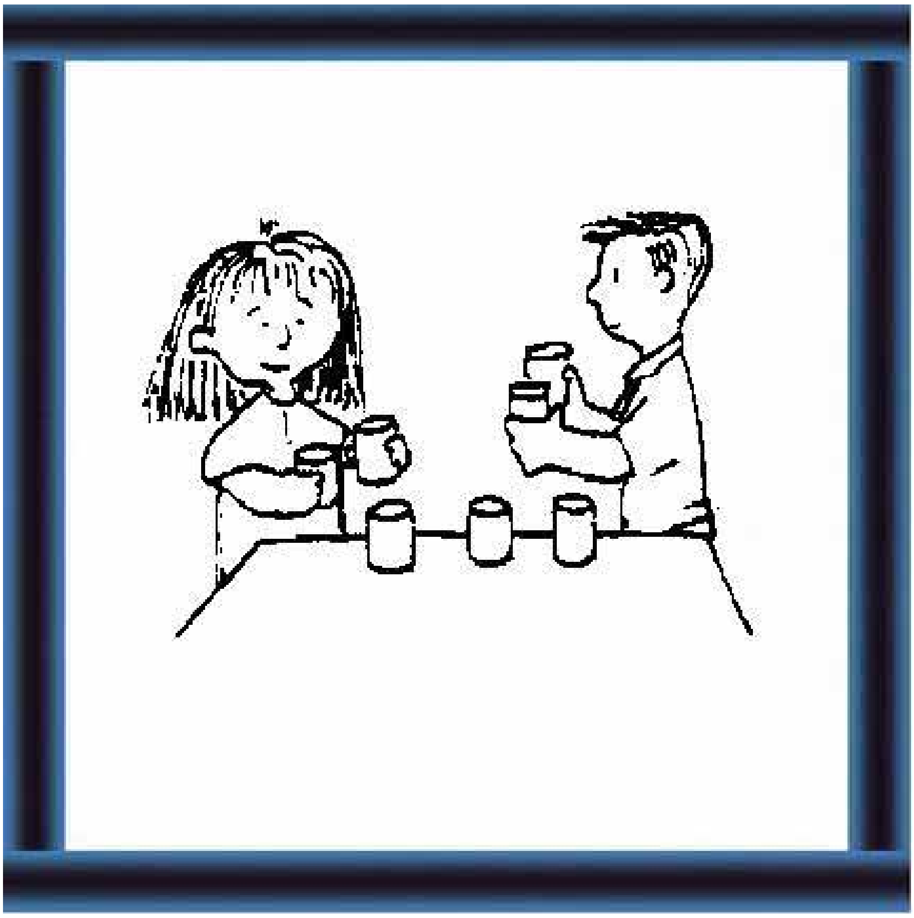
- butter

- cheese

- yoghurt

and many other products.

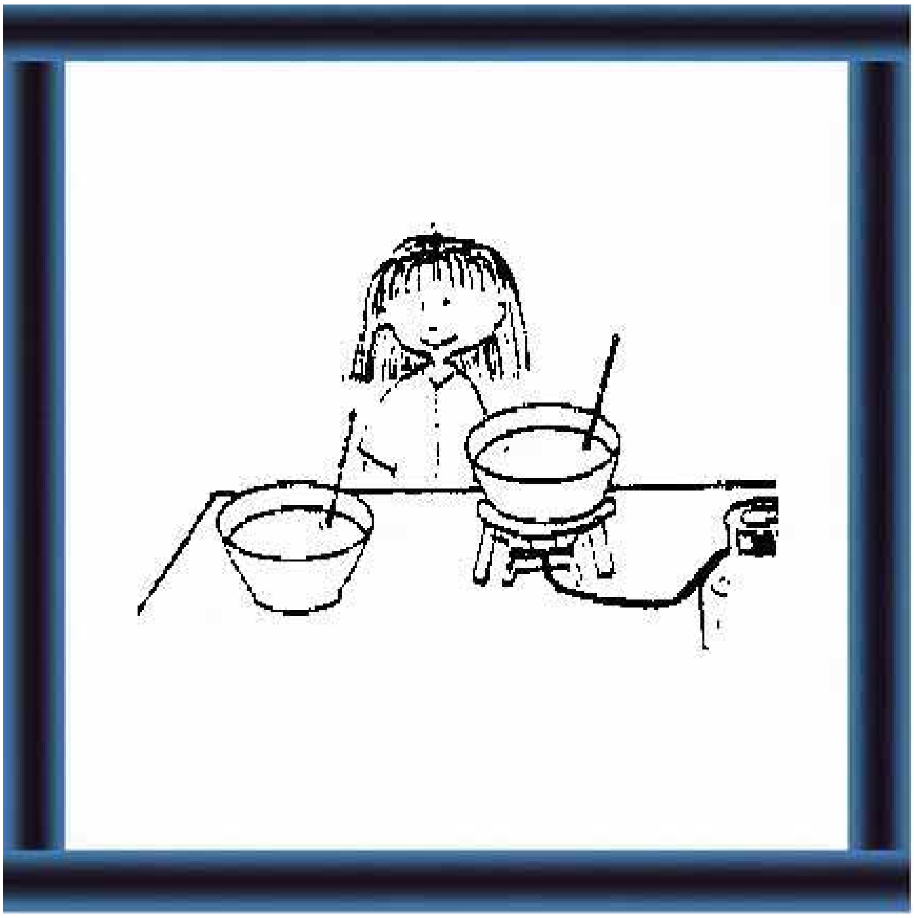
What types of starter culture are there?



12 There are **many types** of starter culture and we can **group them** in different ways.

Optimum growth temperature

13 **Mesophilic**



cultures grow best at about 30 C.

Thermophilic cultures grow best at about 43 C.

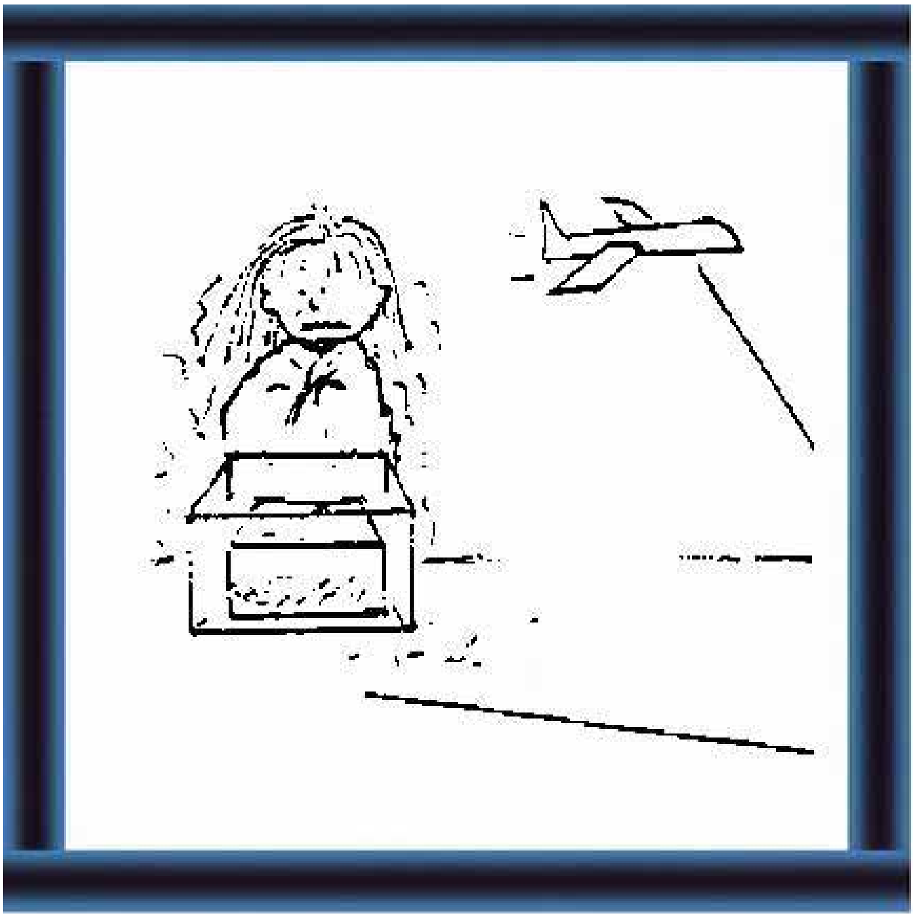
Physical state

14 Starter cultures can be:

- liquids

- solid (deep-frozen)

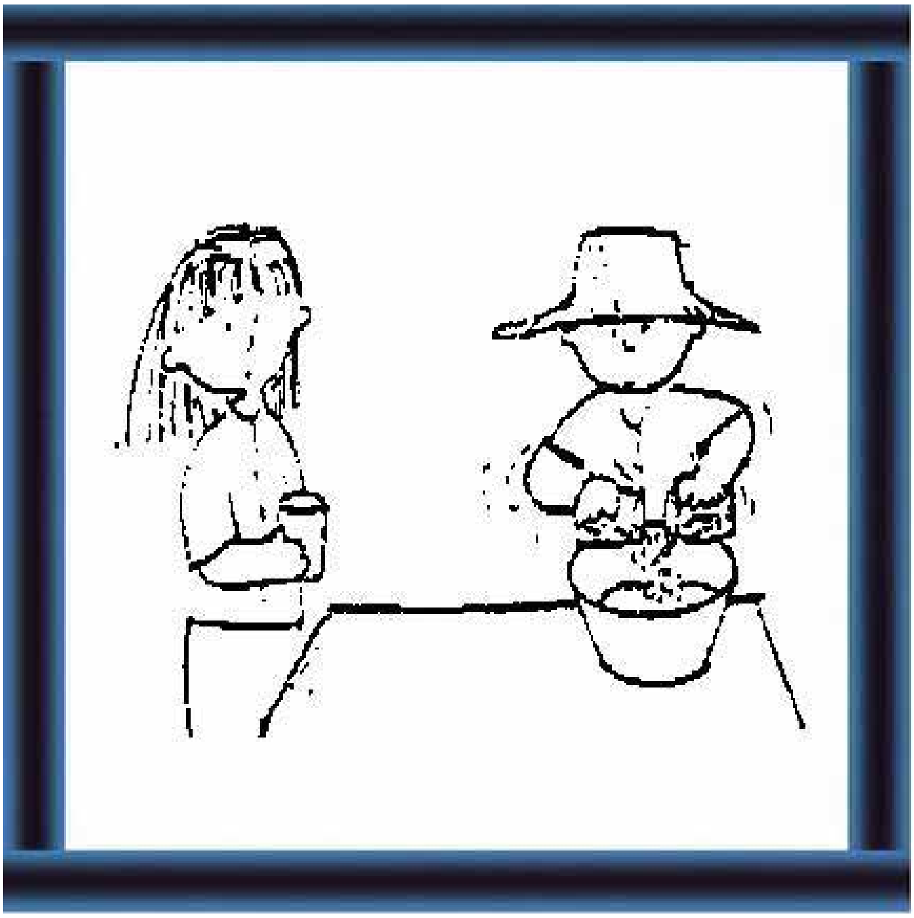
- powders (freeze-dried).



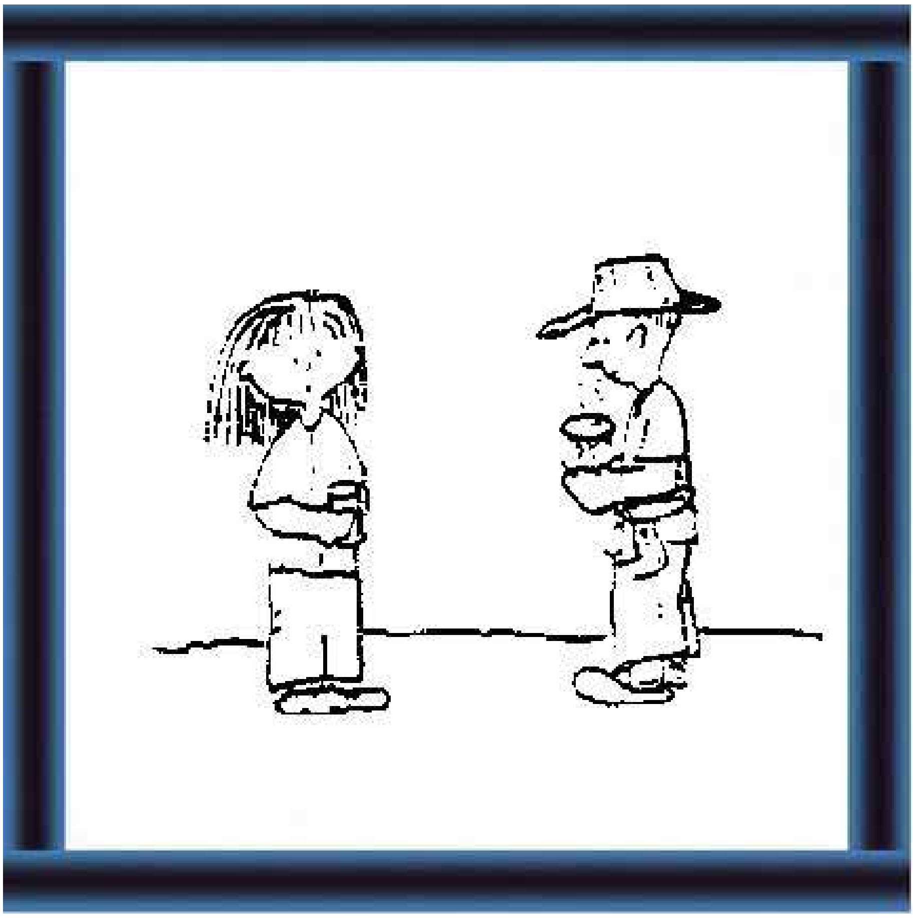
15 Powder cultures are useful because:
- they have **good keeping qualities** (more than 6 months at -20 C)
- you can send them **long distances** by airmail.

Pure/mixed

16 **Pure** cultures have **one** species of



lactic acid bacteria. **Mixed** cultures (more common) have **two or more** species.



Type of lactic acid bacteria.

17 Some lactic acid bacteria produce **only** lactic acid. Others produce lactic acid **gas** and **aromatic compounds.**

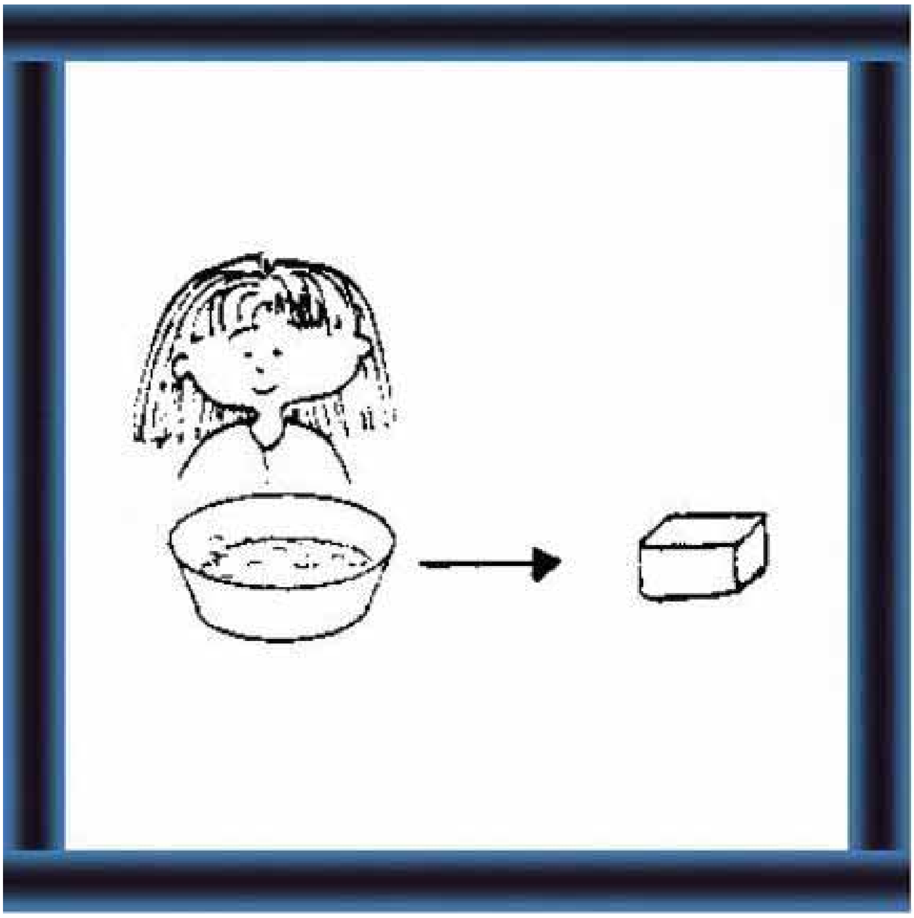
Some **common lactic acid bacteria** used in cultures are:

Mesophilic	**Thermophilic**	
Pure	**Pure**	**Mixed**
Sc. lactis	Sc. thermophilus	Sc. thermophilus
Sc. cremoris	Lb. helveticus	+
Sc. diacetylactis	Lb. bulgaricus	Lb. bulgaricus
Lc. cremoris	Lb. acidophilus	

Note:
Sc. = Streptococcus, Lc. = Leuconostoc, Lb. = Lactobacillus

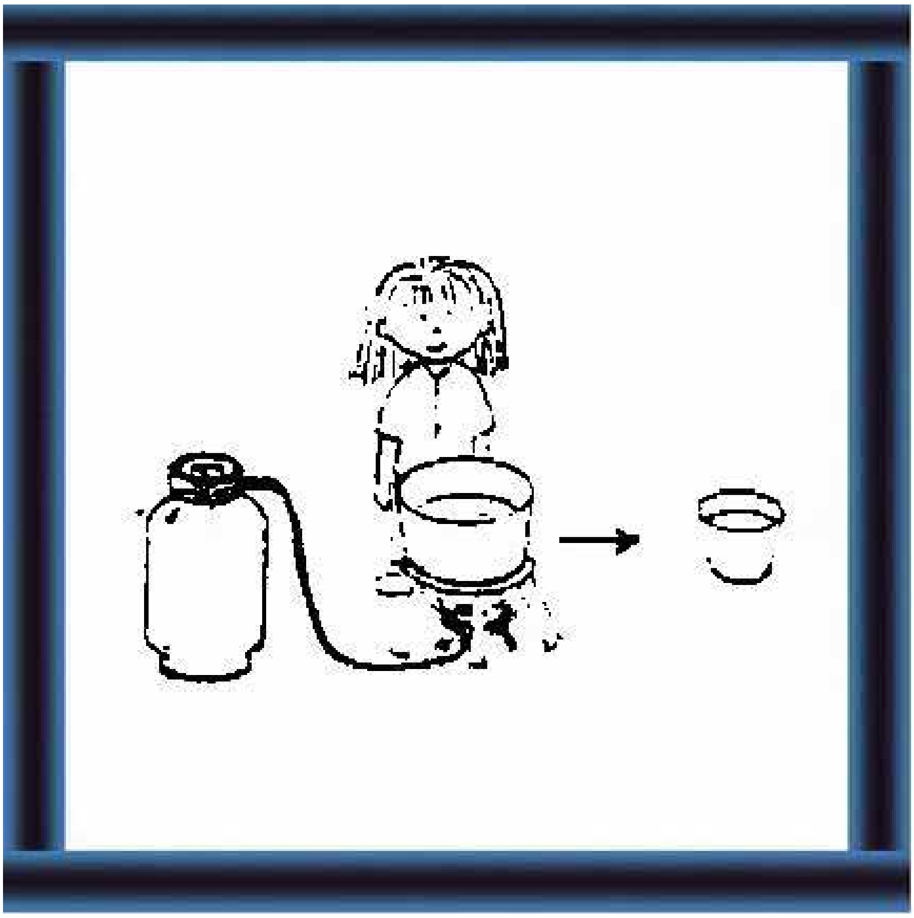
18 When you order, say which product you want to **make.**

For example:



Butter

19 You use a **mesophilic culture** which produces gas (carbon dioxide) and aromatic compounds (acetin and diacetyl).



Yoghurt and soft cheese

20 You can use a **thermophilic culture**.

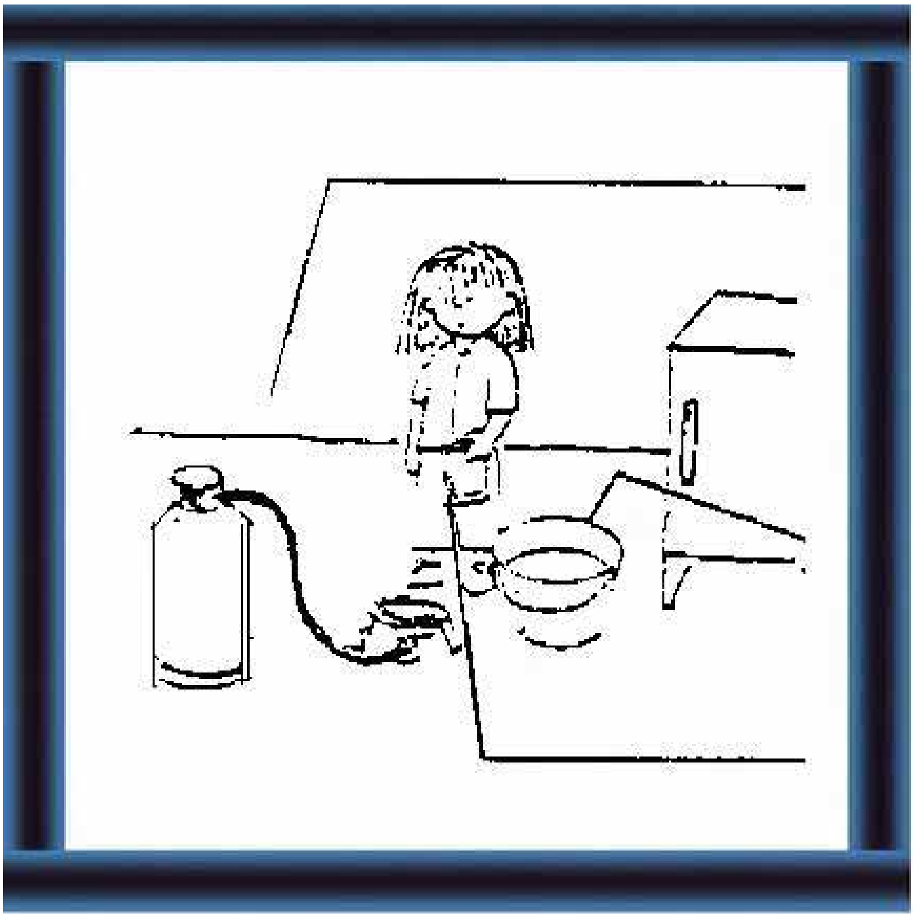
How do you prepare a starter culture?

Hygiene

21 **Clean, sterilize and rinse with boiling water** all utensils before using.

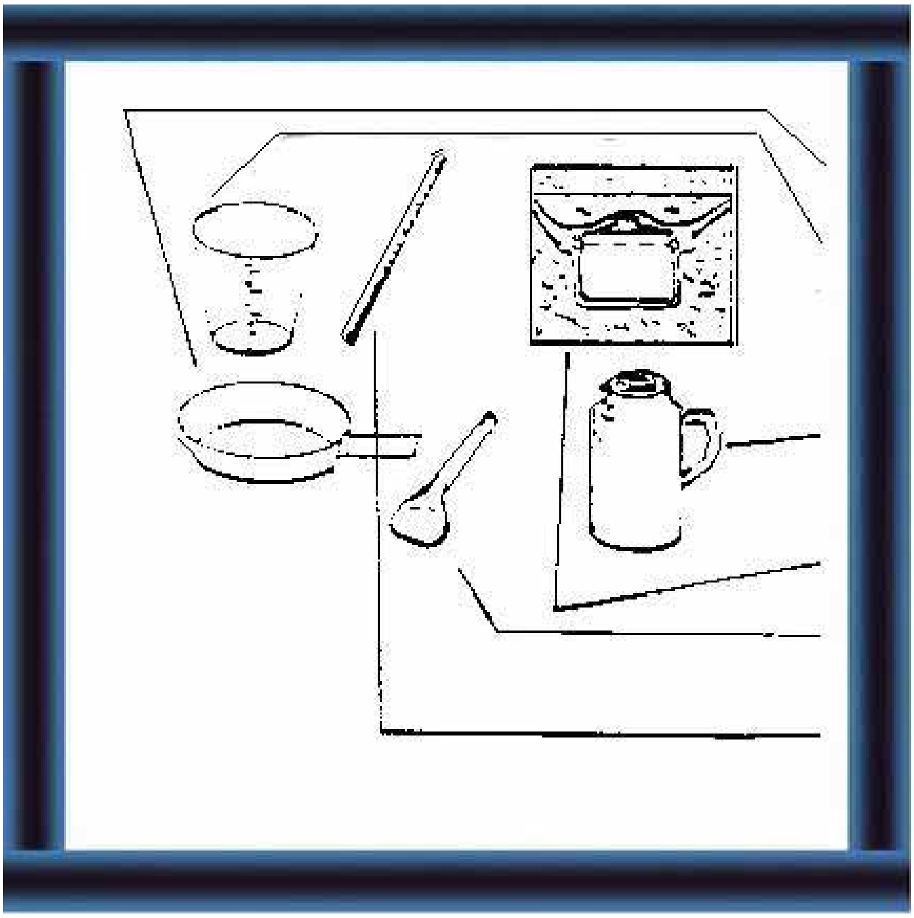
22 Any dirt or

chemicals will **change the action** of the starter culture.



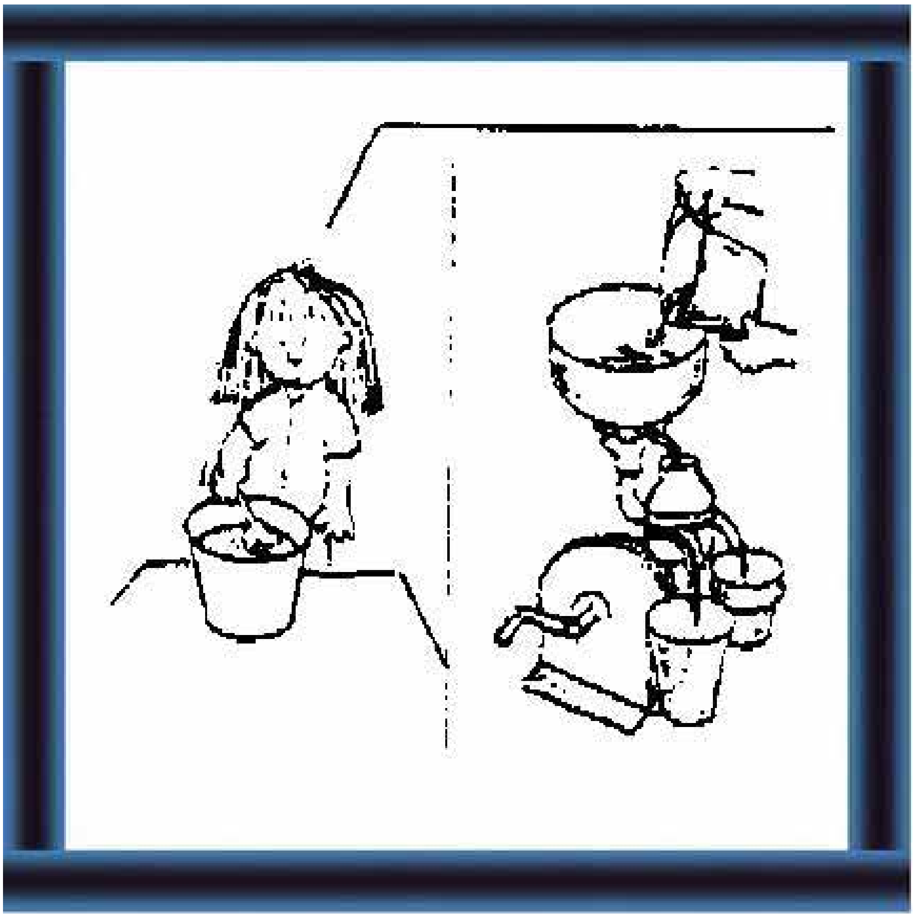
Equipment and materials

23 You need:
-source of heat
-raw milk (with or without cream)
-starter culture powder
-refrigerator or freezer

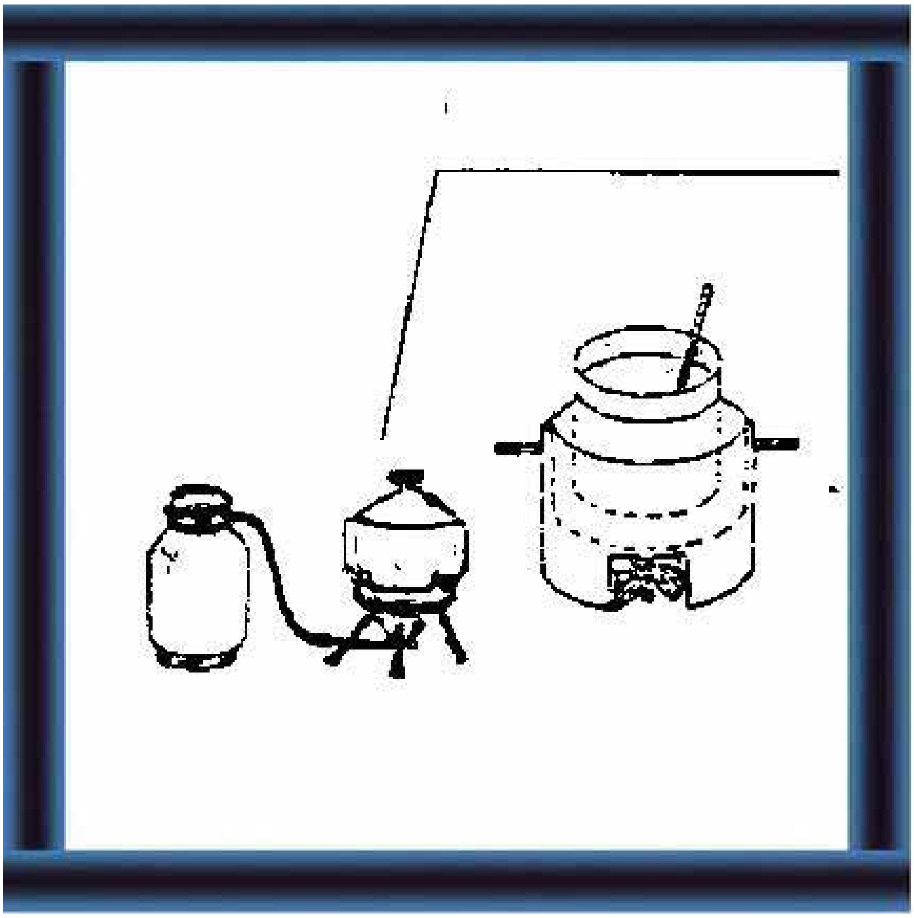


24
-pans and glass pots with lids
-measuring breaker
-thermos flask
-thermometer
-wooden spoon
-place to maintain temperature (e.g. a hay box).

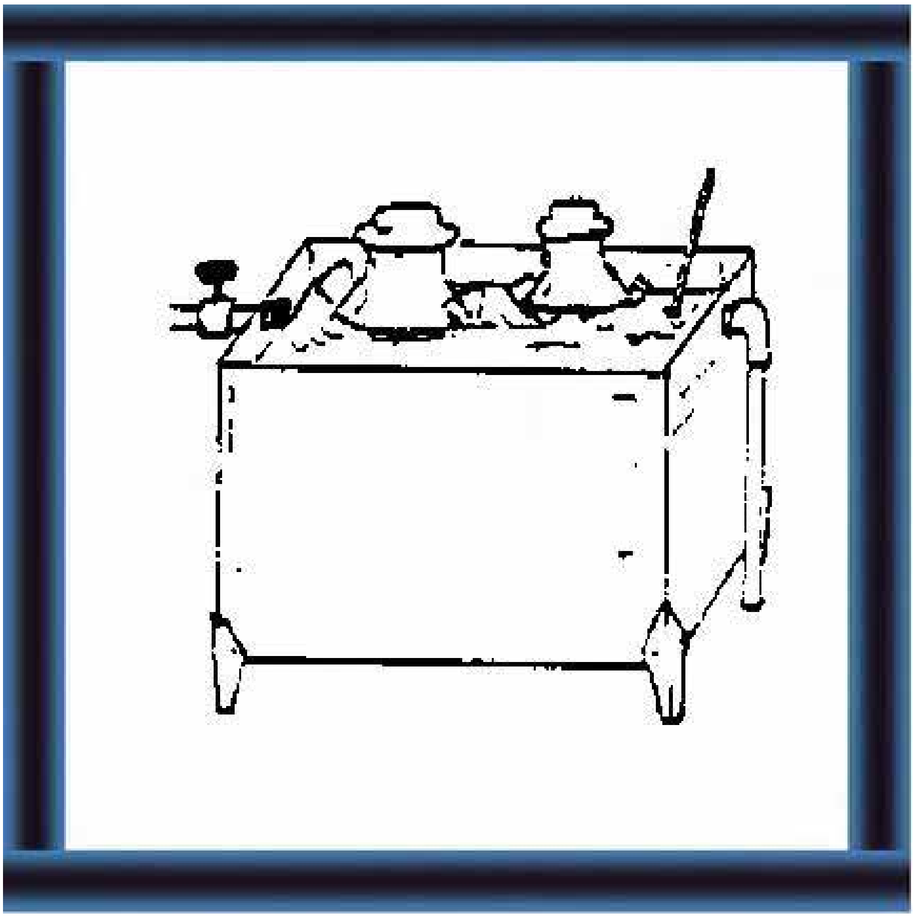
Preparing the milk



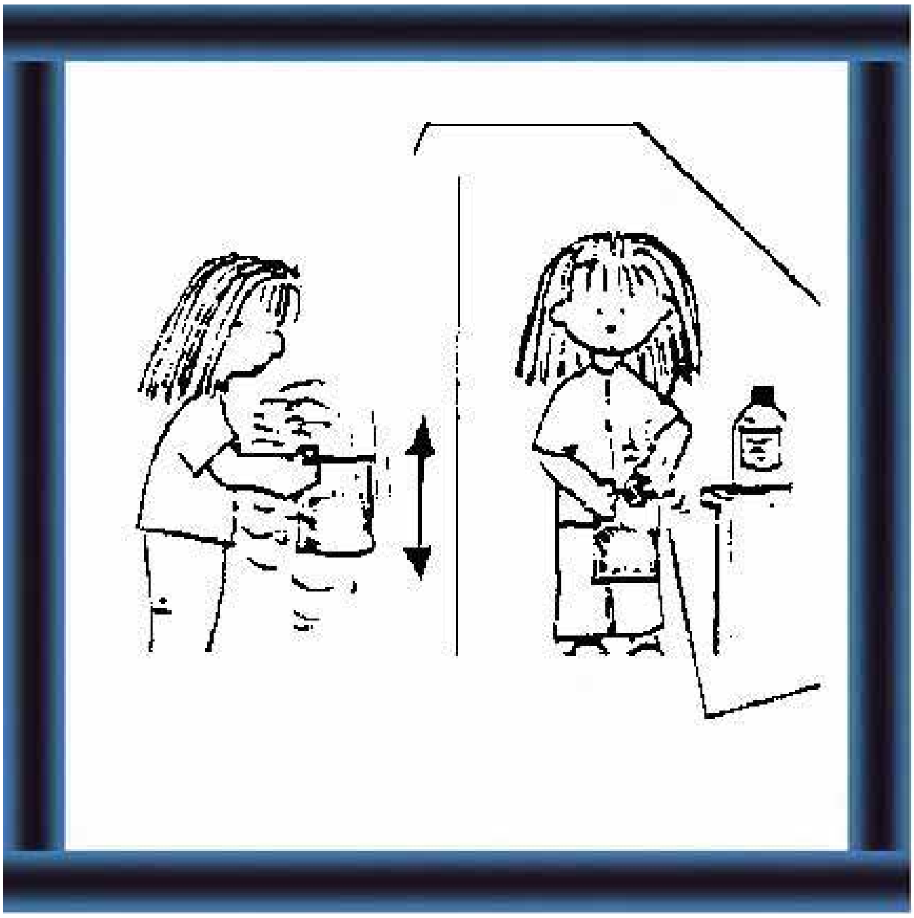
25 **Remove the cream** from high quality milk by skimming or with a hand separator.



26 **Heat treat** the skim milk in a closed pot or jacket vat at 90-95 C for 30-60 minutes.

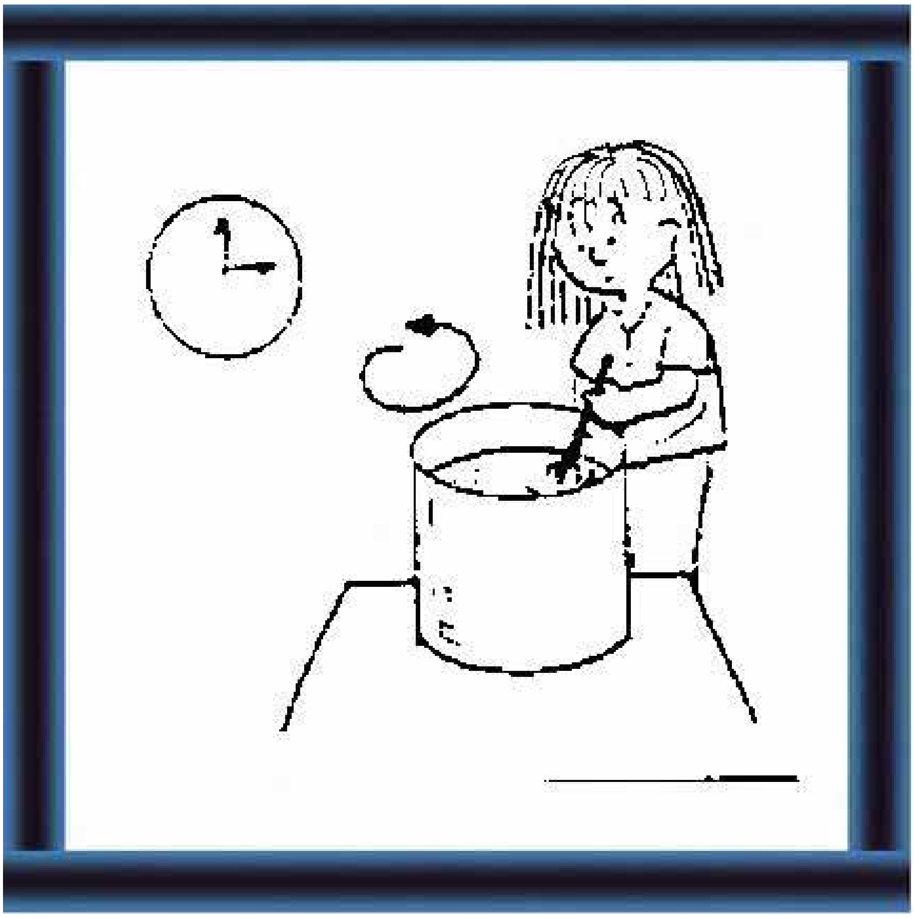


27 **Cool** the milk to the inoculation temperature (see instructions on the starter culture packet.)



Preparing the culture

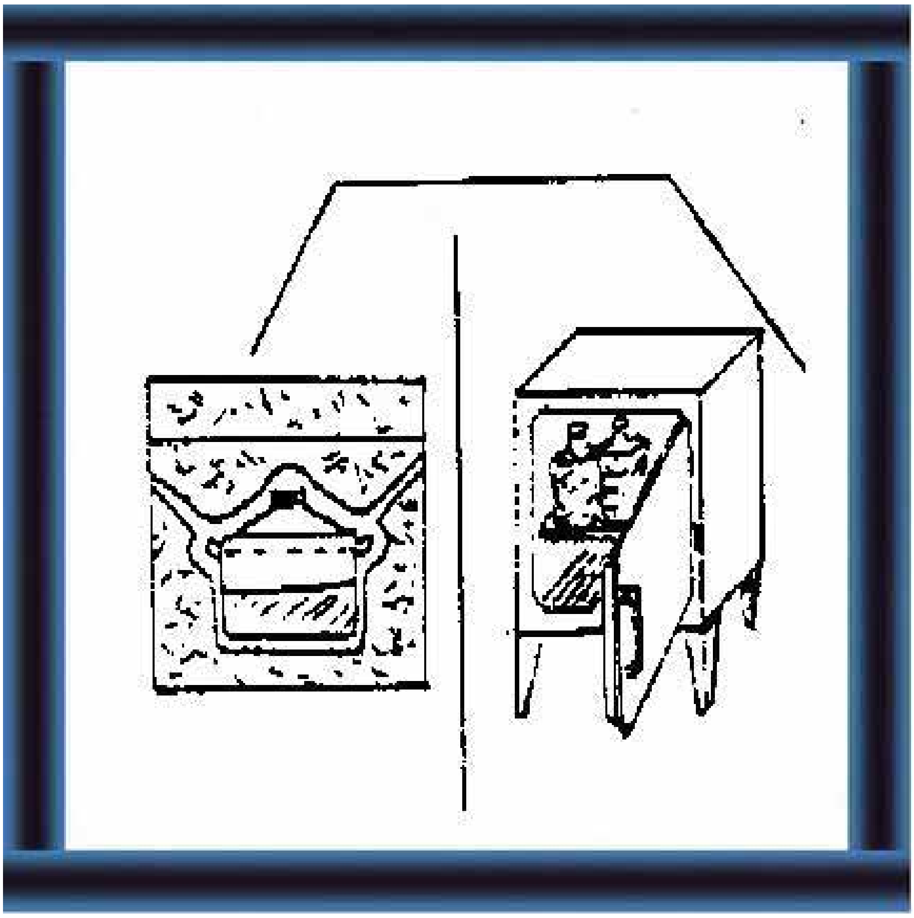
28 **Defrost** the packet 30 minutes before use. **Shake** the powder to the bottom of the packet. **Disinfect** the top part of the packet with alcohol before opening.



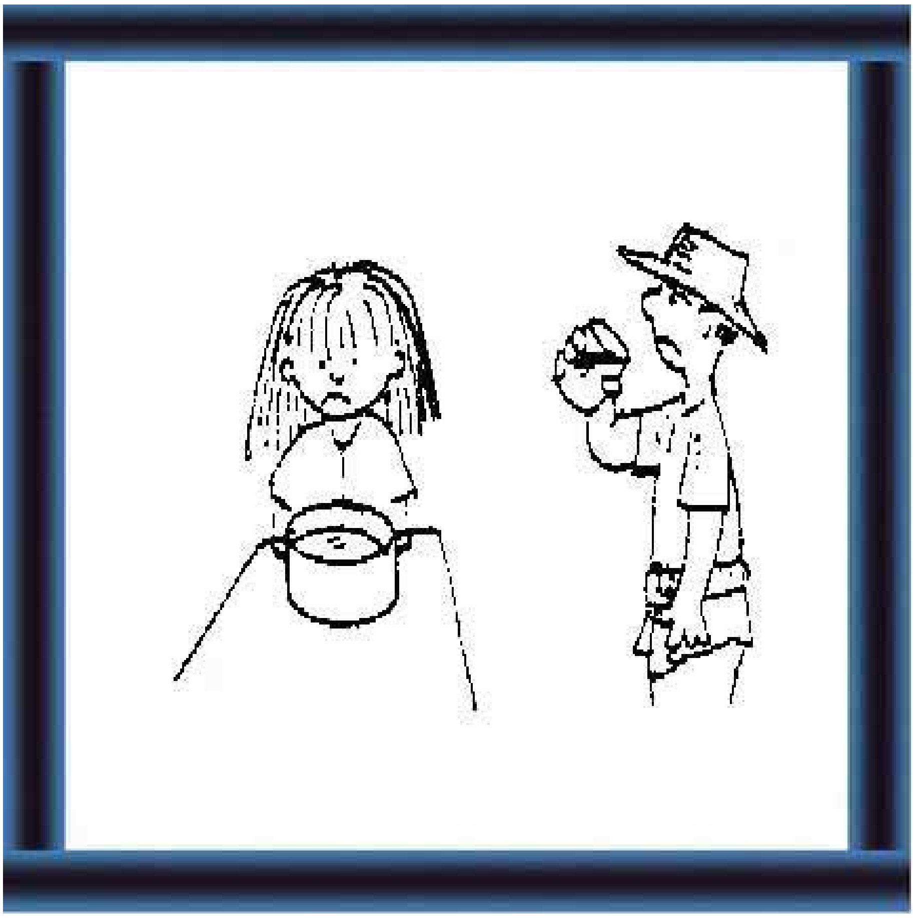
29 **Add** the starter culture to the treated milk and **stir thoroughly** (10-15 minutes). You can also make the culture into a paste first with a little boiled milk.

Maturing the culture

30 Keep the culture at the **correct temperature** for 24 hours



(see packet) by:
-using a hay box or
-wrapping in cloth in a cupboard or
-using a thermos flask.



Maintaining the culture

31 If you keep the mother culture for a **long time**, it gets **weaker**.

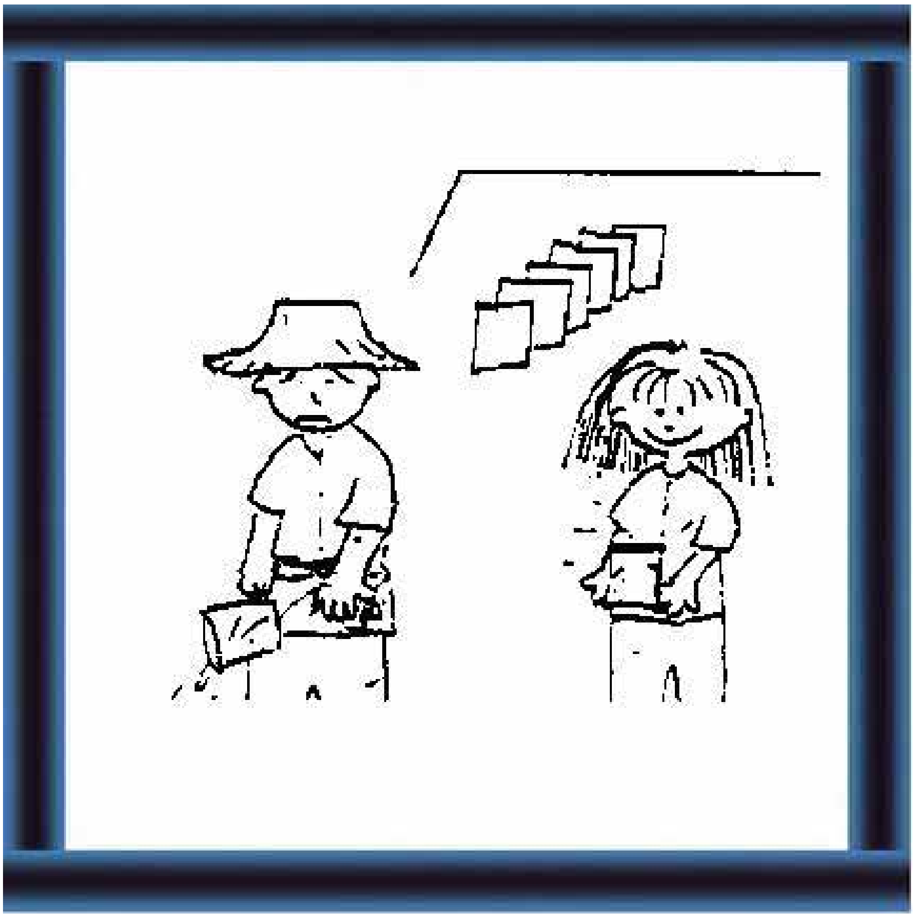
32 Use the **clean** measuring breaker to **inoculate treated milk** with 0.5% mother culture (5 ml culture to 1 l treated milk):
-daily if you have no refrigerator
-weekly if you have one.

Important points

33 The **amount of mother**

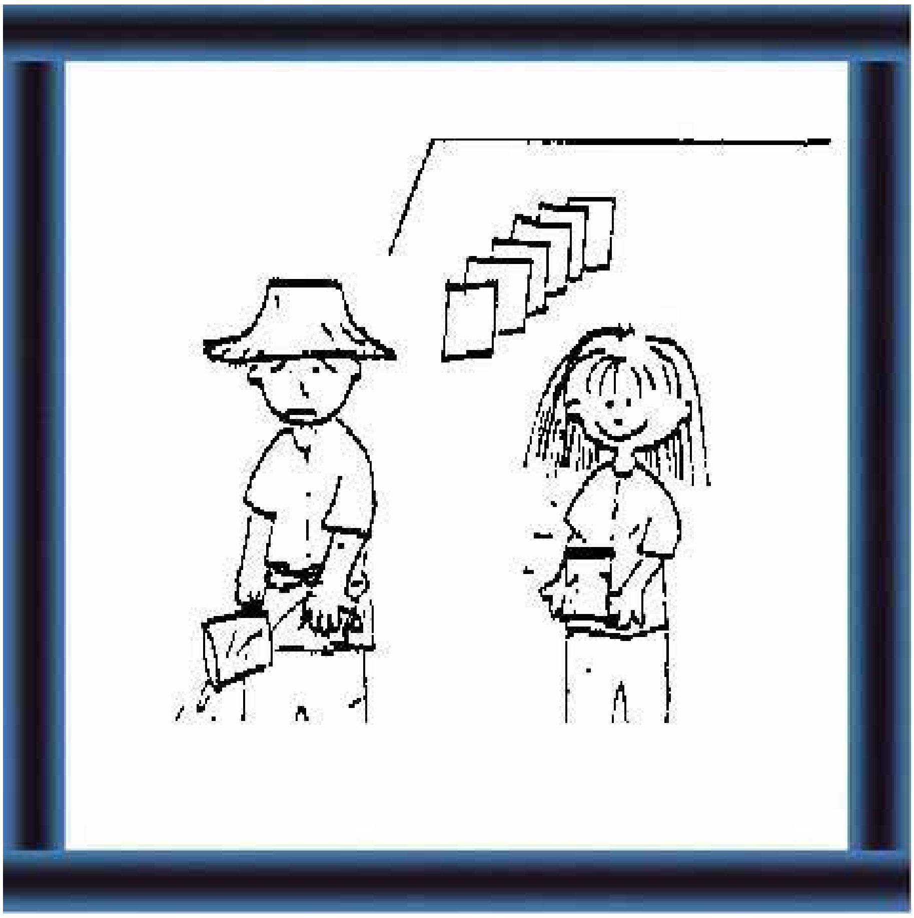
culture for inoculation depends on the **storage temperature.**

Try different amounts until it works well.



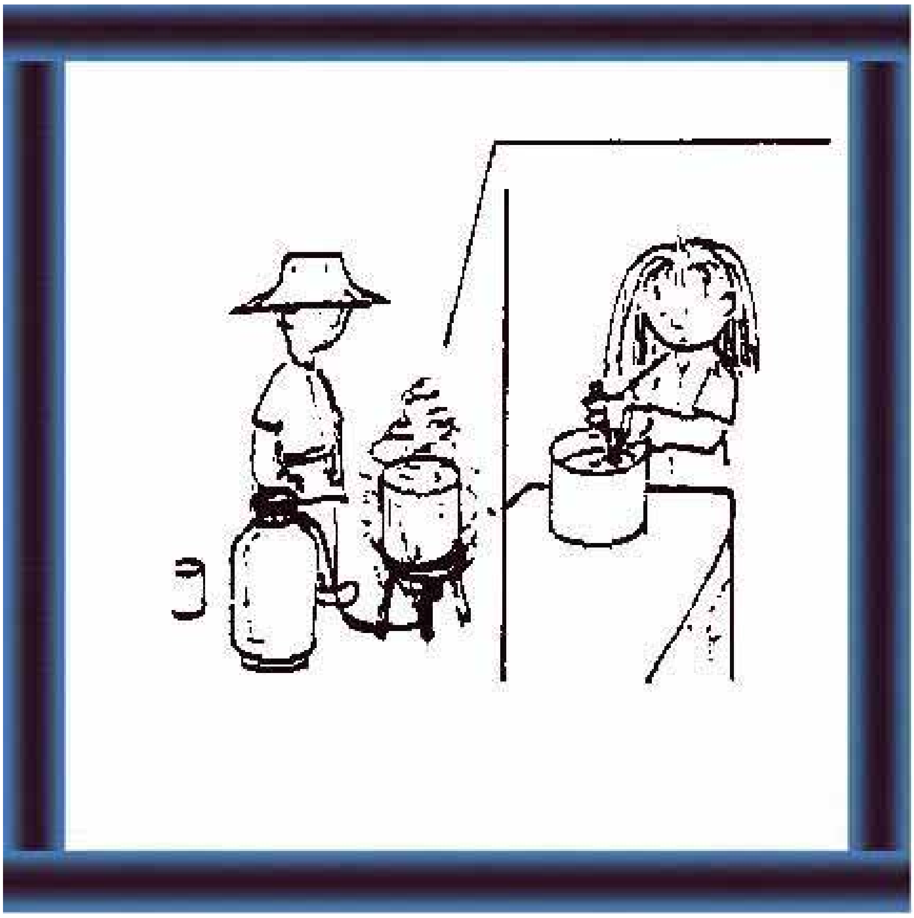
34 Keep the culture in **clean** glass pots, **not** more than half full.

Take the culture from the freezer **only** when necessary and **defrost** before use.



35 The mother culture gets **weak** after some time.

Although it costs more, it is **safer** and **better** to use new starter culture powder after each period.



36 If you use **milk powder** make sure the water is **boiled.**

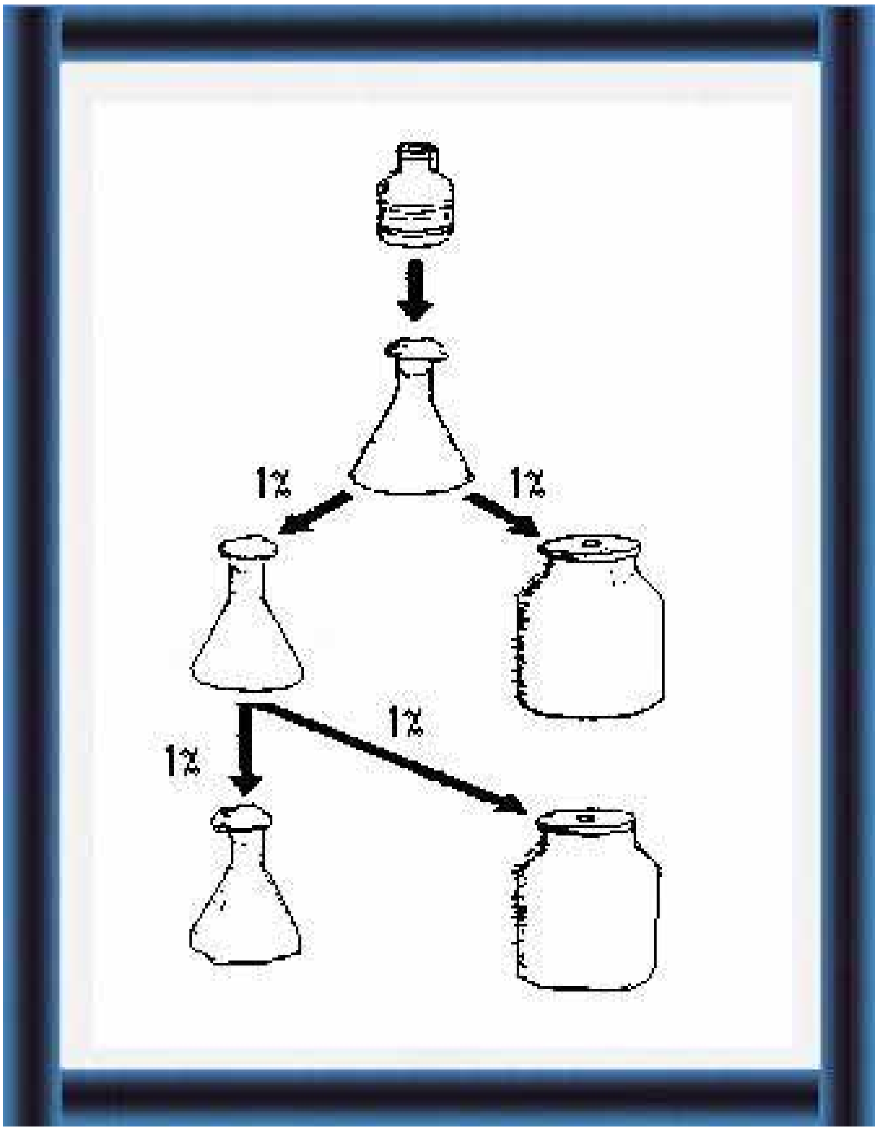
You can **improve your raw milk** for starter preparation by adding 2-3% skim milk powder.

How can you prepare mother cultures for making cheese and yoghurt?

Starter culture for cheese-making

Lyophilized Starter Culture (mesophilic)

37



Mother culture
16h at20 C
in a flask
acidity 80-90^0 D=

0.8-0.9% lactic acid

Second
Mother Starter
Culture
Culture
16h at 20 C

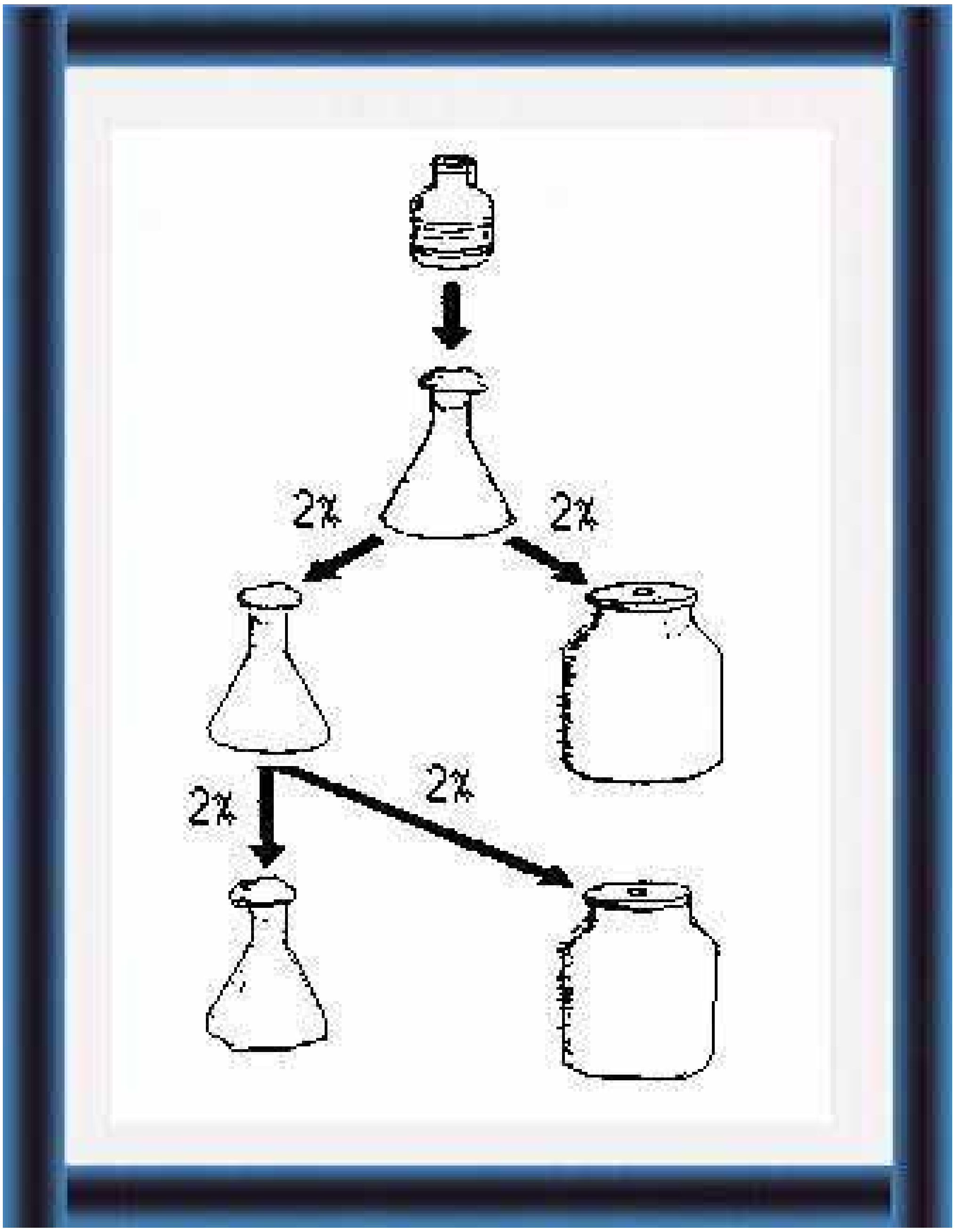
5 l of treated milk

Third
Mother
Starter Culture
Culture
16h at 20 C

Starter culture for yoghurt-making

Lyophilized Starter Culture (thermophilic)

38



Make sure that the treated milk is stable at 45 C before adding the starter culture.

Mother culture
4h at45 C
in a flask
acidity 80^0D =

0.8 lactic acid

Second Mother Starter Culture Culture
4 h at 45 C

5 l of treated milk

Third Mother Starter Culture Culture
4h at 45 C

What do you know about starter cultures?

Starter cultures and their use

Lactic acid bacteria in milk:	(5-6)
1 Change lactose to lactic acid	
2 Sour milk	
Reasons for use	
1 Controlled fermentation and preservation	(7-10)
2 Production of different milk products	(11)
Types of starter culture	
Classified by:	
1 Growth temperature	(13)
2 Physical state	(14-15)
3 Pure/mixed	(16)
4 Type of lactic acid bacteria	(17)
5 Desired product	(18-20)

Preparation and maintenance

1 Hygiene	(21-22)
2 Equipment and materials	(23-24)
3 Preparing the milk	(25-27)
4 Preparing the culture	(28-29)
5 Maturing the culture	(30)
6 Maintaining the culture	(31-32)
7 Important points	(33-36)

Examples of starter cultures

1 Cheese-making	**(37)**
2 Yoghurt making	**(38)**

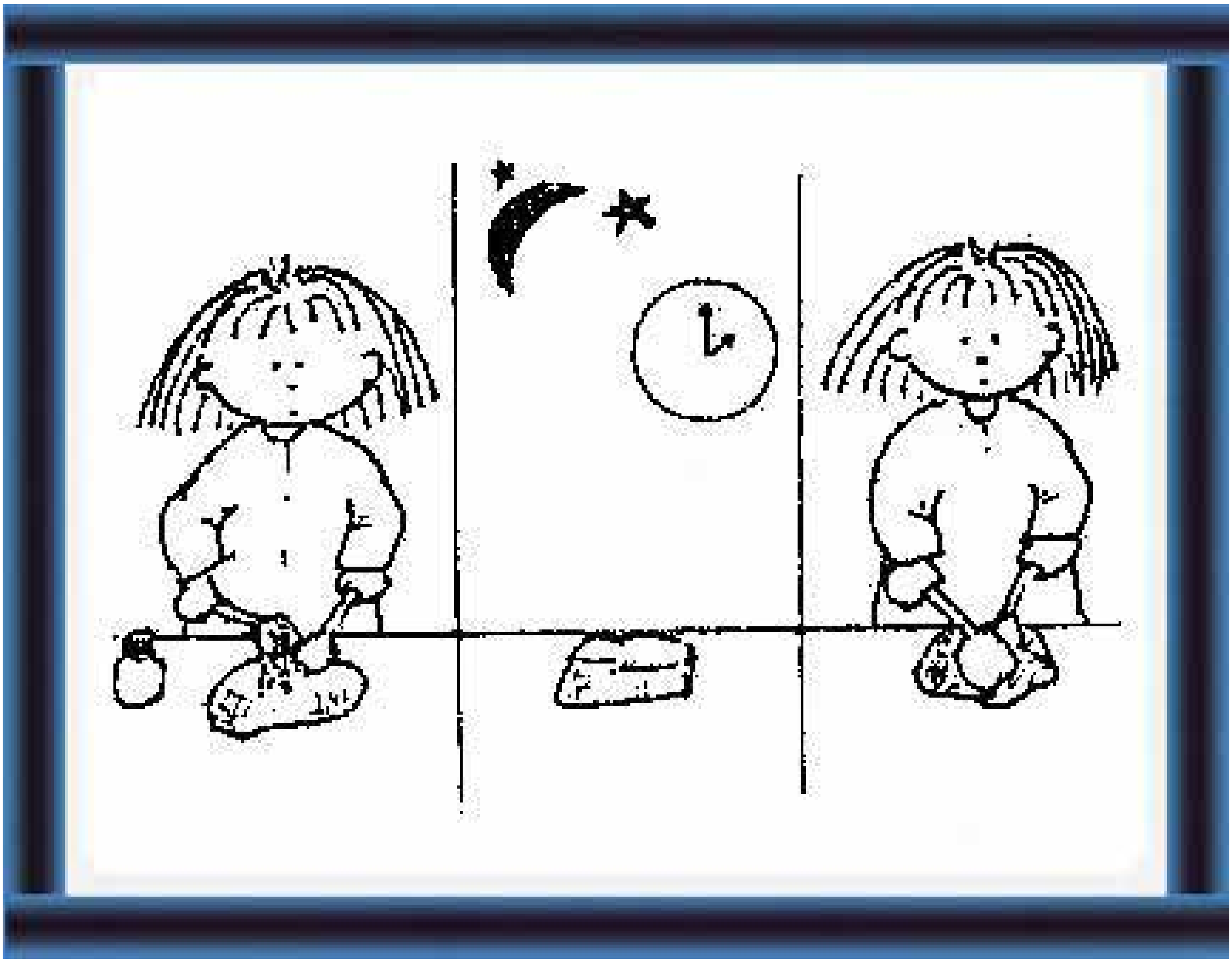
Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 10.2

Small Scale Butter Making



Extension Materials

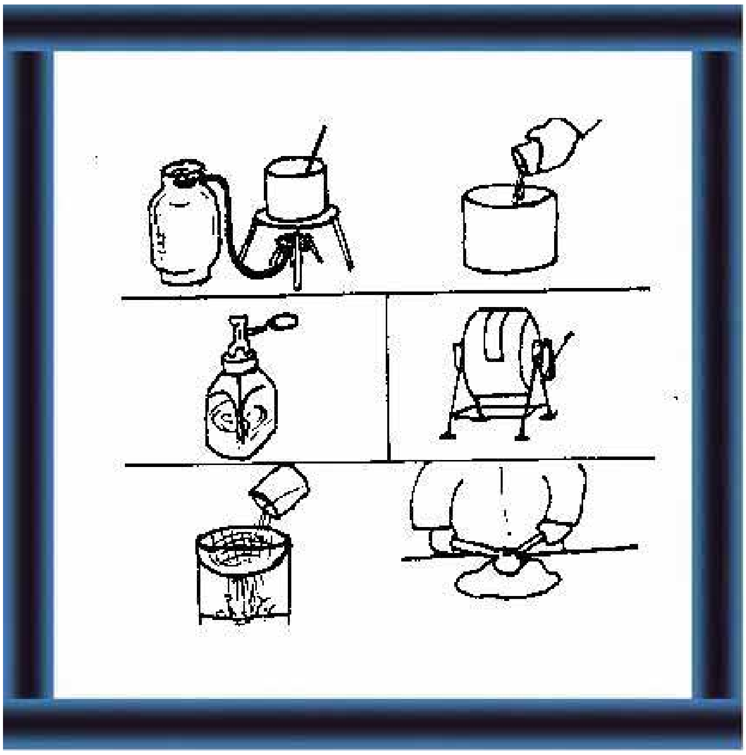
What should you know about making butter?

What is butter and what types are there? (5-11)

1 You should know:

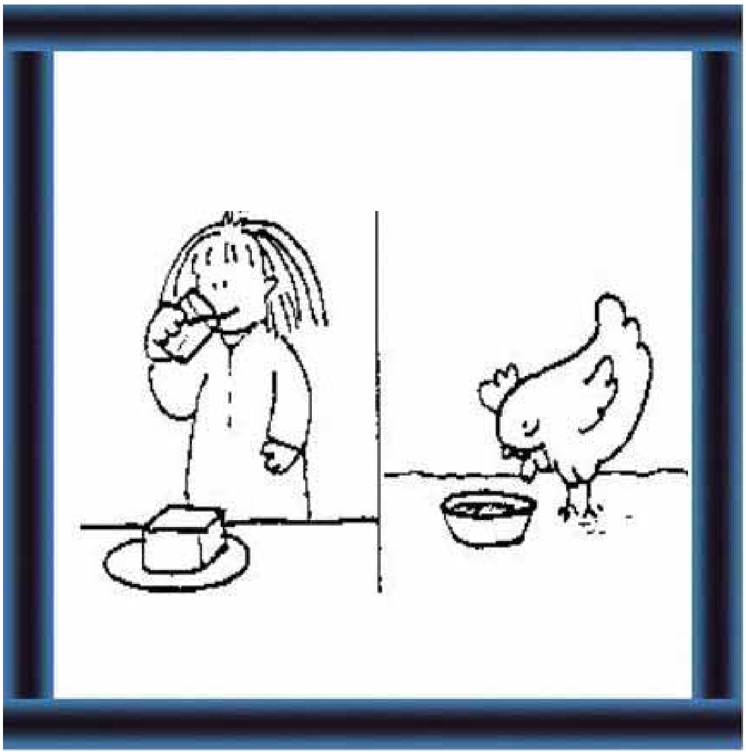
- what is **in** butter e.g. **butterfat** and **water**

- the different types of butter e.g. **salted** and **non-salted**, **sweet** and **cultured** butter.



How do you make butter? (12-59)

2 **Prepare** milk or cream by heat treatment and ripening (for cultured butter).
Churn on a small or a larger scale.
Wash and **work** the butter.



What can you do with buttermilk?(60-63)

3 You can use it for:

- **drinking** or making **milk products**

- **animal feed**.

What can be wrong with butter? (64-75)

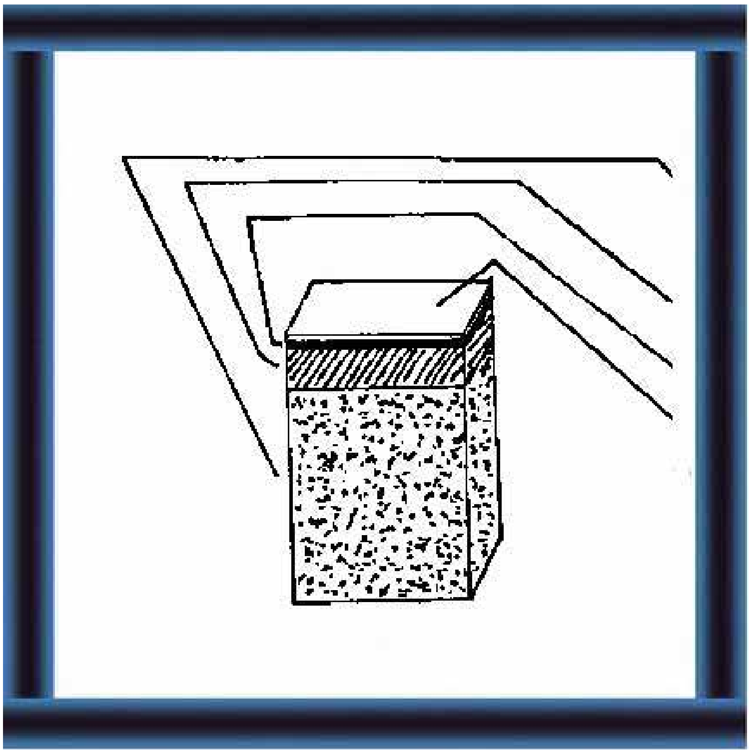
4 If your butter has a bad smell, taste, texture or appearance, **check** your:

- husbandry

- raw materials

- method of making butter.

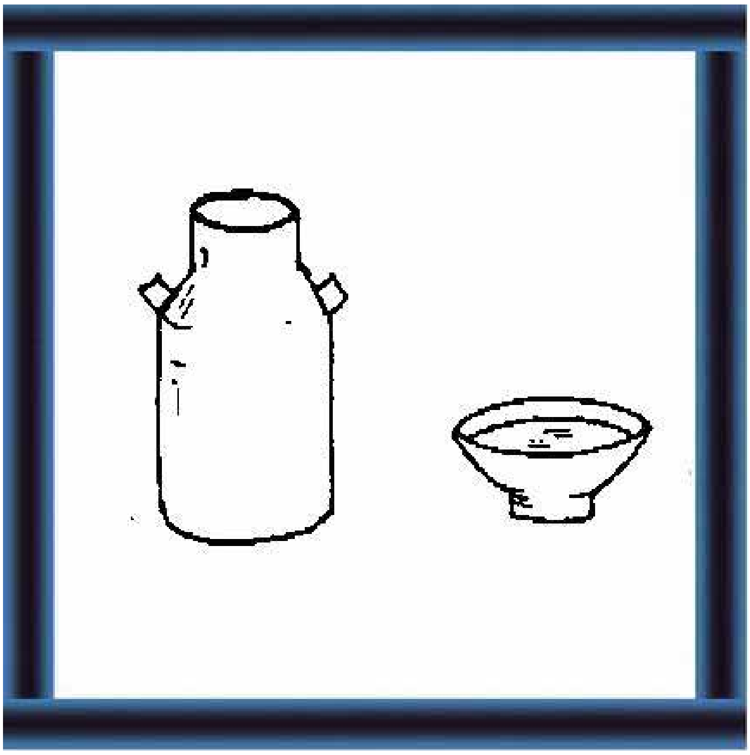
What is butter?



5 Butter contains about:

- 80 % butterfat (minimum)

- 16 % water (maximum)
- 1-2 % solids-not-fat
- 0.2 % salt.



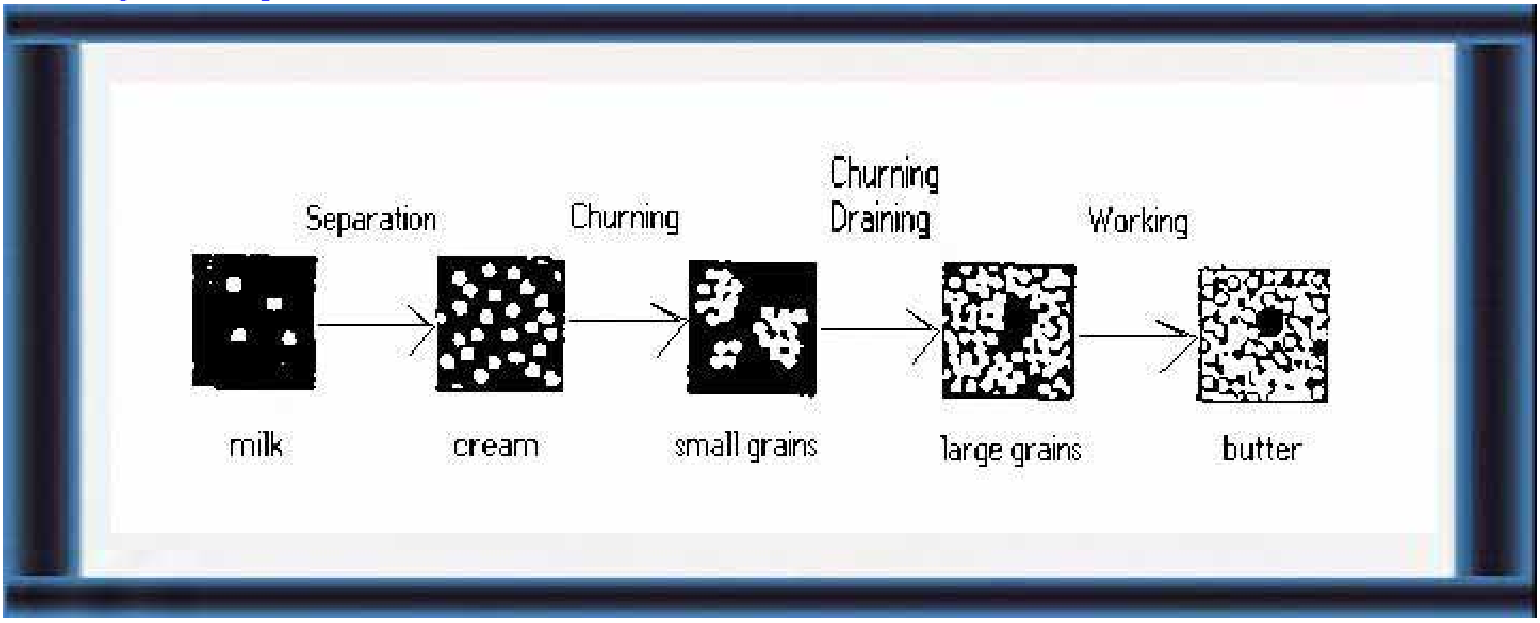
6 You can make butter from:

- milk or

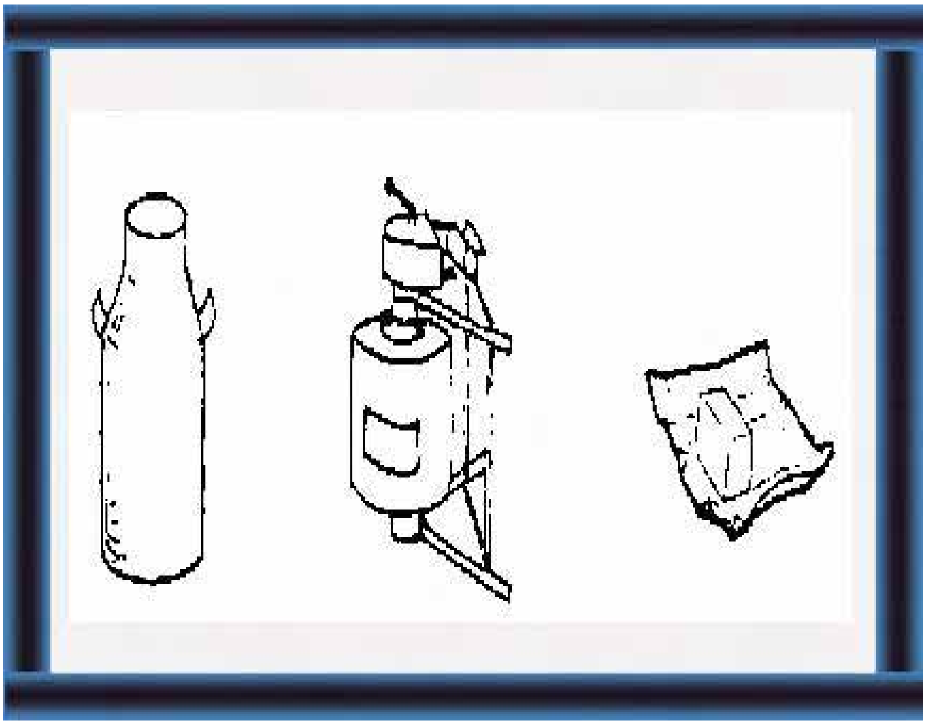
- cream.

1 l of cream makes about 300-400 g butter.

7 The steps in making butter are:



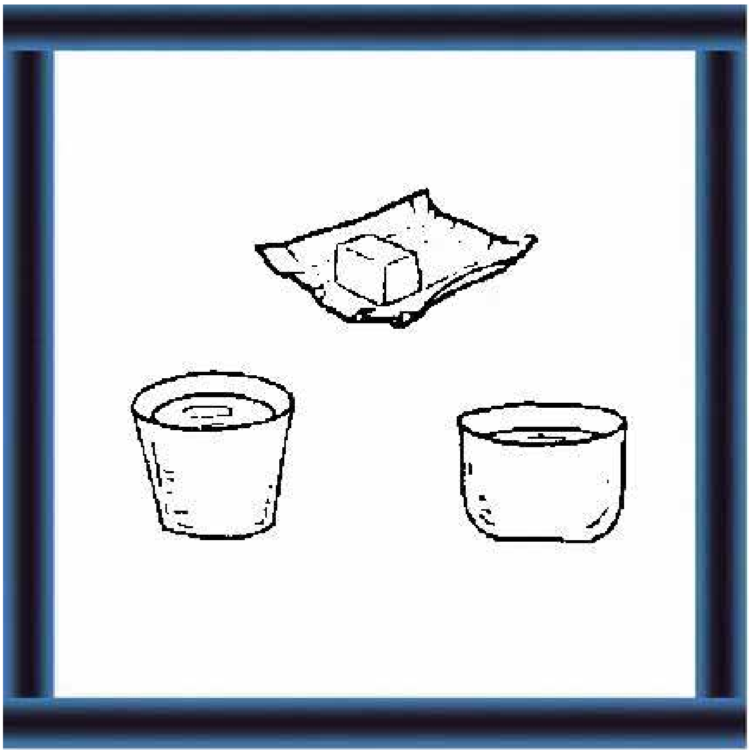
8



MILK -> CHURNING MIXTURE -> BUTTER

MILK	CHURNING MIXTURE	BUTTER
approx. 4.2 % fat	**min. 3.5 - approx. 40 % fat**	**min. 80 - approx. 83 % fat**

What types of butter are there



9 You can make butter from:

- **fresh** cream

- **cultured** cream.

10 You can make butter:

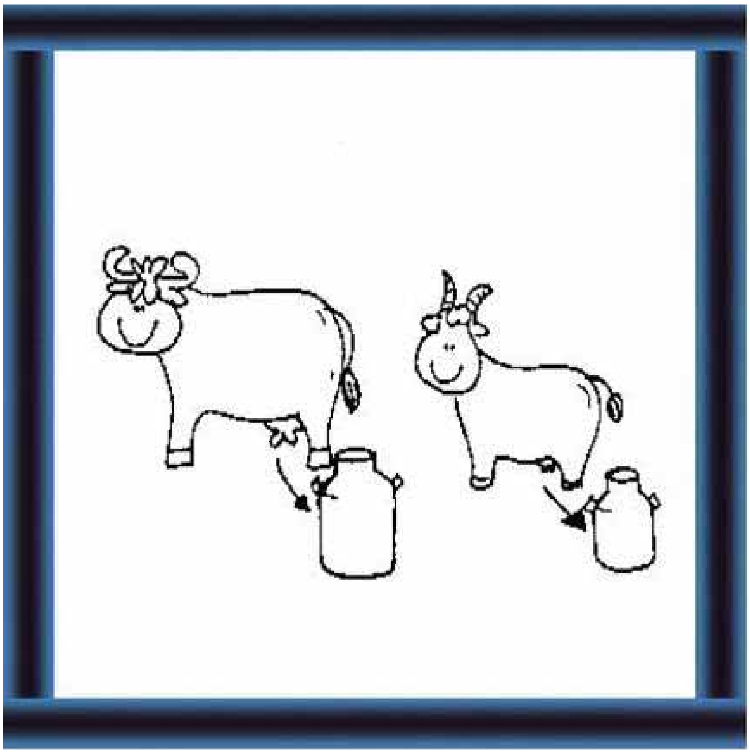
- **without** salt

- **with** salt.

11 For cooking purposes you can make **herb butter** by adding:

- **parsley** or

- **garlic**.



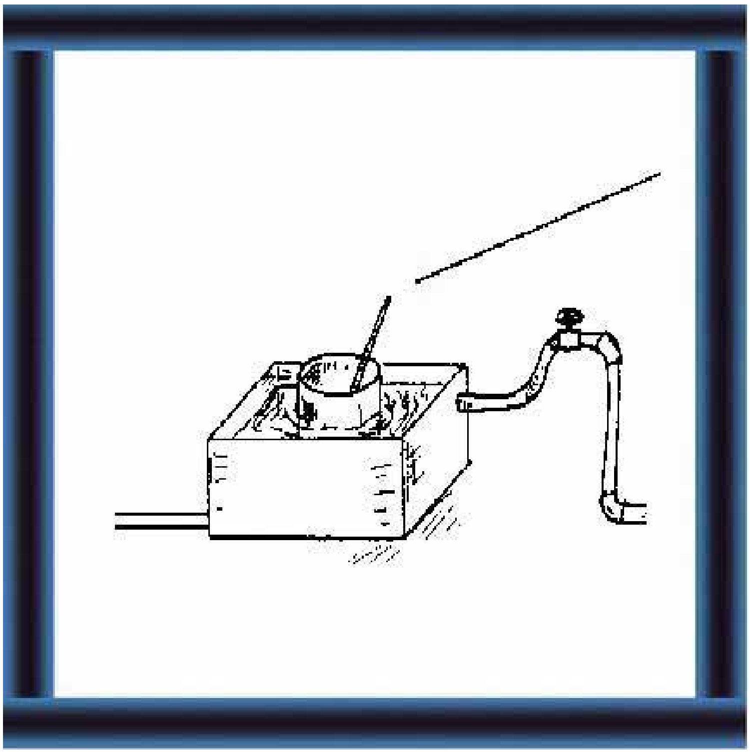
12 **How do you make cultured butter?**

The following recipe is for **cow** or **goat's** milk.

You may need to **change** it for **other** types of milk.

Heating

13 **Heat** the milk or cream to 80 C-90 C.



Cooling

14 Then **cool** it quickly to 18 C in running water.

Use a **thermometer** to measure the temperature accurately.

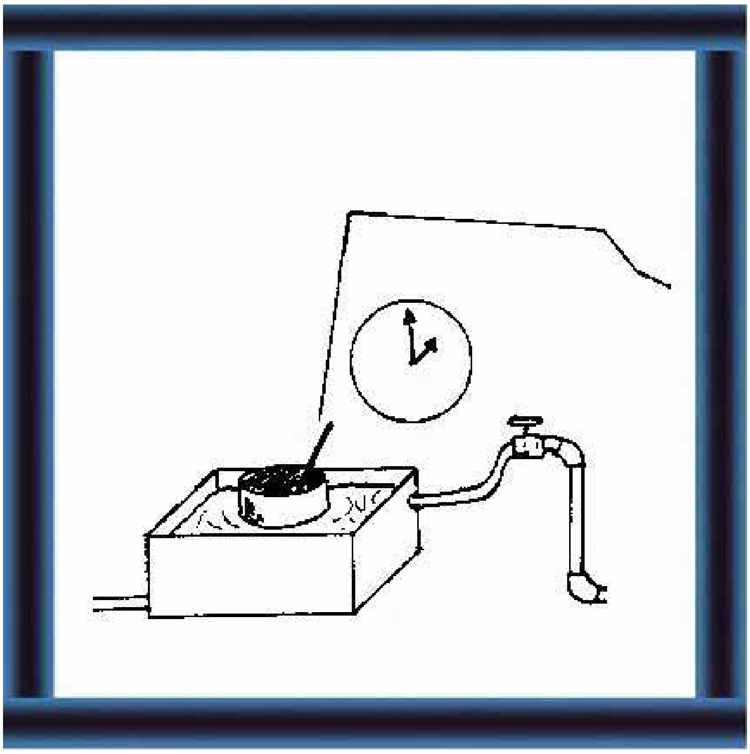
15 **Ripening**

Then **ripen.**

For each 1 1 of milk or cream:

add 50 cc of (3 desert spoons) of sour butter milk or mesophilic starter;

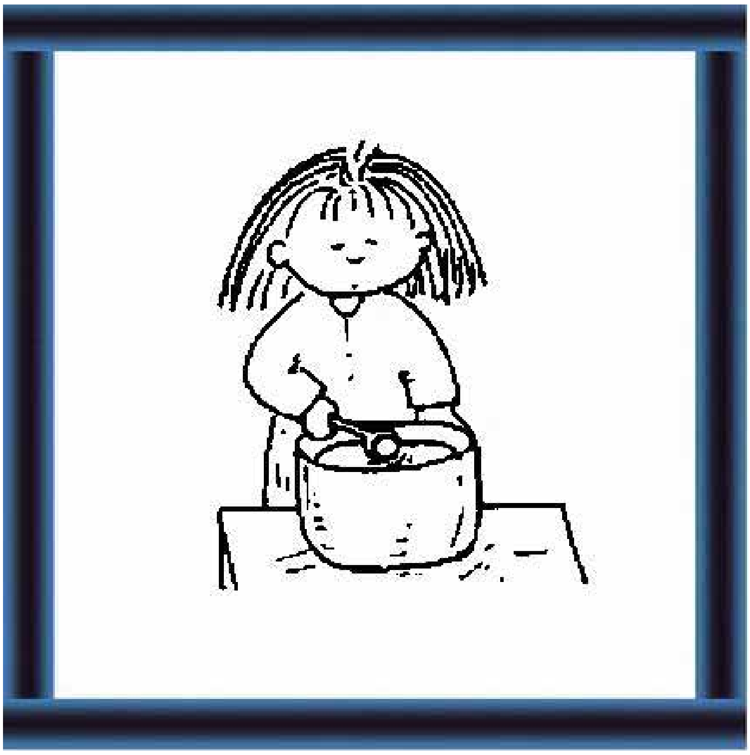
-stir this into the milk or cream



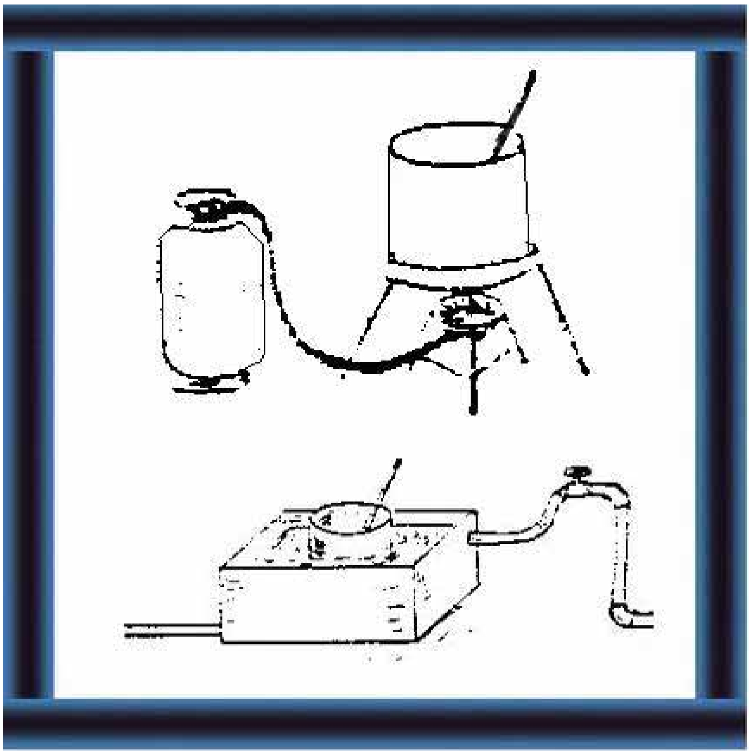
16 **Cover** container and leave for **24 hours at 18 C.**

17 You can use raw milk or cream which is sour naturally if it still tastes and smells **fresh**.

Do **not** ripen it.



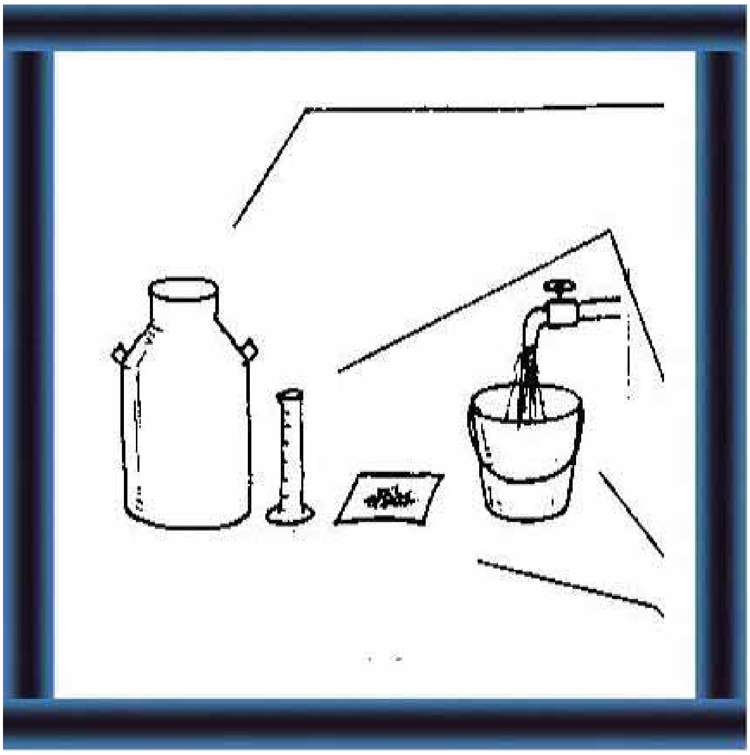
18 You can also make non-cultured or sweet butter from **sweet cream**.
If you collect cream for **several days**, check the **acidity** before pasteurizing.
The cream should have **0.10-0.15 % lactic acid**.
If your cream is **very acid**, you can **reduce the acidity** by adding chemicals.
Ask your extension worker for **advice**.



19 **Heat** the cream as before to **80-90** C.

Cool the cream to the **lowest** possible temperature.

What do you need to make butter from sour cream or milk?



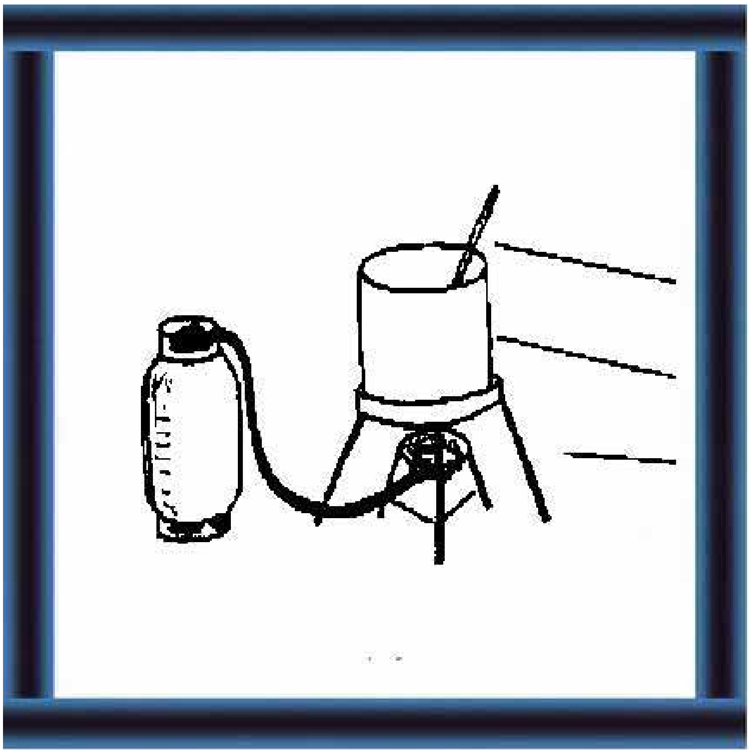
Raw materials
20 You need:

- milk or cream

- sour buttermilk or starter

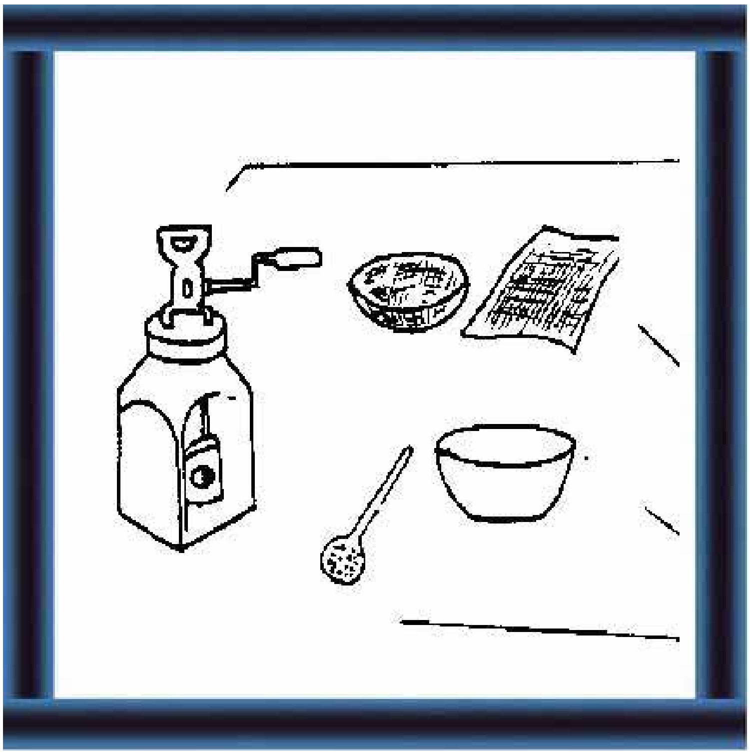
- fine salt

- clean water.



Equipment

21 You need:
- a heater
- a container for the milk or cream
- a thermometer to measure temperature



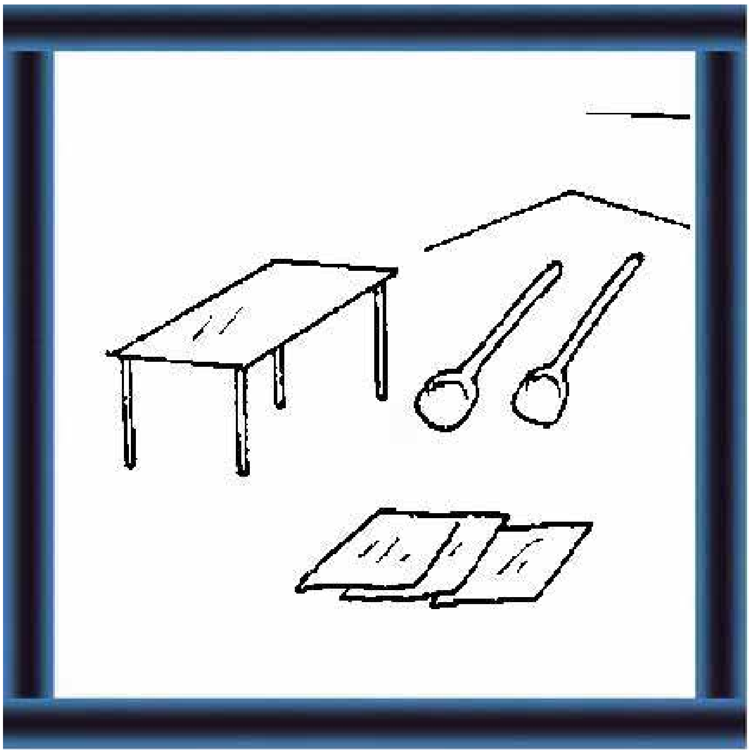
22

- a churn

- a sieve or coarse cloth

- a skimmer

- a bowl



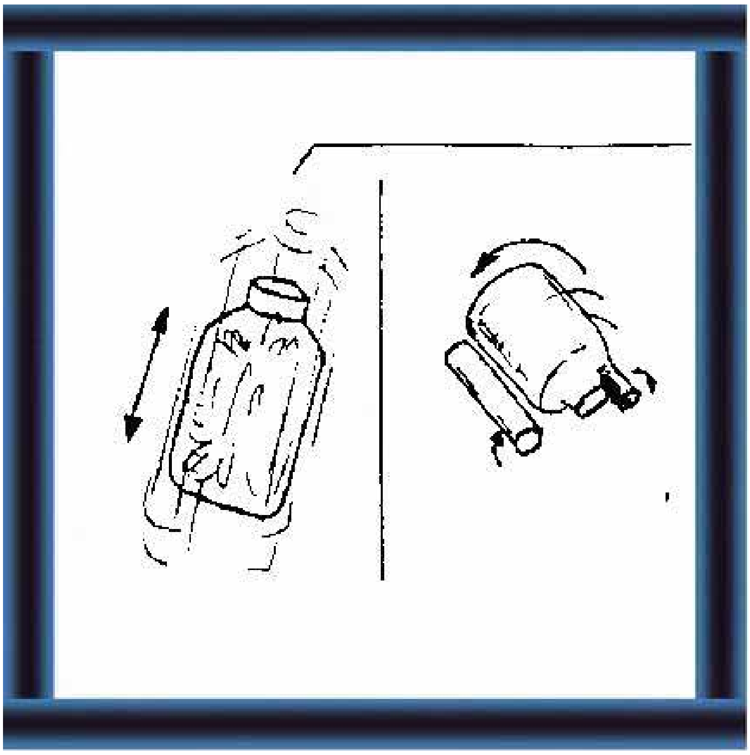
23

- a working table

- wooden spoons

- greaseproof paper for wrapping the butter.

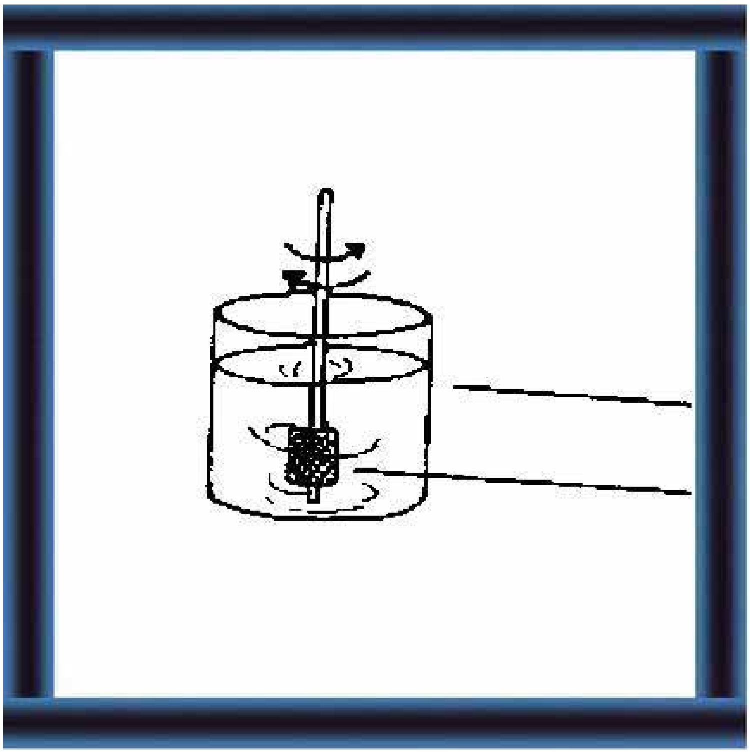
Small-scale churning



24 You can churn milk or cream:

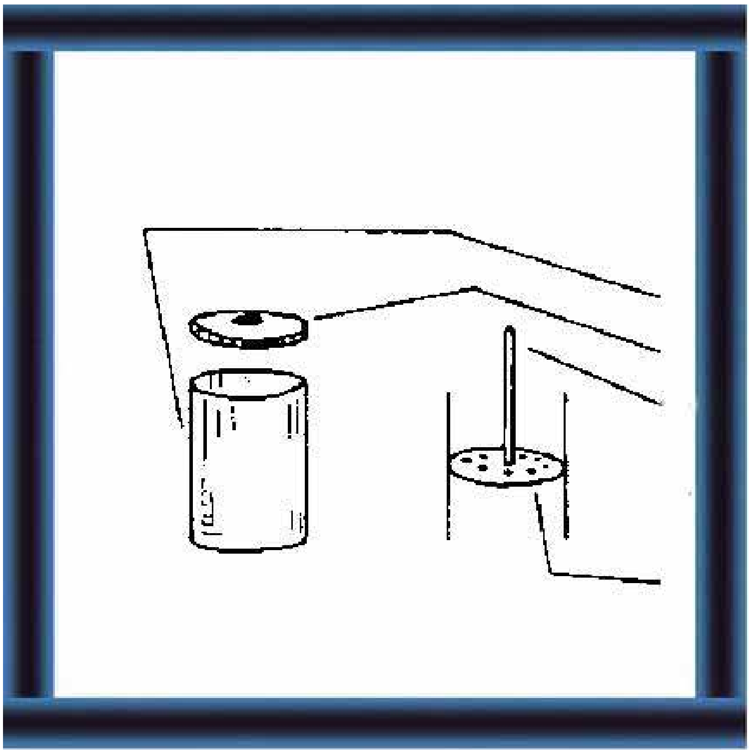
- by **shaking** in a **sealed bottle**

- by **rotating** in a **milk can** but it can be difficult to remove the butter



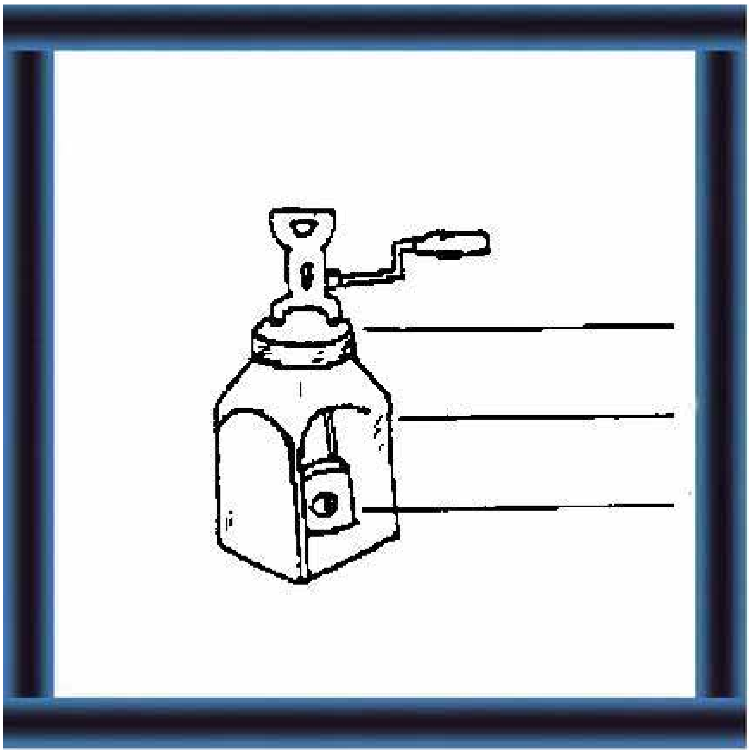
25

- by **whipping** in a bowl:
- **bowl** with cream or milk
- **rotating whippers**

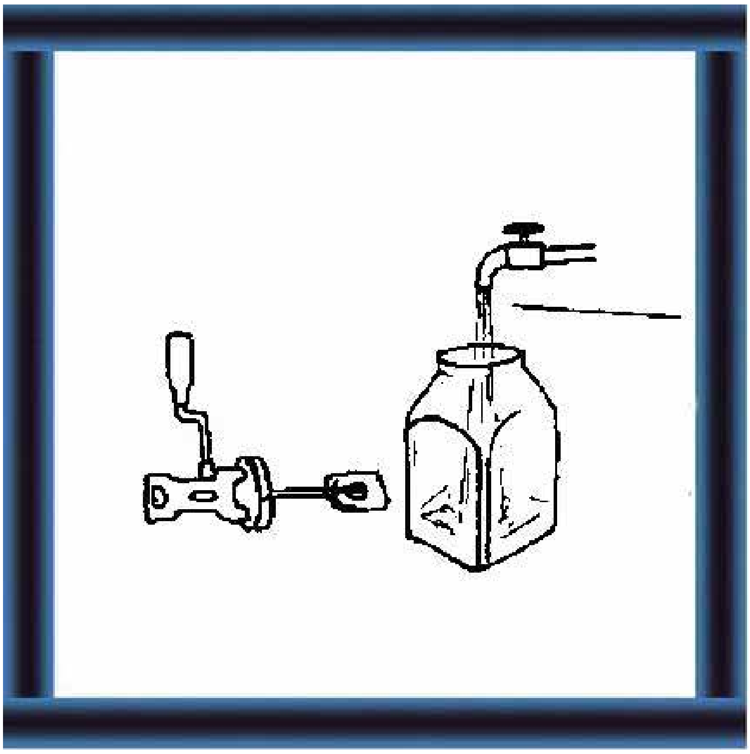


26

- by **plunging** in a container
- **tub** or **can**
- **lid** with **hole**
- **plunger**, moves up and down
- **wooden disc** with **holes**.

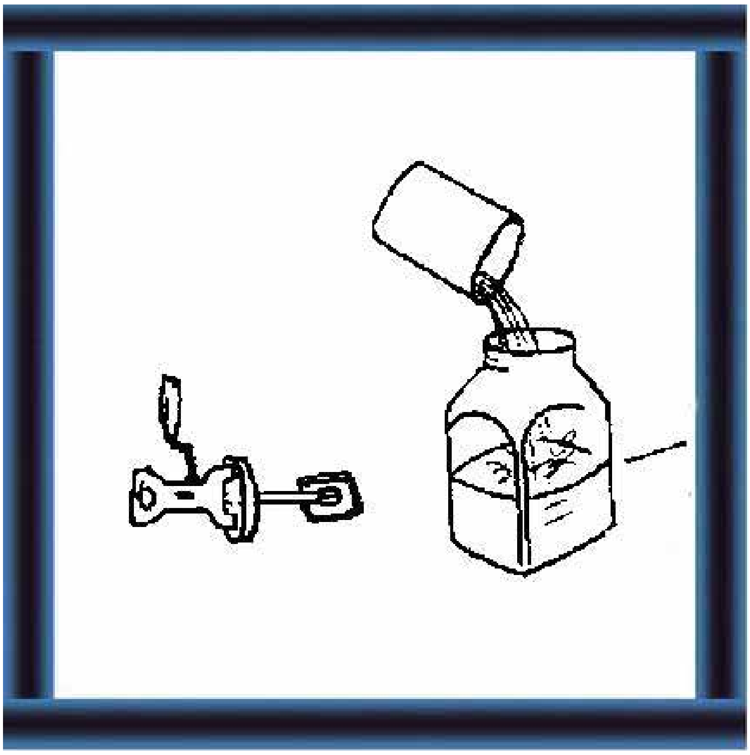


27 This is a small **household glass churn**:
- **screw lid**
- **glass container**
- **rotating whippers**.

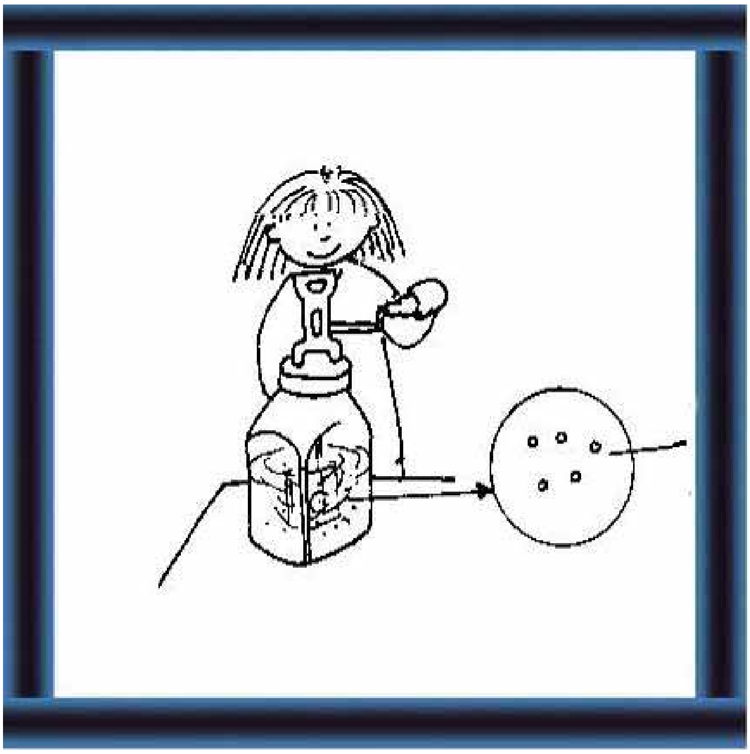


28 **Rinse** the churn with clean water

This **prevents sticking**.



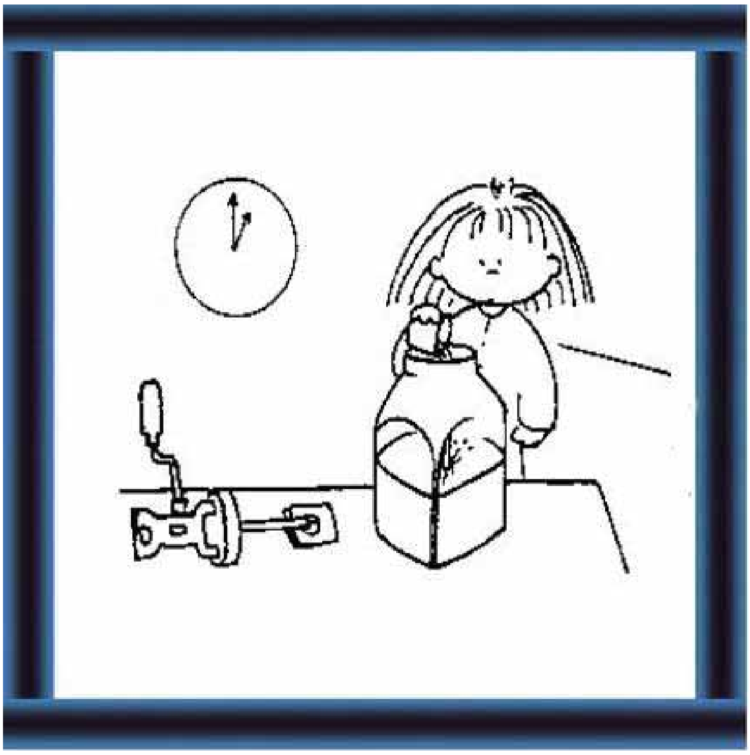
29 **Half fill** with sour milk or sour cream.



30 Churn with a **regular** movement until:

- the pieces of butter are as **big as peas**

- the buttermilk looks **watery**. **Do not** let the pieces of butter become one large lump.

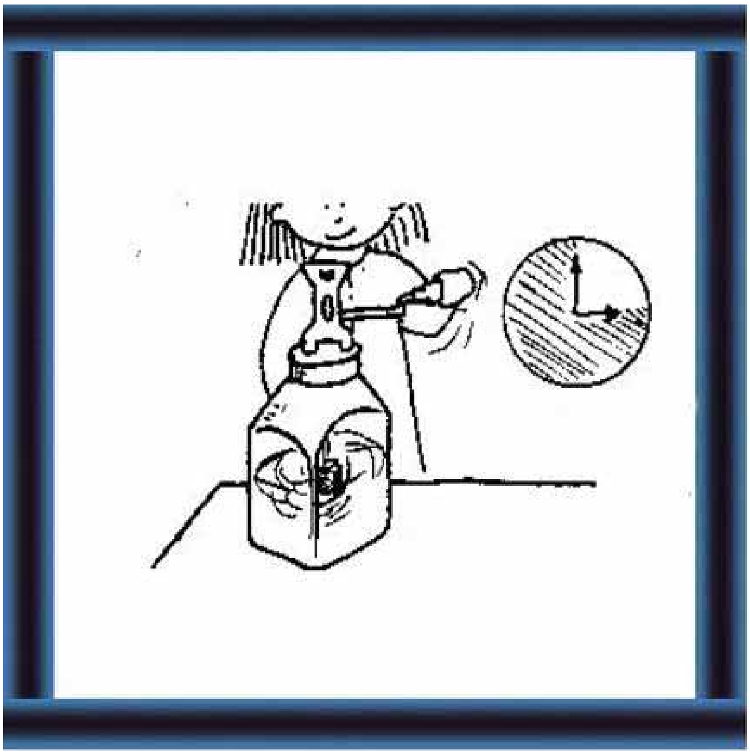


31 If there are **no** pieces of butter after 30 minutes:

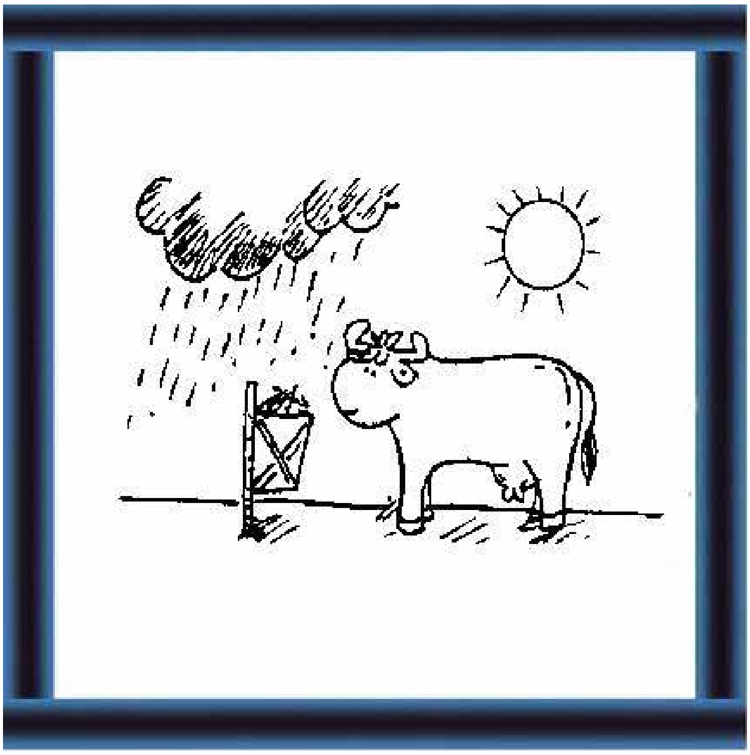
- change the temperature by adding **clean** cool or warm water

- churn again.

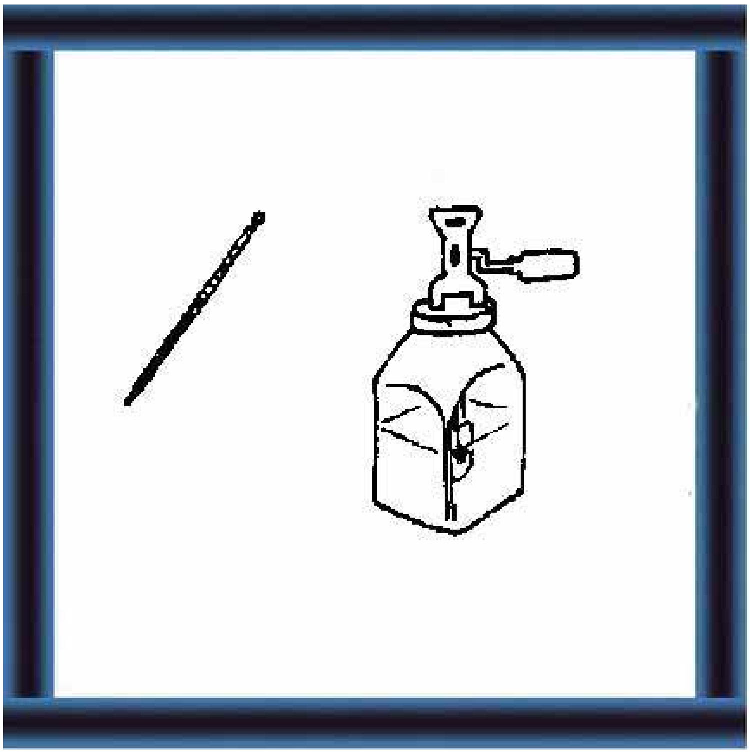
For cream **do not** add more than **25 % water**.



32 Churning may take from **15 to 60 minutes**.

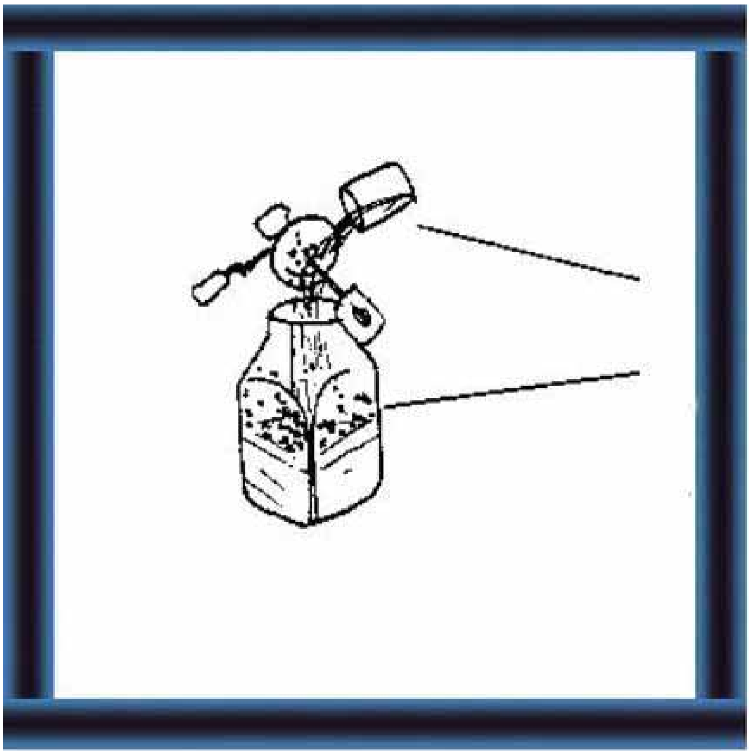


33 The time depends upon:
- the **time of year**
- the **type of animal**
- the **type of feed**



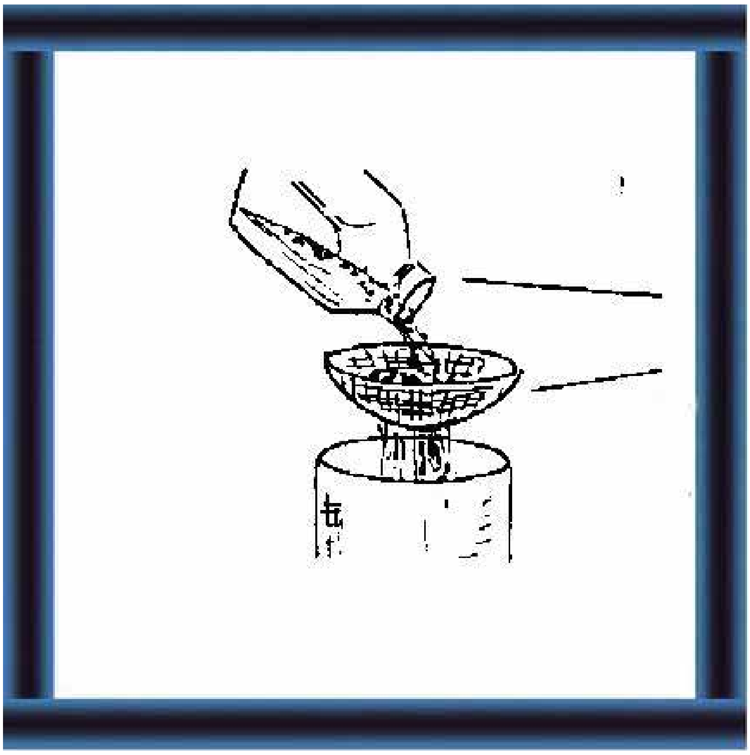
34

- the **temperature**
- the **type of churn**
- the **fullness of the churn**
- the **fat content** of the milk or cream.

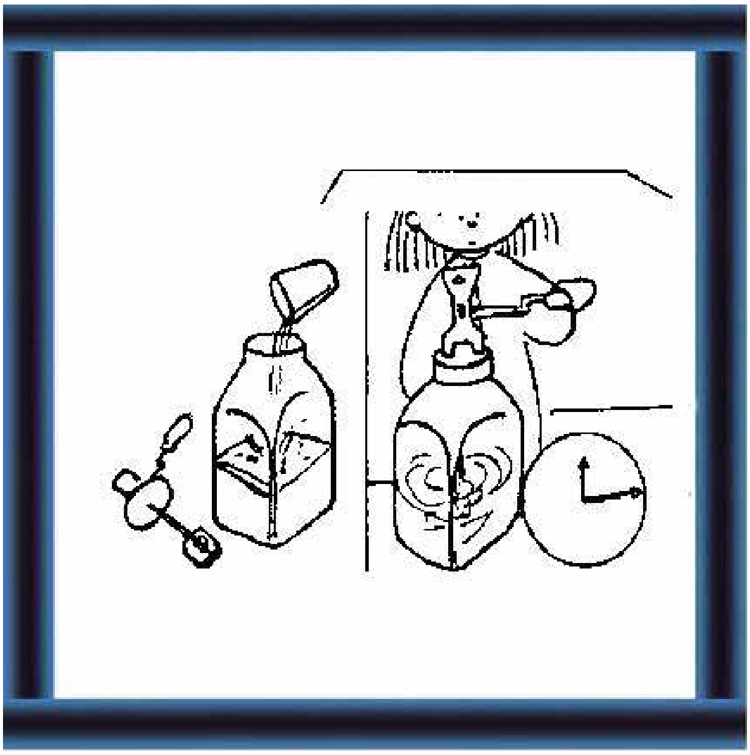


35 **Carefully** remove the pieces of butter from the lid and side with **clean, cold water**.

The water with butter will float **on top** of the buttermilk.
Do not use too much water.



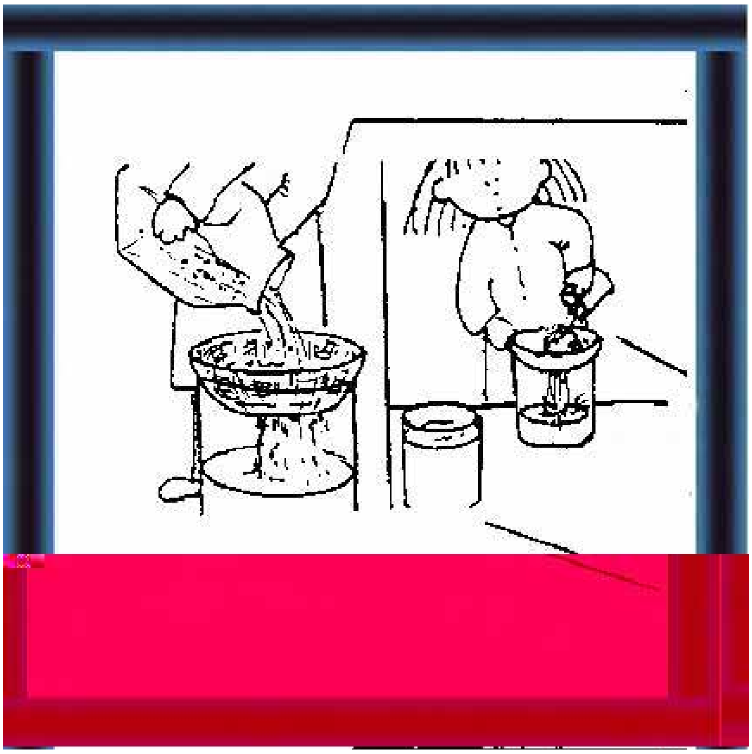
36 **Pour off** the buttermilk through a **coarse sieve**.



Washing

37 Wash the butter to remove the buttermilk - the **more** buttermilk you remove, the **better** your butter.
Either wash the butter in the **churn**:
- **half fill** the churn with **clean cold water**
- **churn** for **at least 10 minutes**

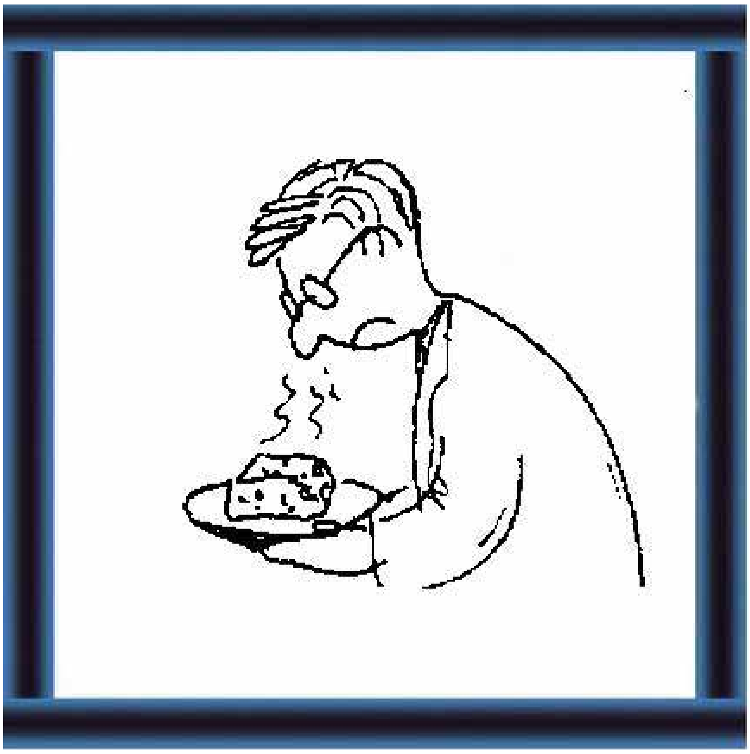
38
- use a **skimmer** to remove the pieces of butter floating on the water



39 **Or** wash the butter in a **sieve**:
- **sieve** the butter and buttermilk
- put the buttermilk on **one side**
- **turn the butter over** while washing with clean cold water.

Do not let the butter become a large lump.

40 If you wash your butter **carefully** you can:
- **lower** the water content
- keep it **longer**.



41 **Do not** overwash.

Your butter will have:
- **less** solids-not-fat
- a **poor** smell.

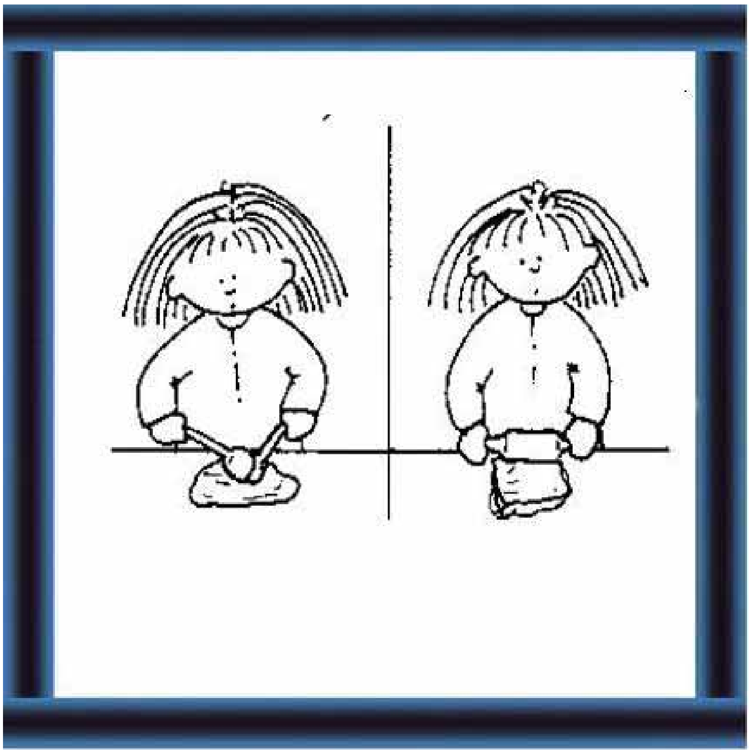
Salting

42 Salt your butter according to **taste**:
- lightly work about **10 g of salt** into every **1 kg of butter**
- leave **overnight**
- work again the **next day**.

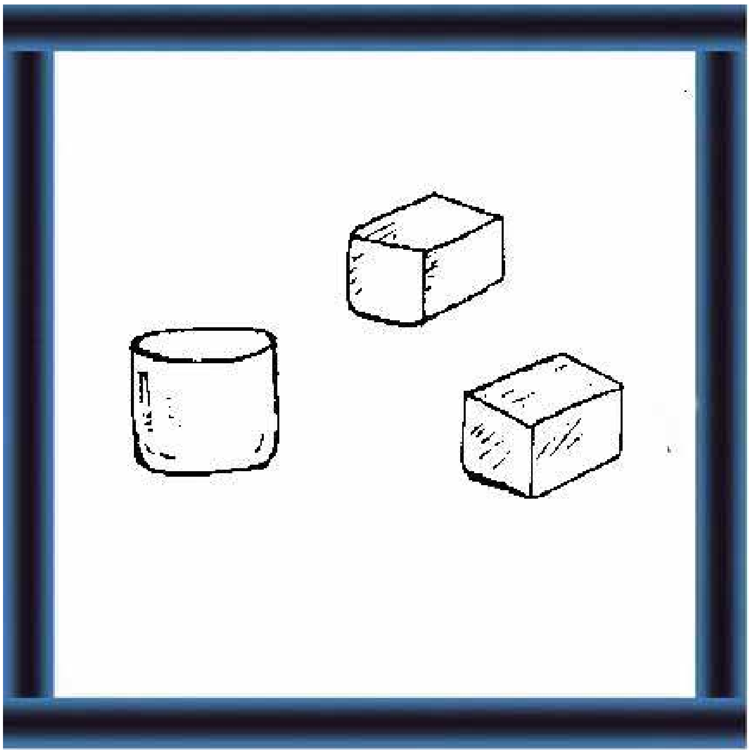
Working (kneading)

43 Working **improves** the **structure** and the **quality** of your butter.

Rinse the working table with **clean water**



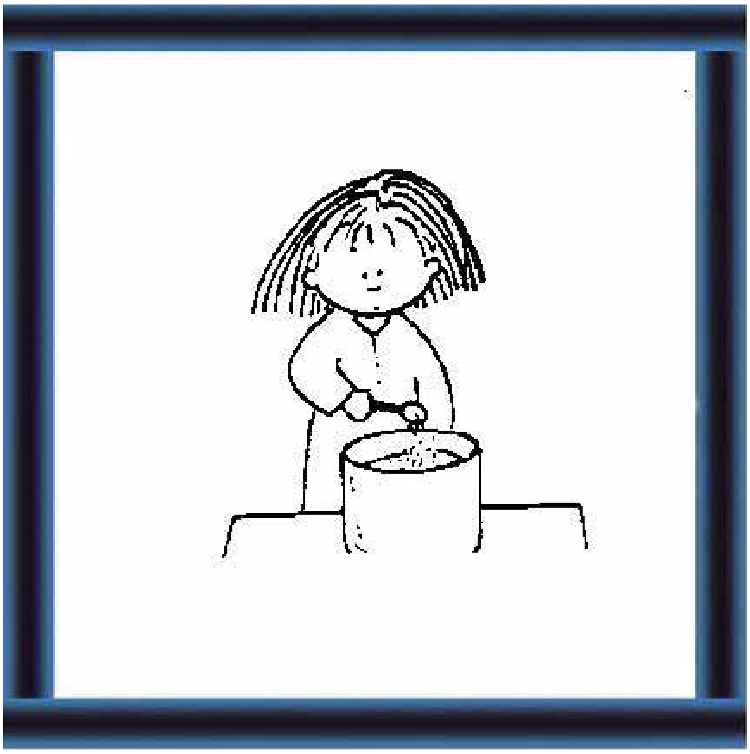
44 Work the butter with **damp wooden spoons** or a **damp roller** until it has a smooth surface and you can see no more drops of water.
As you work, **remove any water**.



Storage

45 Store butter in a **cool place**:

- in a **pot** or
- wrapped in **grease proof paper** or **aluminum foil**.



46 Sprinkle a **little salt** on the surface of butter in a pot:

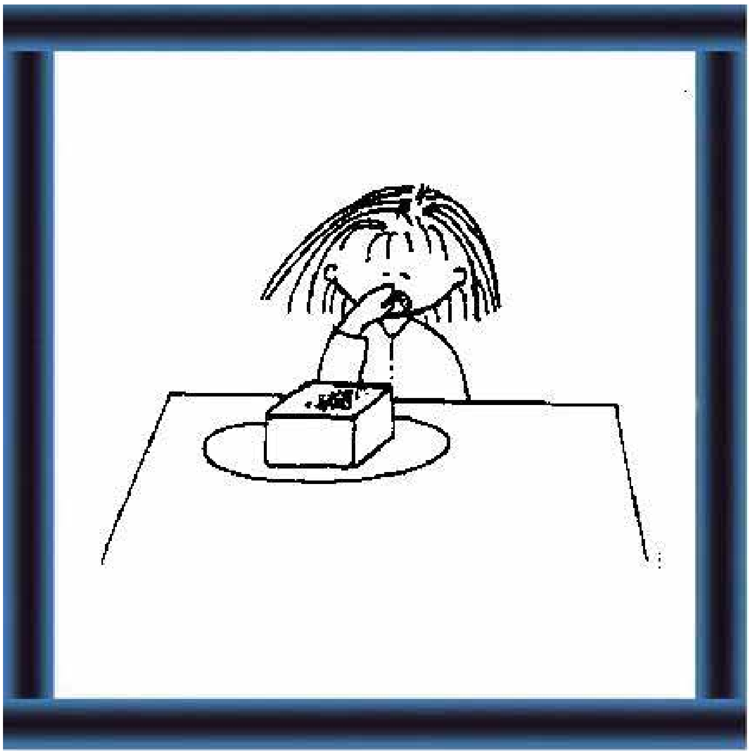
- this **prevents fungus**.

47 You can freeze butter but it becomes **rancid** quickly after defrosting:

- divide the butter into many **small parts**
- defrost **only** what you need.

48 **Do not** freeze salted butter:

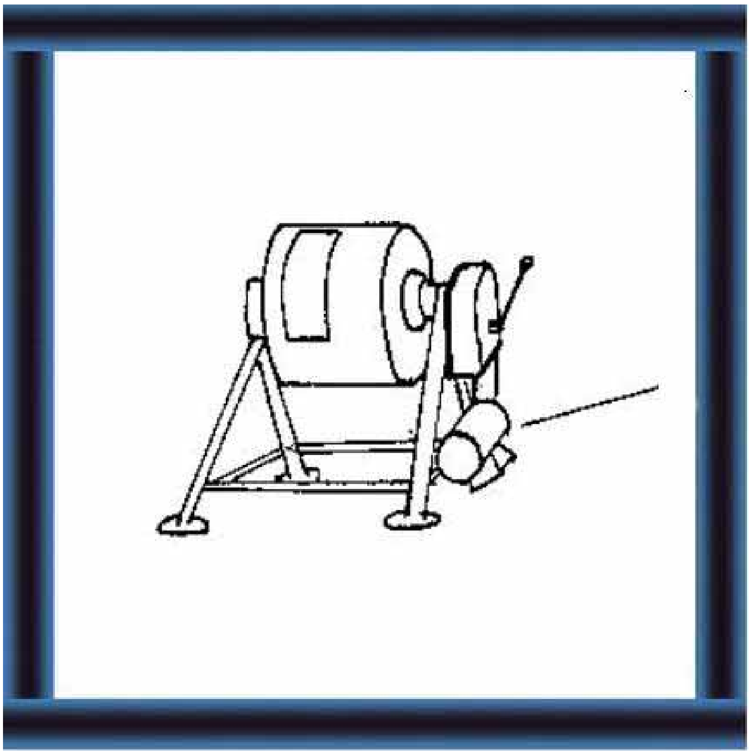
- it easily becomes **fatty** or **oily** and smells **fishy**.



49 If you keep butter for **too long**, it tastes **rancid** or develops **fungus**.

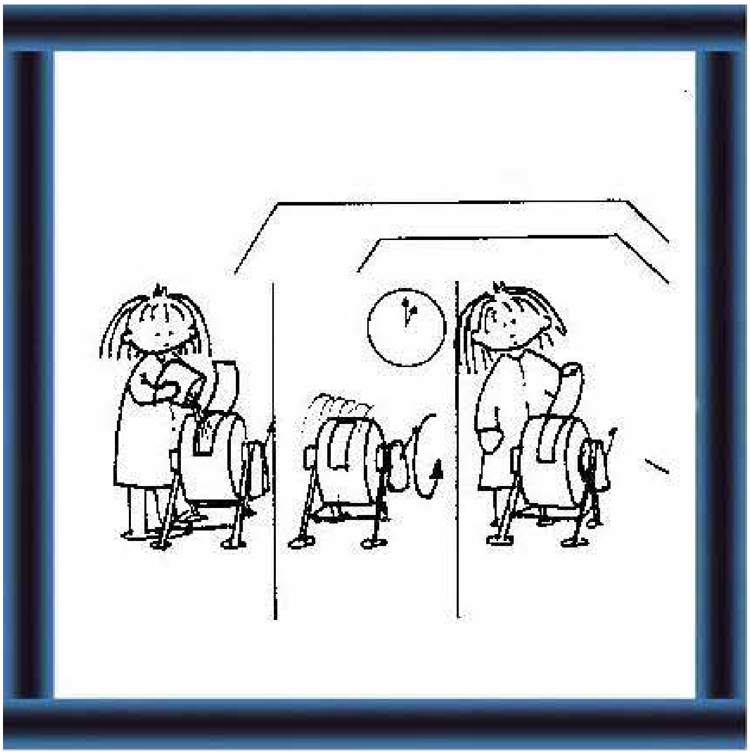
50 You can keep it **longer** by making **ghee**.

Large-scale churning

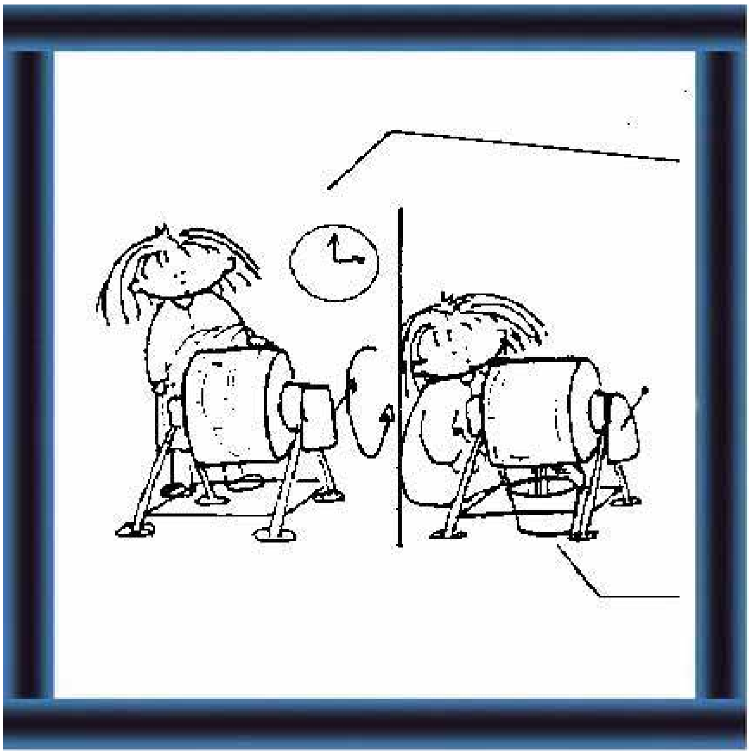


51 You can work this churn **by hand** or use an **electric motor**.

It holds **30-50 l** of milk or cream.

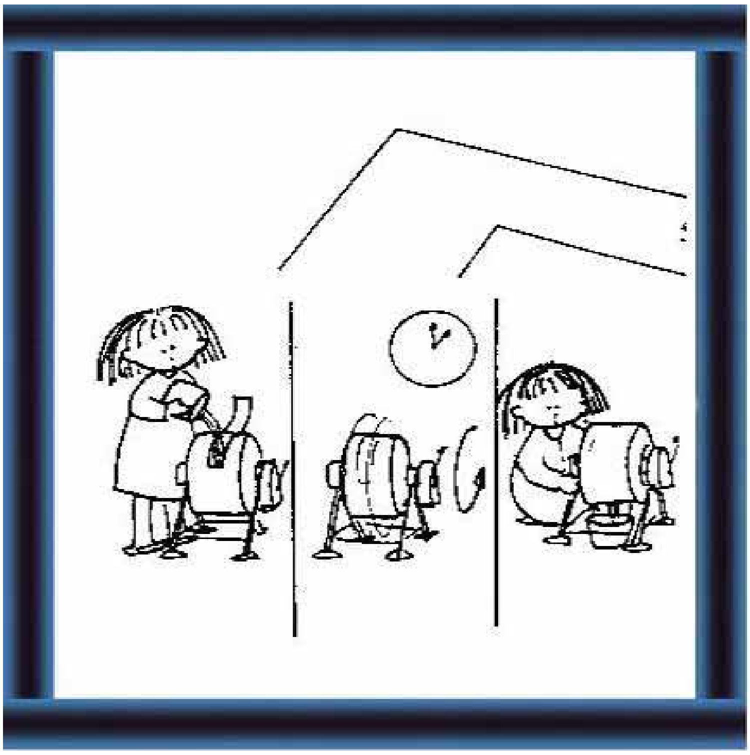


52 **Half fill** the churn with milk or cream.
Churn for 5 minutes (the speed depends on the shape, size and construction of the drum).
Stop the churn and **release the gases**.



53 **Churn again** for 35-45 minutes or until the butter pieces are about 2 cm in diameter.

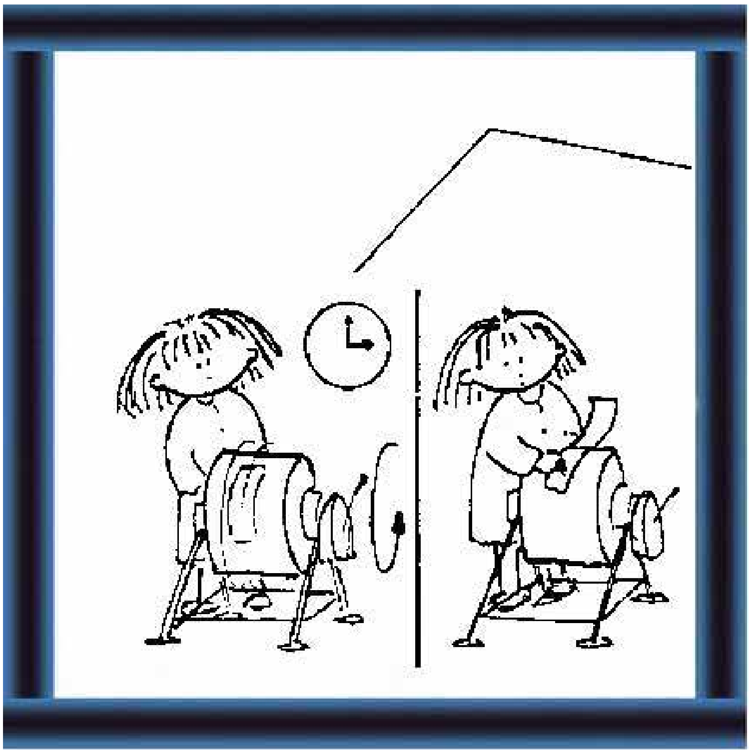
Pour off the buttermilk through the valve into plastic pails.



54 **Add the same amount of water** as buttermilk you remove.

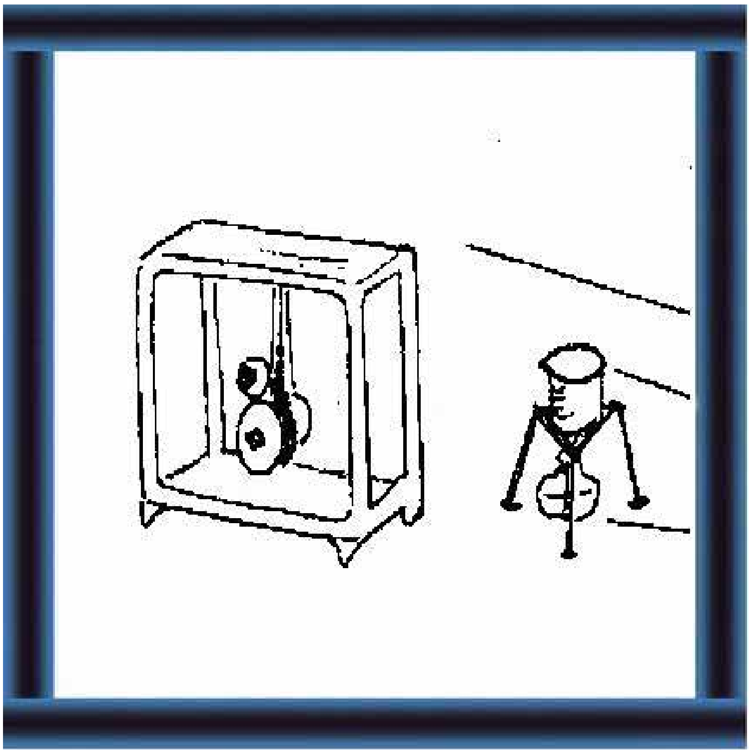
Churn at 10-15 rpm for 5 minutes.

Pour off the water.



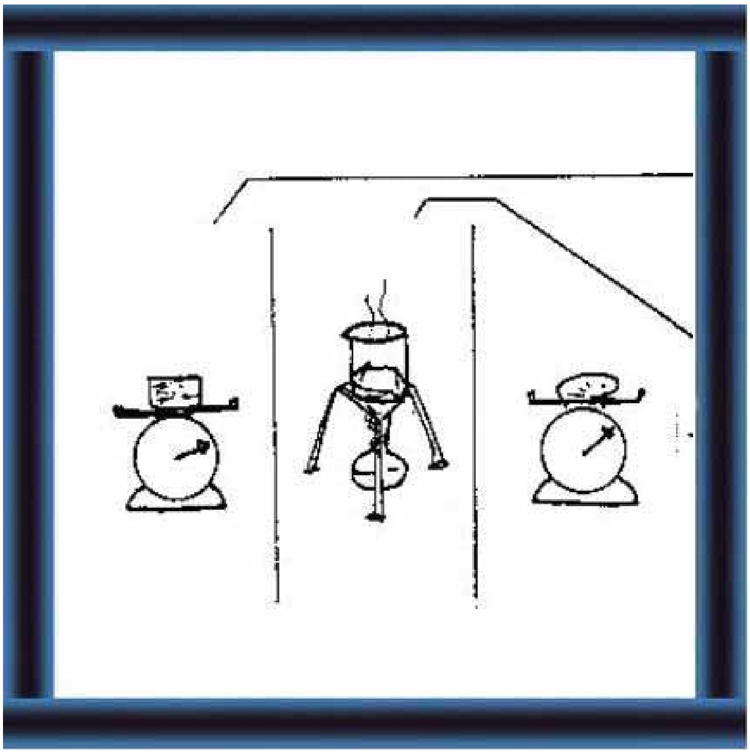
55 **Churn at 10-15 rpm** for about 10-20 minutes.

Check the water content and **if correct** remove the butter from the churn.



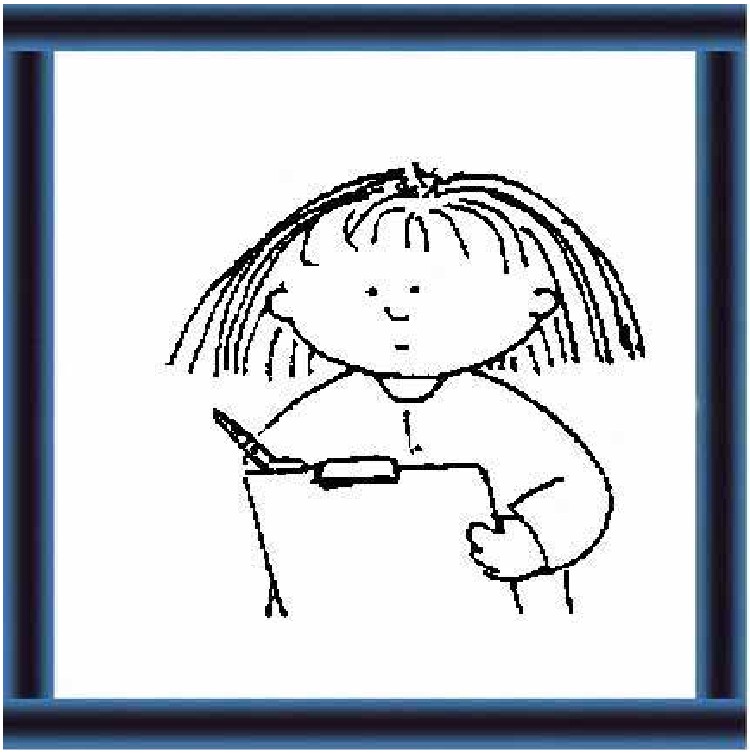
56 You can check the water content of your butter by using a:

- **special balance**
- **beaker** for melting butter
- **burner**.

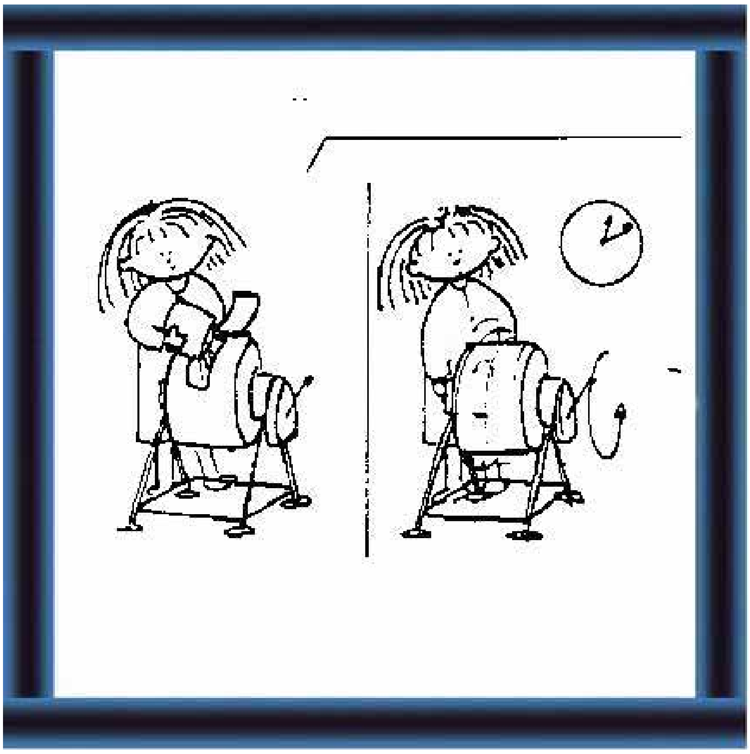


57 **Weigh** some butter **accurately**.
Evaporate the water by heating.

Weigh the butter **again**.



58 If you know the **weight of butter** and the **weight of water lost**, you can find the **% of water in the butter**.



59 You can then:

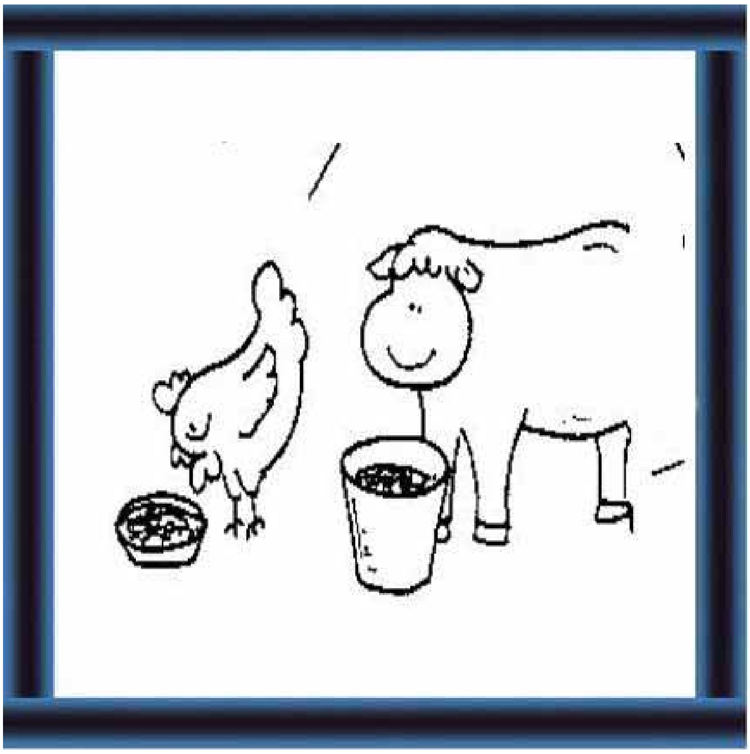
- **add water** if you want a **higher moisture content**

- **churn for longer** without adding water if you want a **lower moisture content**.

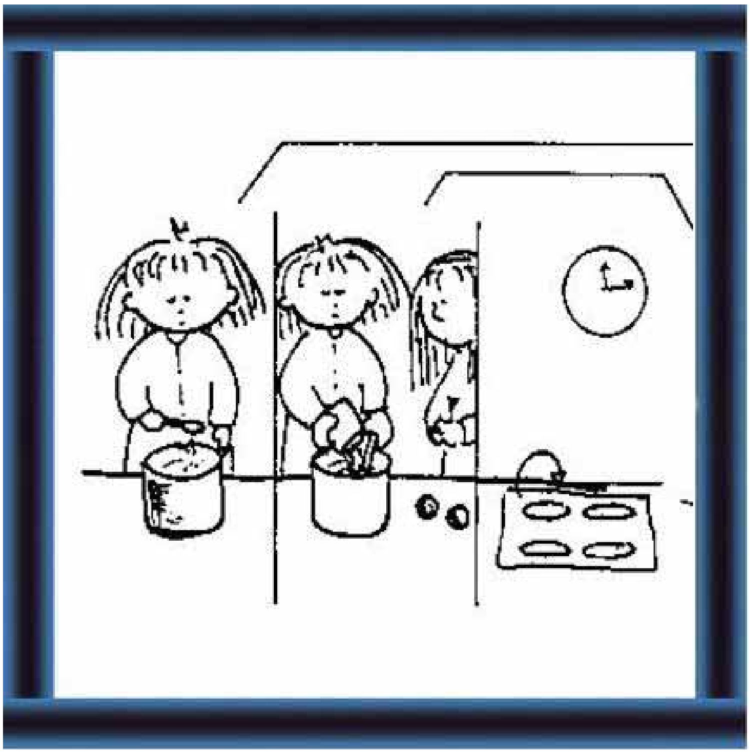
What can you do with buttermilk?

60 Buttermilk is **good** for:

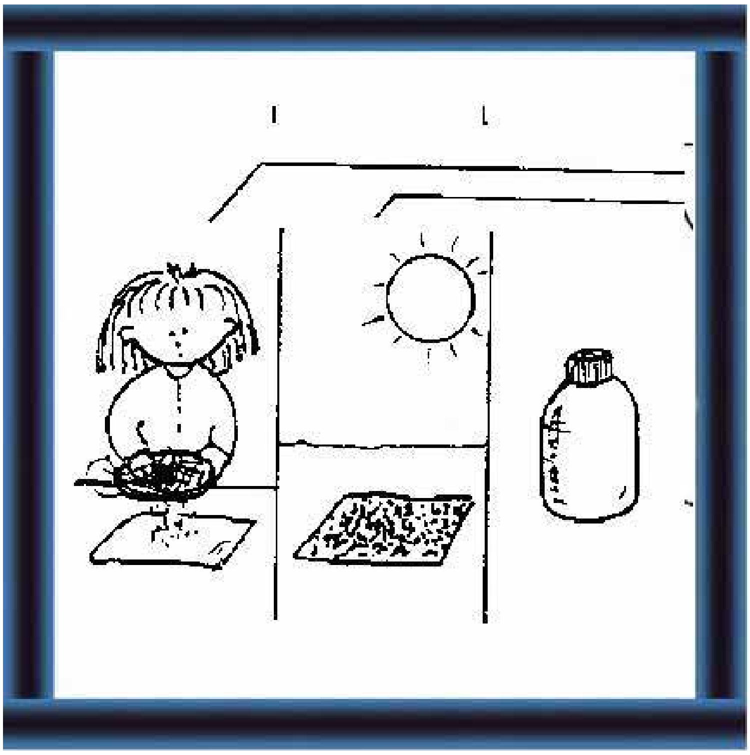
- **drinking**
- putting in **soups or salads**
- making into **cheese**.



61 You can use it for **animal feed**:
- warm it for **chickens**
- as it is or with feed for **calves**.



62 You can make **Trahana**:
- leave buttermilk to become **sour** and **add a little salt**
- **add flour or semolina**, make a stiff dough and shape into **balls**
- **flatten** these and **dry on a clean cloth**, **turn over** every hour



63

- **rub** these through a **sieve**
- **spread** the crumbs on a **clean cloth** to **dry**
- **store** them in a **closed pot or bottle**.

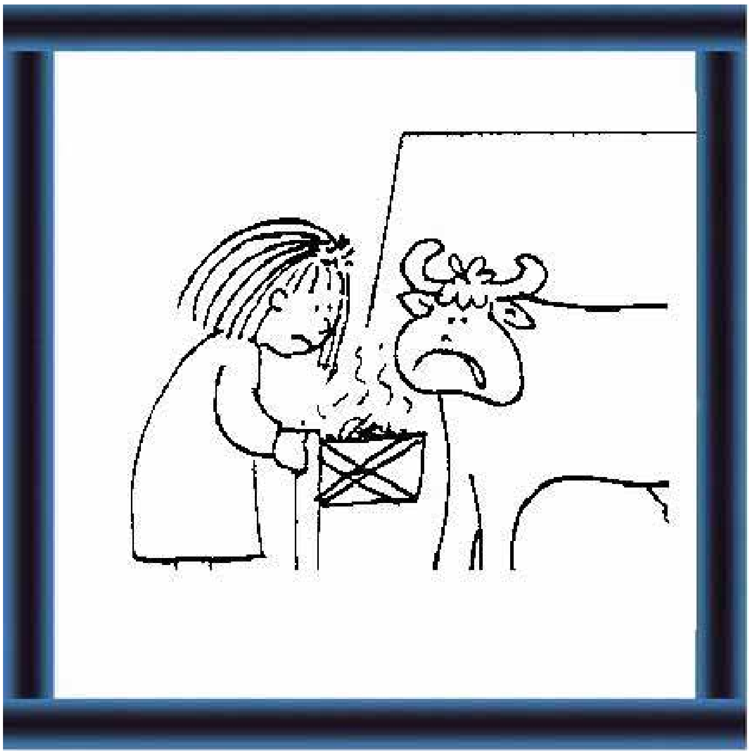
You can keep the crumbs for **several months** and use them in soup instead of pasta or rice.

What can be wrong with your butter?

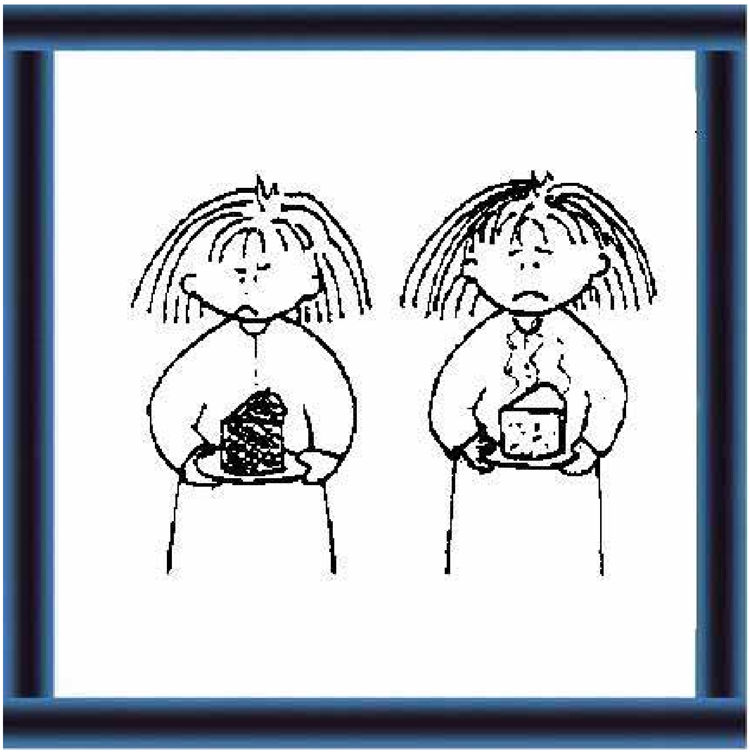
Smell and taste

64 If your butter is **sour** your starter may have **bad bacteria**.

Use a **new starter** and **wash** and **sterilize** all equipment.

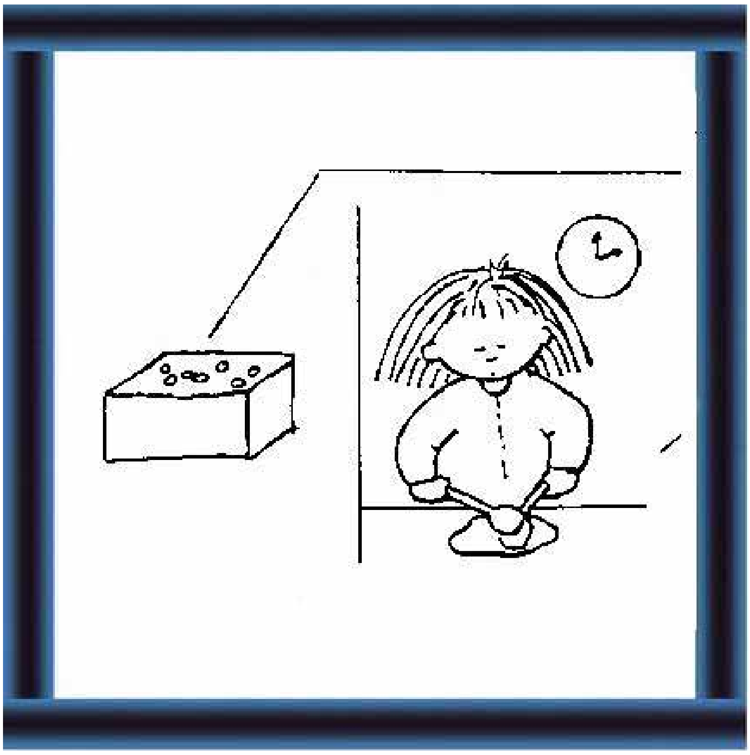


65 If your butter has a **feed flavour** check the **quality of your feed** especially silage, onions etc.



66 If your butter is **green** or **malty** use a **new starter**.

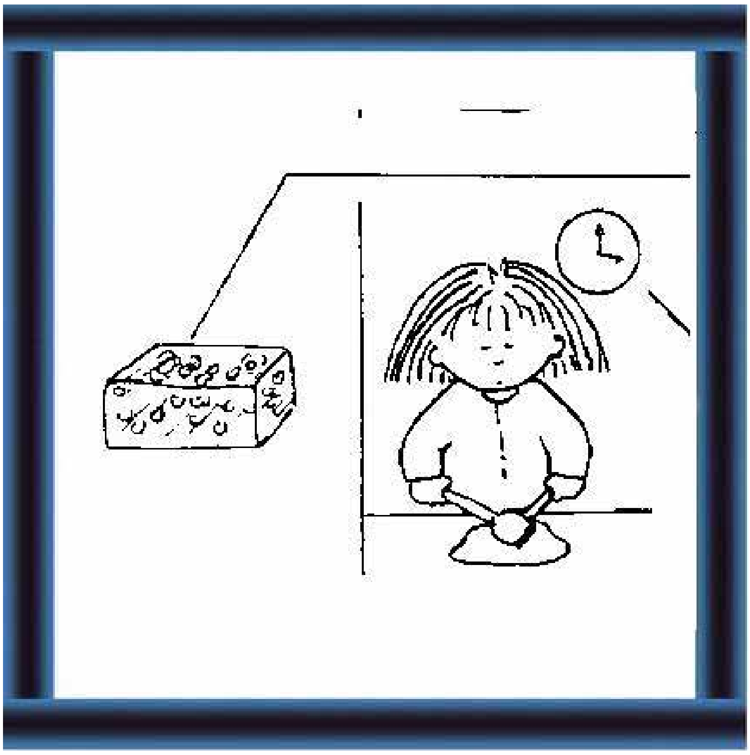
67 If your butter is **oily** or **tallowy** check the **quality** of the milk and cream you are using to make your butter:
- **increase** the **heat treatment**
- make **less-cultured butter**
- use **less salt**
- **work** the butter **less**.



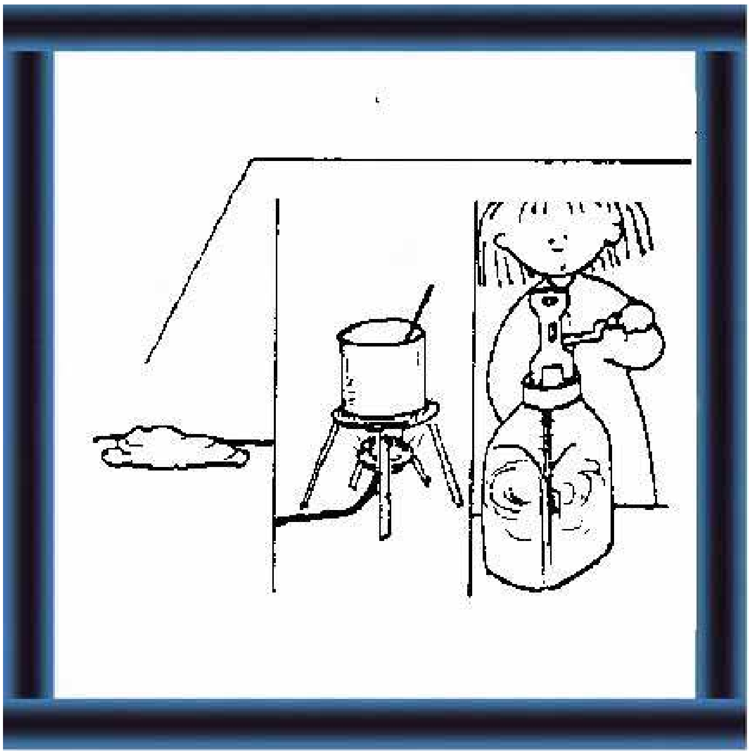
Texture

68 If there are **drops of water** on your butter, **knead it more**.

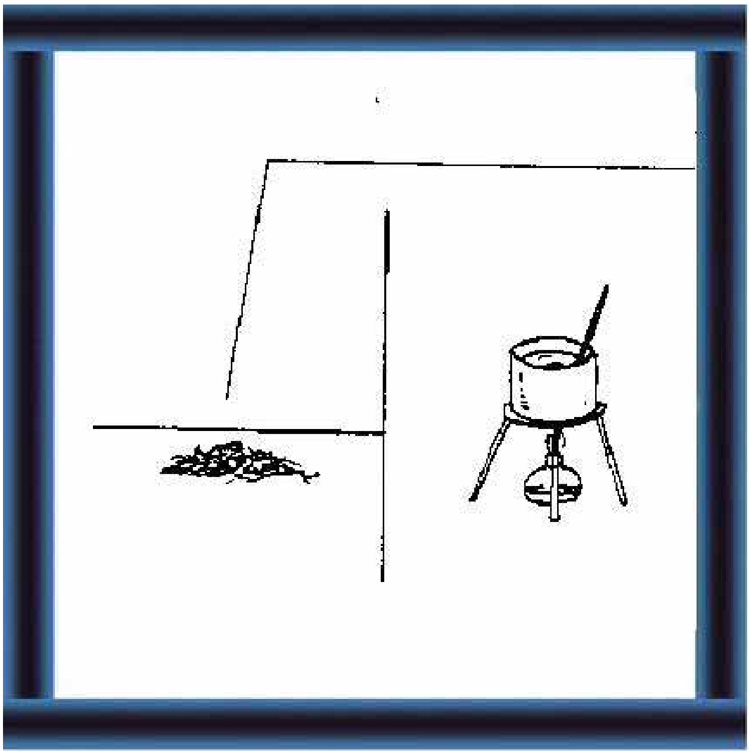
Your butter should be **dry** before packing - **bacteria multiply quickly in damp butter**.



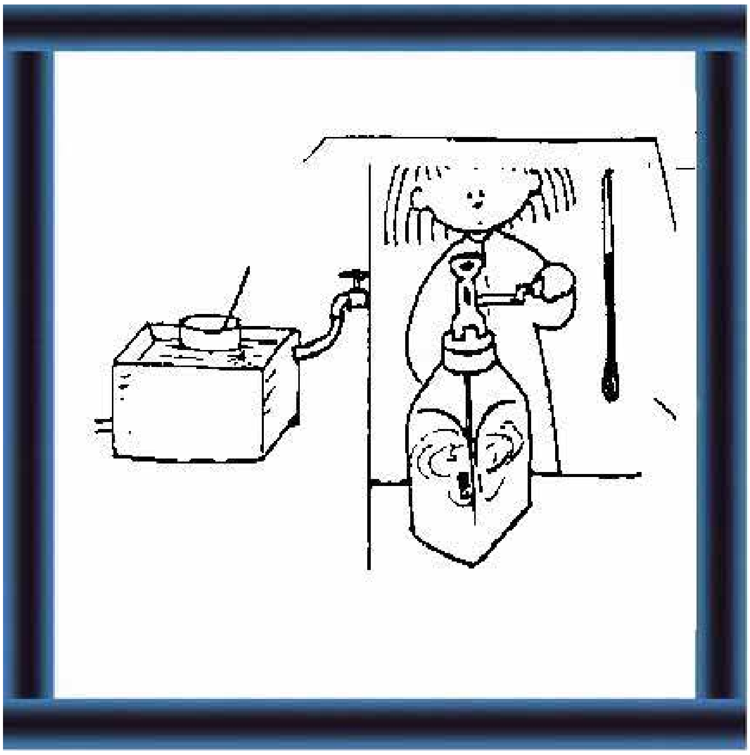
69 If your butter is **oily** you see droplets of oil when you cut it:
- you churning time is **too long**.



70 If your butter is **soft**, **check your mixing**.



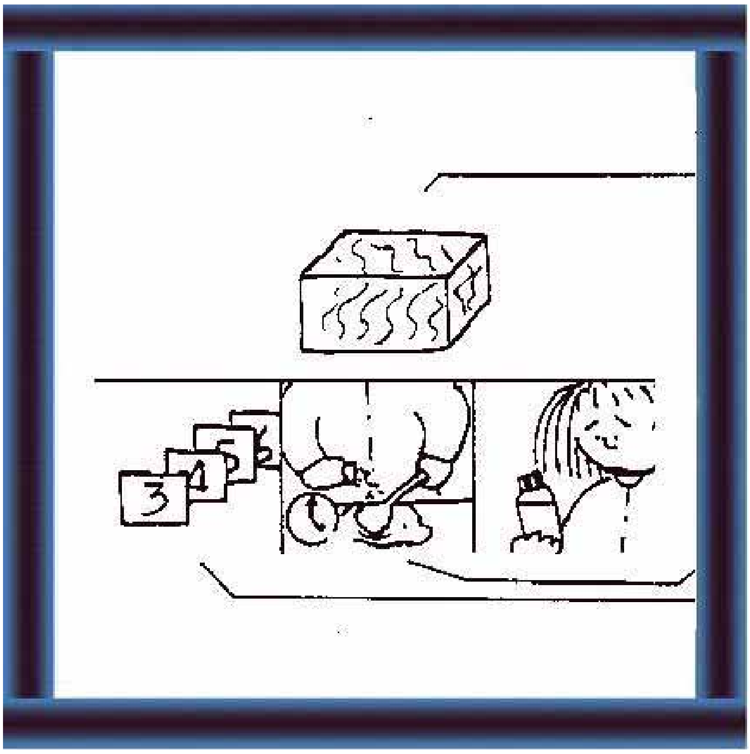
71 If your butter is **crumbly** or has a **high melting point**, **check**:
- your **feeding**
- your **heat treatment**
- your **churning**.



72 **Make sure:**

- you **cool your cream enough** after pasteurization

- you do **not churn** your butter at a **high temperature**.

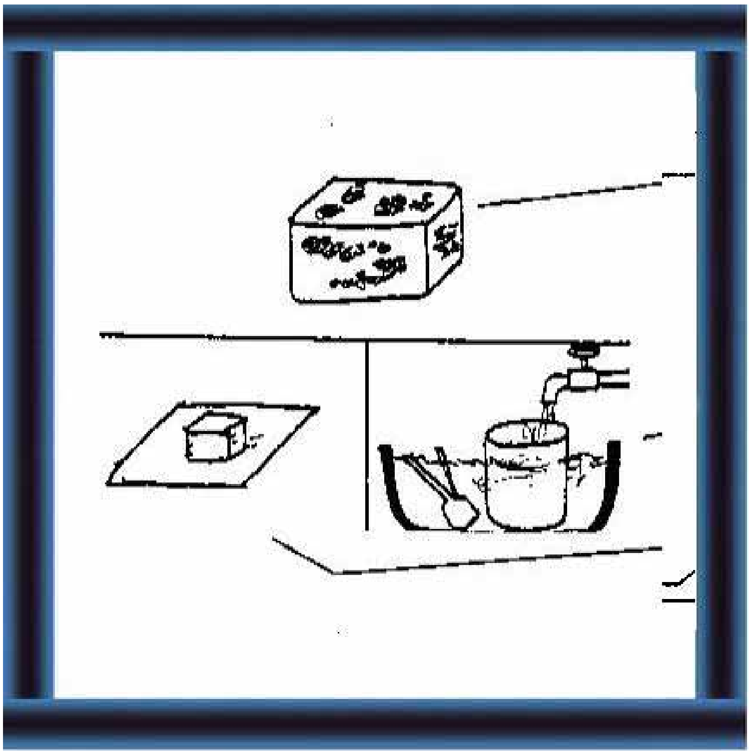


Appearance

73 If your butter has **streaks**, **make sure**:

- you do **not mix** butter from **different days' production**

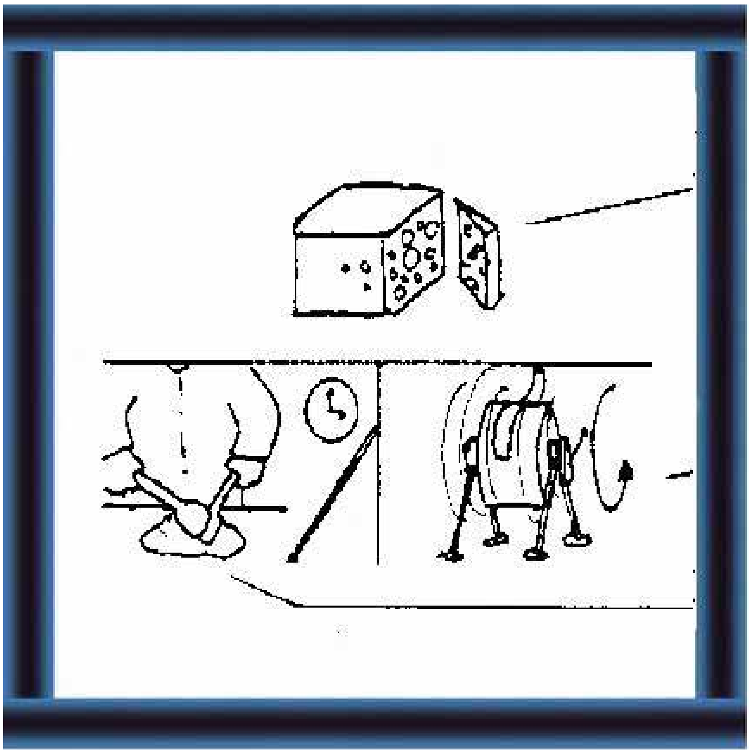
- you **knead the salt** into your butter for **long enough**.



74 If your butter is **mouldy**, **make sure**:

- you are **wrapping it properly**

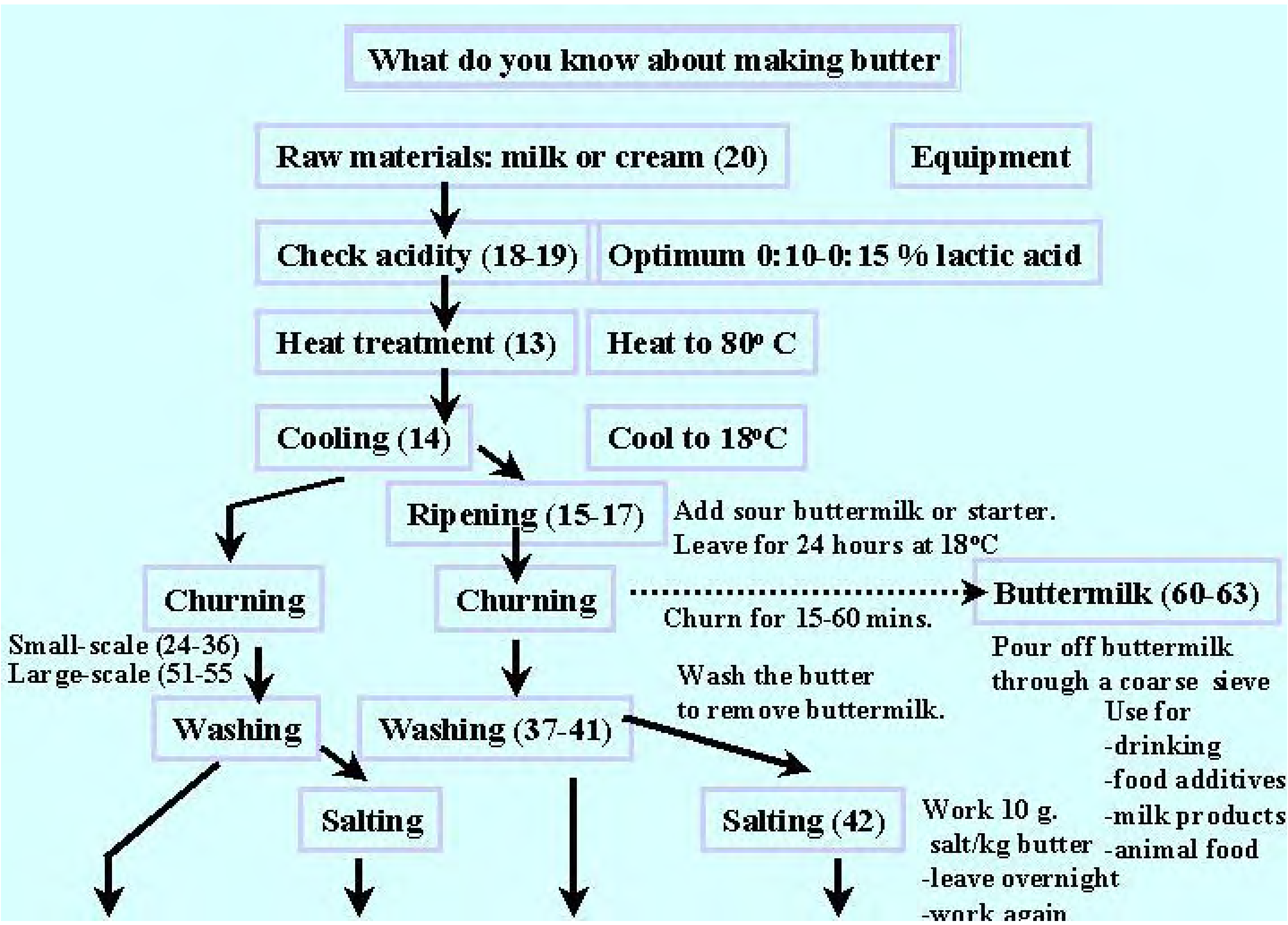
- **all equipment and materials are clean**.



75 If your butter **has holes**, **make sure**:

- you **do not** work it for **too long** or at **too high a temperature**

- there is **no air** in your butter.



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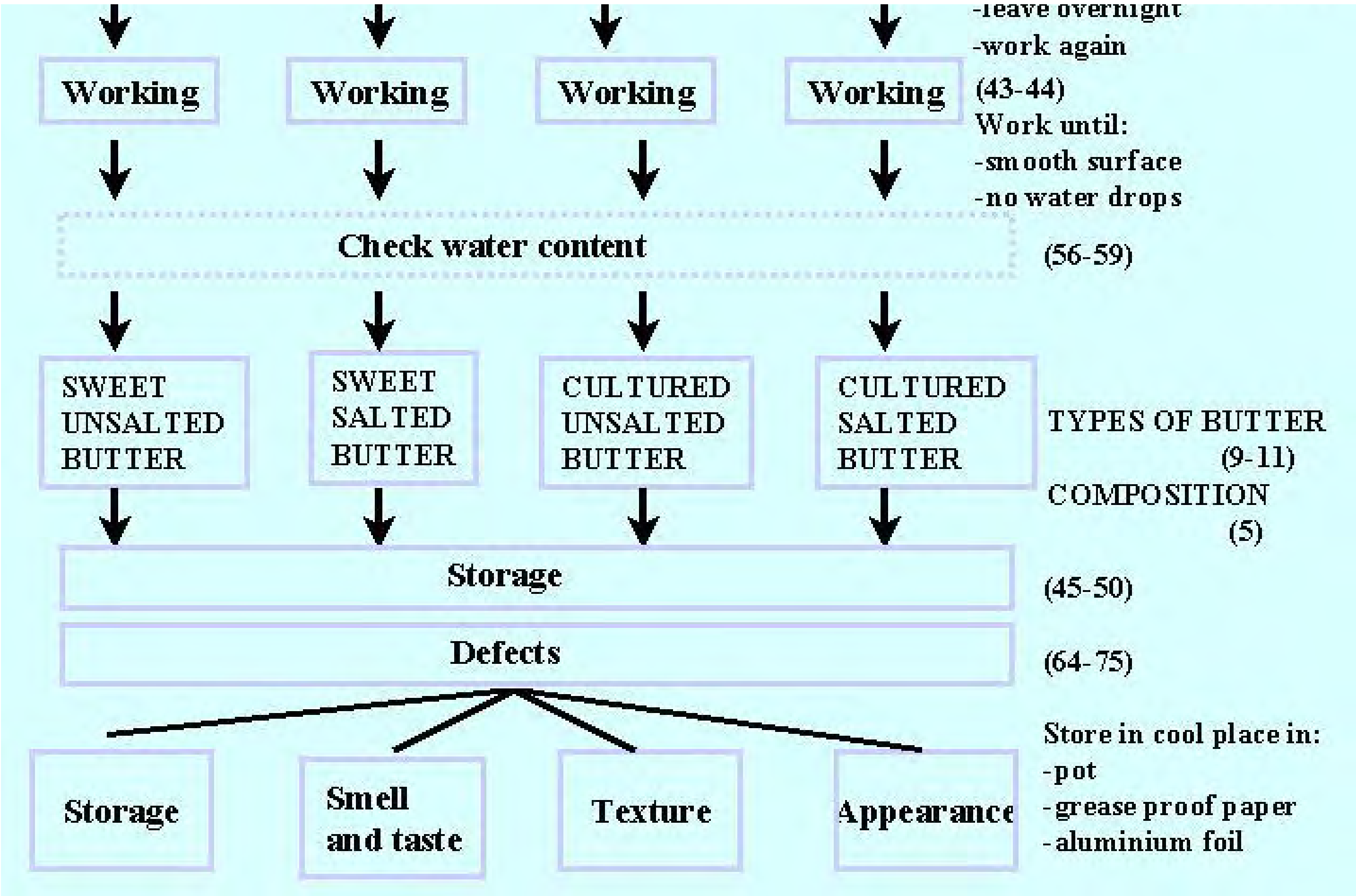

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(64-75)

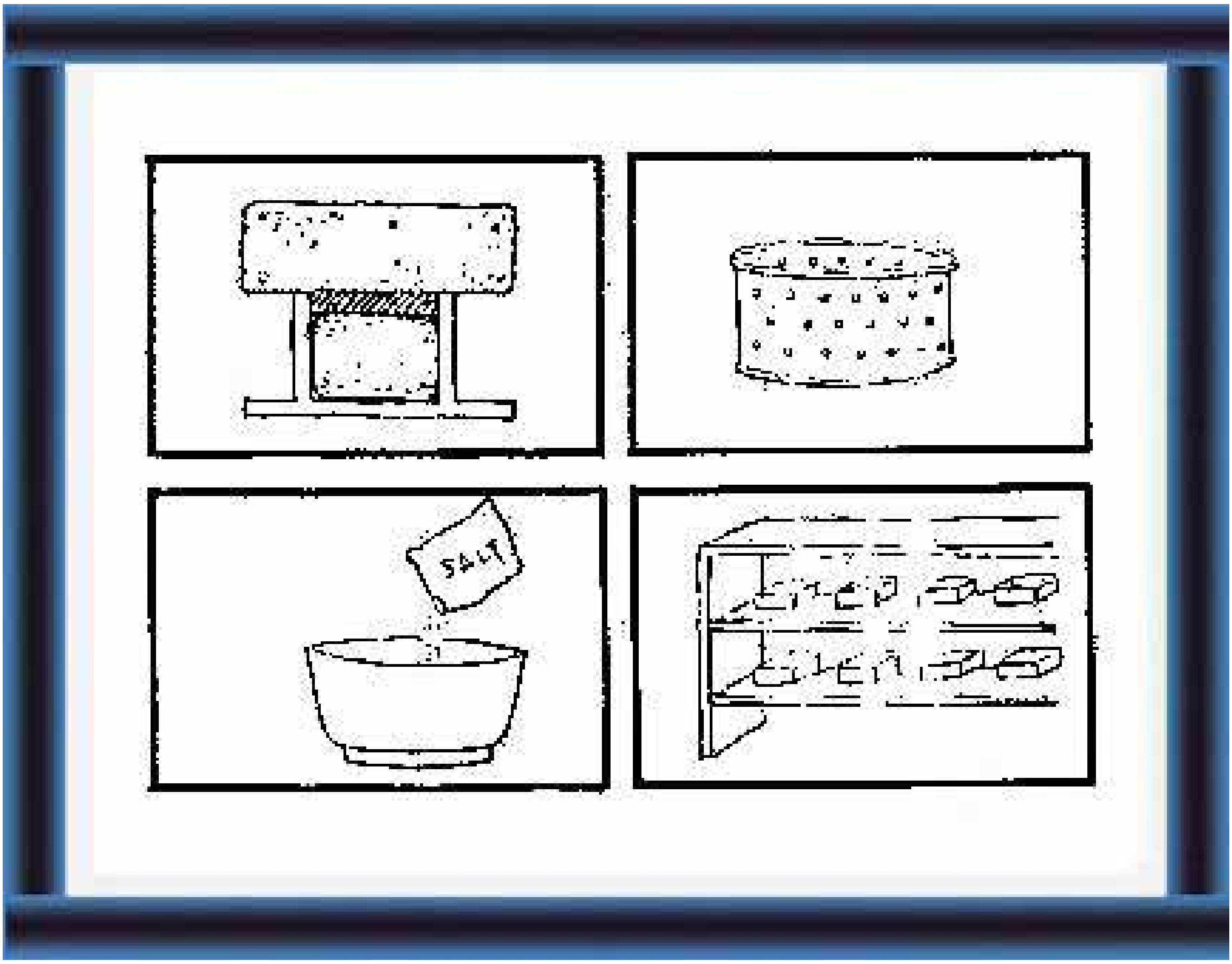
Small-Scale

Dairy Farming Manual

Volume 1

Technology Unit 10.3

Small Scale Cheese Making



Technology Unit 10.3:

SMALL SCALE CHEESE MAKING

Technical Notes

Note: These technical notes are not indexed to illustrations numbers. They are taken from:

CHEESE MAKING TRAINING COURSE
RIT Lampang
24th - 28th October 1989

CHEESE

General introduction

The changing of milk into cheese generally goes through four stages:

1. Coagulation: physical and chemical changes in the casein micelles (protein) due to the action of proteolytic enzymes and/or lactic acid leading to the formation of a protein network.

2. Drainage: separation of the whey after mechanical cutting and agitation of the coagulum followed by moulding and, depending on the kind of cheese, pressing. By this means, cheese is obtained.

3. Salting: incorporation of salt by dry salting on the surface or within the body of the cheese, or by immersion in brine (salt water).

4. Ripening: biochemical changes in the cheese brought about by mainly bacterial enzymes.

Coagulation

Milk contains two different groups of proteins. These are:

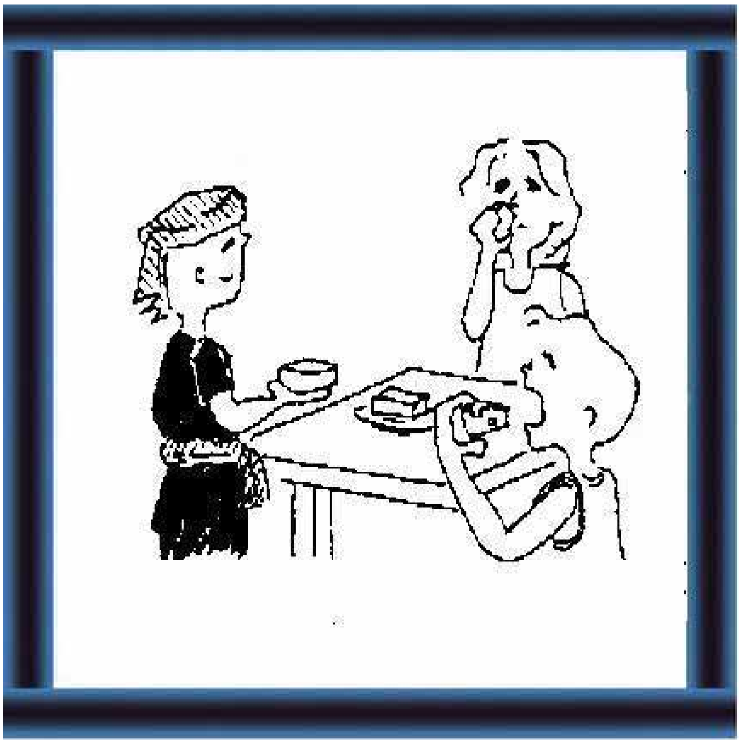
- the casein complex (75-80 % of total protein);
- the whey proteins (20-25 % of total protein).

It is the casein that coagulates when making cheese.

The components in milk are present in different physical states such as true solution, colloidal dispersion or emulsion.

Extension Materials

What should you know about cheese?

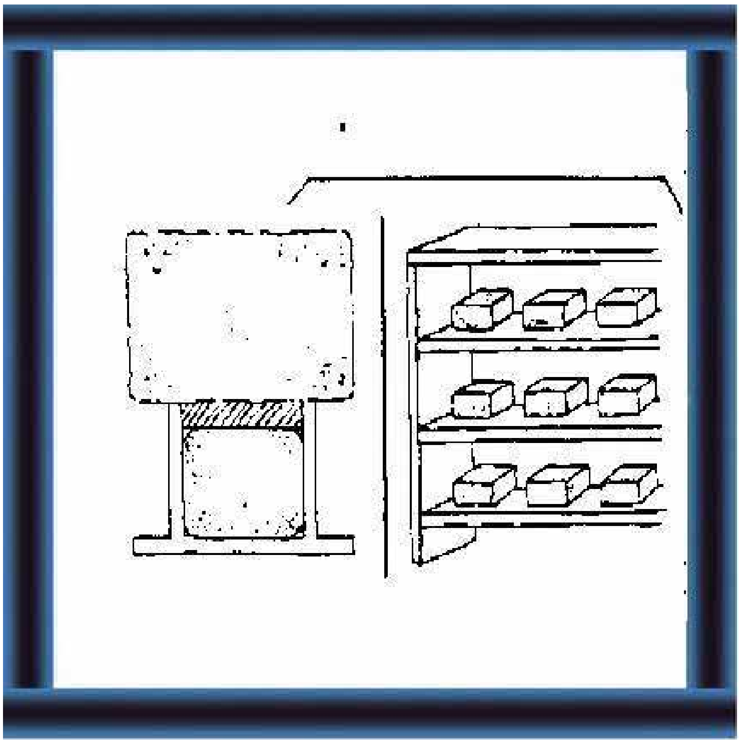


1 **What is important in cheese making?(5-50)**

There are **different**:
- textures
- ways of ripening
- compositions.

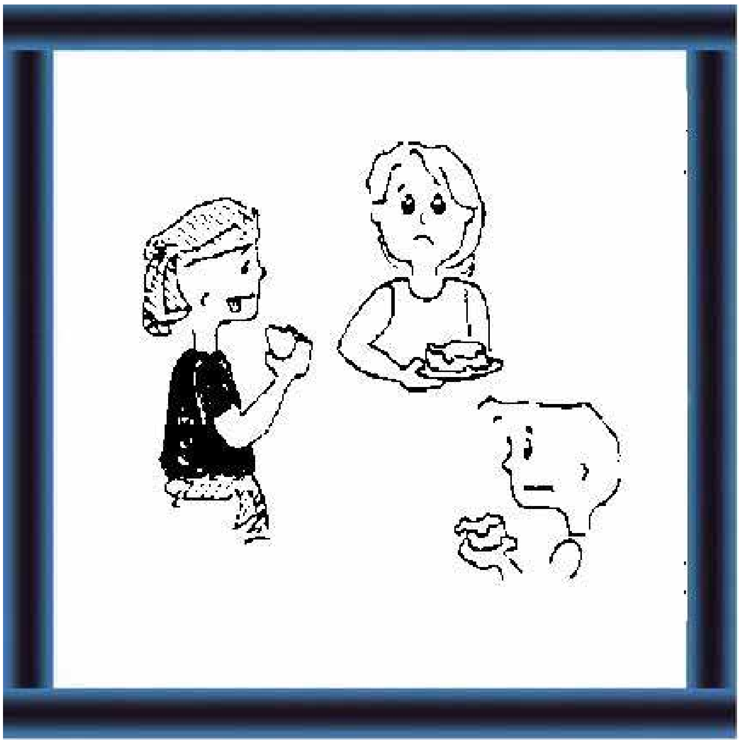
2 **How can you make fresh cheese? (51-86)**

By taking **good quality milk** and:
- cooking
- renneting
- straining.



3 **How can you make semi-hard cheese? (87-131)**

By taking fresh cheese and:
- pressing
- ripening.



4 **What defects are there in cheese? (132-136)**

There are defects of:
- flavour
- texture
- appearance.

A component in colloidal dispersion will precipitate if the factors which make it disperse are changed (hydration, ionization (net charge)) (casein).

A component which is present as an emulsion will precipitate or rise to the surface by the force of gravity if left to stand (milk fat).

The casein is present in the milk as small micelles. The outsides of these micelles have a large excess of negative charge. The effect of this is that the micelles repel each other. Thereby avoiding aggregation ---> sedimentation.

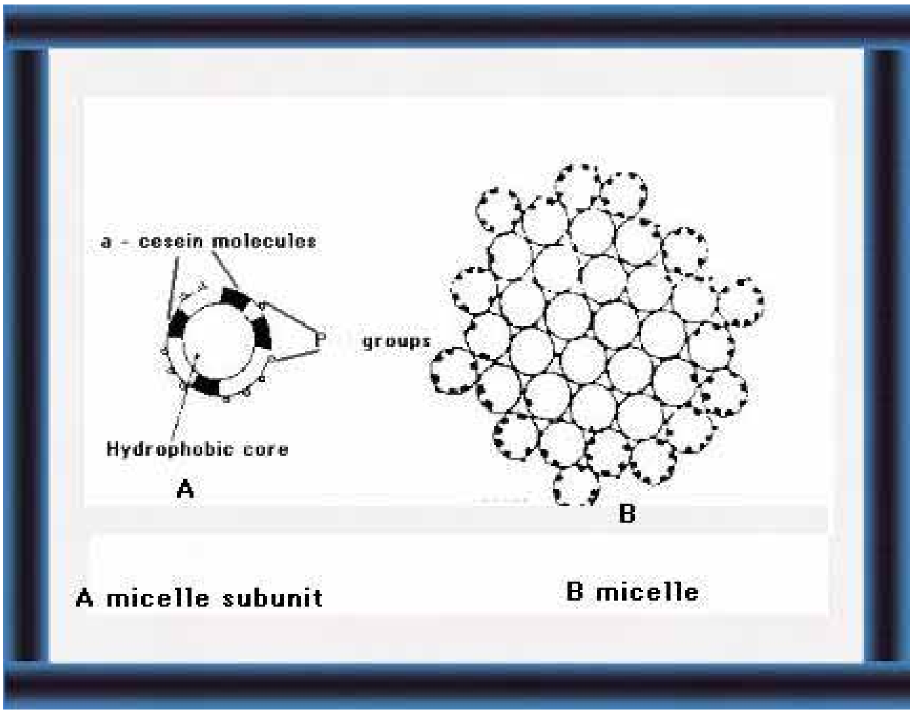


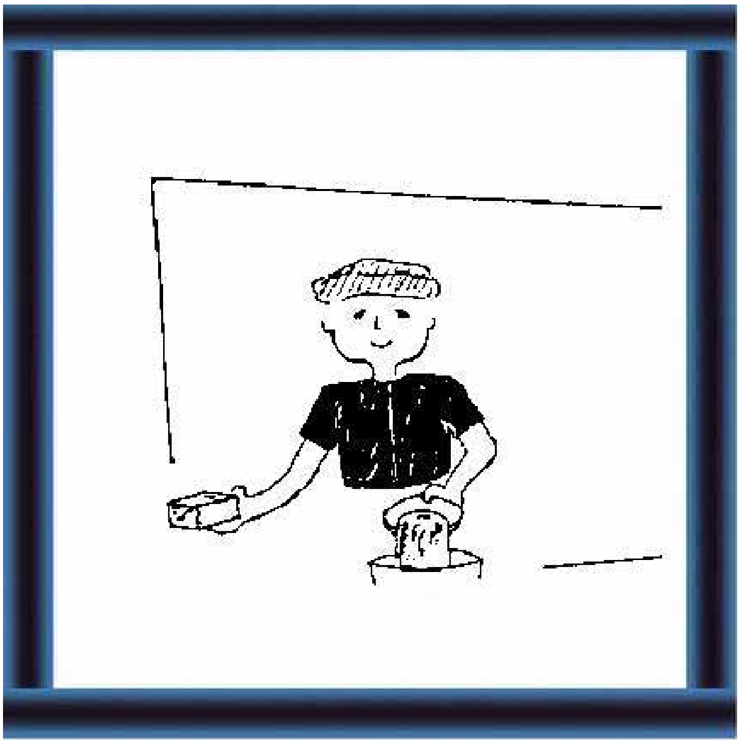
Figure 1: Structure of the casein micelle

The casein micelles also bind a lot of water (hydration). This bound water protects the micelles against aggregation.

In order to coagulate the milk (casein) it is necessary to destabilize the casein dispersion. This can be done by acid or enzyme.

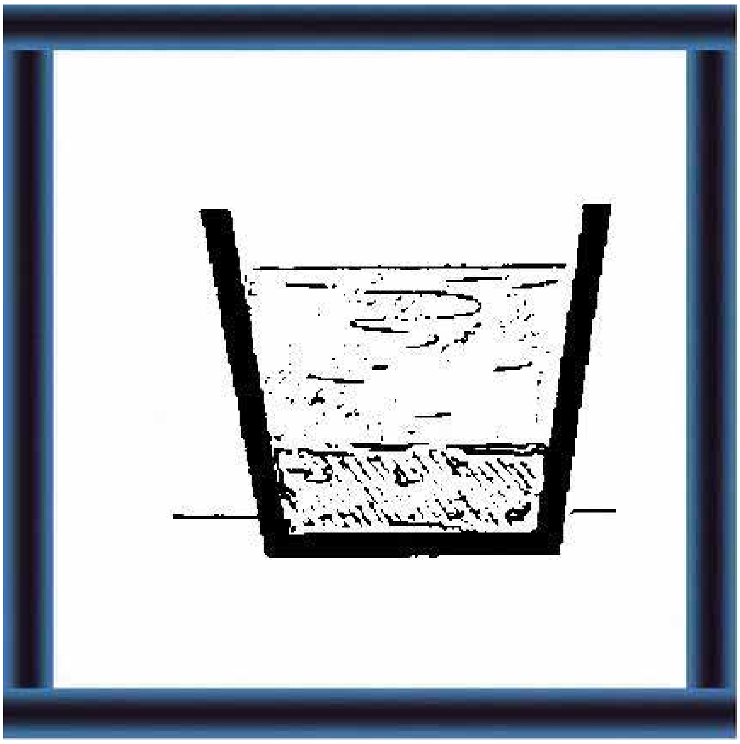
Acid coagulation: By adding acid (H+) to the milk, pH is lowered and the ionization is reduced. When so much acid has been added that there is a neutral charge on the micelles (- and + equals), (isoelectric pH = 4.2) and the hydration is significantly reduced, a coagulum will form. This reaction depends very much on temperature. At higher temperatures the coagulum will form at a higher pH (less acid).

What is cheese?

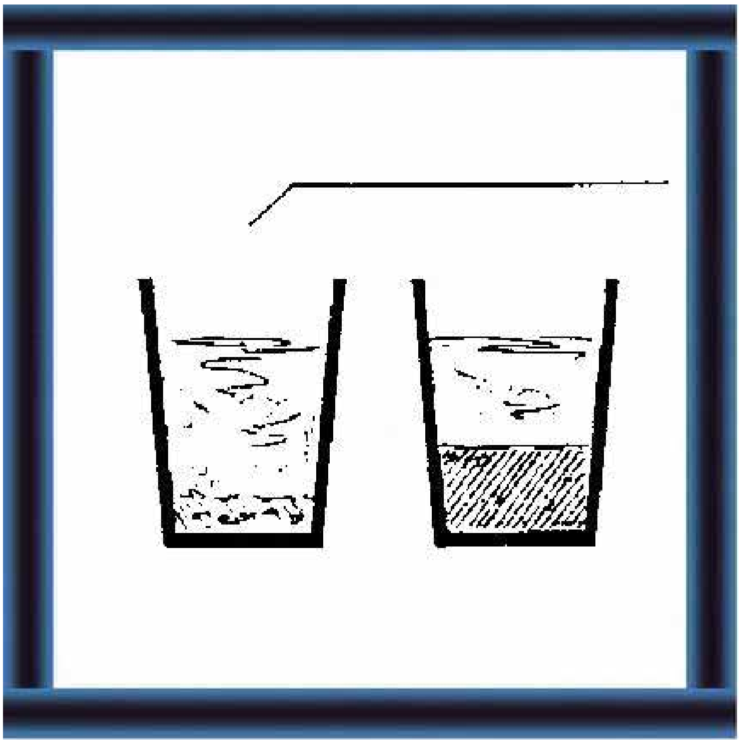


5 Cheese is the **solid** part of milk: **curds** separated by chemical reaction from the **liquid** part of milk: **whey**.

6 You can make the curds **separate** from the whey by adding **acid, bacteria culture** and/or **rennet (starter).**



7 This causes the milk protein, **casein,** to **curdle**.



8 **Acid** or **starter culture** produce a **soft curd** which **breaks up easily**.

Rennet produces a **firm and elasticcurd**

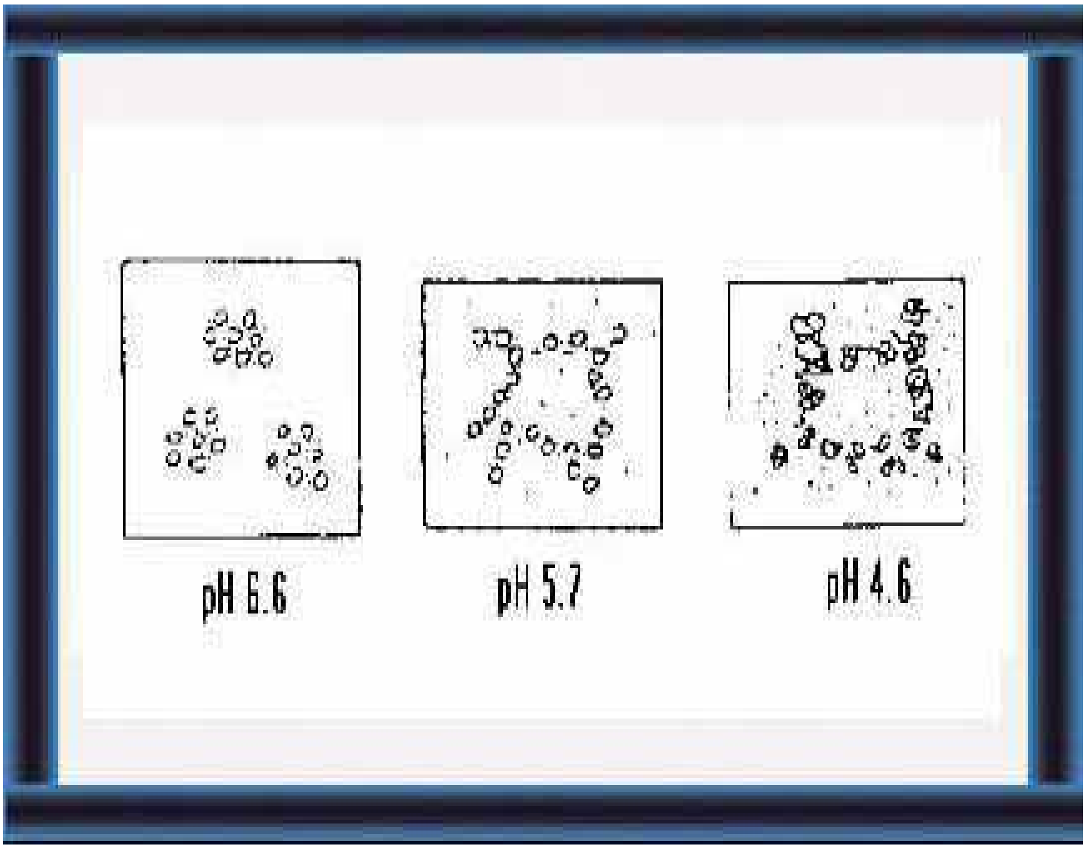


Figure 2: Changes in micelle structure in the course of acidification

Enzyme (rennet) coagulation: the coagulation of milk by the action of rennet occurs in two stages (phases).

Primary phase: Also called the enzymatic phase. The enzyme attacks the stabilizing components of the micelles. A piece of the casein which has a strong negative charge is cut off and hydrophobic (water rejecting) bonds between the casein micelles can be established. The enzymatic phase is in particular influenced by temperature, pH and amount of enzyme. The optimum temperature for rennet enzyme is 40 - 42 C but usually a temperature of around 30-32 C is used because of other factors which will be explained later. The effect of pH can be seen from Figure 3 below.

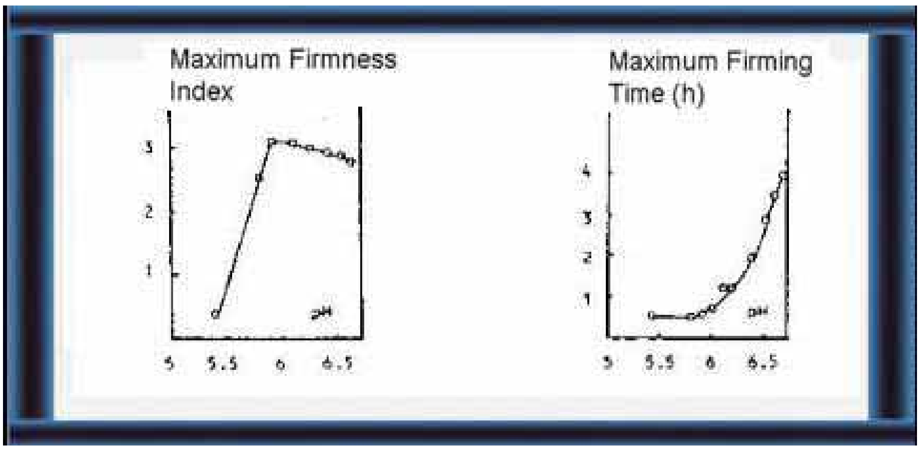


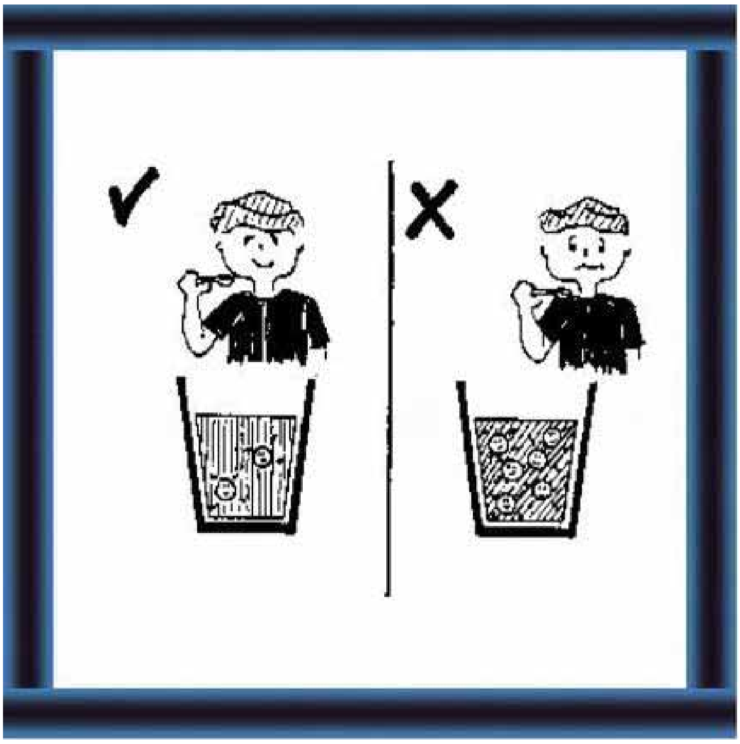
Figure 3: Effect of pH on the firming rate and the maximum firmness

of rennet coagulum

Secondary phase: Also called the coagulation phase. The aggregation of changed casein micelles (para-casein) takes place. The presence of Ca++ and to some extend Mg++ plays an important role in this reaction. The positive calcium and magnesium ions (cations) helps in neutralizing the negative charges on the casein. For this reason additional calcium is sometimes added to cheese milk, to increase velocity of coagulation and to get a firmer coagulum. It is usually added in the form of calcium chloride ($CaCl_2$).

The total time for the primary and secondary phase is from 30 to 45 minutes depending on the factors mentioned.

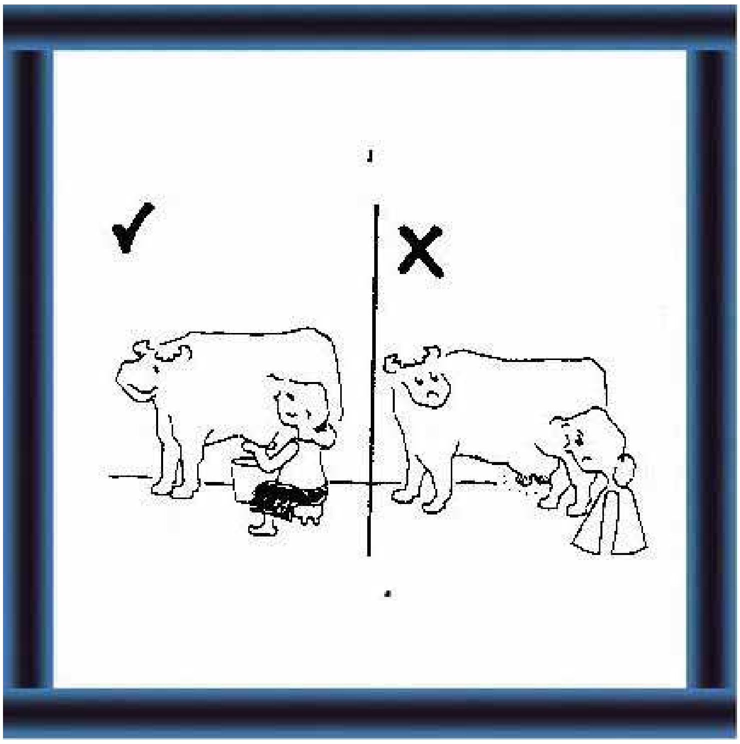
What do you need to make cheese?



Good quality milk

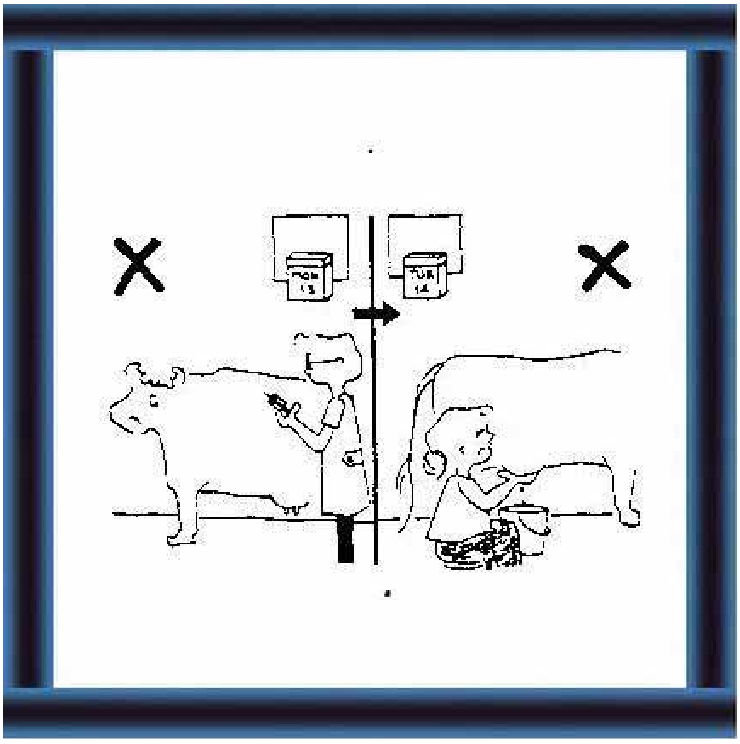
9 You need **good quality** milk with **few bacteria**.

Cheese made from milk with **high bacteria content** has a **bad flavour**.

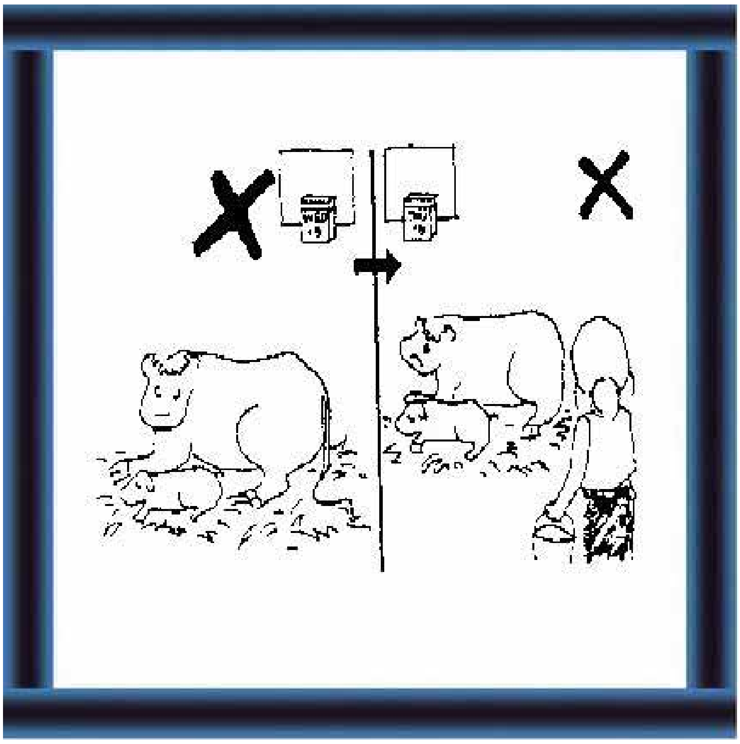


10 Use milk from **healthy** cows.

Do **not** use milk from cows with mastitis or other diseases.



11 Do **not** use milk which contains antibiotics.



12 Do **not** use colostrum.

It turns into **curd on heating** and the curd is **too soft.**

Drainage: Some time after the addition of starter culture and rennet fine droplets of water (whey) are observed on the surface of the milk (curd). The droplets grow larger and eventually they join together and form a liquid envelope around the coagulum. At the same time the coagulum decreases in volume. This process is called **SYNERESIS**.

By **CUTTING** the coagulum into smaller pieces the total surface becomes much bigger and the expulsion of whey (syneresis) increases. In order to control the drainage it is very important to cut the coagulum in equal-sized cubes.

This can only be done by using a proper sharp instrument and by cutting when the coagulum has reached a proper firmness. If cutting is done roughly or with poor instruments too many fine curd particles will be the result. These particles (fines) are lost in the whey resulting in lower cheese yields.

After cutting, the curd is usually left undisturbed for a while so that more whey comes out thus resulting in firmer cubes which can stand **STIRRING**. The stirring is at first done very gently to avoid damage to the cubes. As the cubes become firmer the stirring can be intensified. The stirring has two major purposes. It prevents the cubes from settling and sticking together and it makes the cubes bump into **ONE ANOTHER** whereby whey is pressed out.

While stirring the curd is usually cooked (scalded) as well. The **COOKING** increases the whey expulsion. Cooking means heating to a certain temperature, depending on the type of cheese produced. Two different methods for cooking are possible.

- direct addition of hot water or steam

- hot water or steam in the double jacket of the cheese vat.

When adding hot water direct into the curds, 1/3 of the whey is often removed first. Apart from raising the temperature, the addition of water will lower the concentration of the dissolved components of the whey and the curd. A lower lactose content in the curd will result in lower acid production and consequently higher water content in the final cheese.

Cooking should be done carefully, the temperature should not rise too quickly and it is important that the whey-cheese grain mixture is stirred continuously.

After cooking stirring is continued for some time to expel more whey.

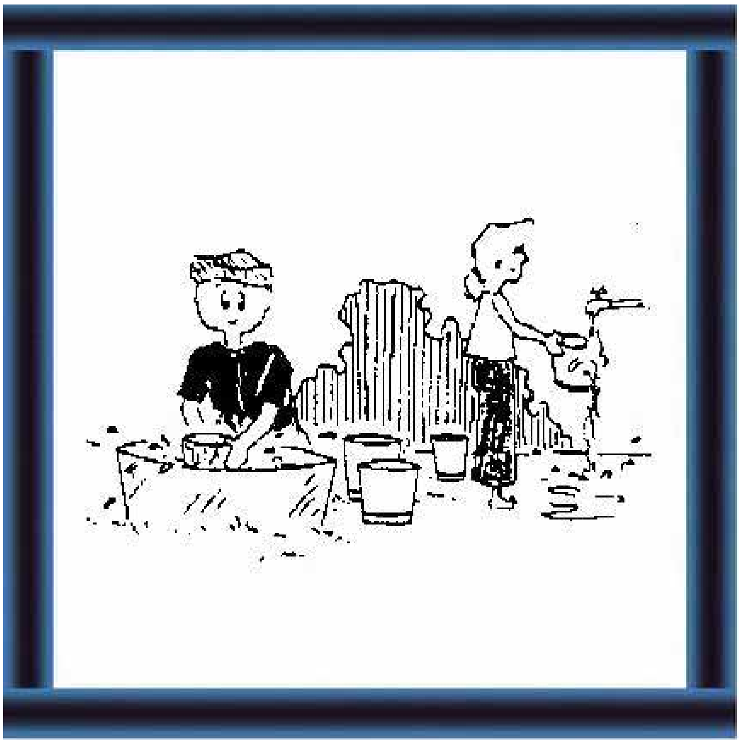
When the curd reaches the required firmness (when it is dry enough) it is processed according to the type of cheese to be made.

This may involve:

- Forming into cheese-loaves and pressing before salting in brine and ripening i. e. Gouda, Tilsitter

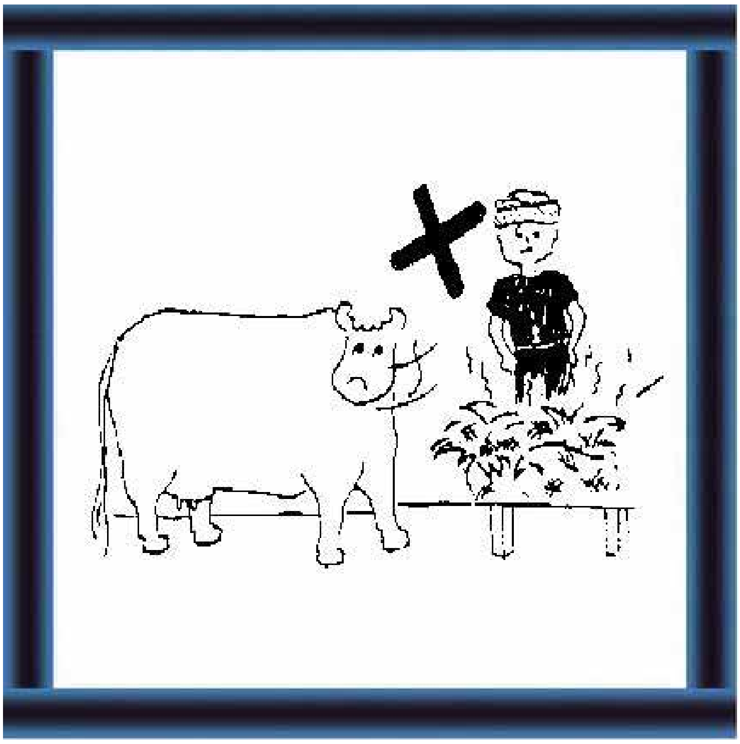
13 **Make sure** you clean and sterilize your milking utensils.

Pasteurization does **not** destroy all bacteria from dirty utensils.



14 **Rinse** your utensils **thoroughly** in **clean** water.

Cleaning agents and disinfectants in cheese milk **kill lactic acid** bacteria which are **necessary for cheese**.



15 Do **not** use poor quality silage.

This contains some bacteria which pasteurization does **not** destroy.

16 These bacteria produce **butyric acid** which gives cheese a **bad taste** and **shape**.

- Ripening curd in the cheese vat, milling, salting, pressing and ripening i.e. Cheddar
- Ripening the curd in the cheese vat, milling, heating, kneading/stretching, salting, moulding i.e. Mozzarella and other pasta filata cheeses.

STARTER CULTURE

The mother culture to be used for cheese-making is usually a mesophyllic culture. This means that the bacteria have an optimum growth temperature of about 25-30 C and that they will grow between 10 and 45 C.

For Mozzarella, however, the same bacteria as for yoghurt are used. These are thermophilic cultures with an average optimum growth temperature of about 50 C and they will grow between 10 and 80 C. The two most common strains used are Lactobacillus bulgaricus and Streptococcus thermophilus, both with optimum growth temperatures between 40 and 45 C. These bacteria are used for Mozzarella because of their fast growth and high acid production.

The yoghurt culture is usually supplied from the manufacturer as a freeze-dried culture (Lyophilized Culture) or concentrated deep-frozen culture.

The preparation of yoghurt culture is shown below.

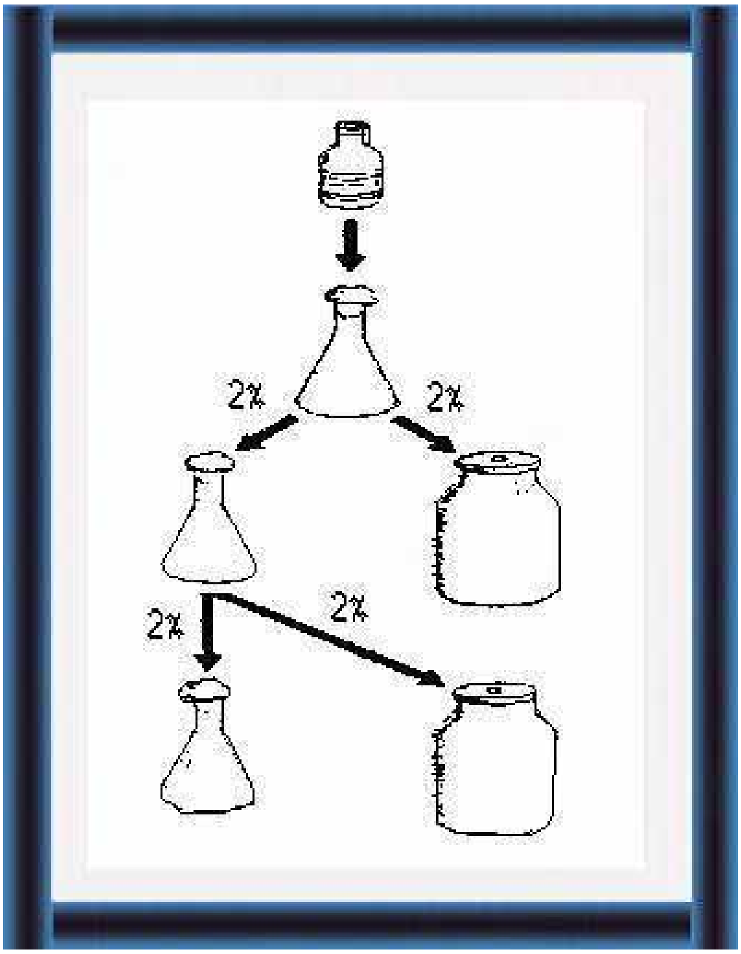
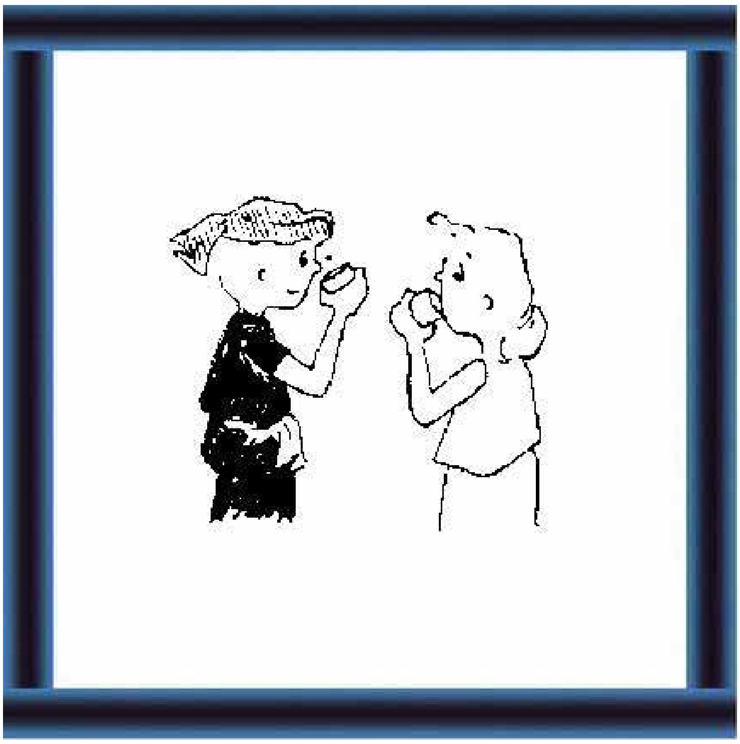


Figure 4



17 You can **test the quality of your cheese milk** by:

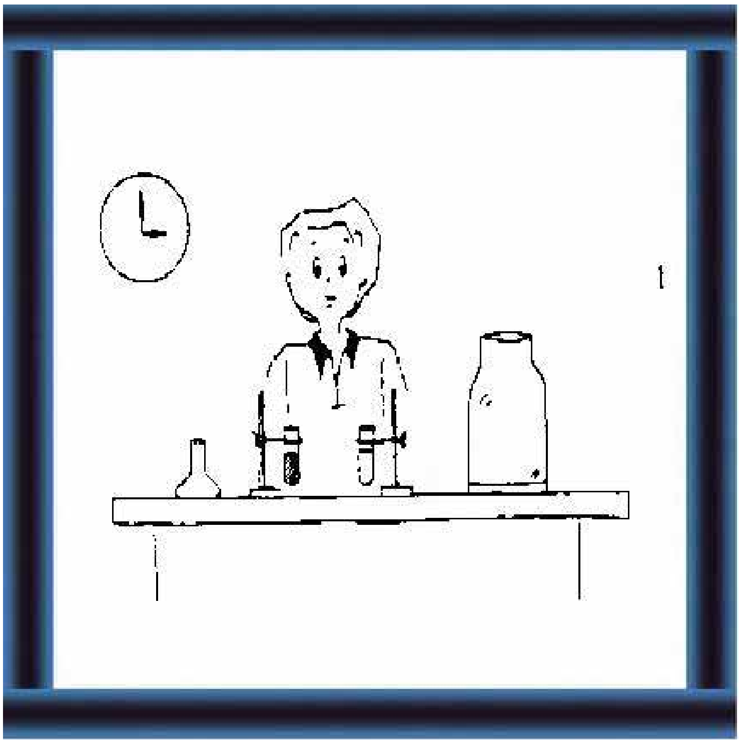
- tasting
- smelling

bad tastes and smells **go to your cheese**

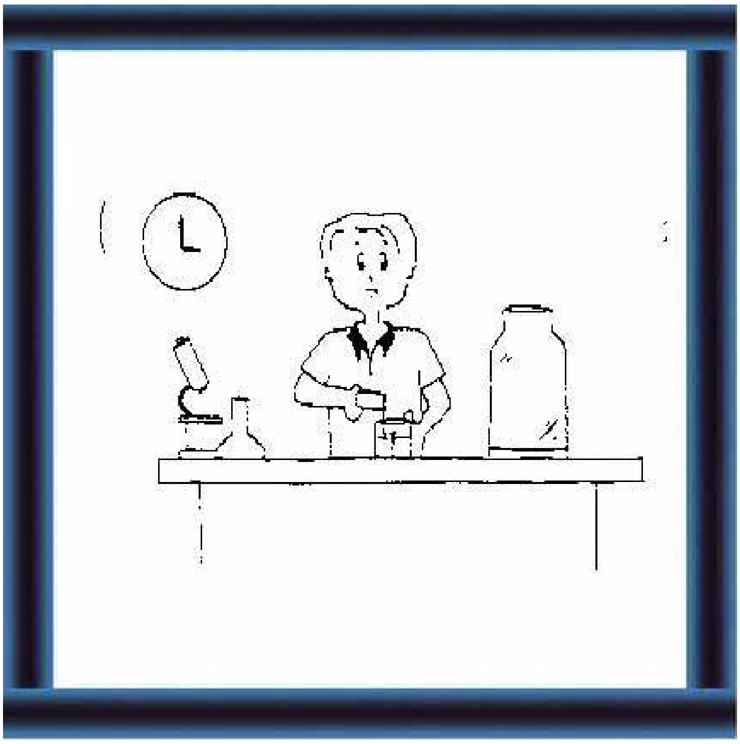
18

- boiling

sour milk or milk with colostrum **precipitates.**



19 Your **milk collecting centre worker** can test the quality of your cheese milk by:
- a **colour reduction** test e.g. methylene blue test which shows the number of bacteria



20
- an **acidity** test e.g. pH or titrated acidity test which shows souring and number of bacteria.

The milk for the starter culture should be heated to 90-95 C for 20-30 minutes. Then cooled down to 43-45 C before adding the culture, and incubating at 43-45 C in either a water-bath, thermo-box or an electric incubator. All the procedures should be carried out under hygienic conditions and with sterile equipment. Stir vigorously before use.

GERBER TEST FOR FAT CONTENT

Reagents:

Sulphuric Acid: sp. gravity 1.816 +/- 0.003, 20 C.
Isoamyl alcohol: sp. gravity 0.811 +/- 0.002, 20 C.

Equipment

Butyrometers
Stoppers
Pipette 10.73 ml
Pipette for H_2SO_4 10 ml
Pipette for Amyl alcohol l ml
Gerber Centrifuge
Water-bath 67 C
Cloth to hold hot butyrometers

Procedure:

1. Fill 10 ml sulphuric acid into butyrometer.

2. Thoroughly mix the milk sample and, using the milk pipette add 10.73 ml milk.

3. Add 1 ml isoamyl alcohol on top of the milk. Care must be taken not to get milk, sulphuric acid or alcohol on the neck of the butyrometer, if this is allowed to happen the stopper may slip out.

4. Push the stopper in the butyrometer.

5. Shake the butyrometer thoroughly until the milk is dissolved. Hold the stoppered end up. Take care!! The butyrometer becomes **HOT**.

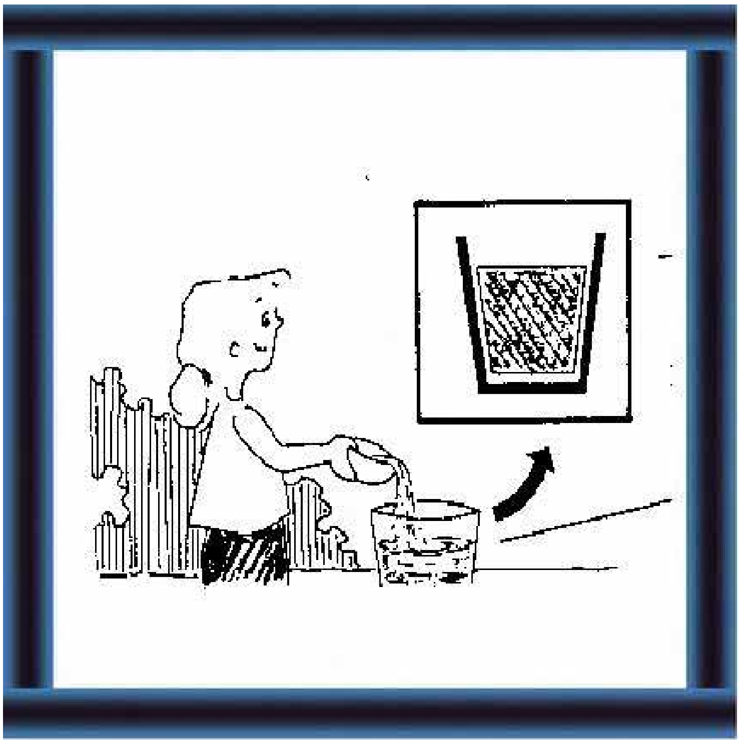
6. Holding the bottle by the stopper and neck. Invert it about 10 times to mix the acid remaining in the bulb with the content.

7. Adjust the stopper so that the expected fat % can be read.

8. Centrifuge for 5 minutes.

9. Immerse the butyrometer in a water-bath at 67 C for 5 to 10 minutes.

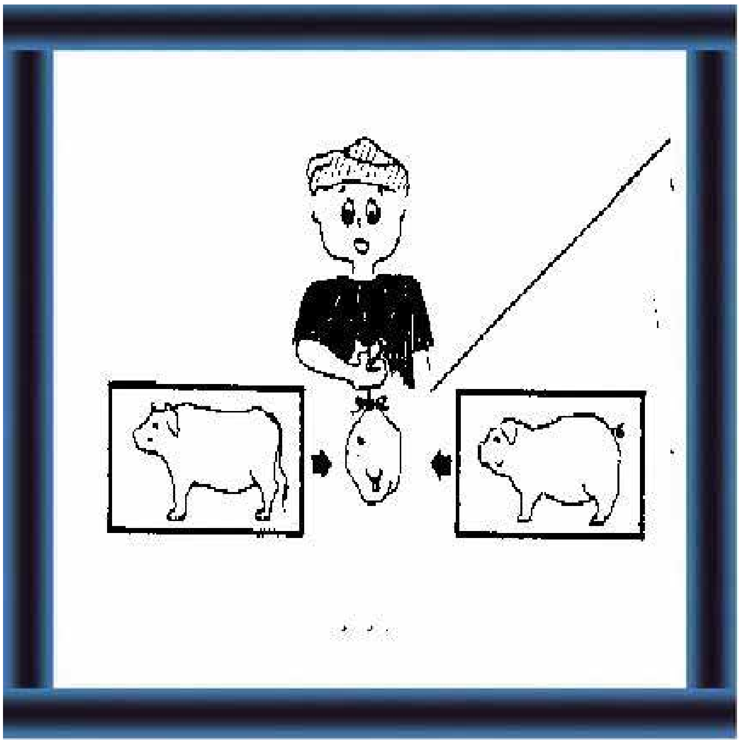
Additives to cheese milk



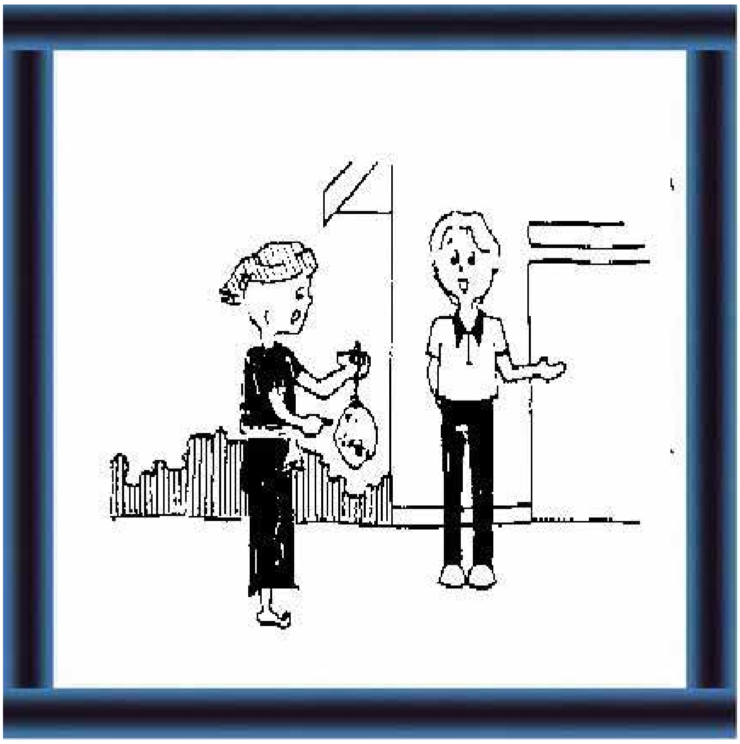
Rennet

21 You add rennet to milk to **coagulate** it.

22 You can:
- **buy** rennet or
- **make it yourself**.



23 You can make rennet from the **4th stomach** of **unweaned calves or pigs** which contain the enzyme chymosin.



24 Consult your extension worker about the simple equipment and chemicals you need to make rennet.

Procedure:(Continued)

10. Adjust the fat column onto the calibrated section of the tube and read as shown in the figure below.

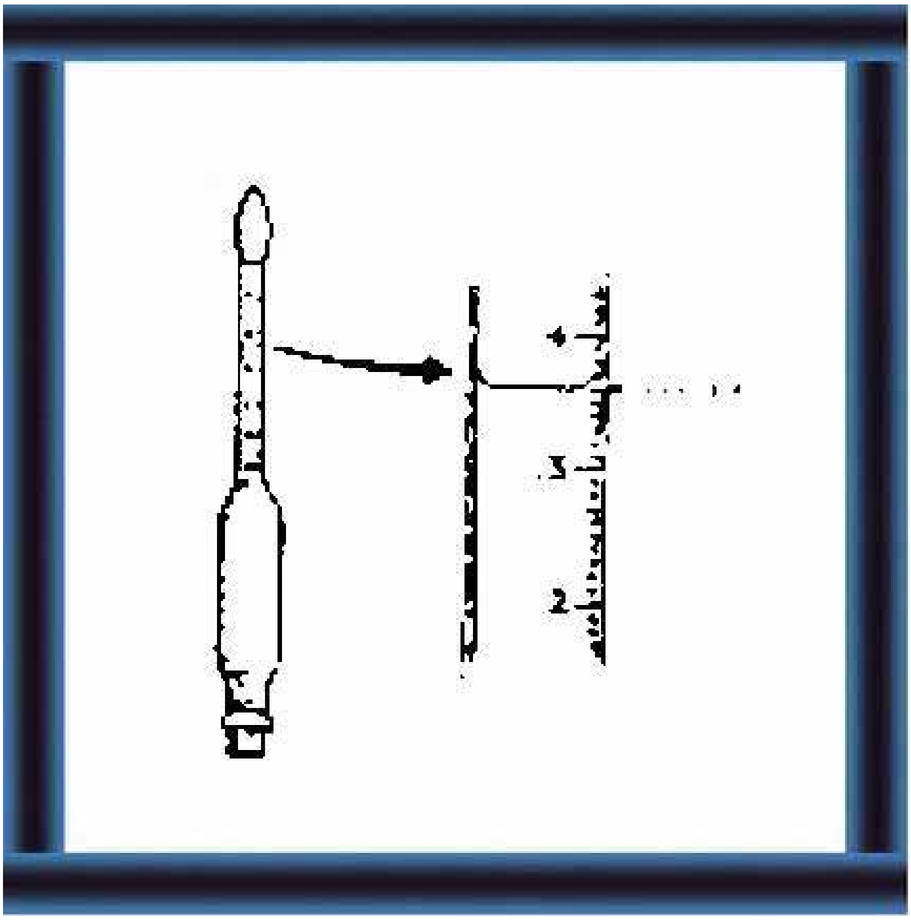


Figure 5

STANDARDIZATION

To guarantee the consumer a product of constant fat content and to meet standards, the fat content for milk products should be standardized. Usually the fat content of raw milk is higher than the required standards. Manufacturing products with an excess fat content will lead to financial losses. In small scale operations the cost of standardization (i.e. purchase and maintenance of separator, fat testing equipment etc.) may be higher than the profits especially if the cream cannot be sold.

Standardization can be undertaken by:

1. Mixing whole milk with partly or totally skimmed milk.

2. Mixing skimmed milk with cream.

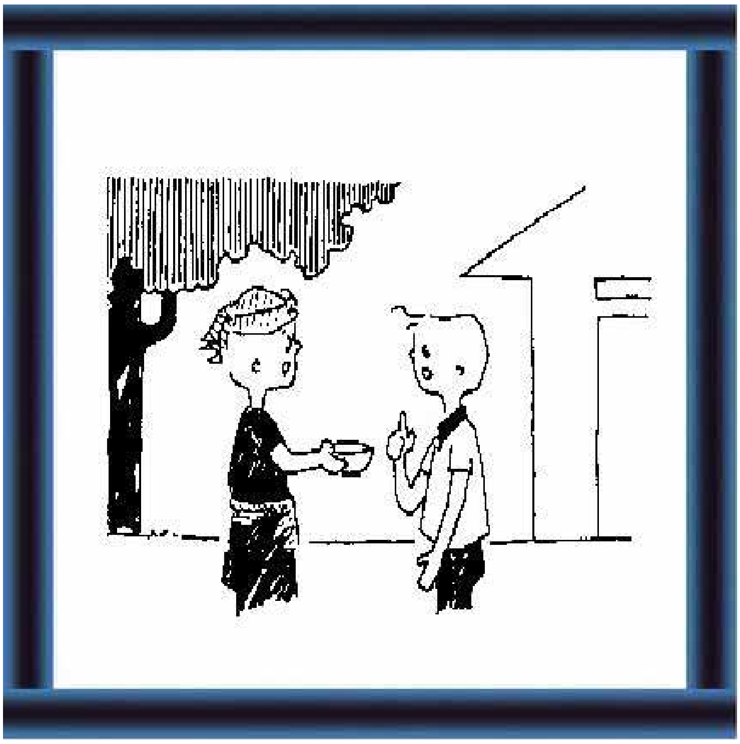
3. Separating whole milk to get the required fat content.

Method 3 requires very sophisticated and expensive equipment so under small scale only methods 1 and 2 are of interest.

Example 1

Suppose 200 kg of raw milk is available. The fat test has shown a fat content of 4.5 % fat. Milk with 3 % fat is required for cheese production. How much raw milk is it necessary to skim (separate). In the calculation it will be assumed that all the fat is removed from the skim milk by separation.

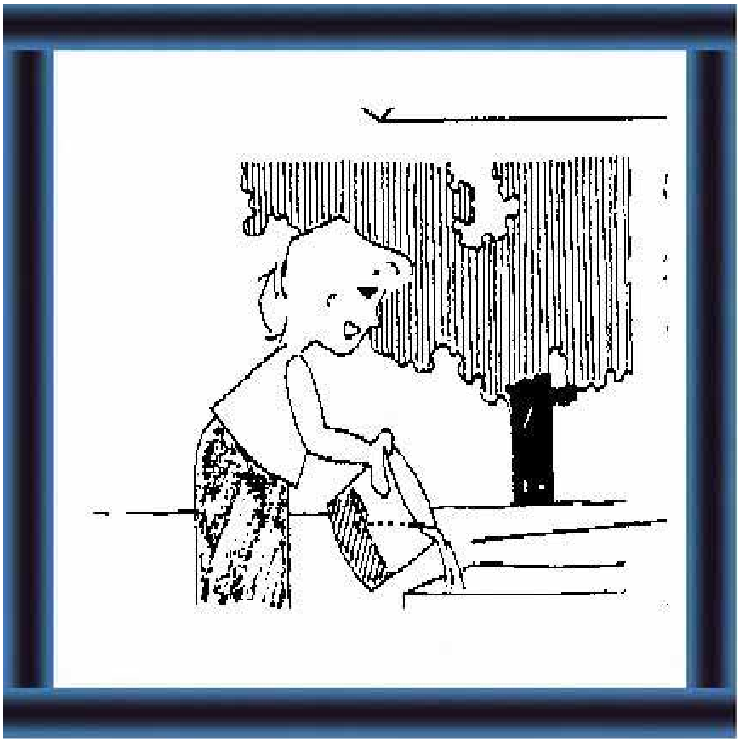
If X = litres of cream with 32 % fat
and Y = litres of milk with 3 % fat



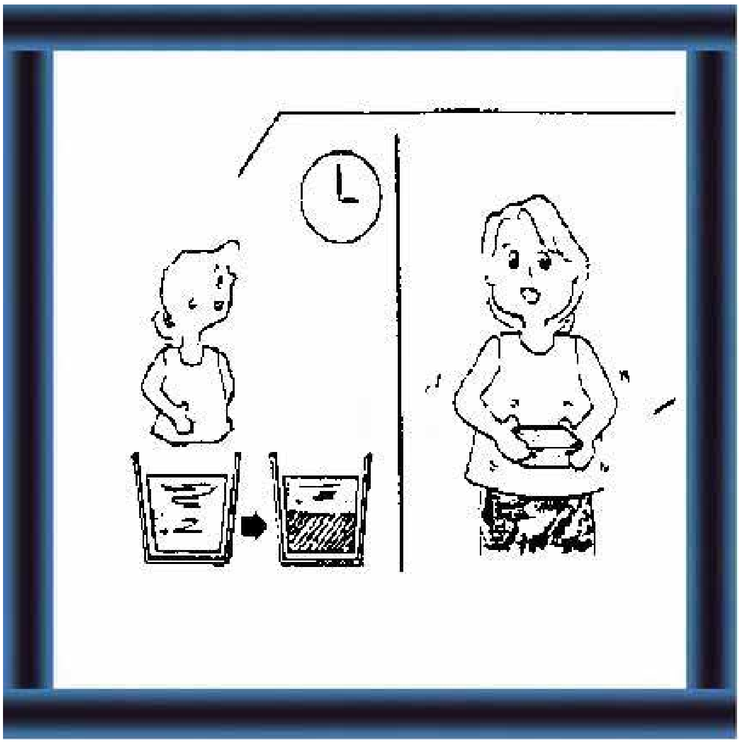
25 You can also get rennet **with enzymes** which **coagulate** milk.

26 **Always**:
- buy or make **small amounts** of rennet
- store in a **dark, cool** place, a refrigerator if possible.

Do not keep for more than 3 months.



Starter (lactic acid bacteria)
27 The starter produces **acid** which:
- helps when you **remove** the **water** from the curd



28
- helps the rennet **coagulate** the cheese milk **quickly**

- makes the cheese **soft**, **rubbery**, **hard** or **brittle**

Example 1 (Continued)

The following equation may be used.

In the calculation the expression fat unit (fu) means 1 % fat in 1 litre of milk.

Total fat units = 200 1 x 4.5 % fat = 900 fu

I X + Y = 200
II 32X + 3Y = 900

Equation I should be multiplied by 32 so that X will be eliminated by subtraction.

I2 32X + 32Y = 6,400
II2 32X + 3Y = 900

Equation II should then be subtracted from Equation I and the following is obtained.

III 29Y = 5,500
III2 Y = 189.7 l with 3 % fat

The Value Y should be inserted in I:

IV X + 189.7 = 200
IV2 X = 10.3 l cream 32 % fat

Now it only remains to calculate how many litres to skim to get 10.3 l of cream with 32 % fat.

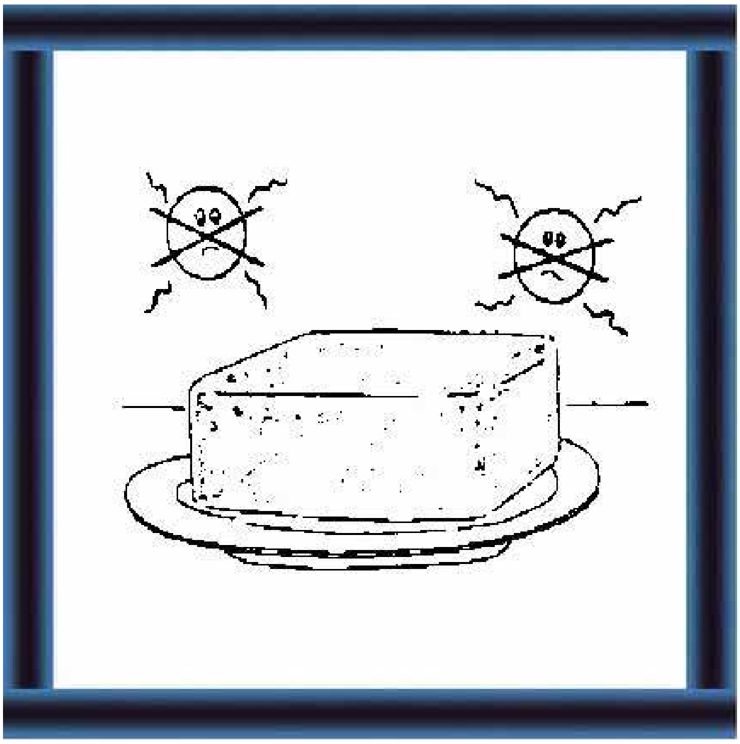
10.3 l x 32 % = 329.6 fu

329.6 fu = 73 litres to be skimmed
4.5 fu/l

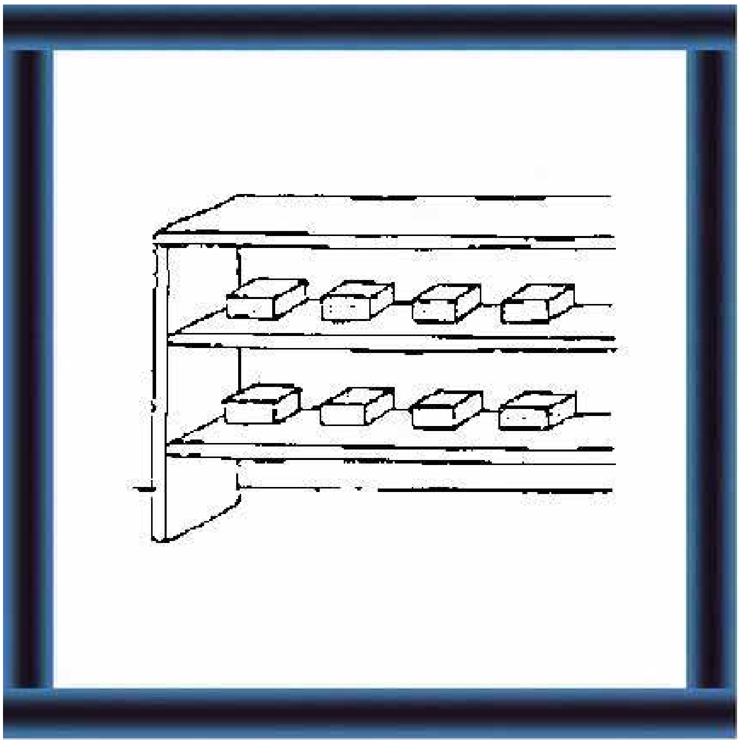
Control of calculation:

189.7 l x 3 % fat = 569.1 fu
10.3 l x 32 % fat = 329.6 fu
898.7 ~ 900 fu

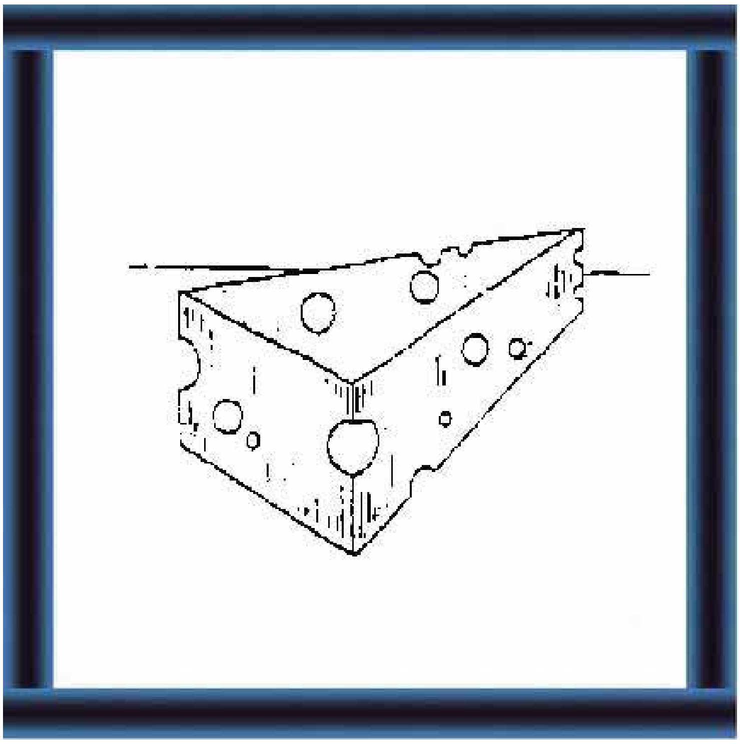
29
- gives the **cheese flavour**



30
- **prevents** the growth of **harmful bacteria**



31
- **breaks down proteins** to **help ripening**.



32 If you want cheese with **eye holes** you need to use a **special starter**.

See T 10.1 Starter Cultures.

Example 2

If skim milk is available for mixing with whole milk to obtain standardized milk with a certain fat content the following mixing square may be used.

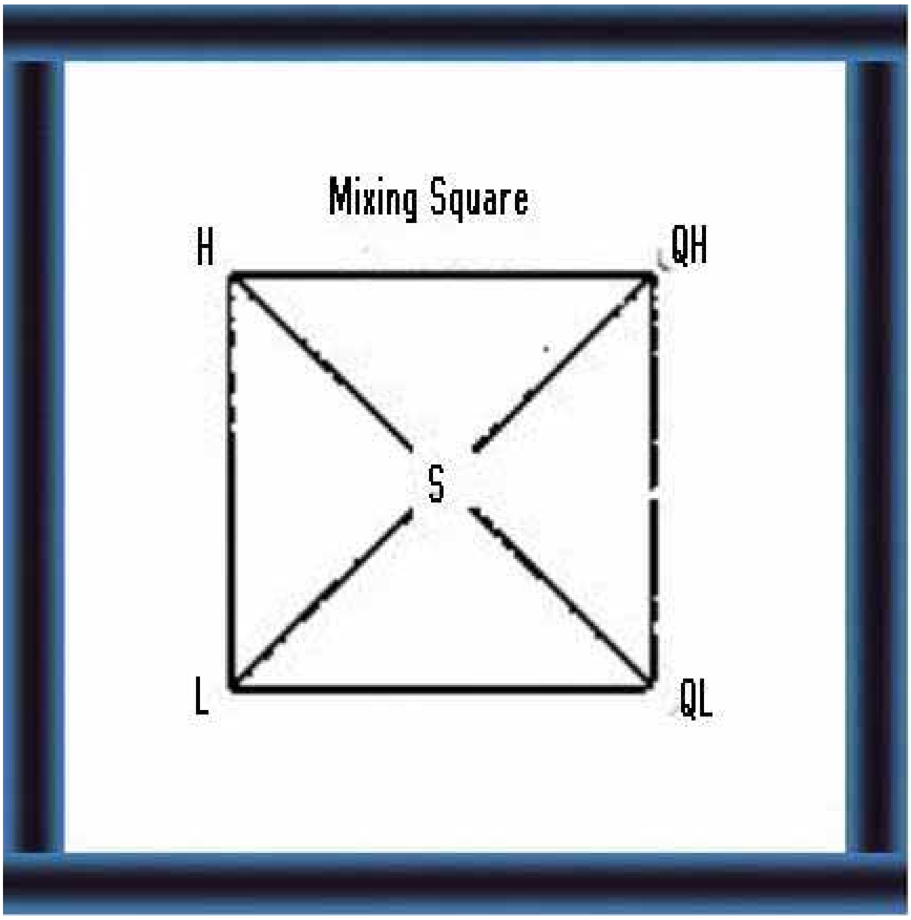


Figure 6

The square shows:

H = fat content of the milk with the highest fat content (e.g. whole milk with 5 % fat)

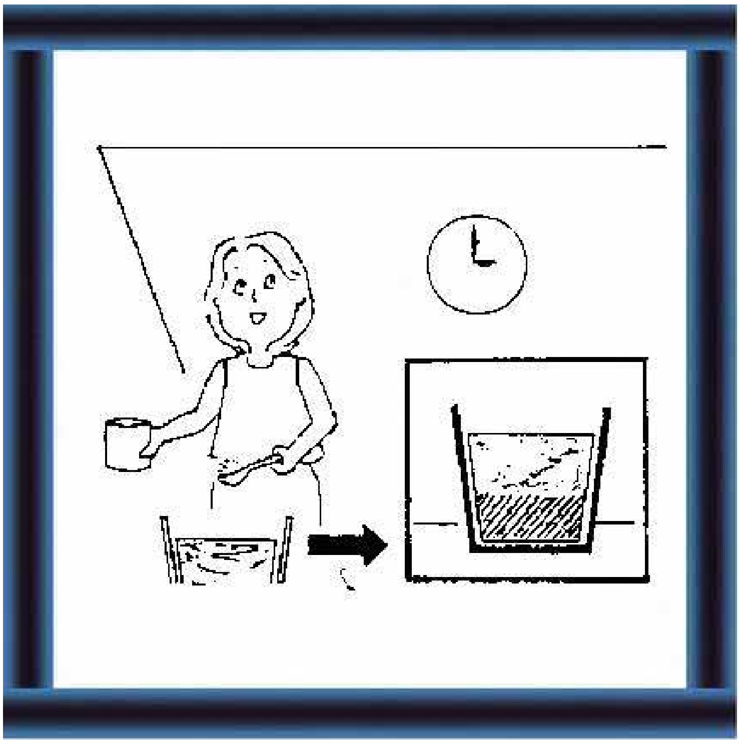
L = fat content of the milk with the lowest fat content (e.g. skimmed milk with 0.05 % fat)

S = fat content of the standardized milk to be produced (e.g. 3 % fat)

QH = quantity of milk available with highest fat content, that is milk to be standardized

QL = quantity of milk with lowest fat content; to be mixed with milk with highest fat content

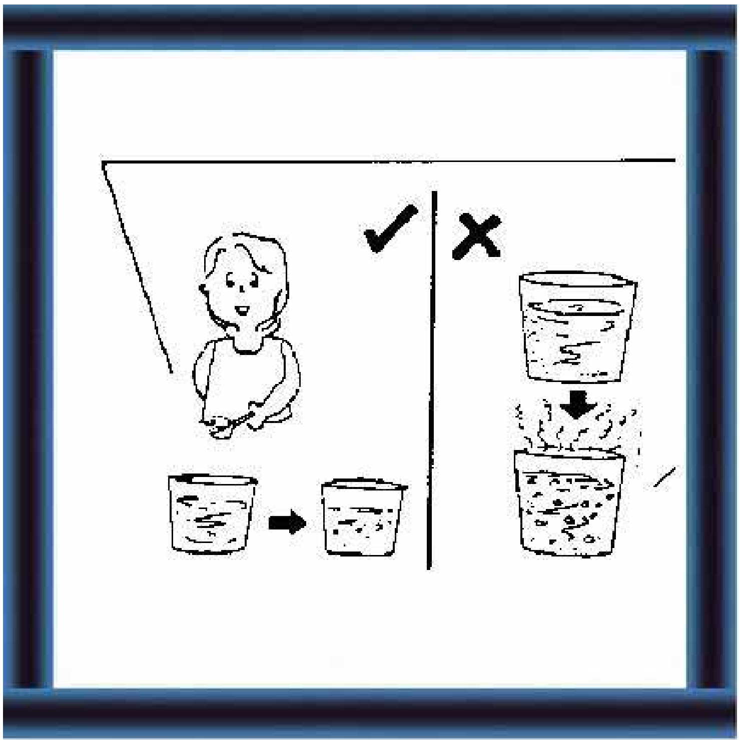
In the example, H - S = QL = 5 - 3 = 2, and S - L = QH = 3 - 0.05 = 2.95, which means that for every 2.95 kg of whole milk 2 kg of skimmed milk has to be added to obtain standardized milk with 3 % of fat; in this case that is 4.95 kg of standardized milk.



Calcium chloride

33 You can add calcium chloride to **coagulate milk faster**.

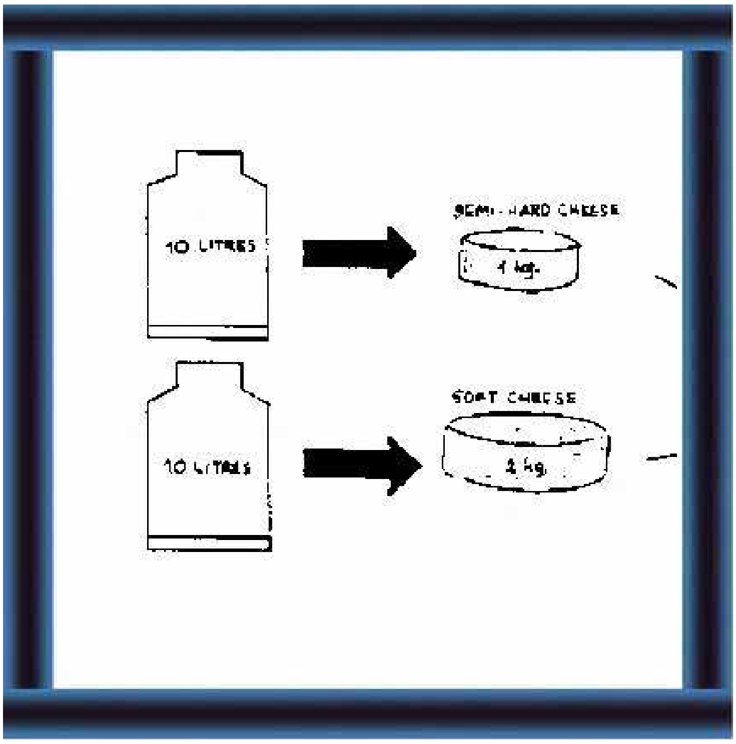
Add 5-20 g calcium chloride per 100 l milk.



Potassium nitrate

34 You can add potassium nitrate to **prevent too much gas** in your milk (from coliform or butyric acid bacteria).

Add 10-15 g potassium nitrate per 100 l milk.



How much cheese do you get from milk?

35 **10 l** of milk makes
1 kg of semi-hard cheese or
2 kg of soft cheese (it contains more whey).

CALCULATION OF EXPECTED CHEESE YIELD

Assumptions:

Approx. 90 % of the fat goes into the cheese.
Approx. 75 % of the protein goes into the cheese.
Approx. 0.5 kg of sugar + ash per 100 kg of milk goes into the cheese.

Calculate the yield from 100 kg of cheese milk with the following composition.

Fat content = 4.2 %
Protein content = 3.4 %

Assumed water percent in cheese = 40 %

Fat yields: $\frac{100 \times 4.2}{100} \times 90\ \%$ = 3.78 kg ~ 33%

Protein yields: $\frac{100 \times 3.4}{100} \times 75\ \%$ = 2.55 kg ~ 22 %

Sugar + ash yields: = 0.50 kg ~ 4 %

Total dry matter = 6.83 kg

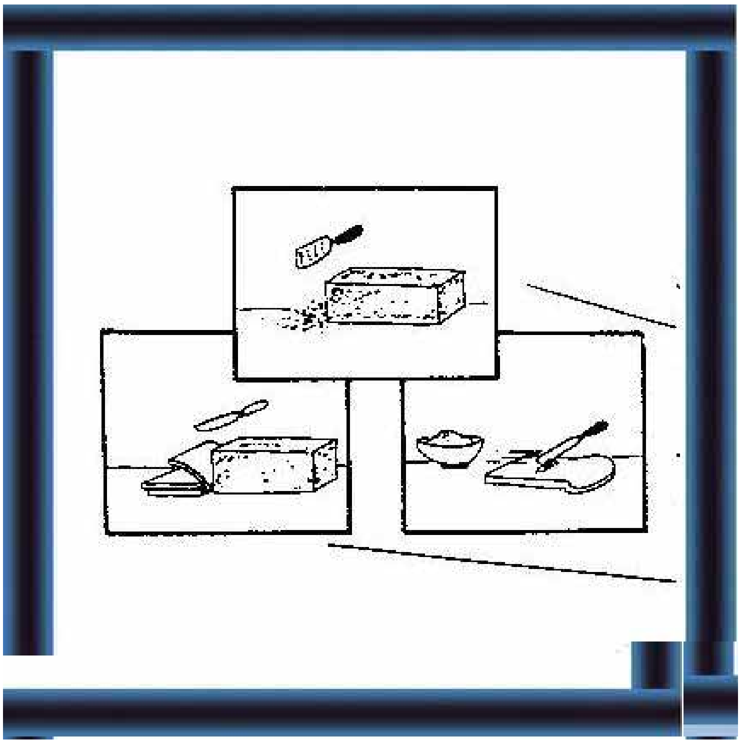
Water yields: $\frac{6.83 \times 40}{60}$ = 4.55 kg ~ 40 %

=11.38 kg ~ 60 %

Kg of milk per kg of cheese $\frac{100}{11.38}$ = 8.8 kg/kg

Fat in dry matter $\frac{3.78 \times 100}{6.83}$ = 55 % = 55+

What is important in making different types of cheese?

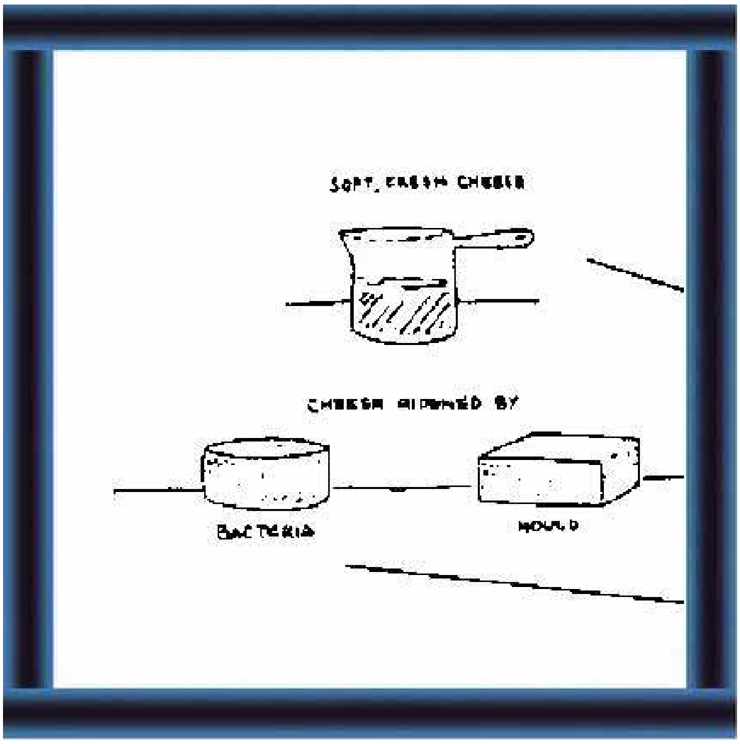


Texture
36 **Hard** cheese - you can **slice** or **grate.**

Semi-hard cheese - you can **slice.**

Soft cheese - you can **slice** or **spread.**

Ripening



37 **Fresh** cheese

Cheese **ripened** by **bacteria/ enzymes**

Cheese **ripened** by **mould**.

Fat and water content

38 Different cheeses contain **different amounts** of **fat** and **water**.

Type of cheese	% fat	% water
Hard Semi hard Soft Very soft	25 - 30 20 - 35 20 - 30 0 - 35	35 - 40 40 - 50 40 - 60 50 - 85

ACIDITY TEST

The titratable acidity test is employed to ascertain if milk contains a large amount of lactic acid which might reduce its heat stability, and thereby its suitability for milk products manufacture.

Titratable acidity generally has been presented as the acidity measured by titration with 0.1 N sodium hydroxide, due solely to lactic acid. This is not really so because what is actually measured is the quantity of alkali necessary to bring the pH of the milk to approximately 8.3 at which point phenolphthalein shows the characteristic pink colour. Generally, freshly-drawn milk does not contain lactic acid. Some bacteria which contaminate milk can attack the milk sugar (lactose) and form acids of which the principal is lactic acid. The indicator substance phenolphthalein is colourless in an acid solution but red in an alkaline solution. On adding phenolphthalein to milk it remains colourless because the milk is acidic, its inherent acidity being due to its natural constituents particularly the protein and phosphates. The addition of a solution of an alkali like sodium hydroxide neutralizes the acid and, when a slight excess has been added, the phenolphthalein turns red.

Method

1. Pipette 9 ml of the well-mixed sample of milk into a 100 ml Erlenmeyer flask.

2. Add 10 drops of 1 percent phenolphthalein solution (prepared by dissolving 1 gm phenolphthalein in 75 ml of 95 % Ethyl alcohol and adding enough distilled water to make total volume 100 ml).

3. Fill the burette with the 0.1 N sodium hydroxide solution, run out a portion to ensure that there are no air bubbles in the column, then adjust to a convenient graduation mark, preferably zero.

4. While agitating the sample continuously, run the sodium hydroxide solution in slowly from the burette until the first permanent pink colour is obtained. A permanent very pale pink is the correct endpoint.

5. Read off the quantity of alkali used and calculate the amount of titratable acidity as percent lactic acid.

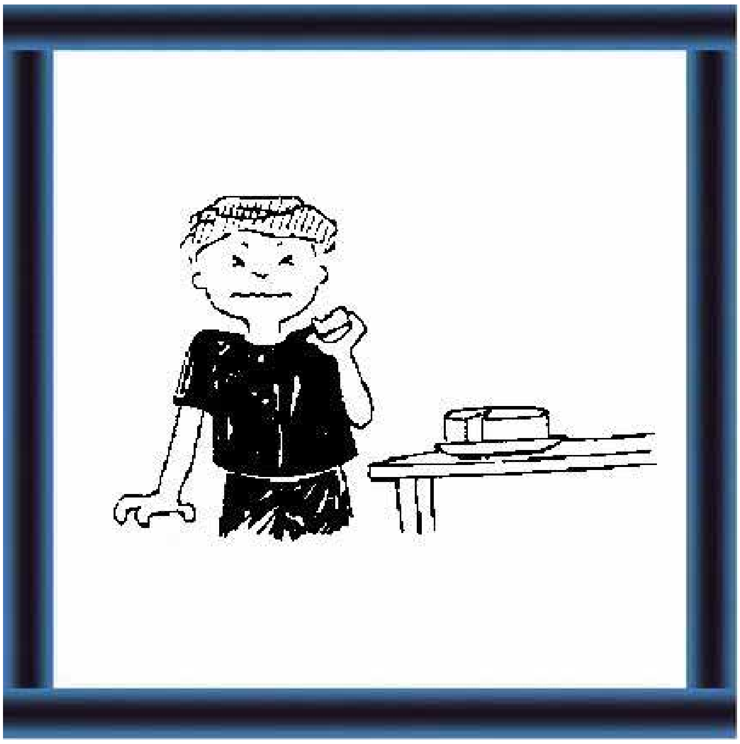
Titratable acidity = $\dfrac{\textbf{ml 0.1 M NaOH x 0.009 x 100}}{\textbf{Volume of sample}}$ **= % lactic acid**

Example: V**olume of sample 20 ml**

ml 0.1 M NaOH = 29 ml

Titratable acidity = $\dfrac{\textbf{29 ml x 0.009 x 100}}{\textbf{20 ml}}$ **= 1.3 % lactic acid**

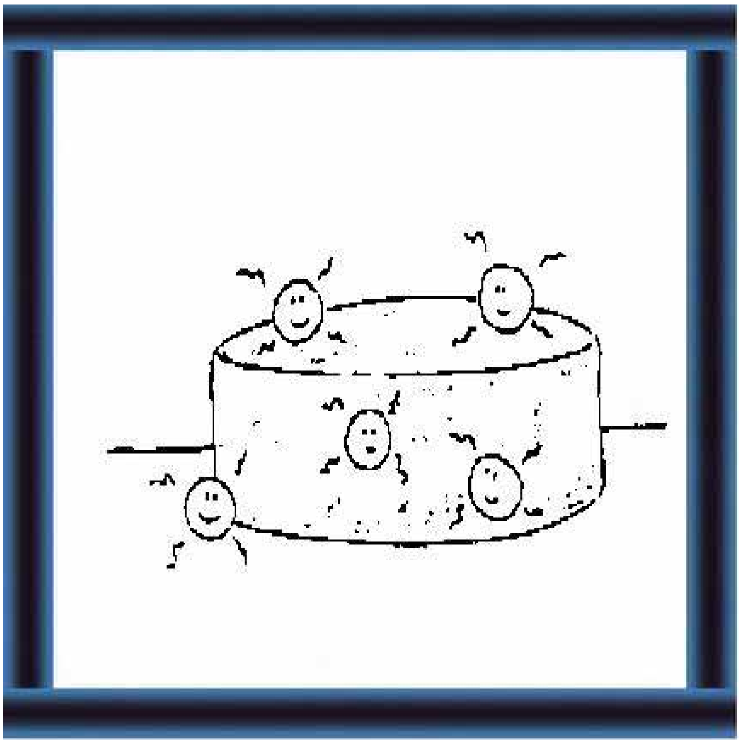
Whey content



39 The **amount** of whey in the curd affects the

- taste

too much whey makes the curd **sour**



40

- keeping quality

too little whey makes it **easy** for **bacteria to attack** the curd.
We usually **remove more whey** from **fresh cheese** than from cheese for ripening.

SMALL SCALE MOZZARELLA CHEESE MANUFACTURING

Essential equipment:

Cheese vat, jacketed 100-200 l
Curd cutting knife
Agitator
Scale
Thermometer
Heat source (gas-burner)
Basin for heating water in
Basin for heating cheese in water
Knife
Sieve
Cheese cloth
Bucket
Gloves
Moulds
Wrapping material
Freezer/Refrigerator

Optional equipment: pH-meter

Lactodensimeter
Fat testing equipment
Acidity testing equipment

Electric incubator
Vacuum packing machine
Separator

Materials:

Milk (standardized fat %)
Yoghurt starter culture
Rennet (powder or liquid)
Salt (NaCl)
Ice

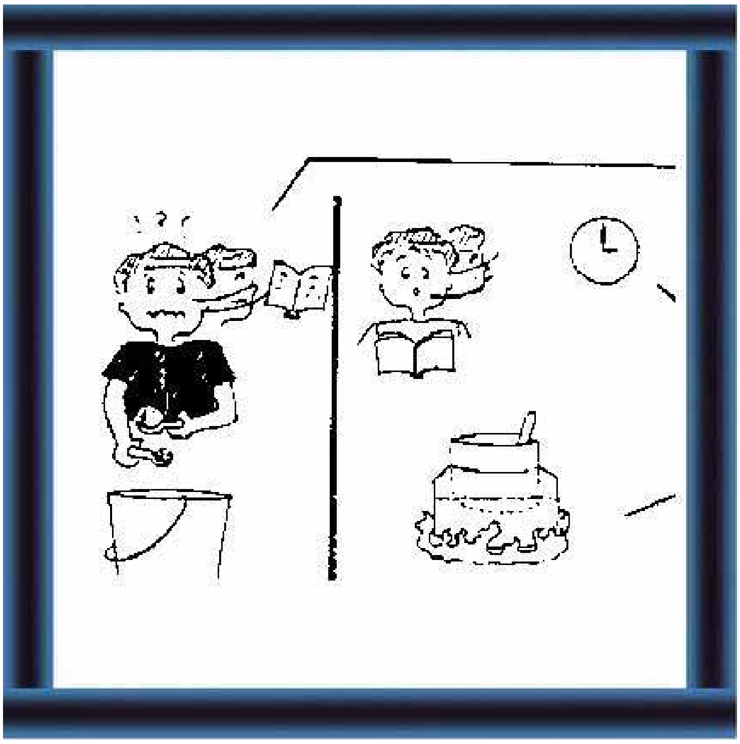
Procedures:

1. Raw milk is poured into the cheese vat through a cloth. The temperature should be > 32 C

2. 1.25 % yoghurt starter is added and the milk is thoroughly stirred. Leave to stand for 30 minutes.

3. Add rennet according to instructions from supplier. Stir milk to ensure equal distribution of rennet. Leave untouched until a shiny firm coagulum has formed (35-45 minutes).

41 Because the composition of milk is **not always the same**, you must **adapt**the recipes.



42 **Try out different**:

- **quantities** of rennet or culture
- **times** for curdling
- **temperatures** for curdling.

Each time you make cheese, keep **records:**

Date:
beginning .... pressing .... ripening ....

Quantity of: **Quality:**
milk .... **type ....**
culture/acid/rennet .... **hardness ....**
salt .... **taste ....**

Temperature:
adding culture/acid/rennet ....
curdling ....

Time:
for curdling ....

Next time you can **adapt** your recipe and **improve** your cheese.

Procedures: (Continued)

4. Cut the curd into equal sized cubes of 1 to 1.5 cm. Cut horizontally first, then twice vertically, if cubes are too big cut again vertically.

5. Start heating with low fire and leave to stand for 15 minutes.

6. Start stirring gently and put on full fire. Gradually intensify stirring. Keep on stirring and heating until the temperature is 47 C. Stop heating and keep on stirring for about 30 minutes.

7. Stop stirring. The cheese grains will then sediment on the bottom of the vat. Remove with a clean bucket as much whey as possible. Pour the whey through a sieve into a milk churn or another container. Push cheese grains away from the outlet, insert a sieve in front of the hole and remove remaining whey through outlet.

8. The cheese grains will stick together within 5 minutes after removal of the whey. Cut the lot into pieces of approx. 25 x 25 cm and turn them. Put lid on the vat.

9. Cut, turn and pile the cheese every 30 minutes for 1 1/2 hours of until pH has reached 5.1 - 5.3. The cheese should be like boiled chicken meat.

10. Cut the cheese into ribbons of approx. 25 x 8 cm. Weigh out 2.2 kg, put them into a basin with holes in the bottom of the side.

11. Insert basin into another basin containing water at 82 - 85 C. Leave the cheese there for 10 minutes.

12. Take basin with cheese out, knead and stretch the cheese vigorously while it is hot. Add salt (one spoonful per 2 kg) and knead again.

13. Insert cheese in hot water for short time (1-2 minutes) take it out, shape it and fill it in the mould.

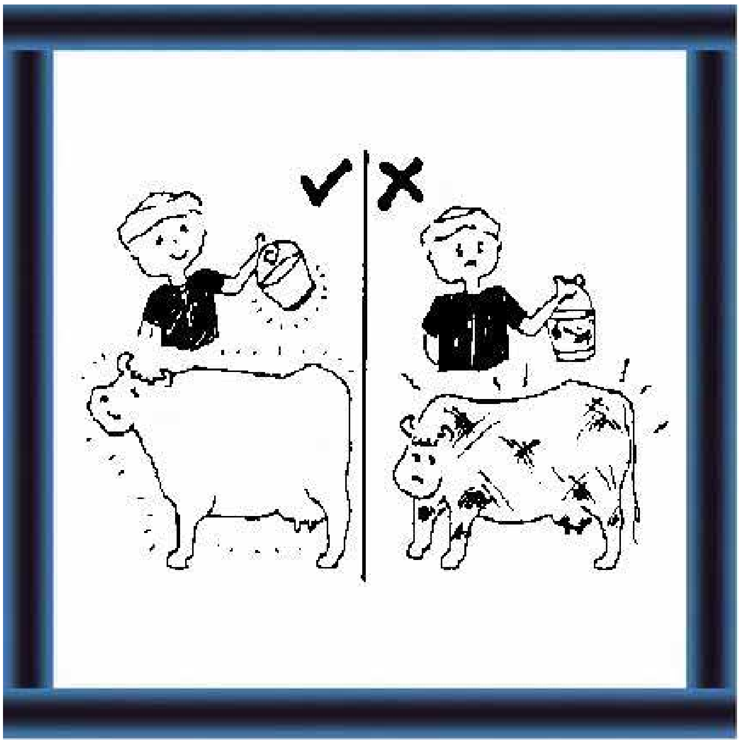
14. Put mould with cheese into ice-water.

15. Cool the cheese in the ice-water until it becomes firm, about 1 hour.

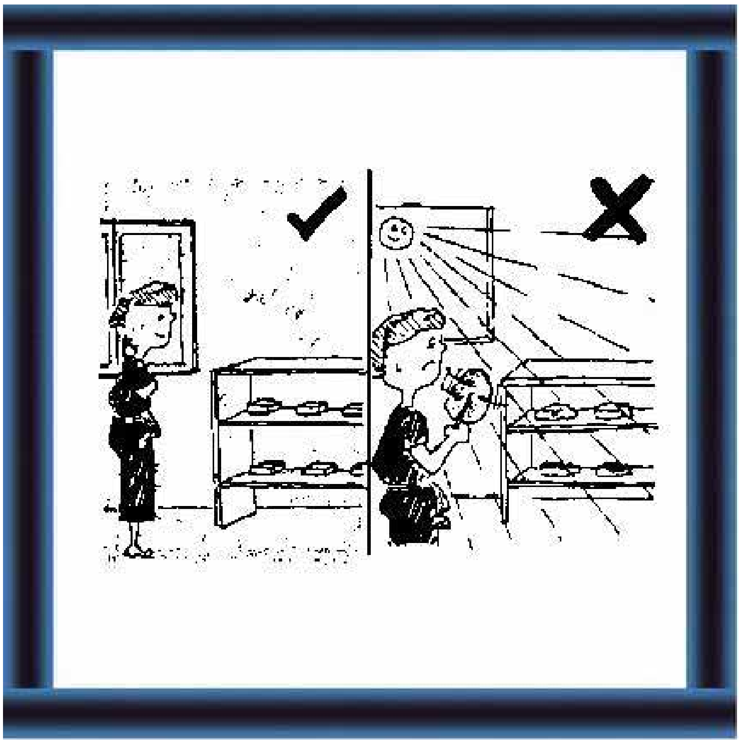
16. Let the surface of the cheese dry before packing.

17. Put the packed cheese in the freezer or refrigerator.

What are the problems of making cheese in the tropics?

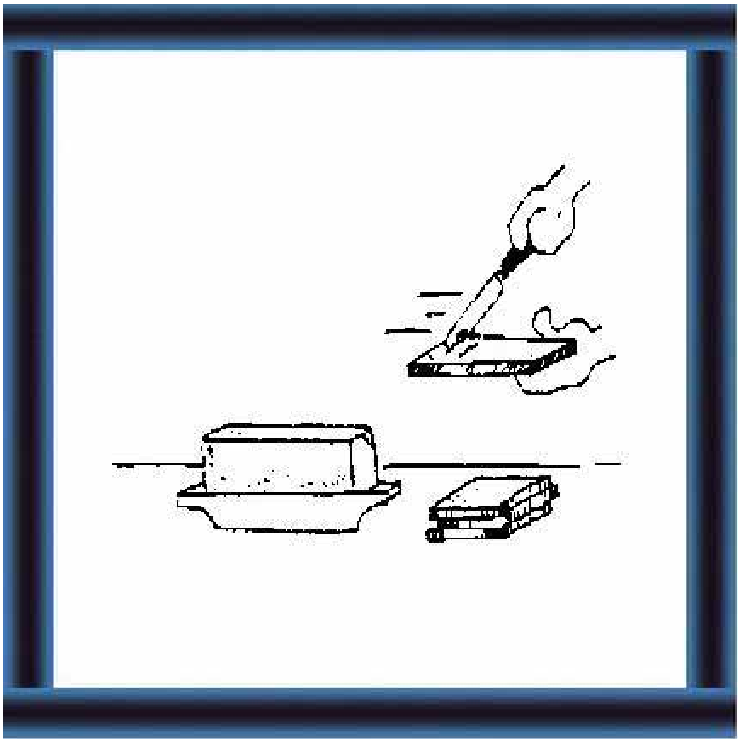


43 Hard and semi-hard cheeses require a **high quality** of milk and a **very hygienic method of production**.



44 Ripening cheeses requires **lower temperatures** and **higher humidities**, than available under normal conditions.

45 Farmers should produce cheese which people like and has a good market (e.g. with a **good flavour** and **smell** for consumers).



46 For these reasons, farmers usually produce **soft, fresh** cheese in the tropics.

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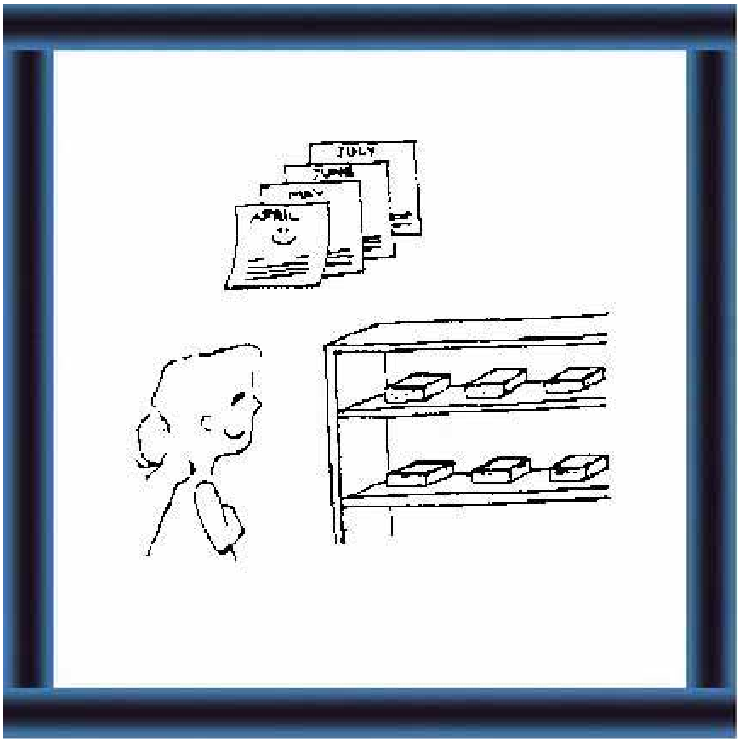
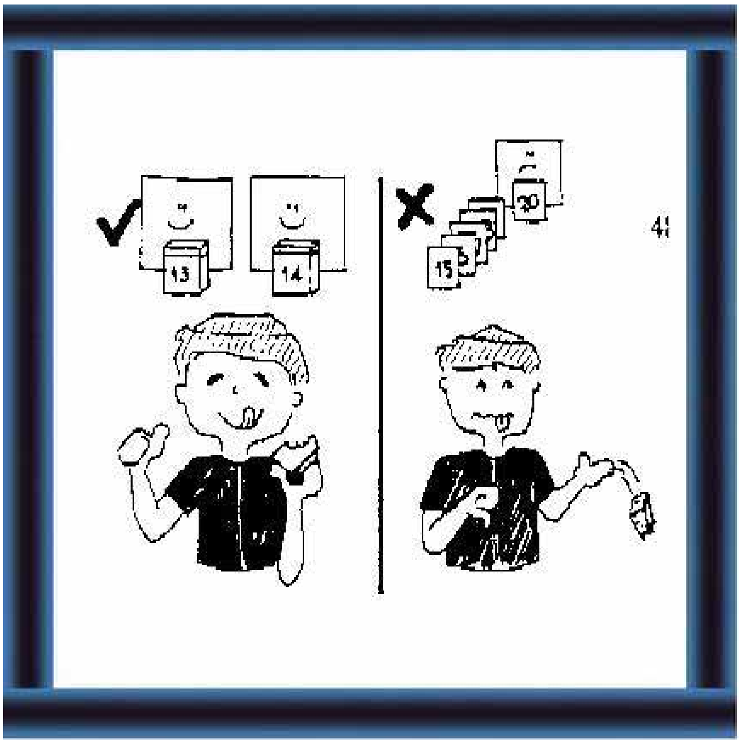
What are the keeping qualities of cheese?

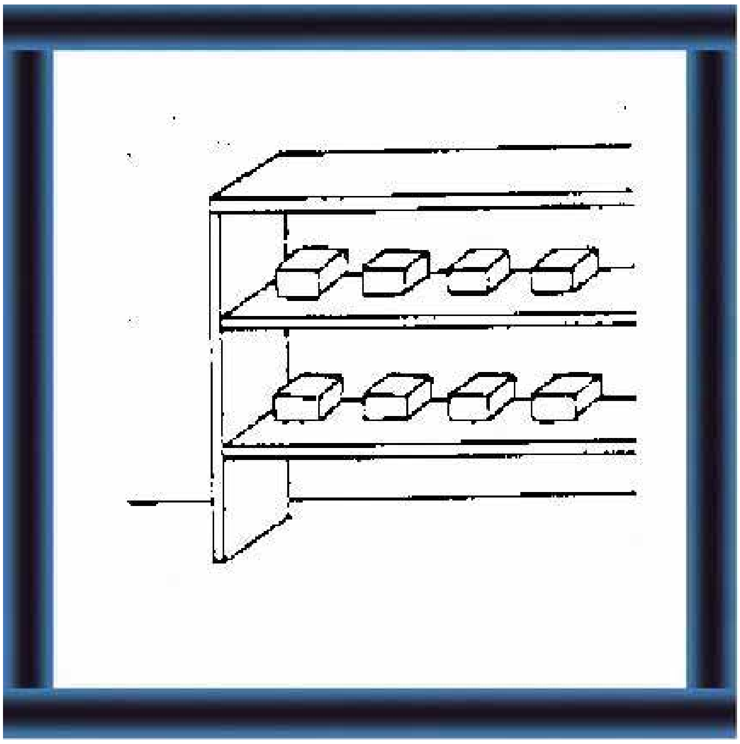


47 Making cheese from milk is one method of **preservation.**



48 Fresh and soft cheeses are **very perishable** and you should eat them **within 1-2 days.**

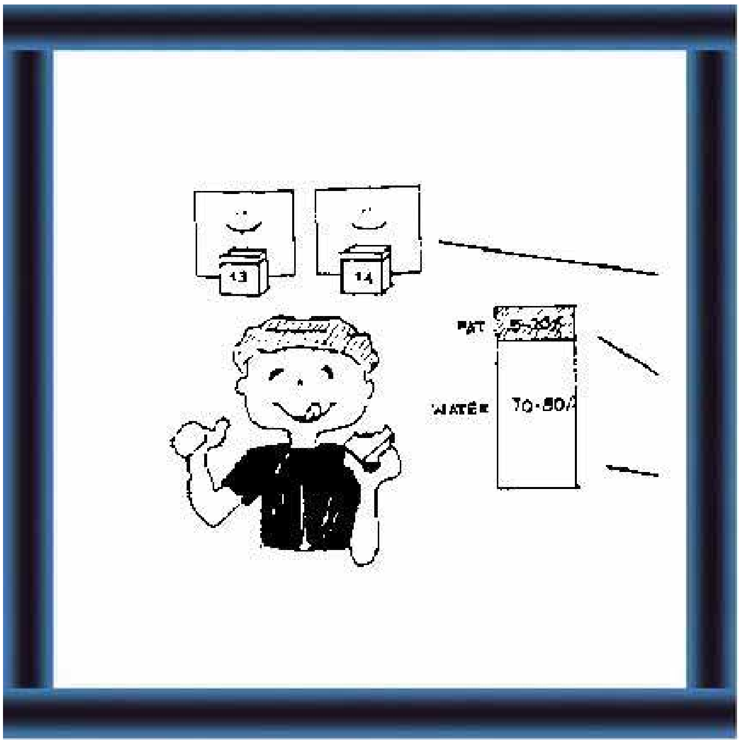
49 You can keep them longer by **salting heavily.**



50 You can keep semi-hard cheeses for **3-4 months.**

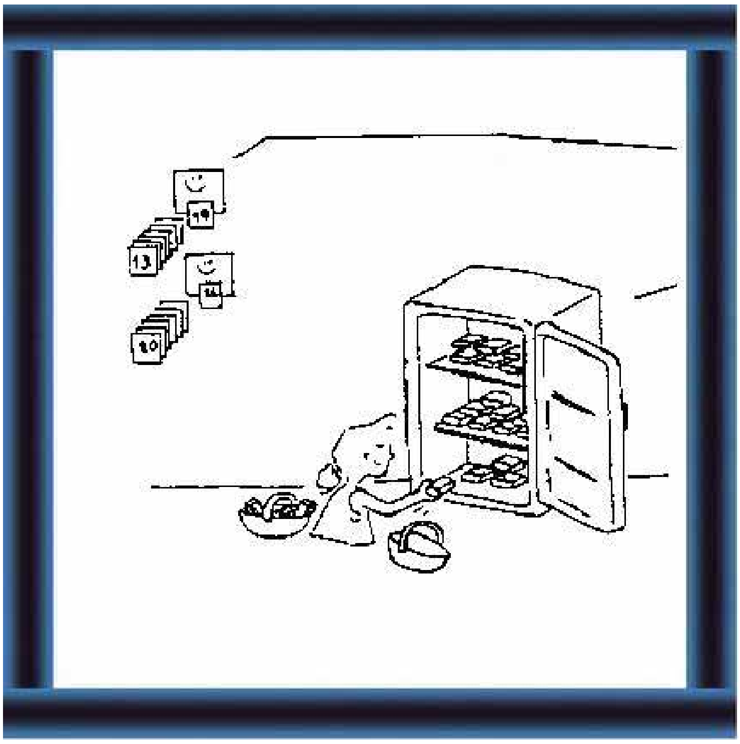
Cheeses which are ripening should be kept in a **cool place at** 10-15 C until they are ripe, **not** in a refrigerator.

What is fresh cheese?



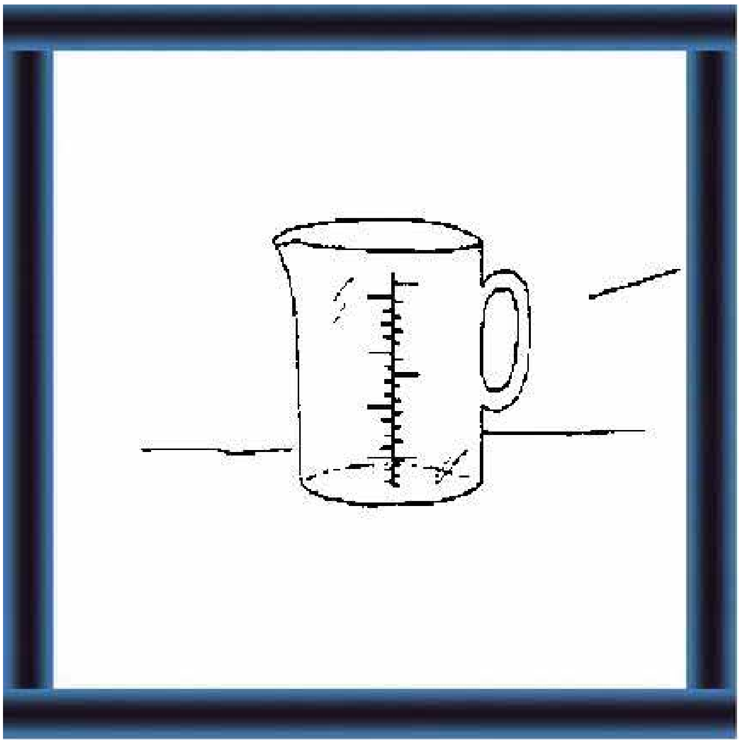
51 Fresh cheese is cheese you can eat **immediately after making**.

It has a **high** water content (70-80 %) and a fat content of 5-20 %



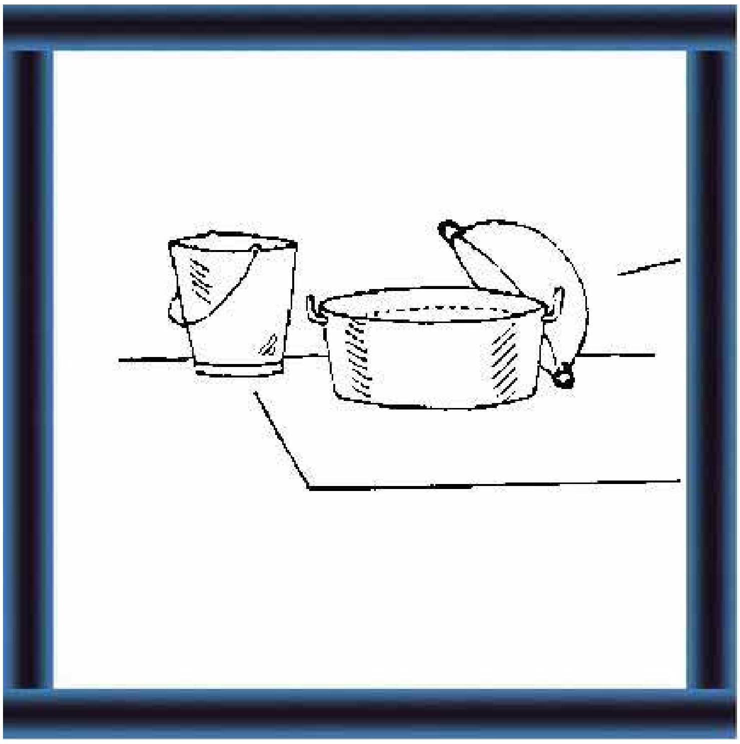
52 You can keep fresh cheese in a **refrigerator** (4-6 C) for 1 to 2 weeks.

What equipment do you need to make fresh cheese?
Important: All equipment should be stainless steel and must be clean.



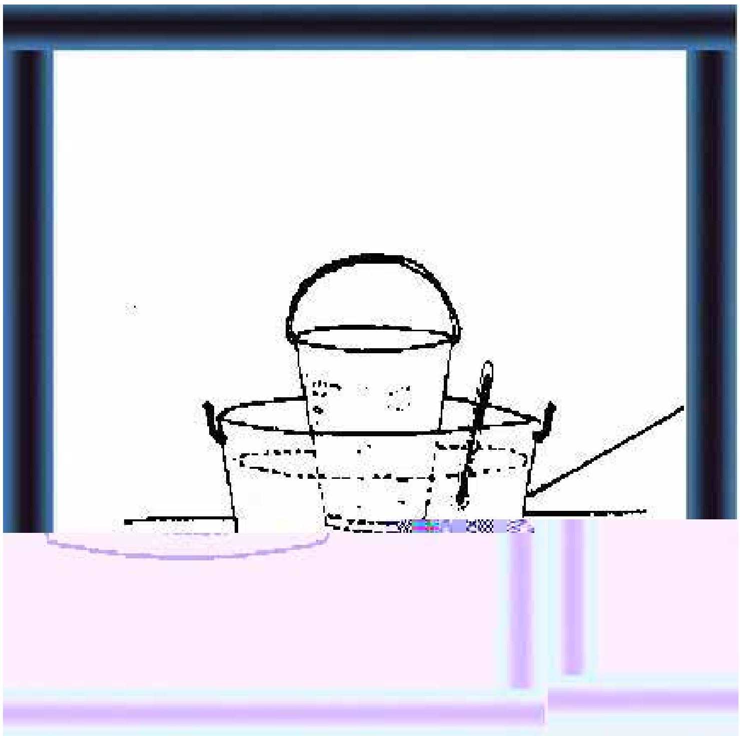
53 A **measuring beaker** made of glass or stainless steel.

Try not to use plastic as it is **difficult** to clean and **absorbs smells**.

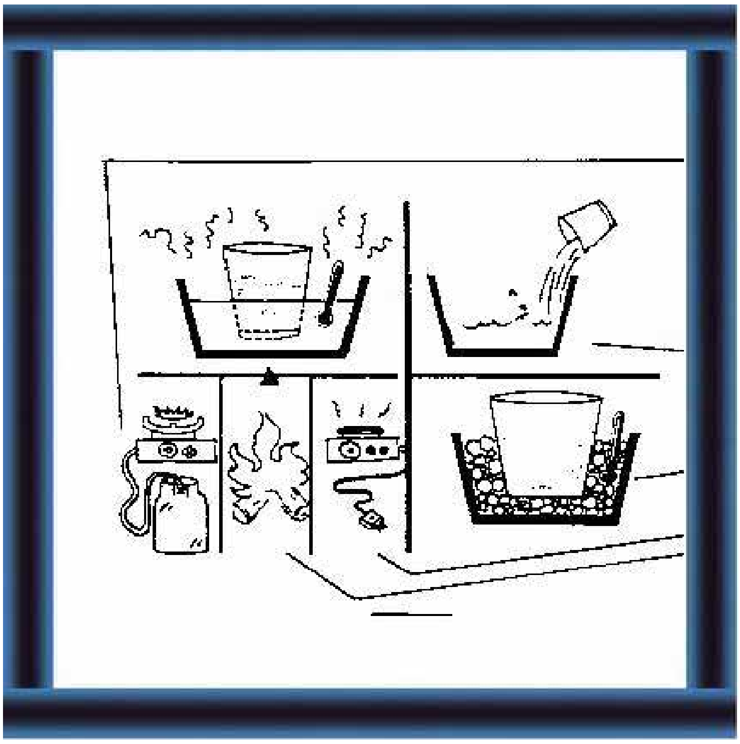


54 A **cheese vat**:
- you can use a **pan** or a **bucket** made of stainless steel or aluminium.

Do not use iron or zinc as these can **corrode quickly**.

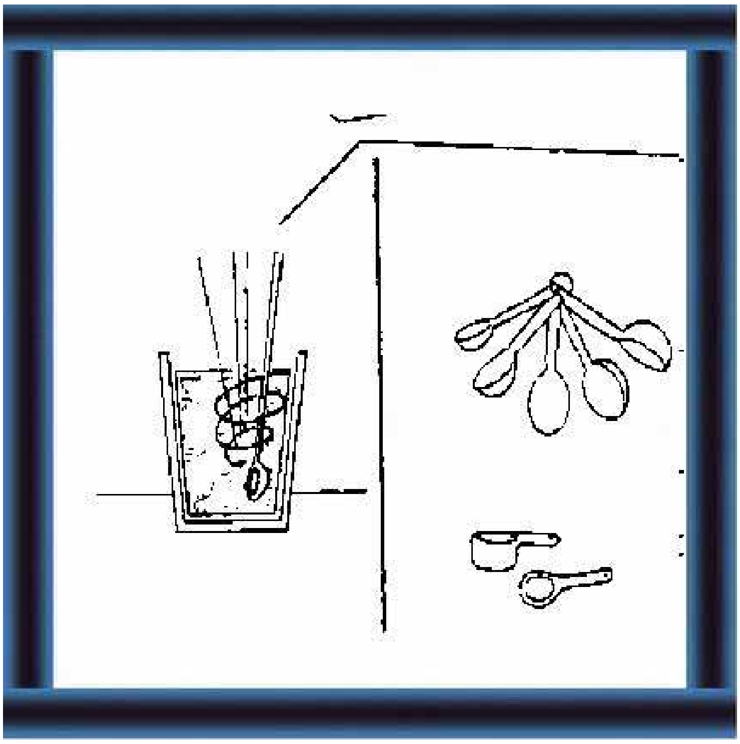


55 A **water bath** for indirect heating and cooling of the **milk/ curd** in the cheese vat.



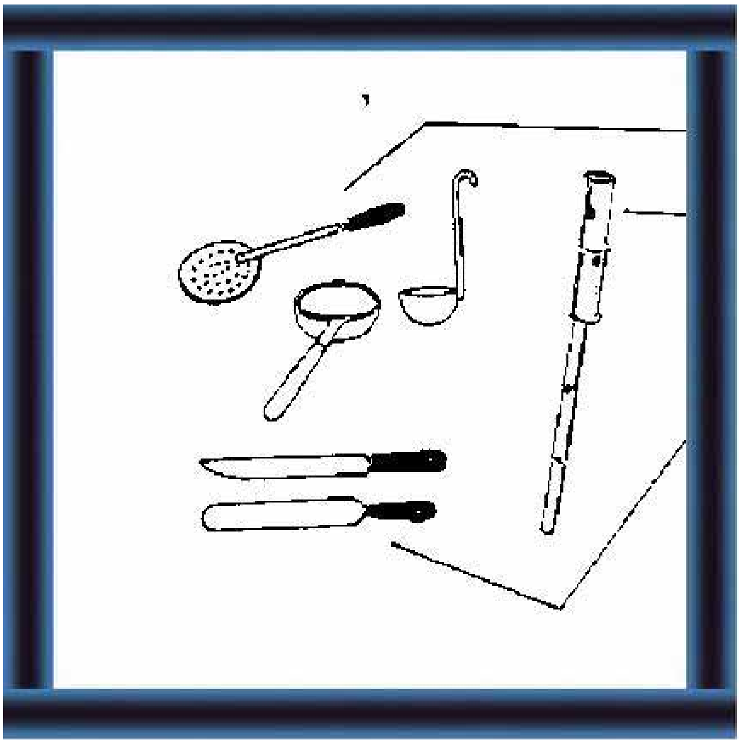
56 A source of **heating** e.g. gas, wood electricity.

A source of **cooling** e.g.ice, water.



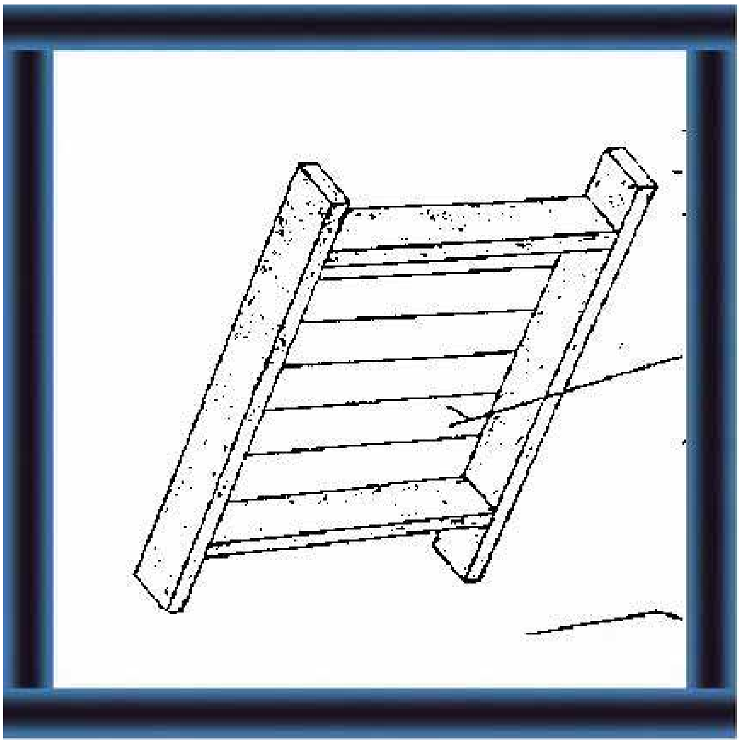
57 A **ladle** or **long-handled spoon** for stirring the milk.

A **spoon** for measuring the culture.

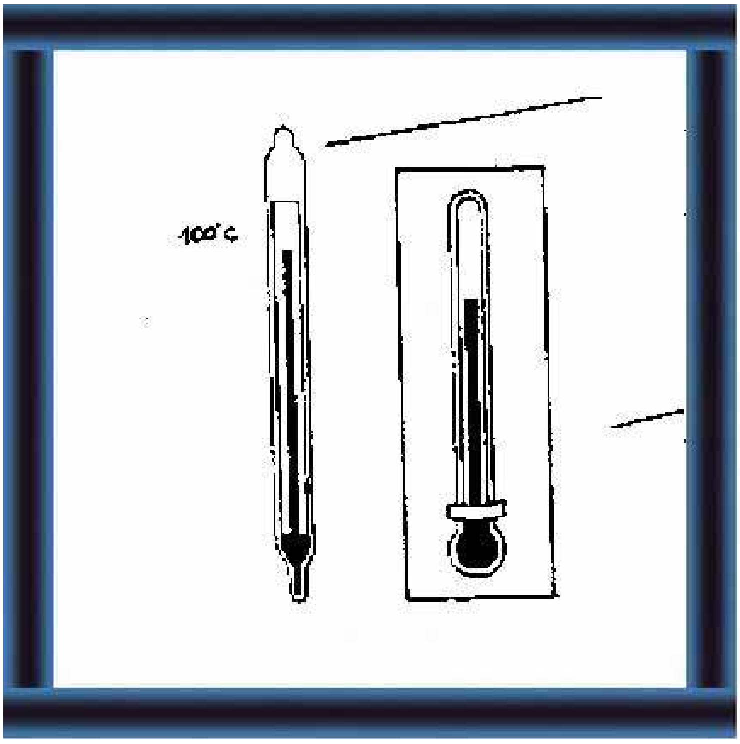


58 A **skimmer** for removing curd from the cheese pan.

Knives with long handles or **split cane bamboo** for cutting the curd.

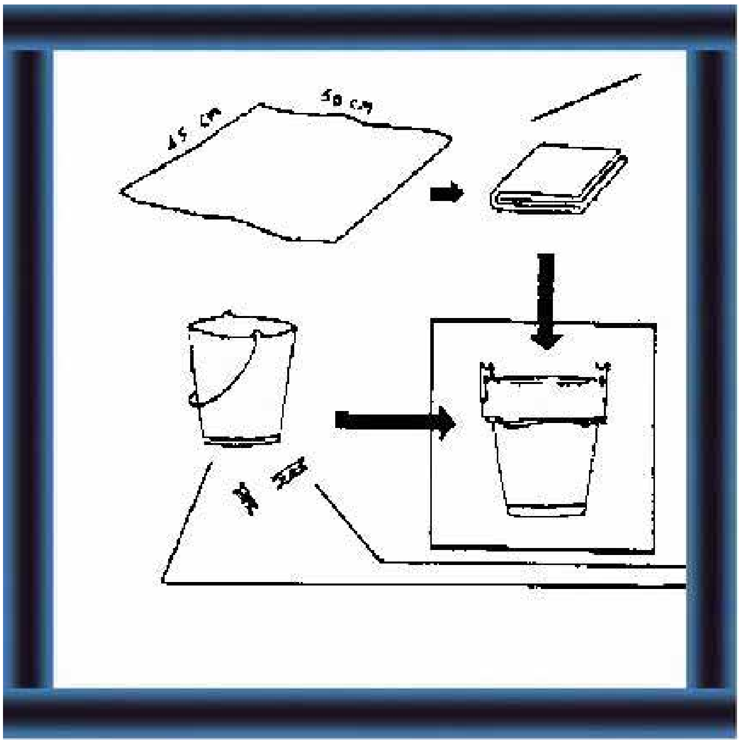


59 You can also use a **square frame** with **wires** about **15 mm apart** for cutting the curd.



60 A **thermometer** with a maximum temperature of 100 C for measuring the temperature of the heated milk.

A **thermometer** for measuring outside temperature for making culture and ripening cheese.

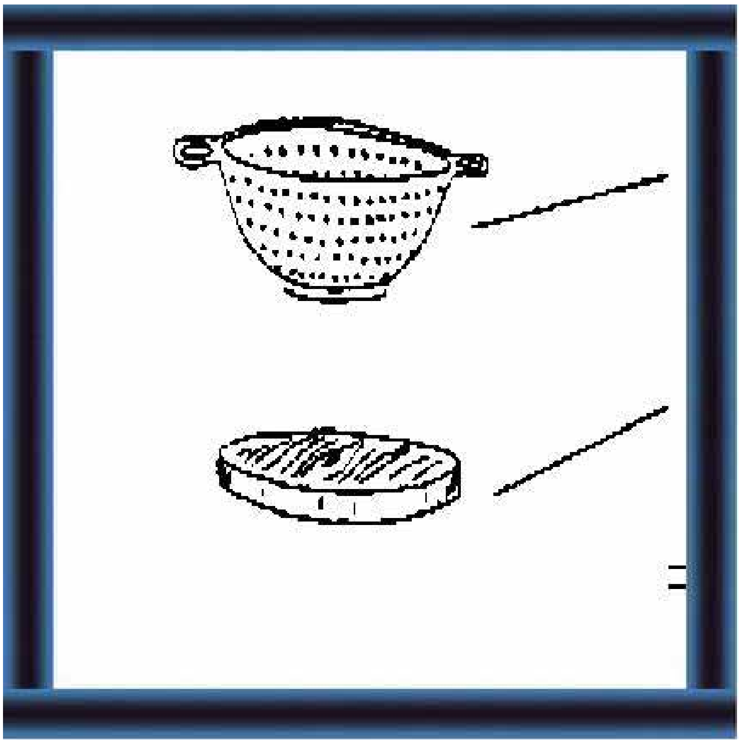


61 A **cheese cloth** made of fine cotton for draining off the curd.

It should measure about 45 x 60 cm and you should use it folded double.

A **bucket** for collecting the whey.

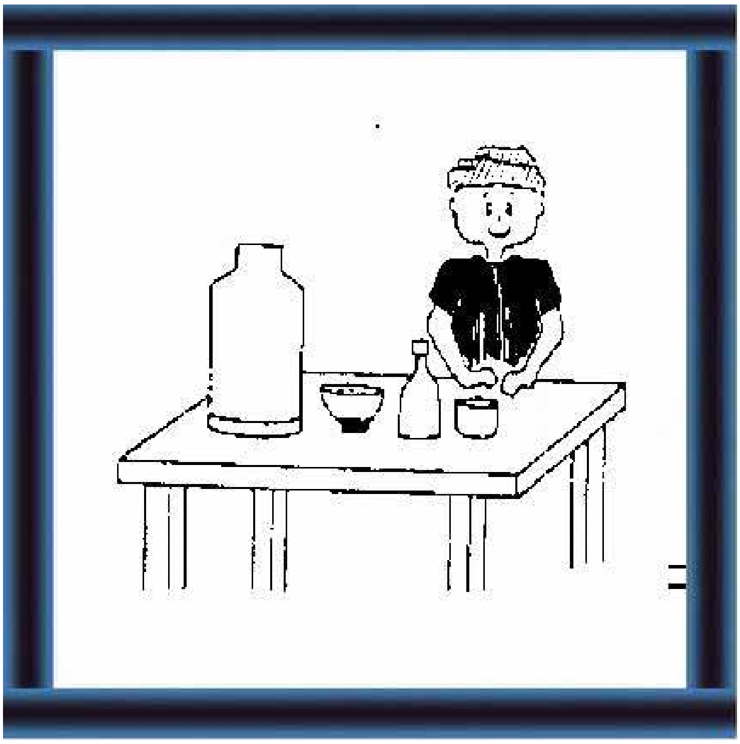
Clothes pegs for holding the cloth over the bucket.



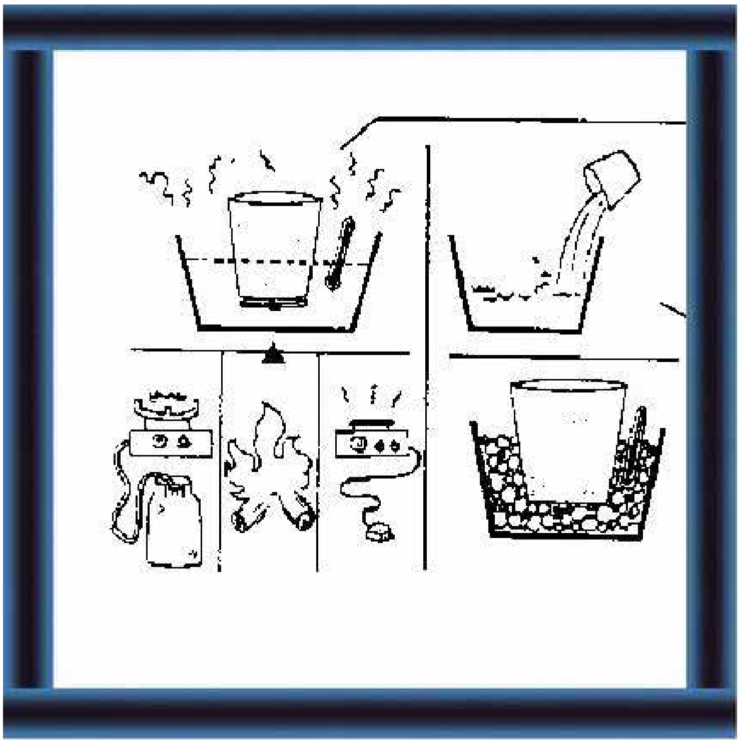
62 A **sieve** or **colander** made of stainless steel or plastic for draining the curd.

Wooden draining board on which to place the cheese mould while it drains.

How can you make fresh cheese?

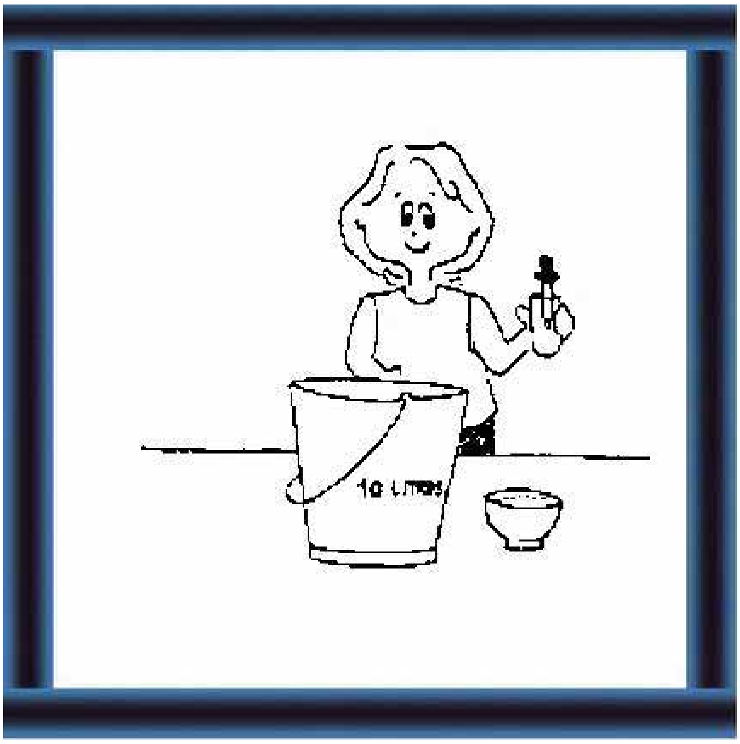


63 Prepare your equipment and collect the **materials** you need:
- milk
- starter culture
- rennet
- flavours.



64 Heat the milk to 63 C for 30 minutes.

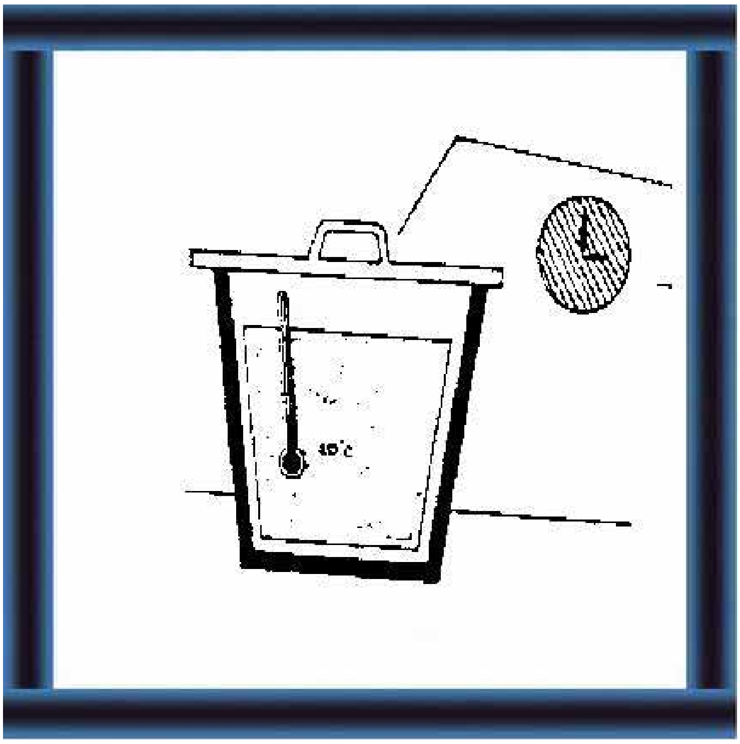
Then cool to 20 C



65 For each 10 l of milk:

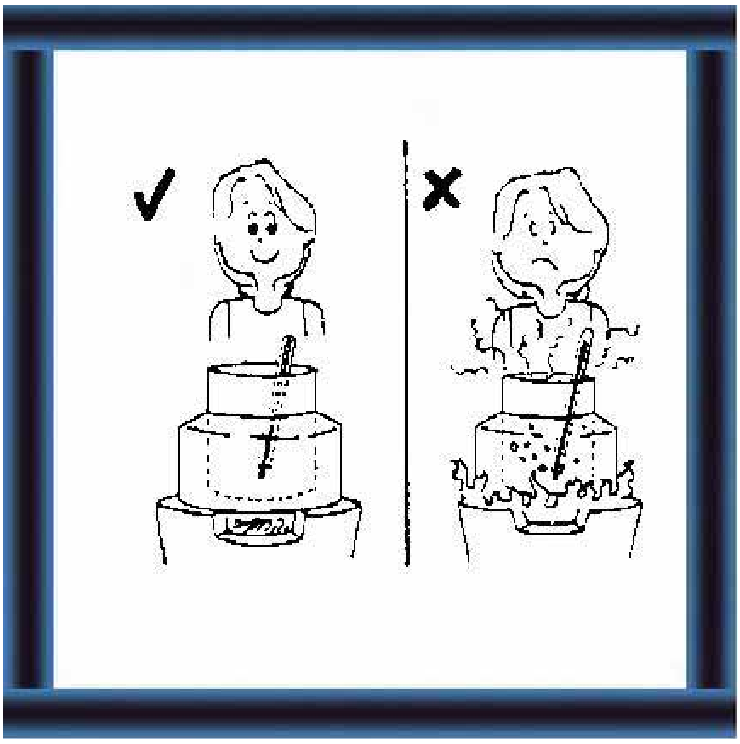
- add $^{1}/_{2}$ l mesophyllic starter culture

- add rennet according to the instructions on the bottle or packet.



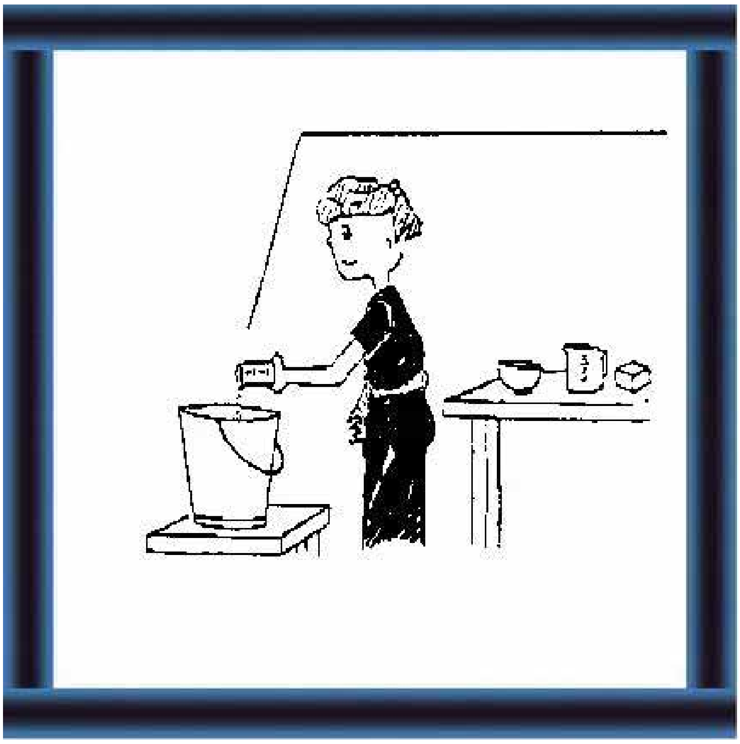
66 **Cover** the milk and leave the milk to stand for **24 hours** at **20 C**.

In this time the milk **sours** and **curdles**.



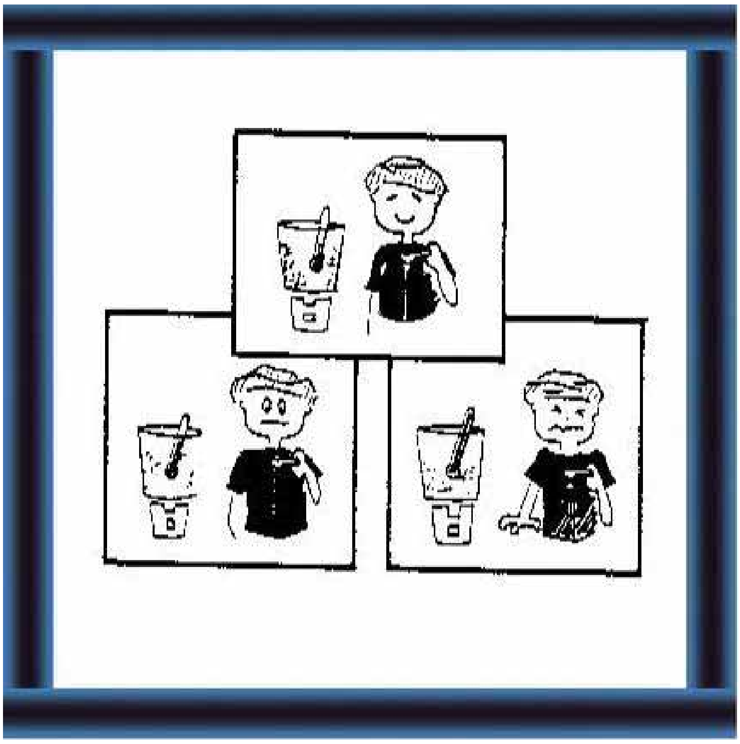
67 Rennet works well with **warm** milk but **does not work** at temperatures above 55-60 C.

68 Rennet works **better** with milk which is slightly **sour** (acid).

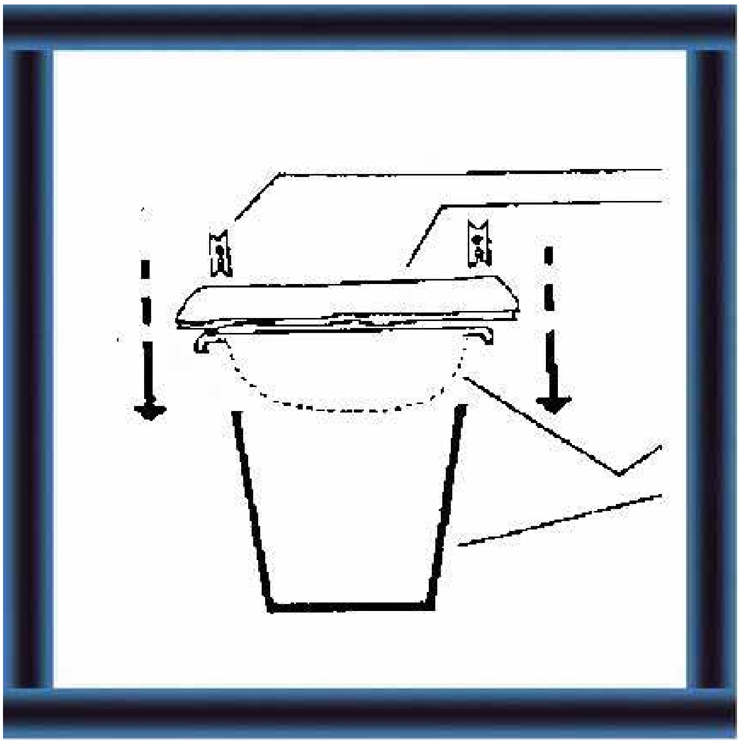


69 You must add the **right amount** of rennet.

Too much rennet (or too high a temperature) makes the curd soft.



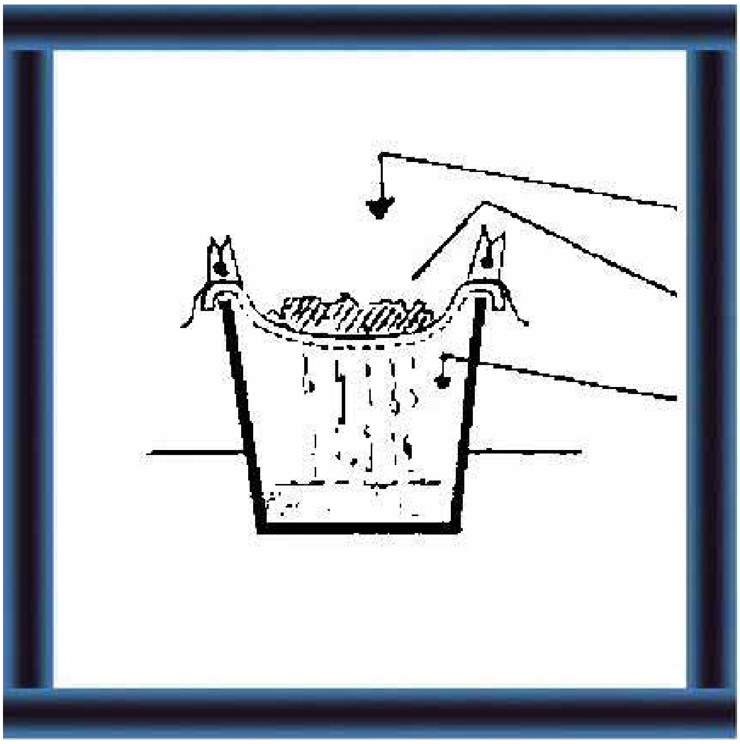
70 You can make your cheese hard or soft by changing the **temperature** and the **sourness** of the milk when you add rennet.



71 Spread a **clean cheese cloth** over a **sieve**.

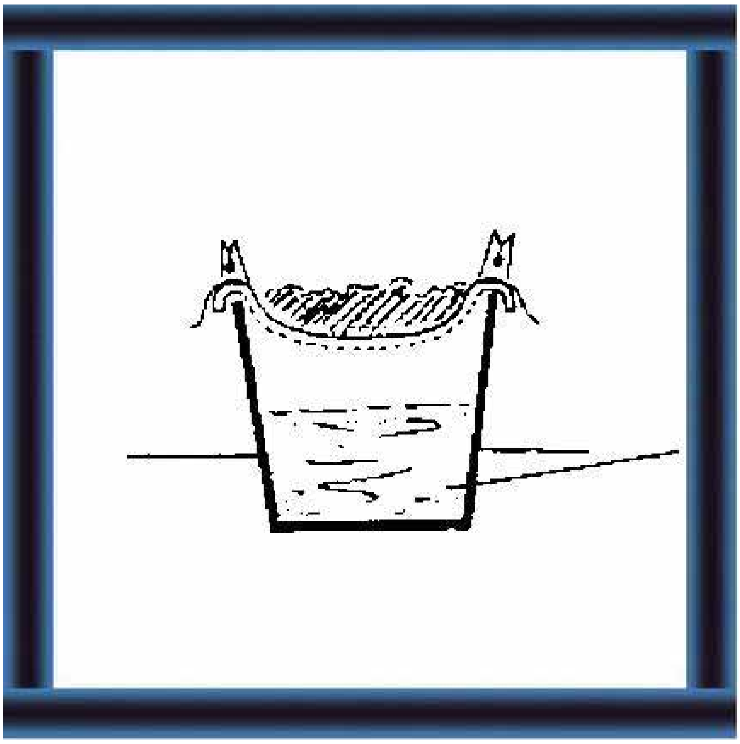
Fit into a **bucket**.

Fix with **clothes pegs**.

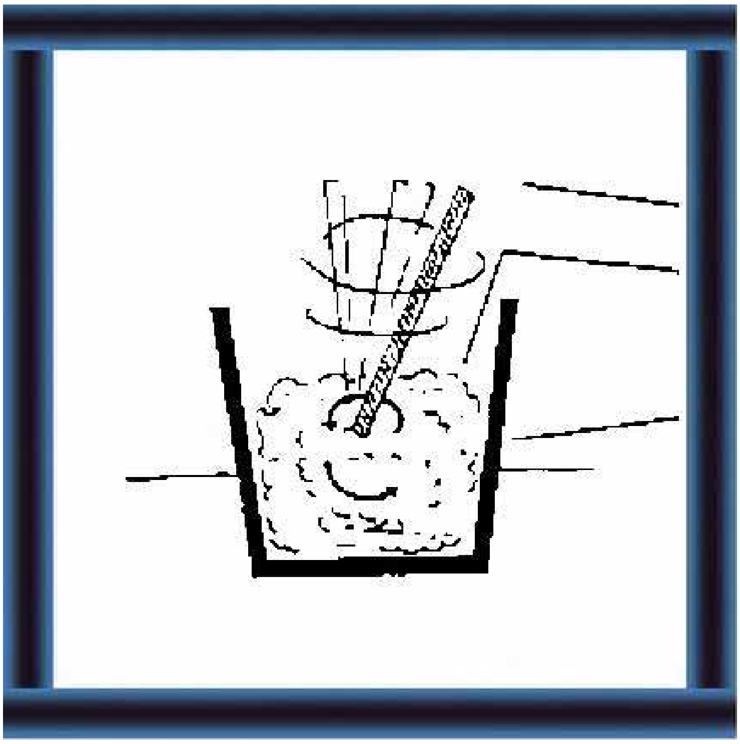


72 Put the **curdled milk** on the **cheese cloth**.

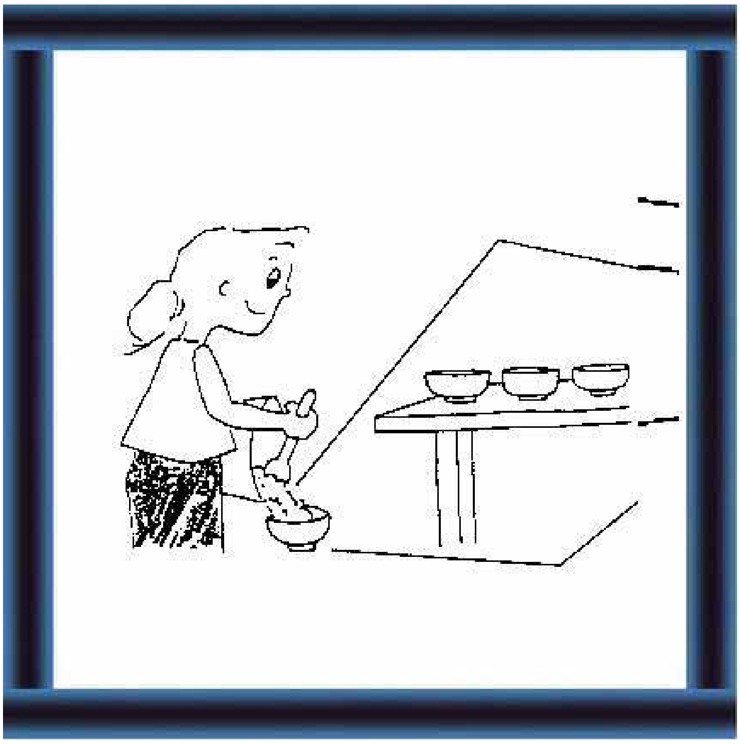
The **curds** remain on the cloth and the **whey** filters through.



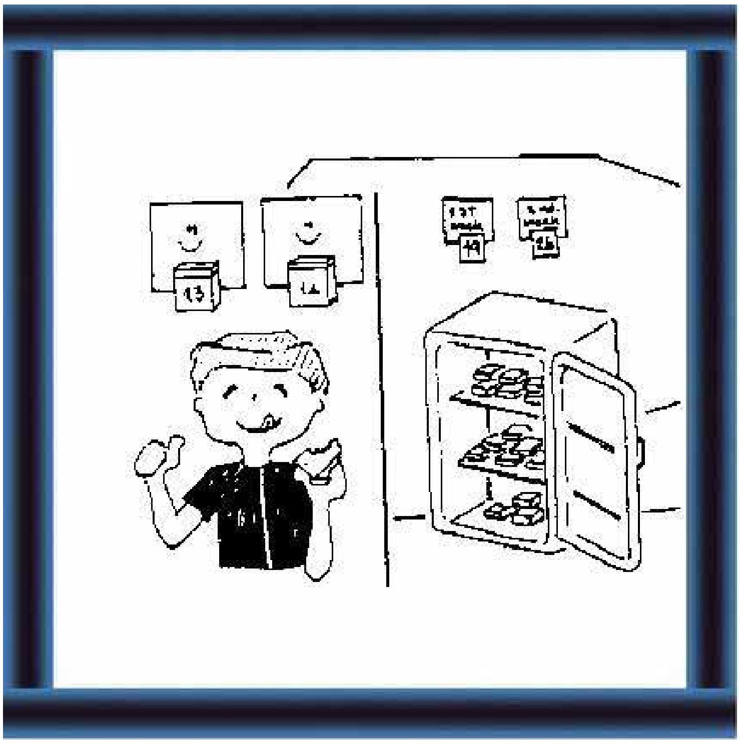
73 After another 24 hours, most of the whey filters through.



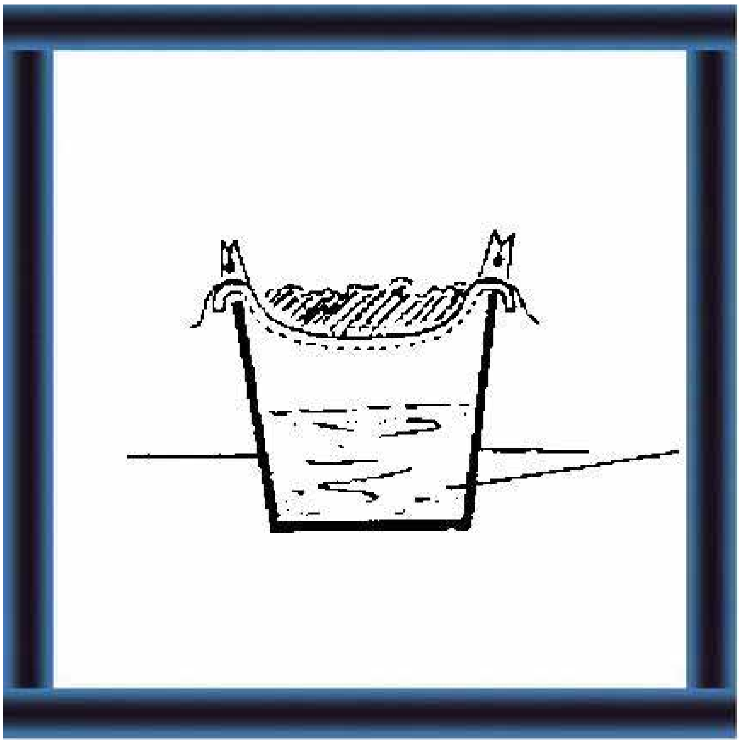
74 Put the curd in a **cheese vat** and **stir well**.



75 Transfer the fresh cheese to **bowls** or **small containers**.

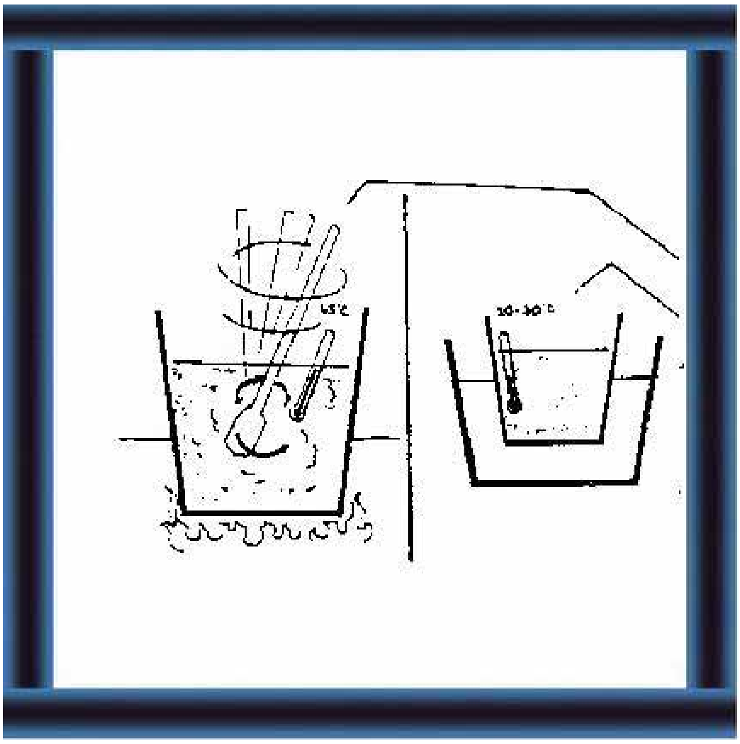


76 You can eat the cheese immediately or keep it in a refrigerator for 1-2 weeks.



What can you do if you have no starter culture?

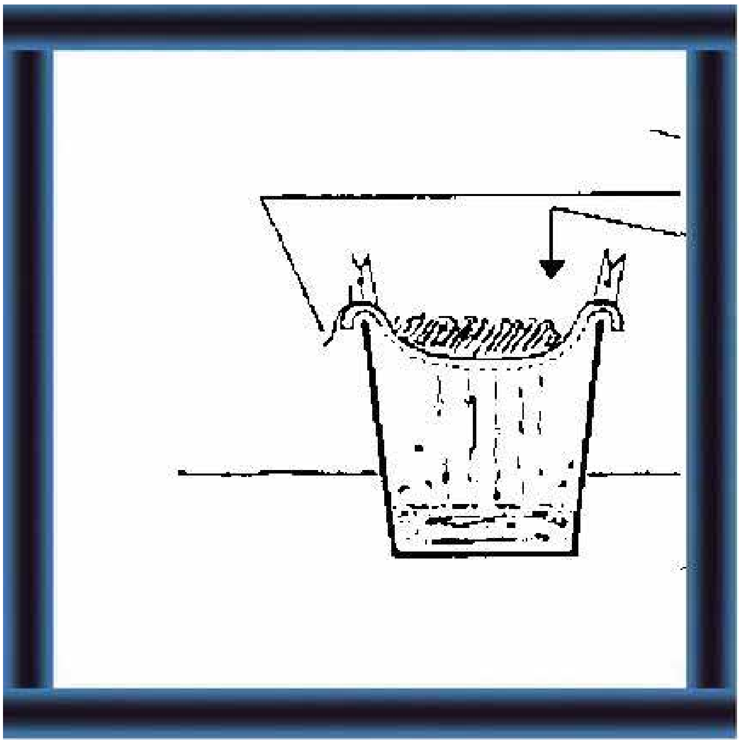
77 If you cannot get starter culture, you can use **acid from fruit** or **vinegar**.



78 Pasteurize the milk at **63 C** for 30 minutes.

Stir **all the time**.
Cool to **20-30 C**.

79 Add the **lemon juice** (or vinegar, citric acid) until the milk **curdles**.

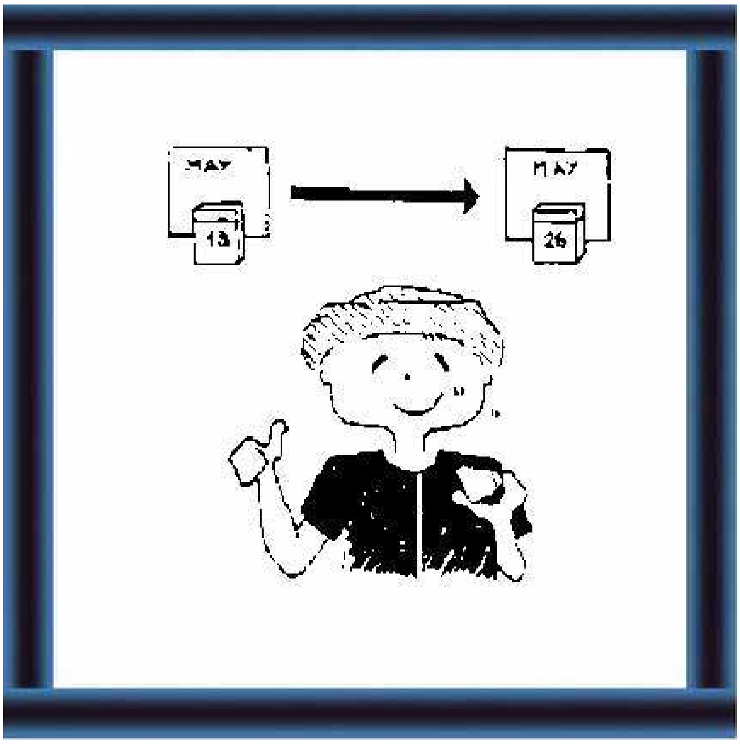


80 Put the curdled milk into a **cheese cloth** and let the whey filter through for about **6 hours**.

The outside temperature should be **cool**.

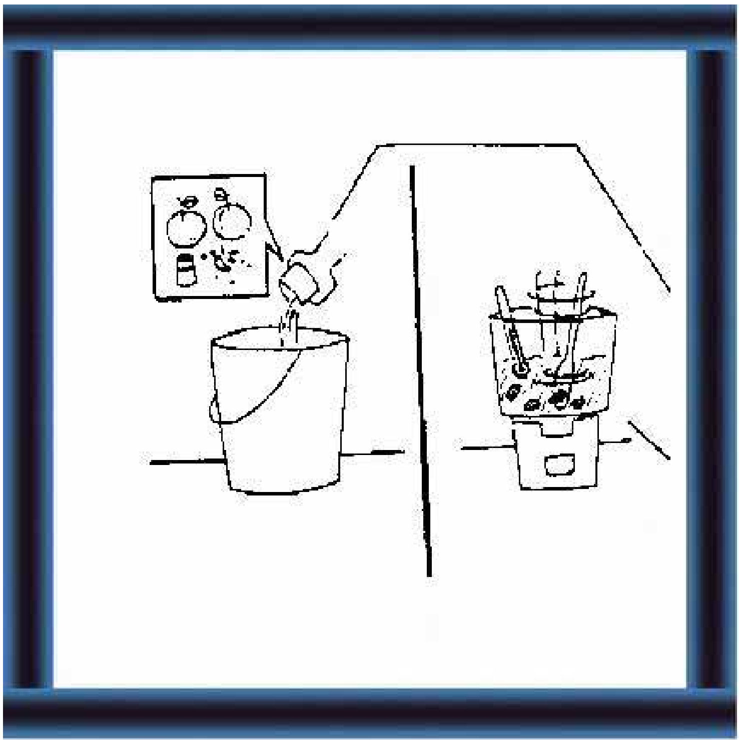
Can you add flavours to fresh cheese?

81 Yes, you can add flavours such as salt, curry, chili, garlic or other herbs and spices.

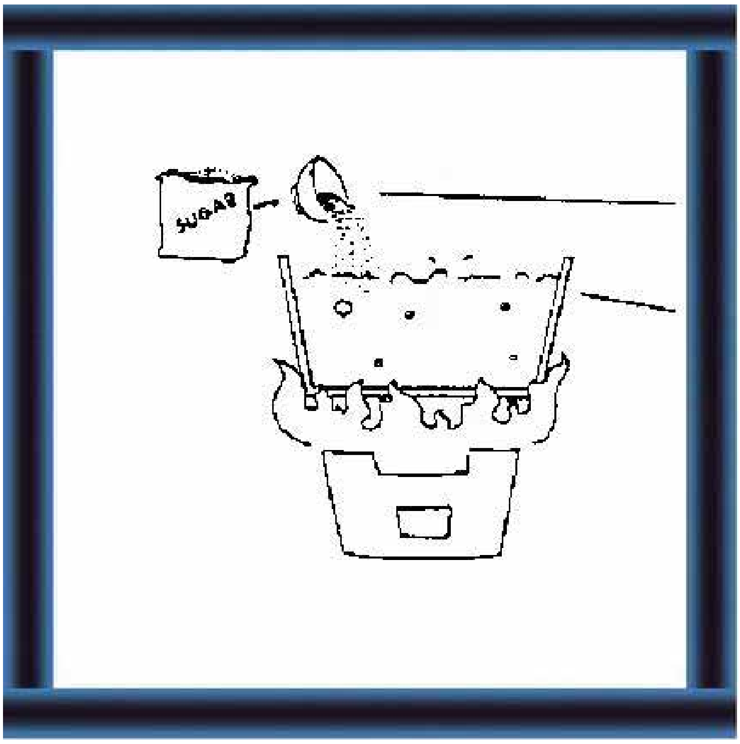


82 Adding chili or garlic flavours may help you to **preserve** fresh cheese.

What can you do with the whey?



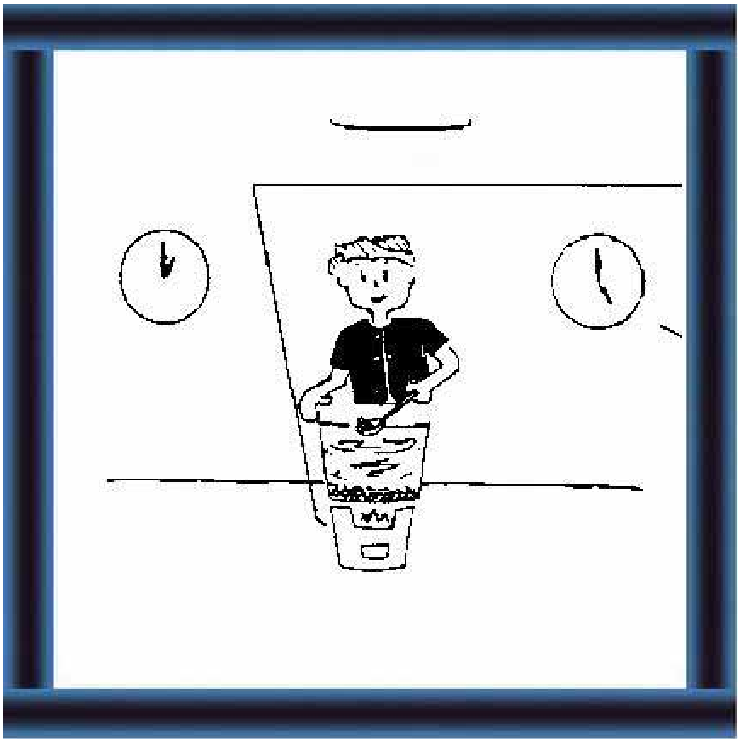
83 Make a **tasty drink** by:
- adding **fruit juice** or **herbs** to the whey
- **soaking** or **cooking** grain, pulses or dried fruit in the whey.



84 Make **cheese** (mysost) by:

- cooking the whey in a **pot** with a **cup**

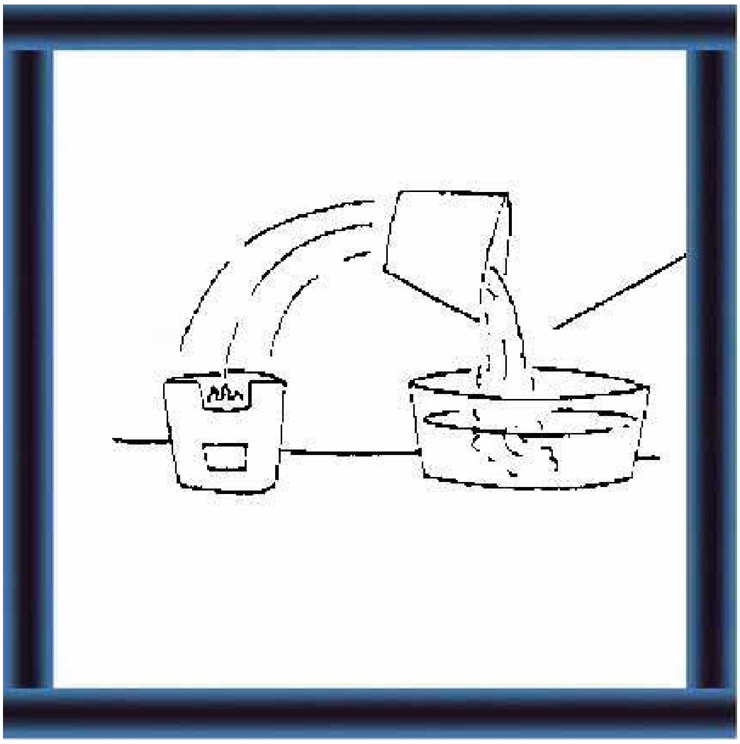
- adding sugar, cloves or cumin for **flavour**



85

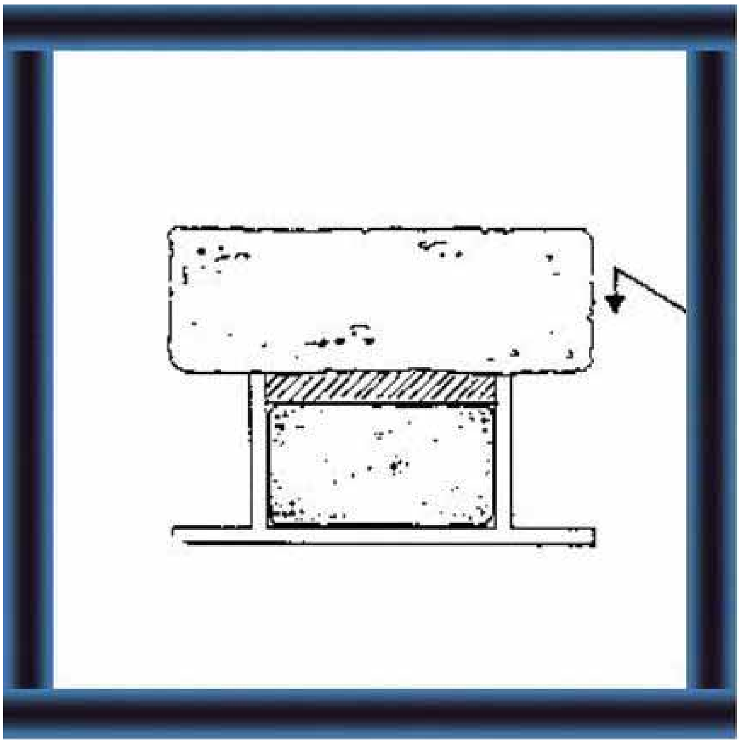
- **lowering** the heat when the whey **thickens**

- **gentle** cooking for about **5 hours** until the whey is **nearly solid**

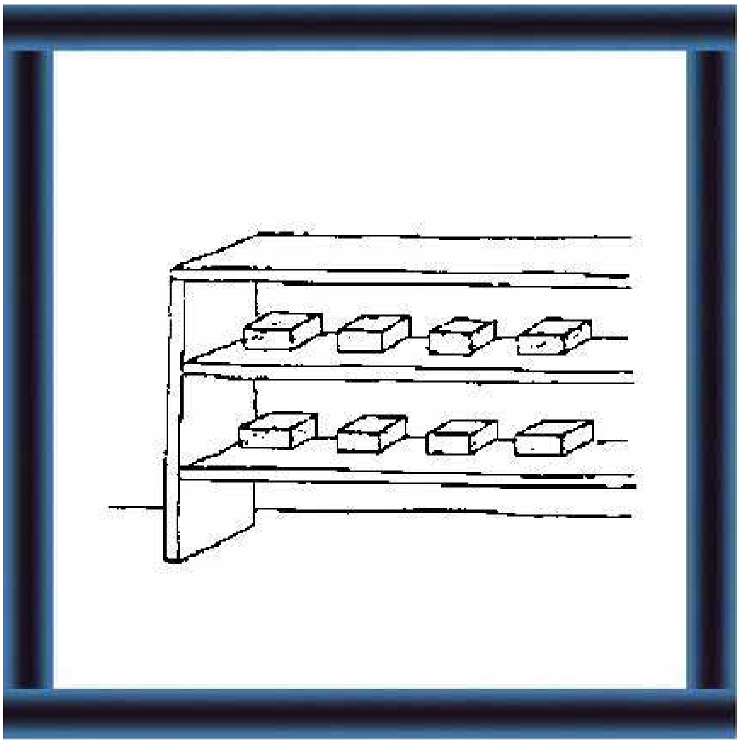


86
- putting the nearly solid, brown cheese into **cold water**.
1 l of whey gives about 200 cc of cheese and you can keep it for a long time.

What is a semi-hard ripened cheese?

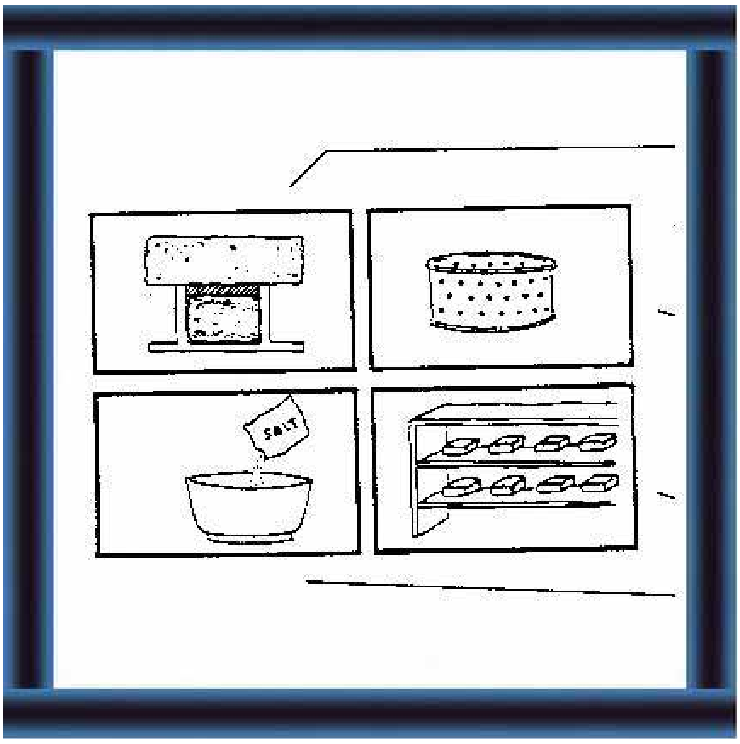


87 It is a cheese where:
- you press the fresh cheese for a **short time**



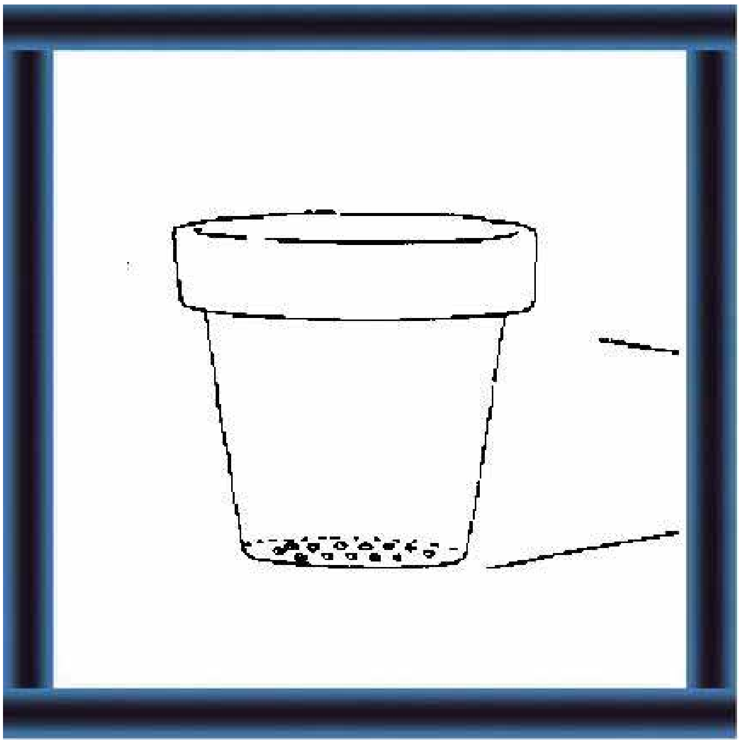
88
- and then store the fresh cheese to ripen.

It has a water content of 40-50 % and a fat content of 20-35 %.



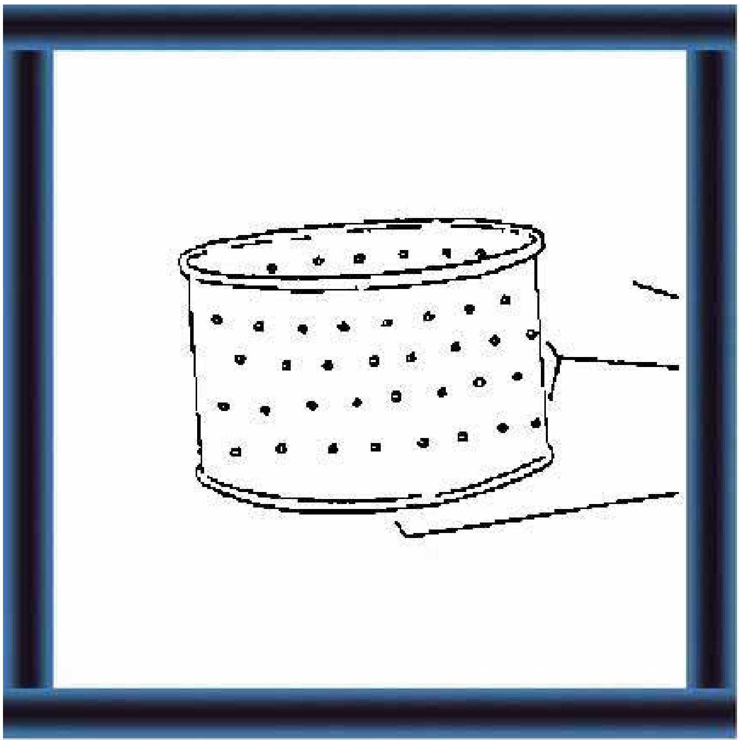
What other equipment to you need to make a semi-hard ripened cheese?

89 You need equipment for:
- moulding
- pressing
- salting
- ripening.



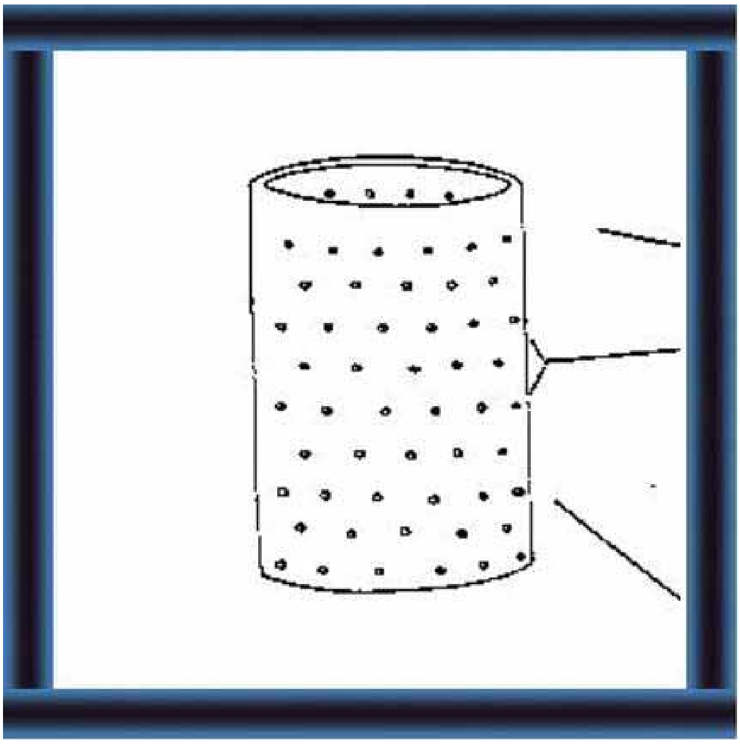
90 You need **cheese moulds**:

- a **flowerpot** with holes in the bottom



91
- a **cake tin** with no bottom and holes in the side

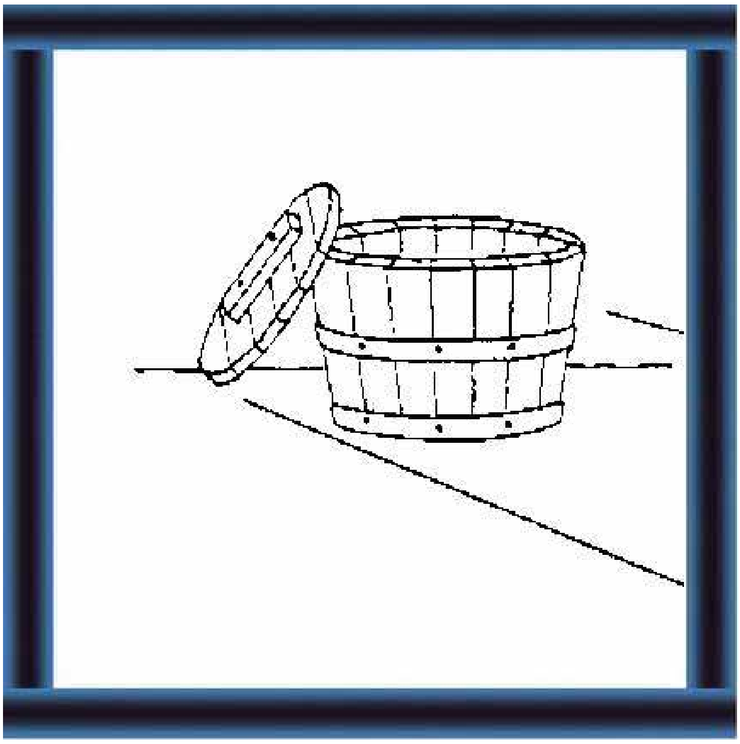
(**do not** use it for long or it will begin to rust)



92
- a **plastic tube** with holes in the side

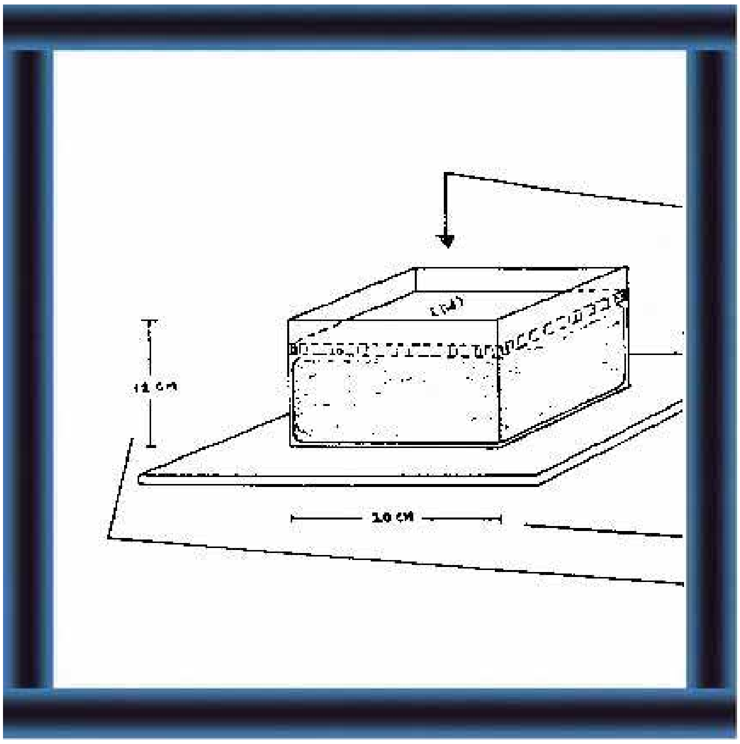
(**do not** use plastic tubes from building work as these **contain poison**).

Important: If possible, make holes from the **inside to the outside**.



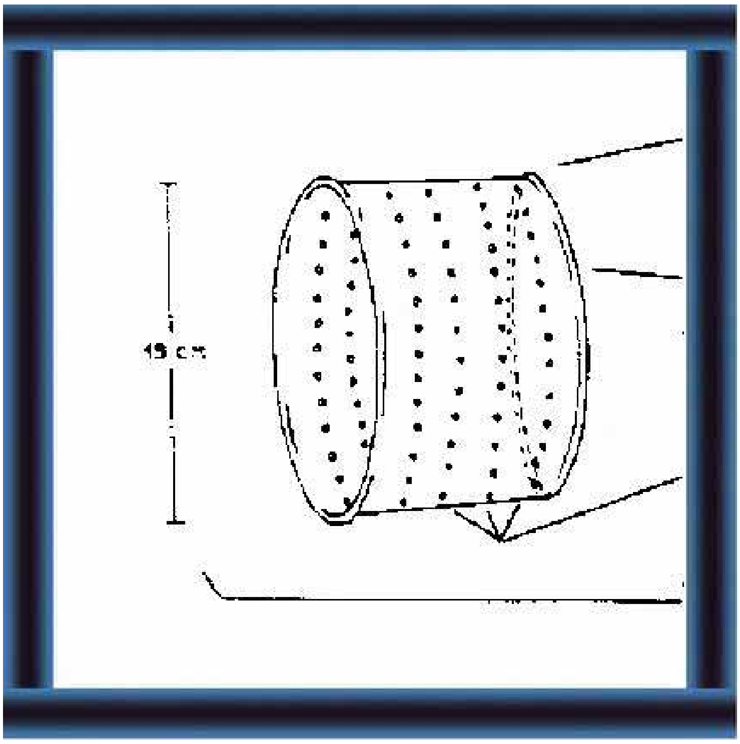
93 Make the edges of the holes **smooth** so they do not tear the cheese and it is easy to get the cheese out.

Cheese mould with a lid made from a **wooden barrel**.



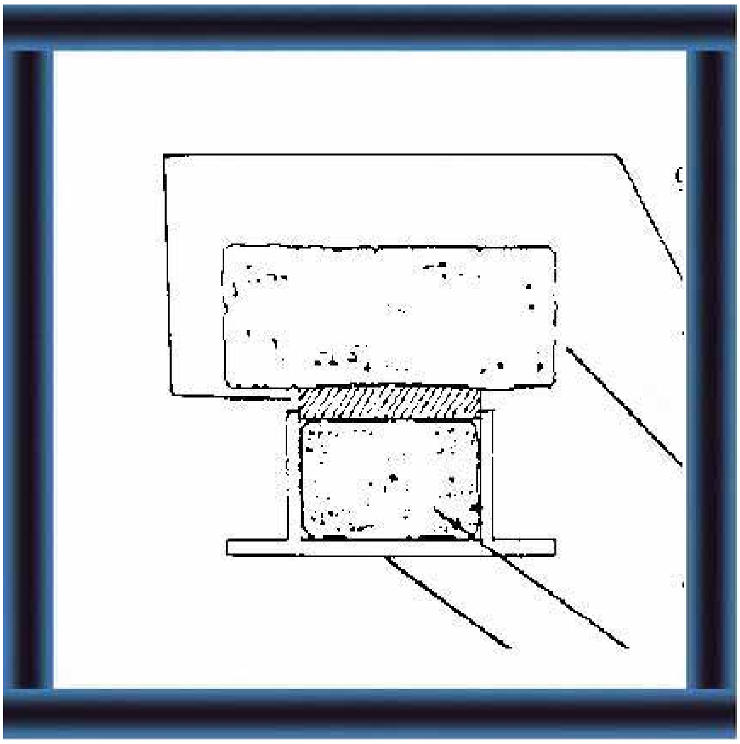
94 You need a **cheese press**.
This cheese mould is made of wooden planks and is big enough for cheese from **20 l of milk**.

It has a **lid** which is used to **press** the cheese.
length : 20 cm
width : 20 cm
height : 12 cm



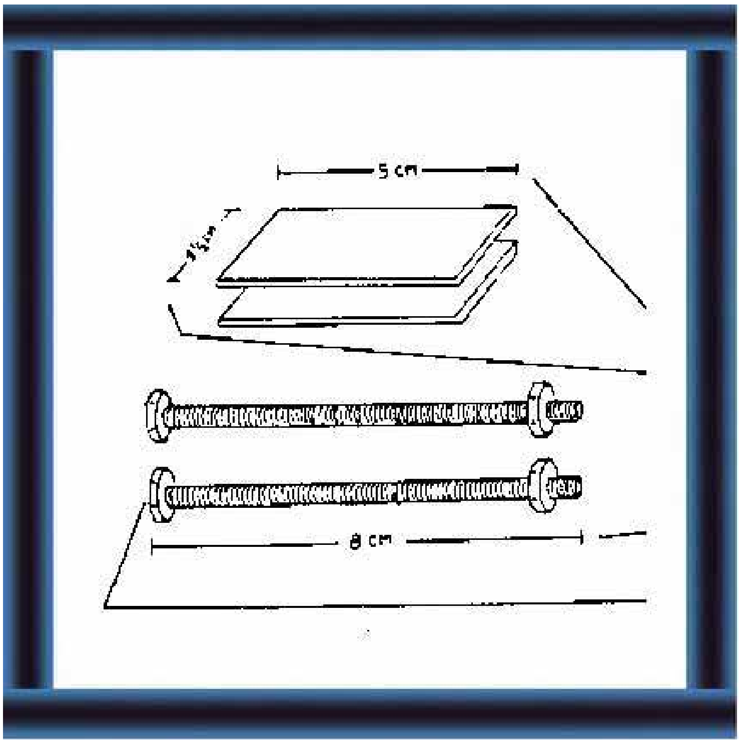
95 This cheese mould is a **tin** with a diameter of **15 cm**.

It has no ends and holes in the sides.



96 Place:
- the tin on a **clean, flat surface**
- the **cheese** inside the tin
- a **wooden lid** of about 13-14 cm diameter on the cheese
- a **large stone** on the wooden lid.

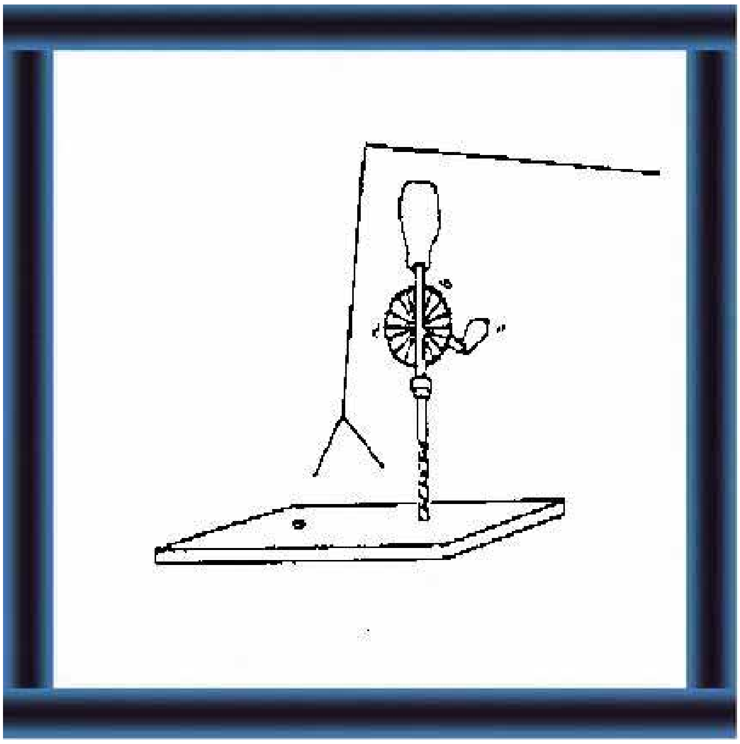
This is big enough to press the curd from about **9 l of milk**.



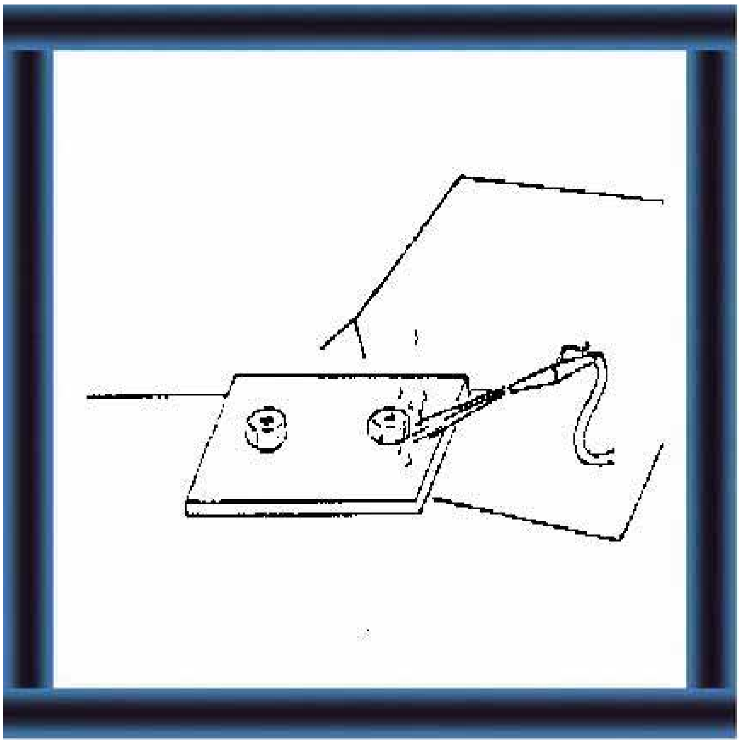
97 You can make a **press** from the following materials (example measurements):

- 2 **metal plates**
5 cm long by
$2^{1}/_{2}$ cm wide

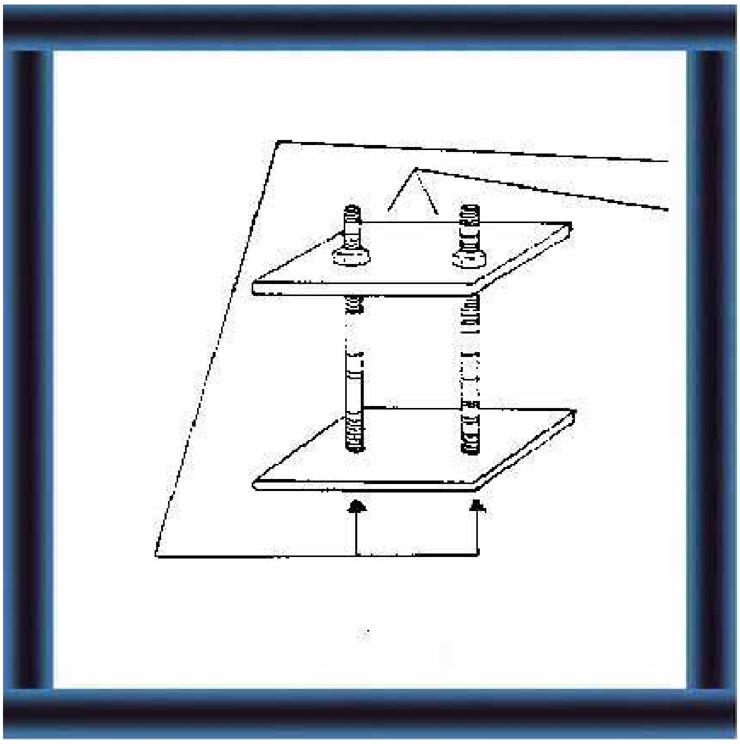
- 2 **nuts** and **bolts**
8 cm long by
$^{3}/_{4}$ cm in diameter.



98 Drill **two holes** in each plate for the bolts to fit through.



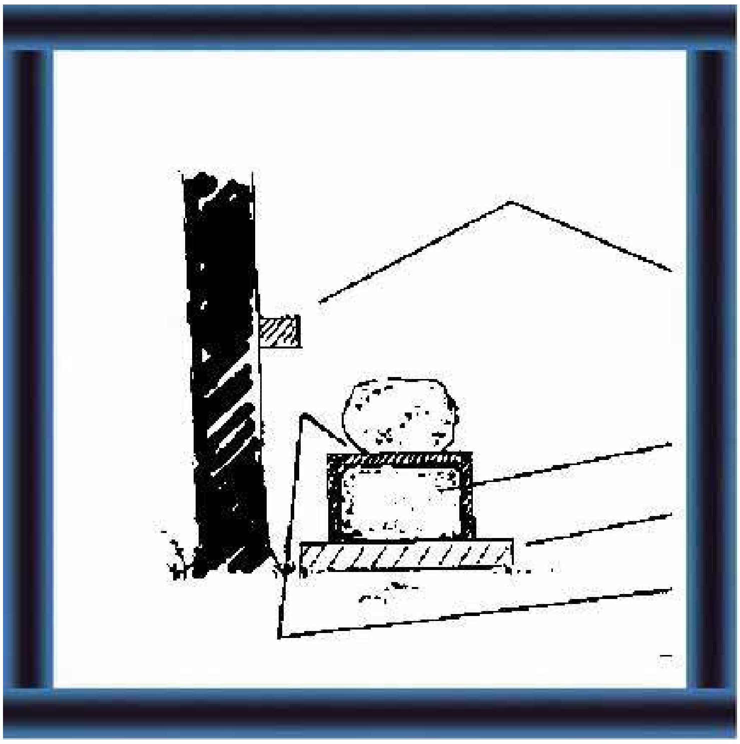
99 Weld the **nuts** over the holes on the **top plate**.



100 Put the bolts **through** the bottom plate and **screw into** the nuts.

The plates can be bigger or smaller as required.

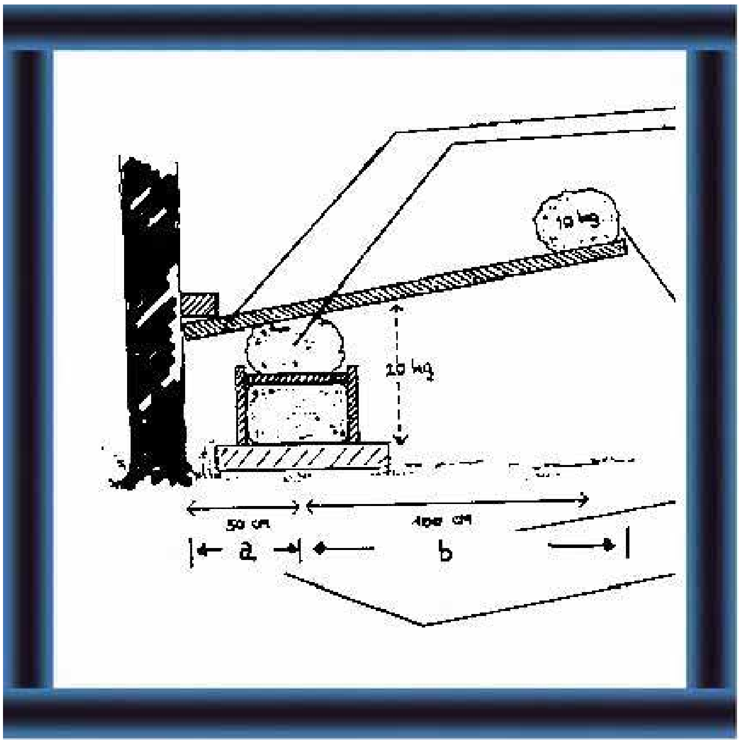
Adjust the pressure **often** as the cheese **shrinks.**



This cheese press works with a **lever**.
101 Nail a **piece of wood** into a tree or wall.

Place the **cheese** inside a **container** with no ends and with holes in the sides on a **clean flat base**.

Put a **lid** on top.



102 Place:
- one **stone** on the lid
- **a strong pole under** the piece of wood **on** the stone
- another **stone** on the **end** of the pole.

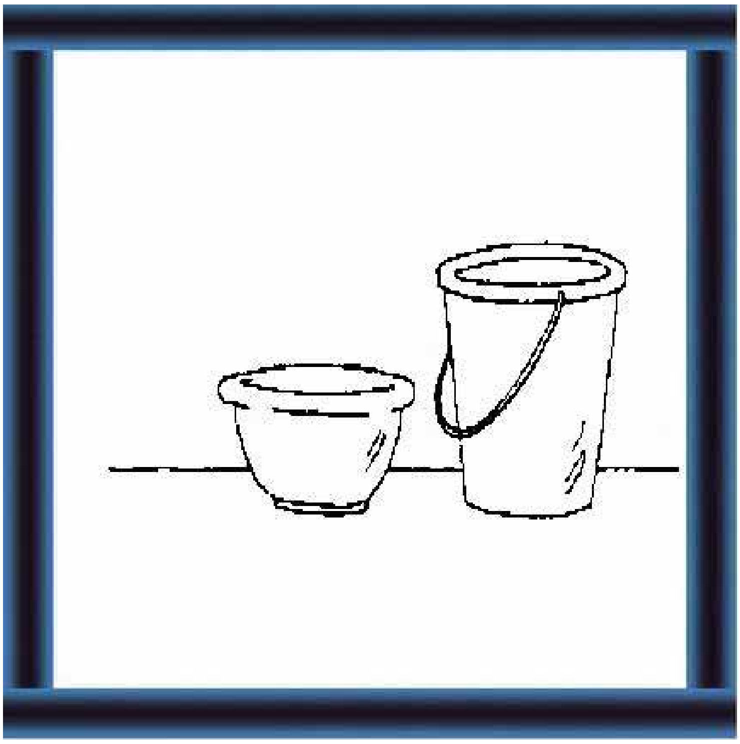
The **longer** b and the **shorter** a, the **stronger** your press.

103
If the **distances** are 50 cm and 100 cm the **leverage** is 100:50 = 2:1

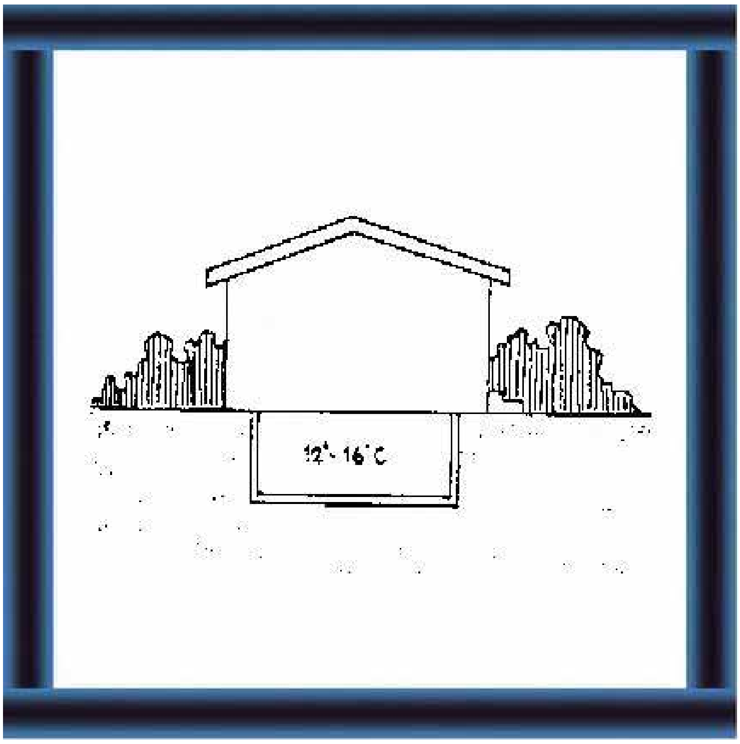
if the **weight** of the stone is 10 kg

the **press** is 10 x 2 = 20 kg.

Important, make sure:
- the materials are **not poisonous**
- the materials are **easy** to clean and disinfect
- the press is **strong enough**
- you can **check** the **pressure** and **keep it the same**.

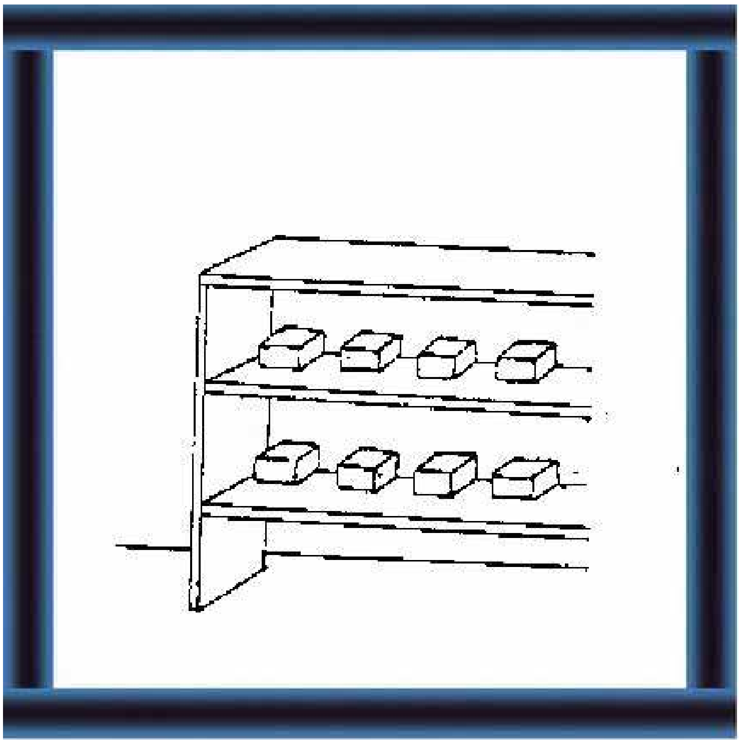


104 **You need:**
- a **brine** (salt water) container
you can use a plastic bucket or bowl



105
- a **place** for **ripening** the cheese

the temperature should be 12-16 C and it should not be too dry

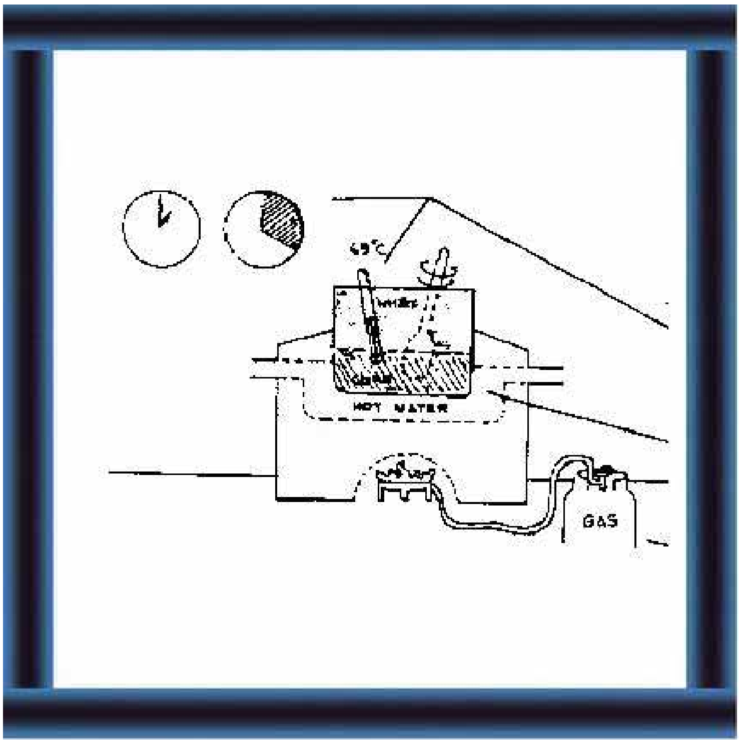


106
- **wooden shelves** to **store** the cheese while ripening

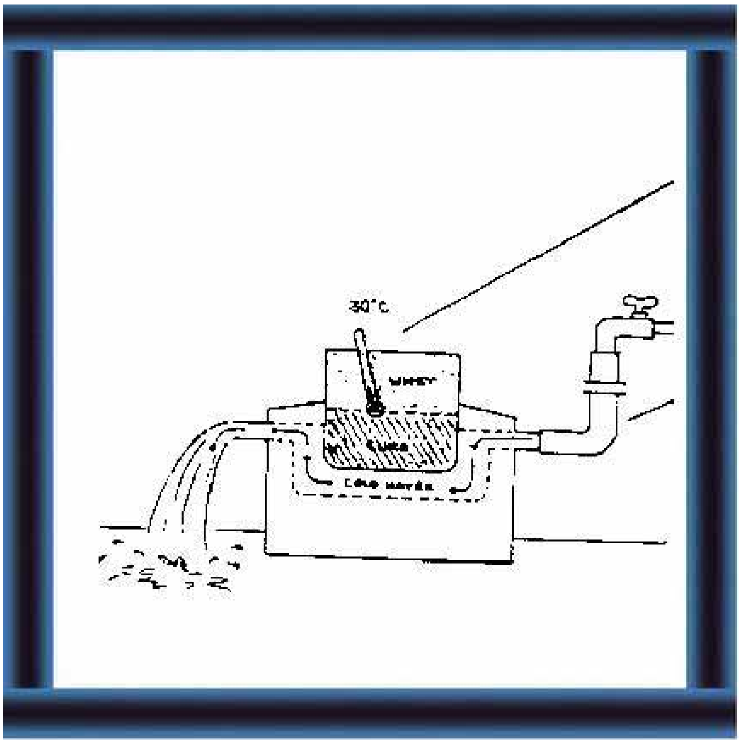
107

- raw milk
- mesophyllic starter culture
- rennet powder or liquid
- salt (NaCl)
- calcium chloride ($CaCl_2$) and potassium nitrate (KNO_3), optional.

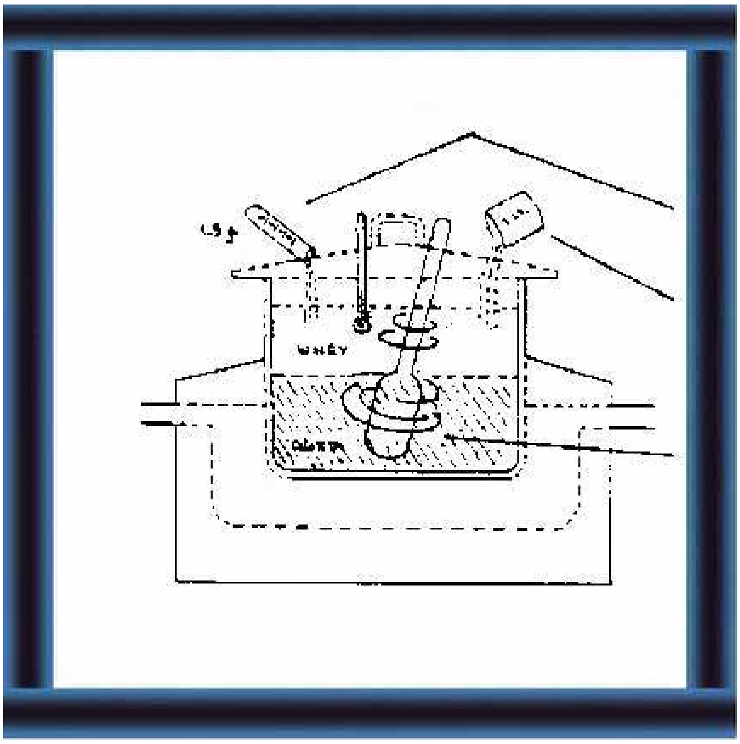
How can you make semi-hard cheesewith 100l of milk?



108 You should:
- pasteurize the **milk** for **20 minutes** at **65 C**
- use **indirect heating** if possible and **stir all the time**
(this heater uses **gas**)

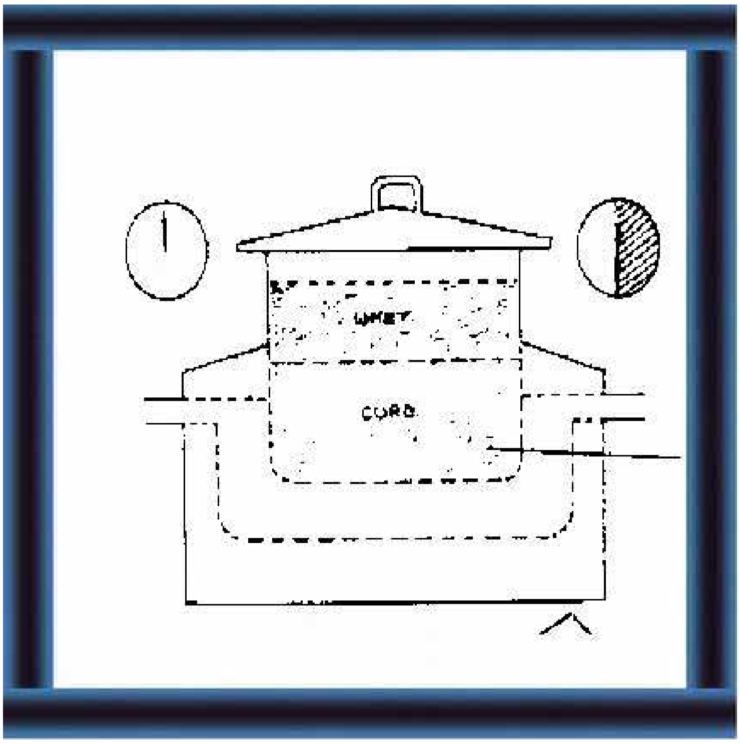


109
- cool the milk to **30 C** by running **cold water** through the jacket or inserting the vat into a basin with cold water (use ice)

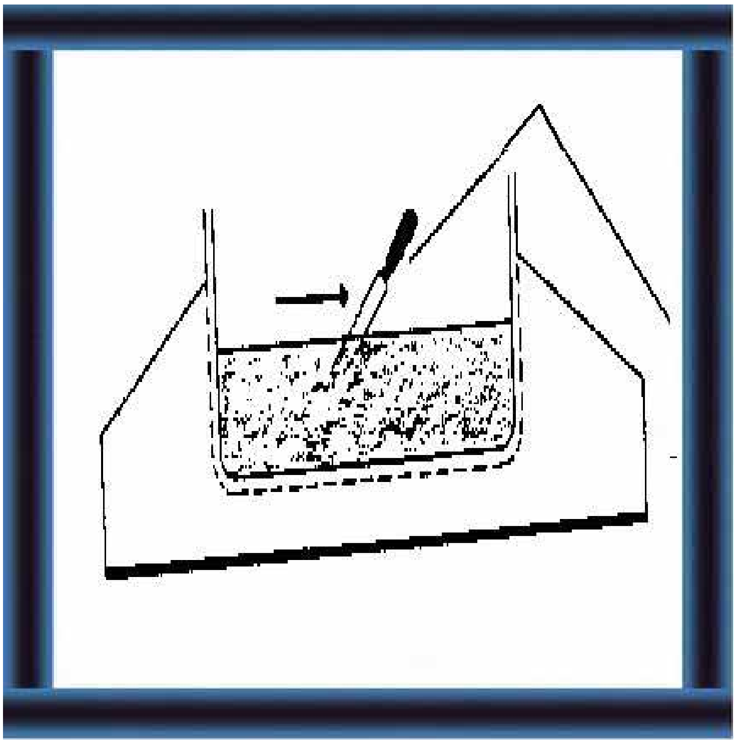


110 (the following is an example but you should follow good advice or instructions)
- **dissolve** 1.5 g of rennet in a little clean water and **add** to the milk
- **add** 1.0 l of **mesophyllicstarter culture**
- **stir well** and **cover with a lid** to make sure the temperature does not fall.

If the rules allow, **add** 10 g of potassium nitrate (KNO_3).

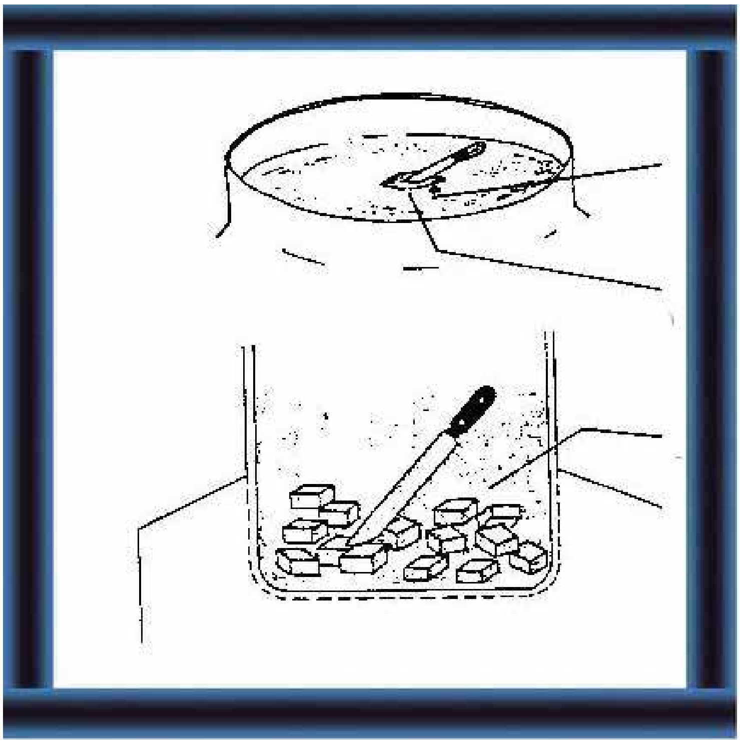


111 **Leave** the milk for about **30 minutes** until the **curd is firm**.



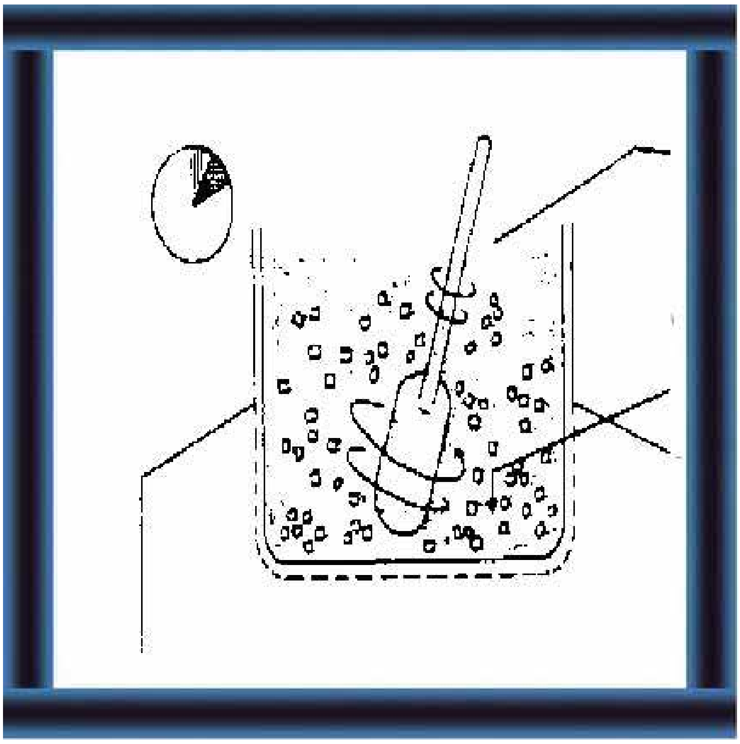
112 To test the **firmness** in the vat **cut** the curd with a **knife**.

Put the knife **under the cut** and **lift up gently**.

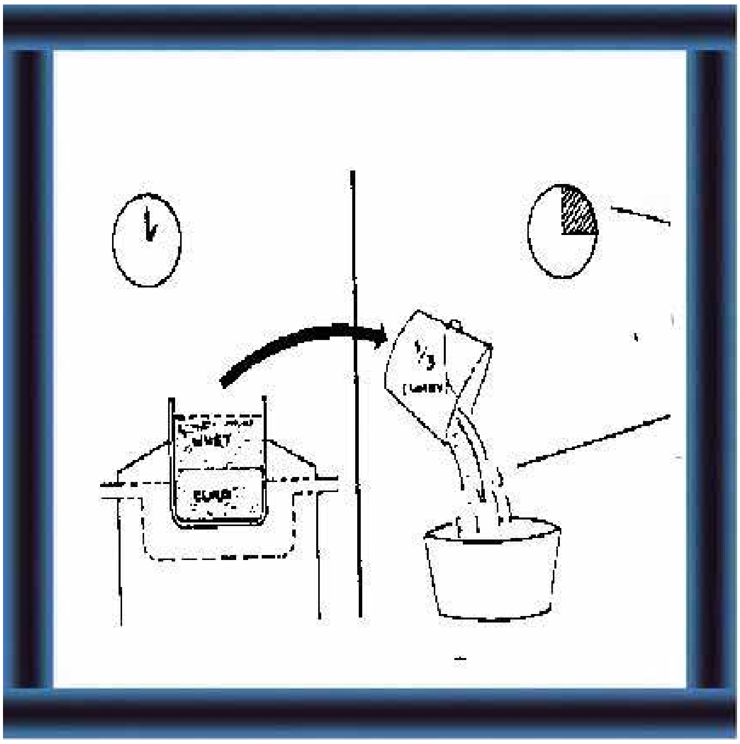


113 The cut surface should be **shiny smooth, yellowish and wet** from whey.

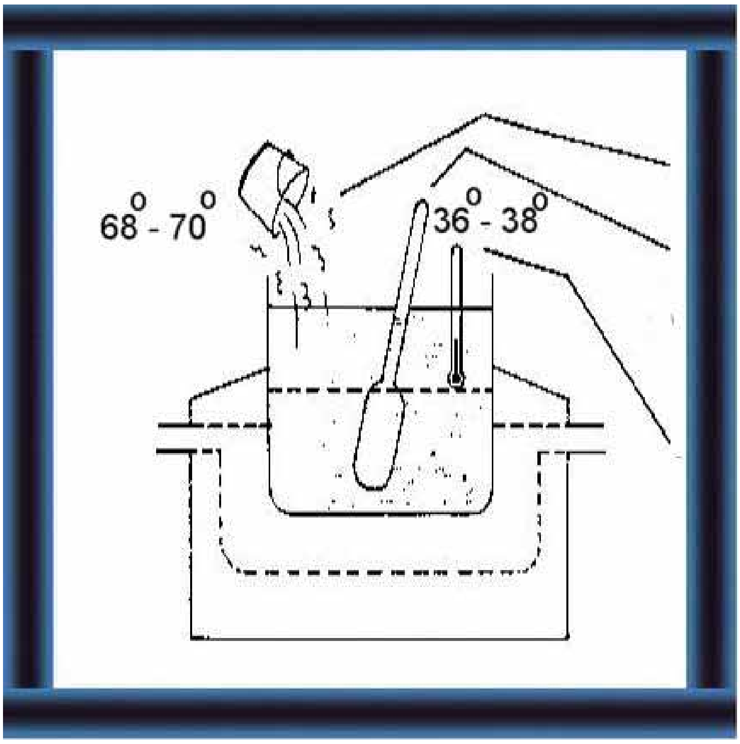
Cut the curd into **cubes** with a side length of 10-15 mm.



114 Wait for **5-10 minutes,** then stir the cheese grains gently for **15-20 minutes** until they start **settling to the bottom.**

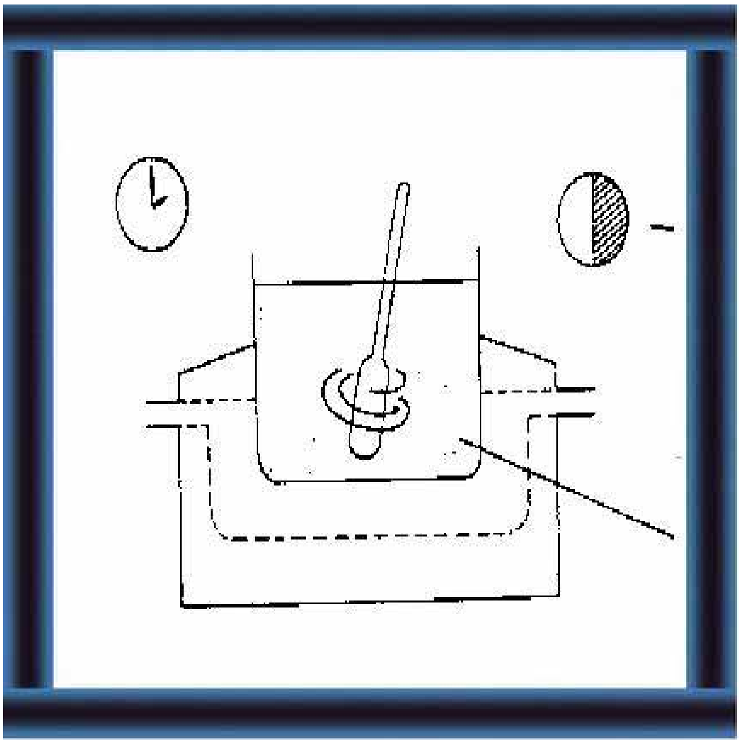


115 Leave the cheese to stand for 15 minutes and then remove $^{1}/_{3}$ of the whey.

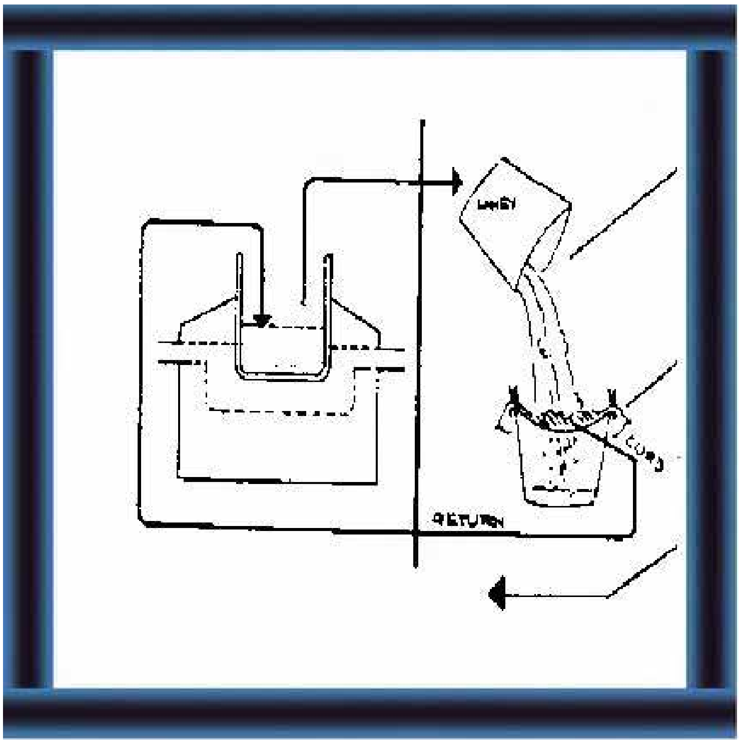


116 **Loosen** the curd by **stirring.**

While stirring **pour small amounts of** hot water at **65-70 C** into the cheese until the mixture reaches a temperature of **36-38 C**.

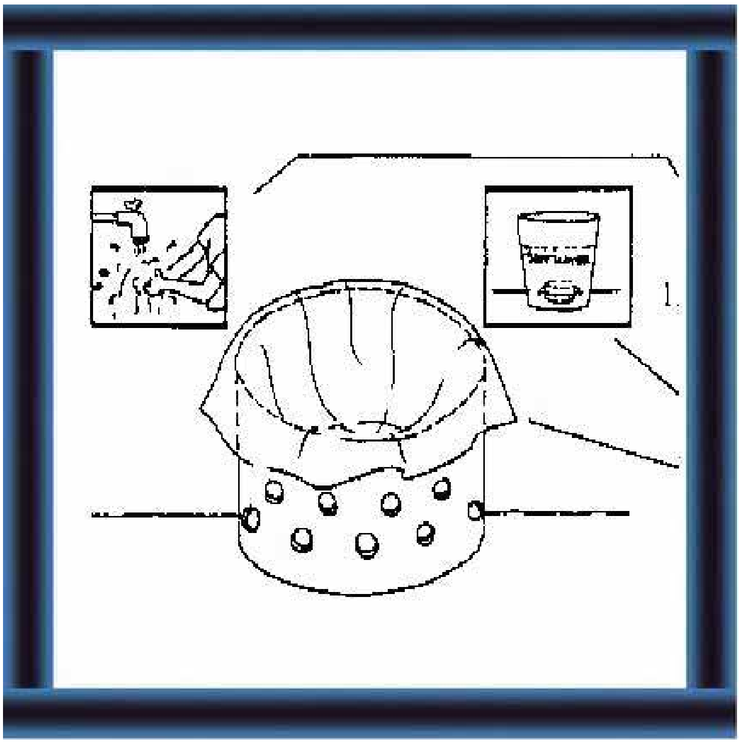


117 **Keep stirring** for about **30 minutes** until the cheese grains are **firm** but **not rubbery**.



118 **Remove** the whey to the **level of the curd.**

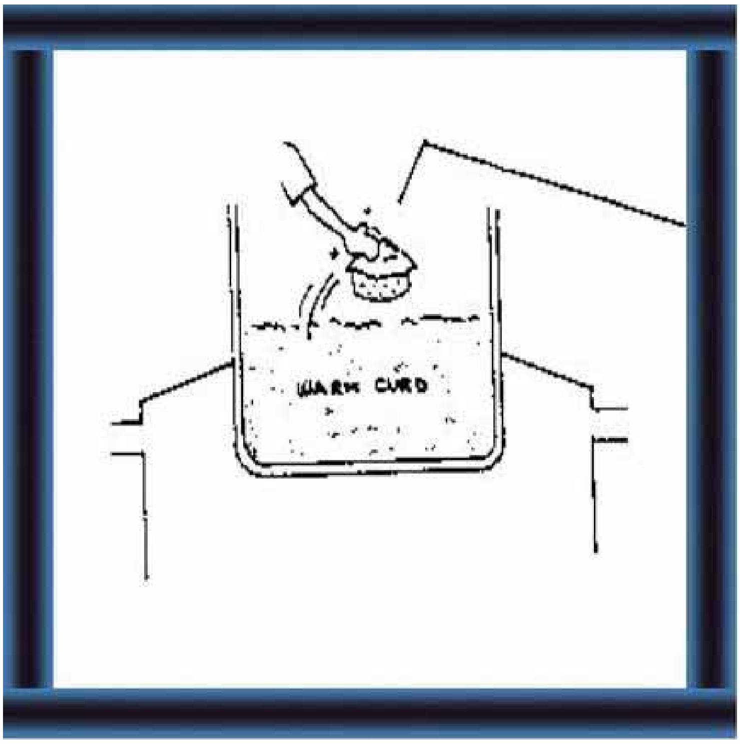
Use a **sieve and cheese cloth** to **catch cheese grains** and **return** to the cheese.



119 **Wash** your hands.

Place a **cheese cloth** inside a **cheese mould.**

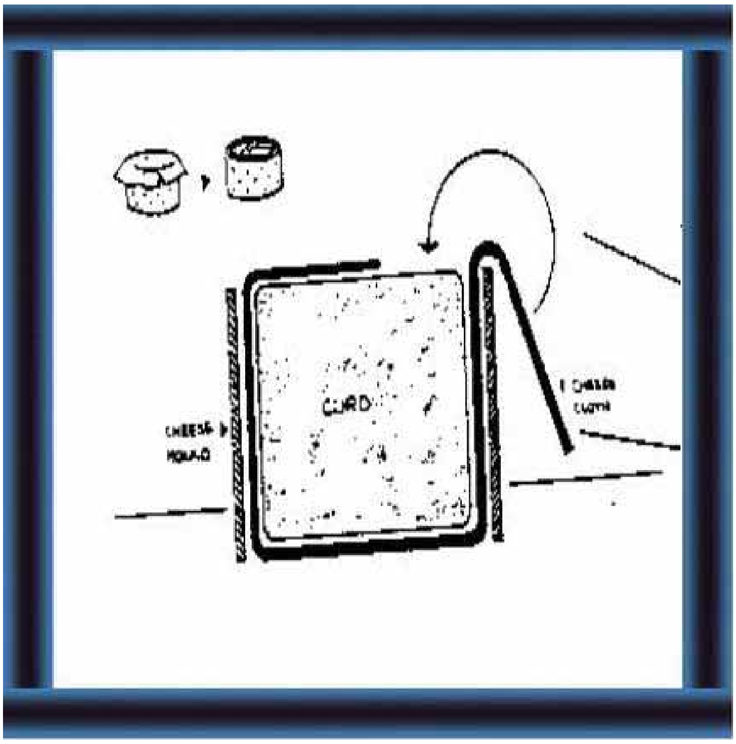
Warm in hot water just before use.



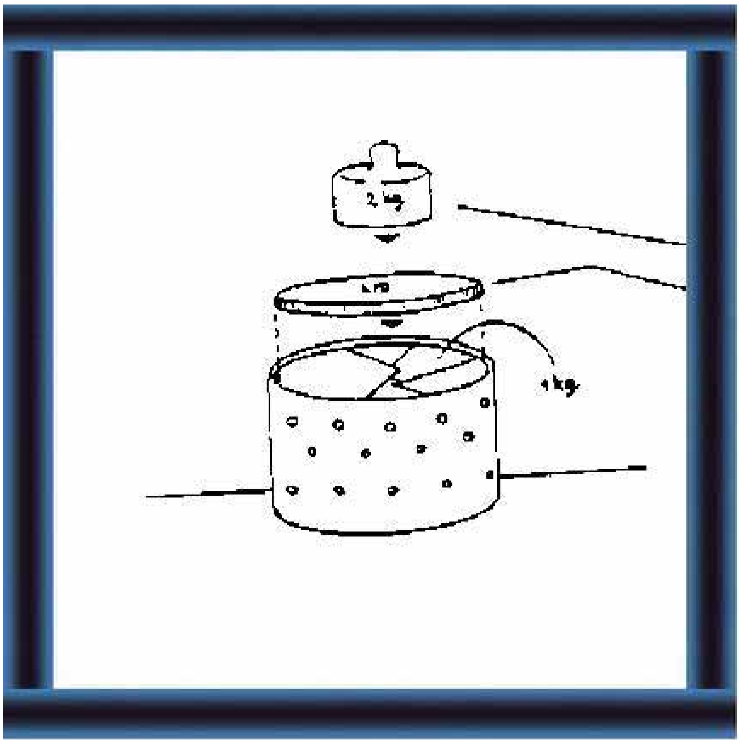
120 Fill the **mould** with **curd very quickly.**

Do not let the curd cool.

Use **only** clean hands for filling.

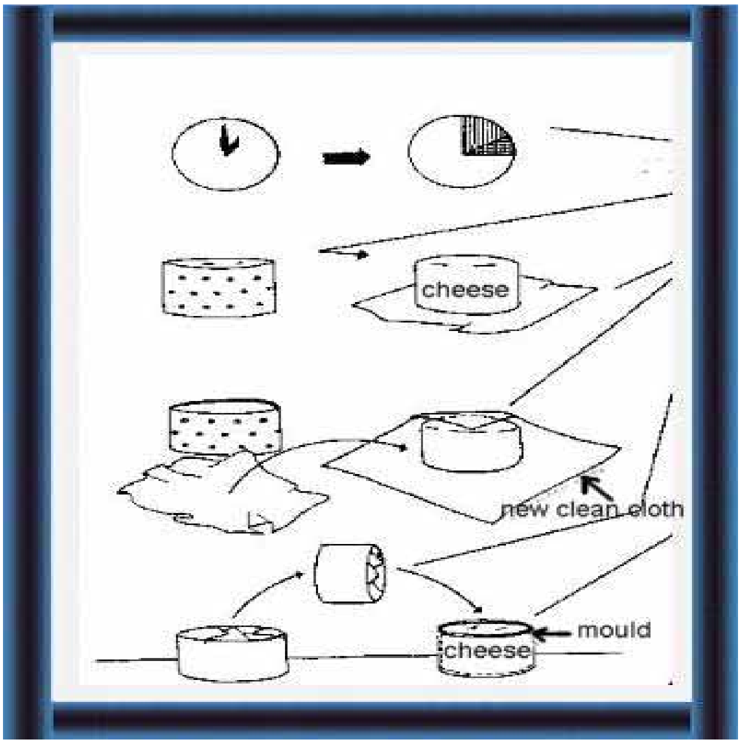


121 Fold the **cheese cloth** smoothly over the **curd.**



122 Put the **lid** on.

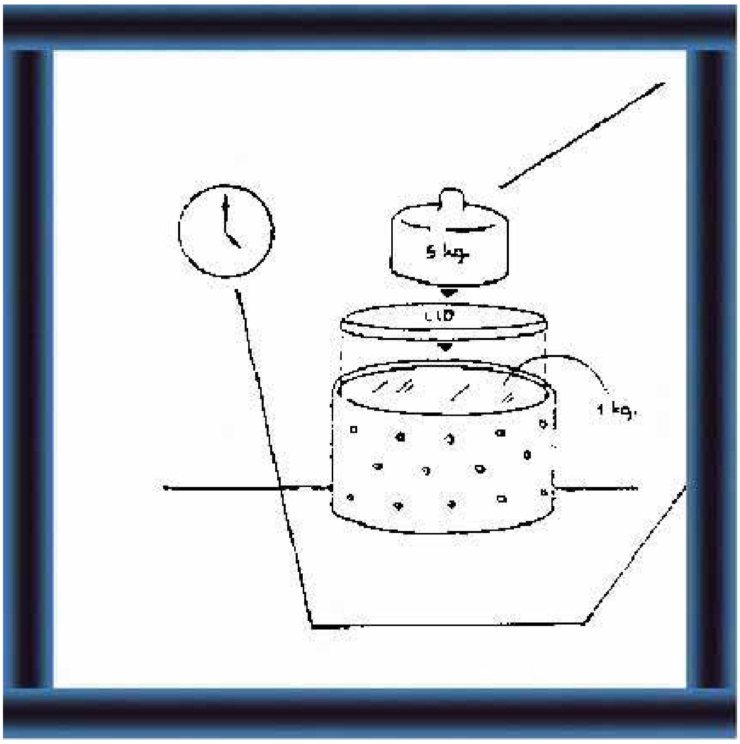
Press with **twice the weight** of the cheese (for every **1 kg cheese** use **2 kg press)**.



123 After **1-2 hours** of pressing take the **cheese** out of the **mould**

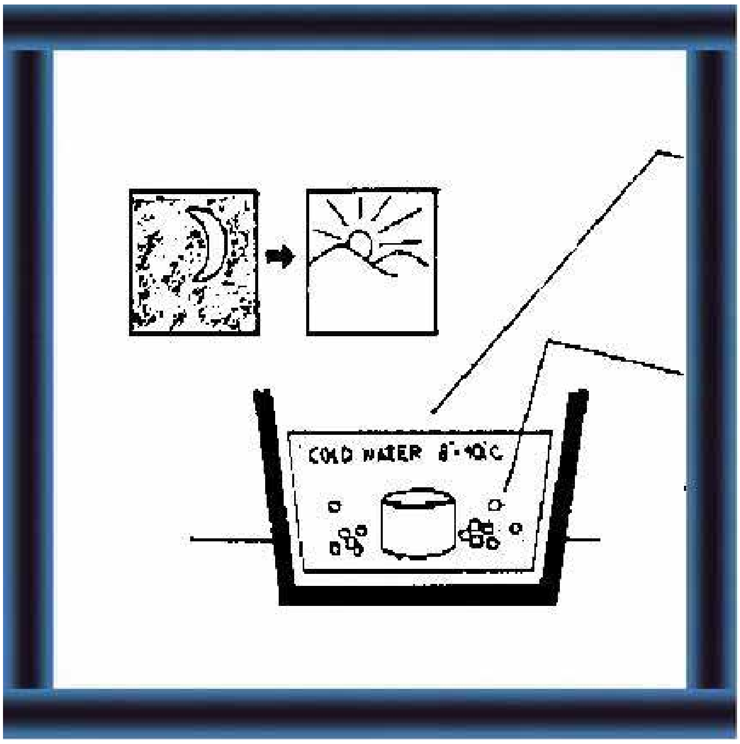
wrap the **cheese** in a **new, clean cheese** cloth and turn **upside-down**

put the **cheese** back in the **mould**.



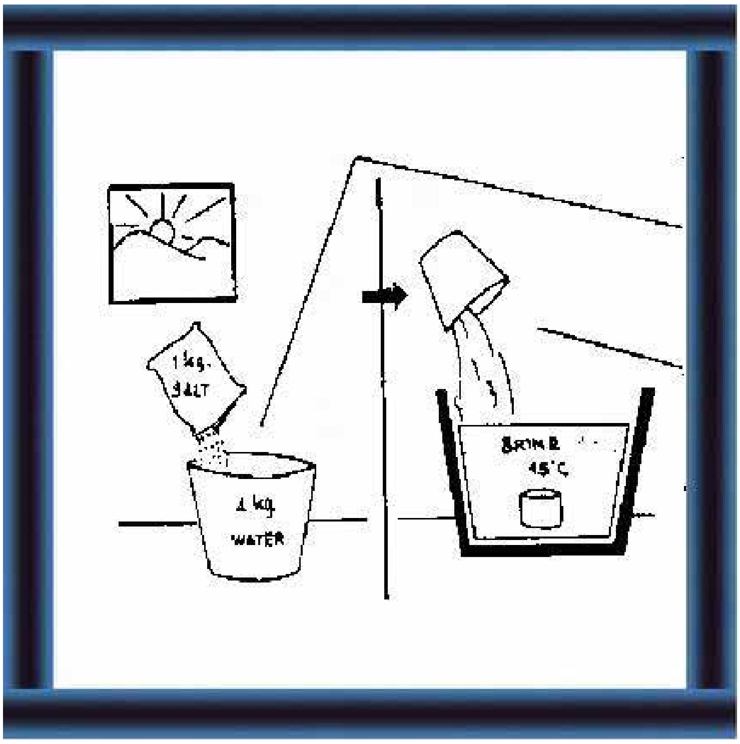
124 **Press again** with **five** times the weight of the cheese (for every **1 kg** cheese use **5 kg** press).

Press for **2-3 hours** for lighter cheeses and **4-5 hours** for heavier cheeses.



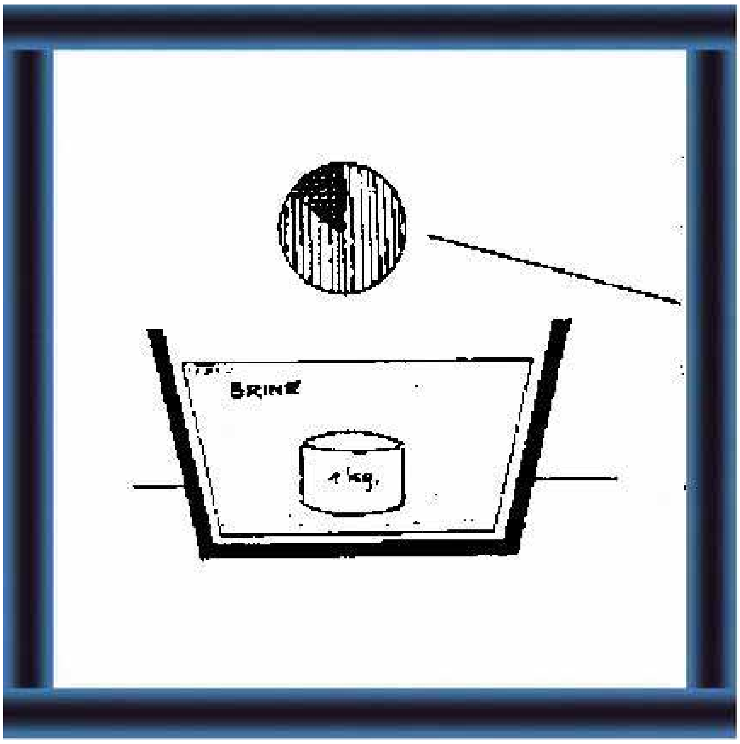
125 After pressing, put the **cheese** in cold water **8-10 C** until next morning.

Use **ice** if necessary.



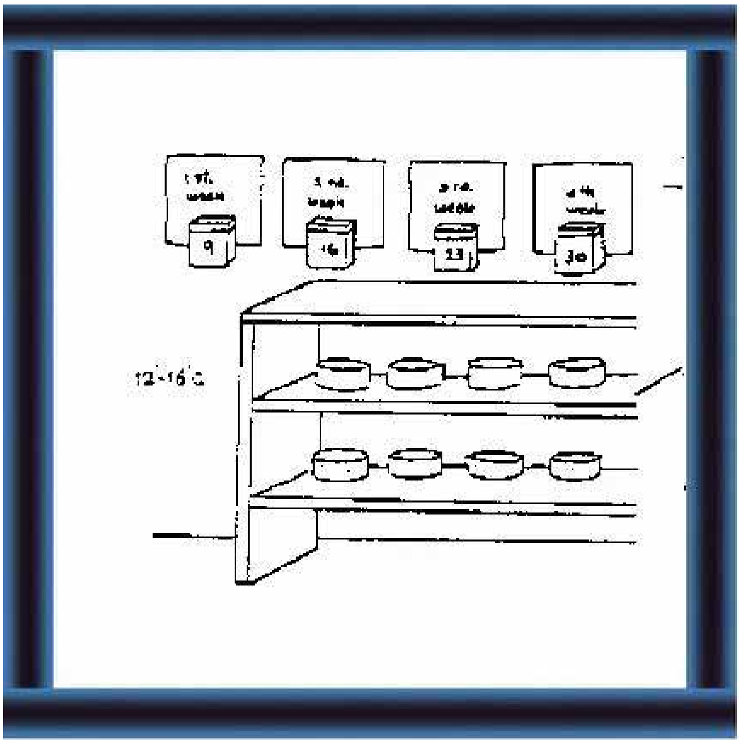
126 Next morning, make **brine** (1 kg salt for every 4 kg water).

Put the **cheese** in the **brine** at a temperature of about **15 C**.



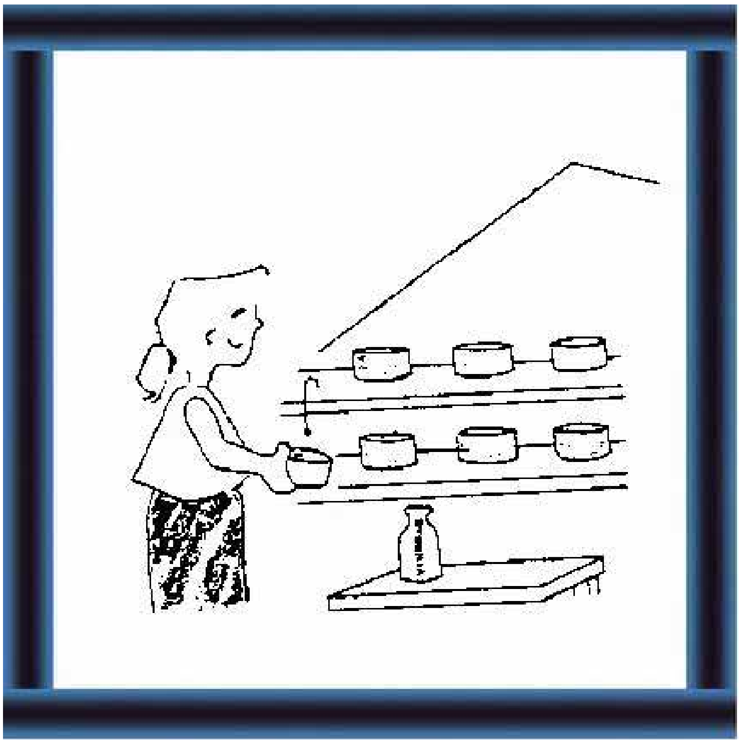
127 For a 1 kg cheese, leave in brine for about **20-24 hours.**

Make the **time longer** or **shorter by taste**.

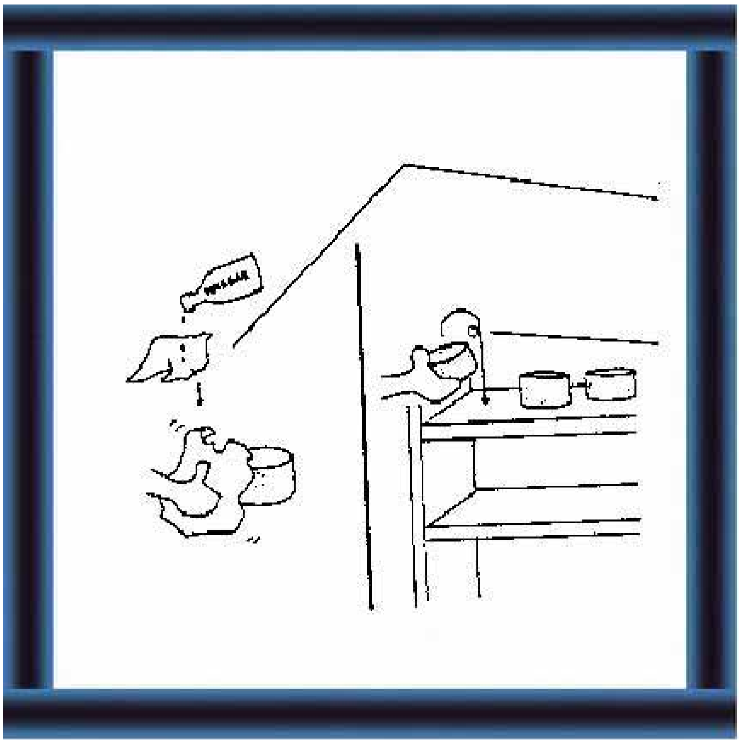


128 After salting, **dry** the cheese.

Ripen it on **clean wooden shelves** for **at least 4 weeks** at a temperature of **12-16 C**.



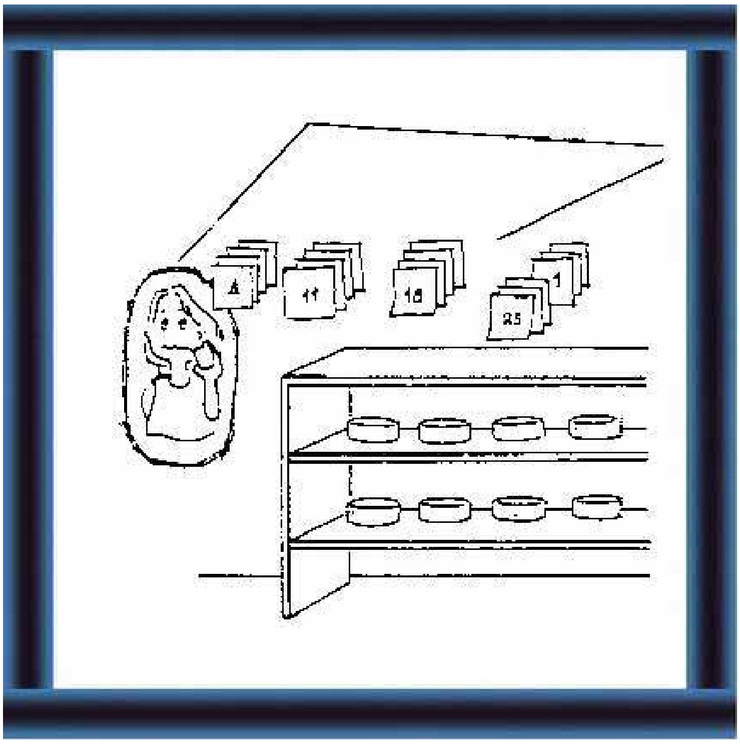
129 During ripening, **take** the cheese **off** the shelves **every 3 days**.



130 Put **vinegar** on a **cloth** and wipe the **cheese.**

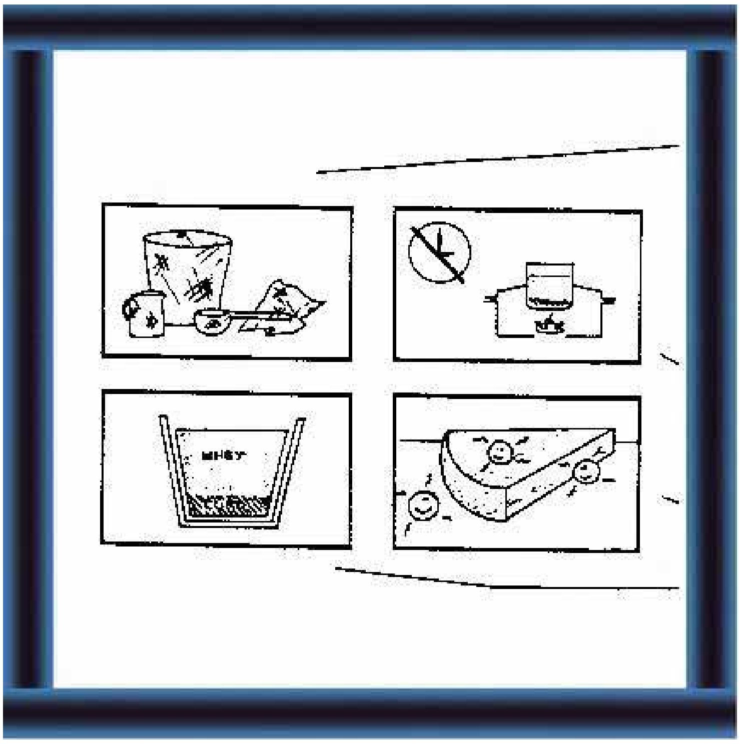
This **prevents fungi.**

Put the cheese back **upside down.**



131 The **longer** you ripen cheese, the **stronger** the **flavour.**

What defects are there in cheese?



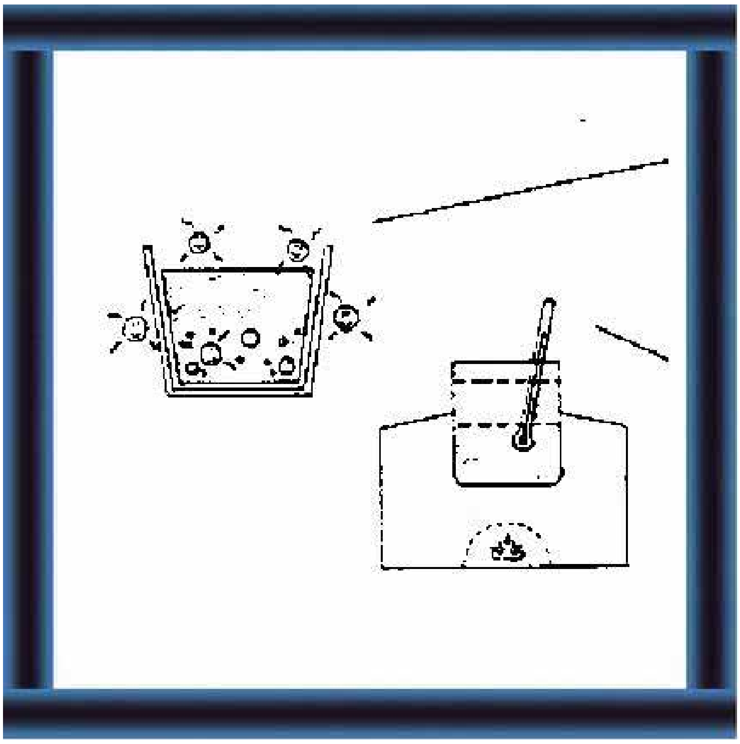
Flavour defects

132 **Taints** and **off-flavours** can come from:

- **dirty** equipment
- **lack** of **cooking** of curd
- **too much whey** in curd
- **bacterial growth**.

133 **Sour flavours** can come from **too much acidity**.

Bitterness can come from **protein breakdown**.



Textural defects

134 **Gassy curd** comes from **bacteria**.

Tough curd comes from **too high** a **temperature** at cooking.

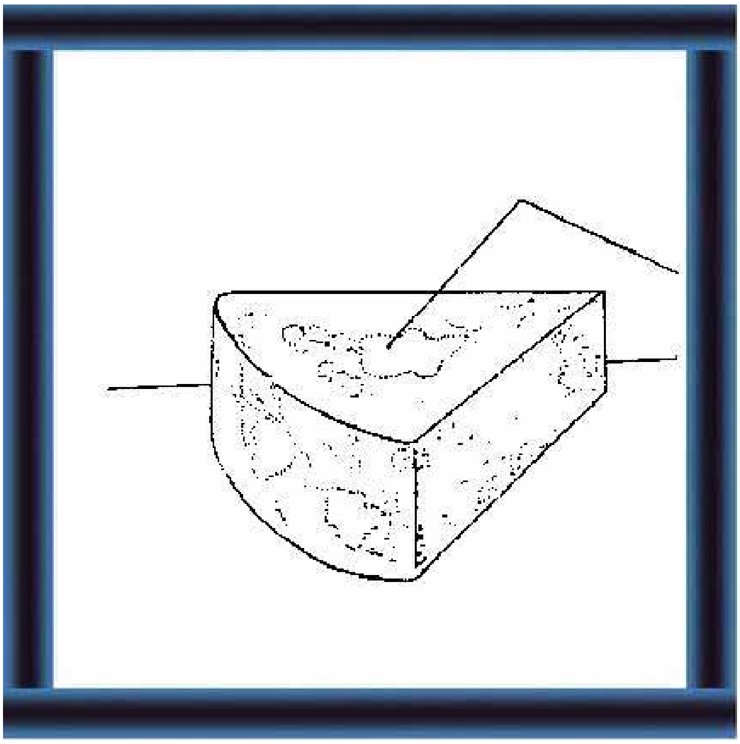
135 If your cheese is **very soft**:

- it contains **too much water** and **does not keep long**

- your **starter culture** is **too old**

- your milk **contains chemicals** that **stop bacteria** multiplying e. g. antibiotics from mastitis treatment.

Always wait 5 days after antibiotic treatment before using milk.



136 **Defects in appearance**

Slimy growths may be white to yellow/brown and come from **moulds** or **bacteria**.

What do you know about cheese?

What cheese is

Curds separated from whey	(5-8)

Items for making cheese

1 Good quality milk	(9-20)
2 Rennet	(21-26)
3 Starter	(27-32)
4 Additives	(33-34)

Quantity of cheese from milk	(35)

Important things in cheese making

1 Factors affecting type of cheese	(36-40)
2 Adapting recipes and keeping records	(41-42)
3 Problems of cheese making	(43-46)

4 Keeping qualities of cheese (47-50)

Two common types of cheese

1 Fresh cheese (51-52)

- equipment (53-62)

- manufacture (63-76)

- working without starter (77-80)

- flavouring (81-82)

- using whey (83-86)

2 Semi-hard ripened cheese (87-88)

- equipment (89-107)

- manufacture (108-131)

Defects of cheese

1 Flavour (132-133)

2 Texture (134-135)

3 Appearance (136)

Small-Scale

Dairy Farming Manual

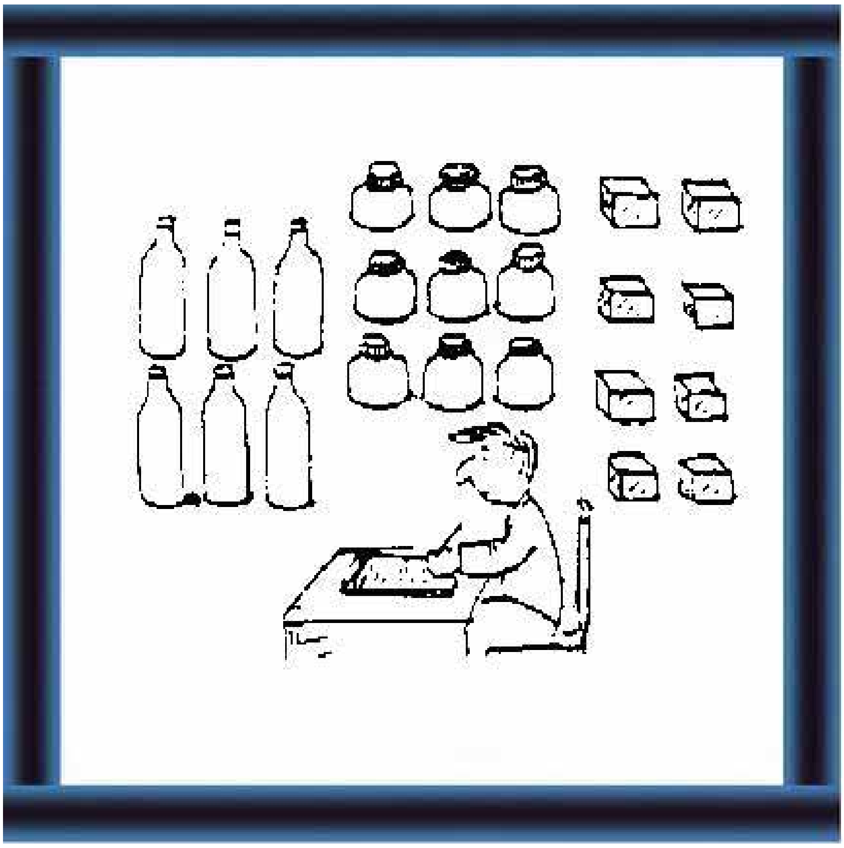
Volume 1

Technology Unit 11

BASIC PRODUCTION AND BUSINESS CALCULATIONS FOR MILK PROCESSING PERSONNEL AND MILK COLLECTING CENTRES

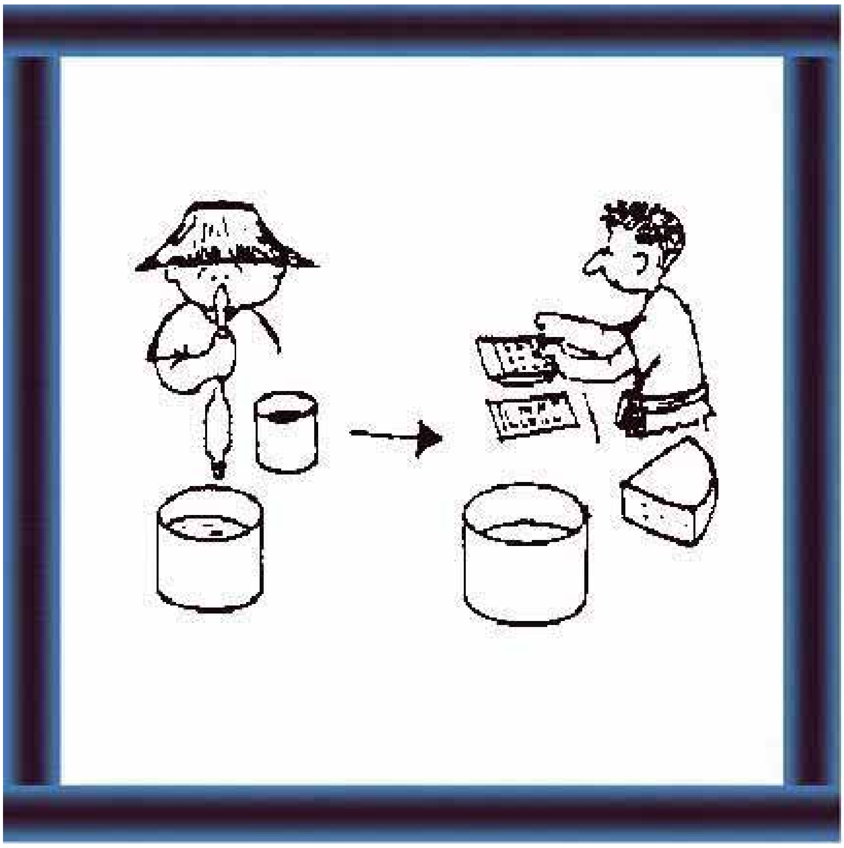
Extension Materials

What should you know about basic production and business calculations?



1 **How can you keep reception records?(4)**

You should know how to keep records of the **quality**, **price** etc. of milk coming into your centre.

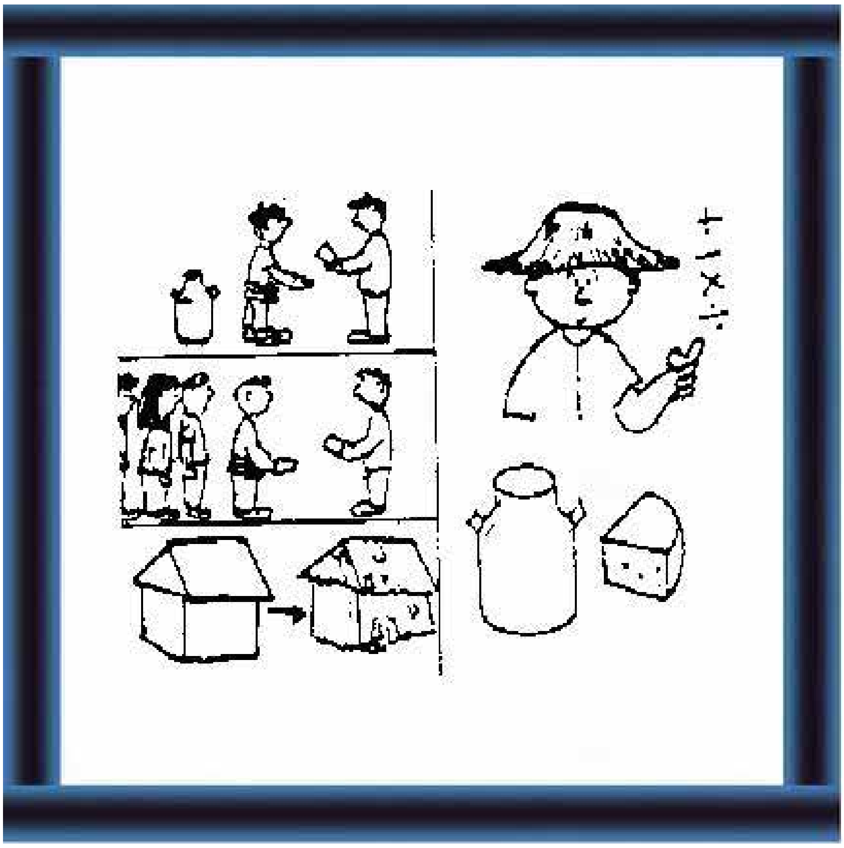


2 **How can you calculate fat contents for standardization?(5-10)**

You should know how to:

- find the **fat content** of your **cream** and **skim milk** so you can

- **calculate** the **fat content** of your **products**.



3 **How can you calculate production costs? (11-27)**

You should know how to find the costs of:
- raw materials
- wages
- depreciation etc.

so that you can **calculate the cost** of each litre of milk, kilogram of butter etc.

How can you keep reception records?

4

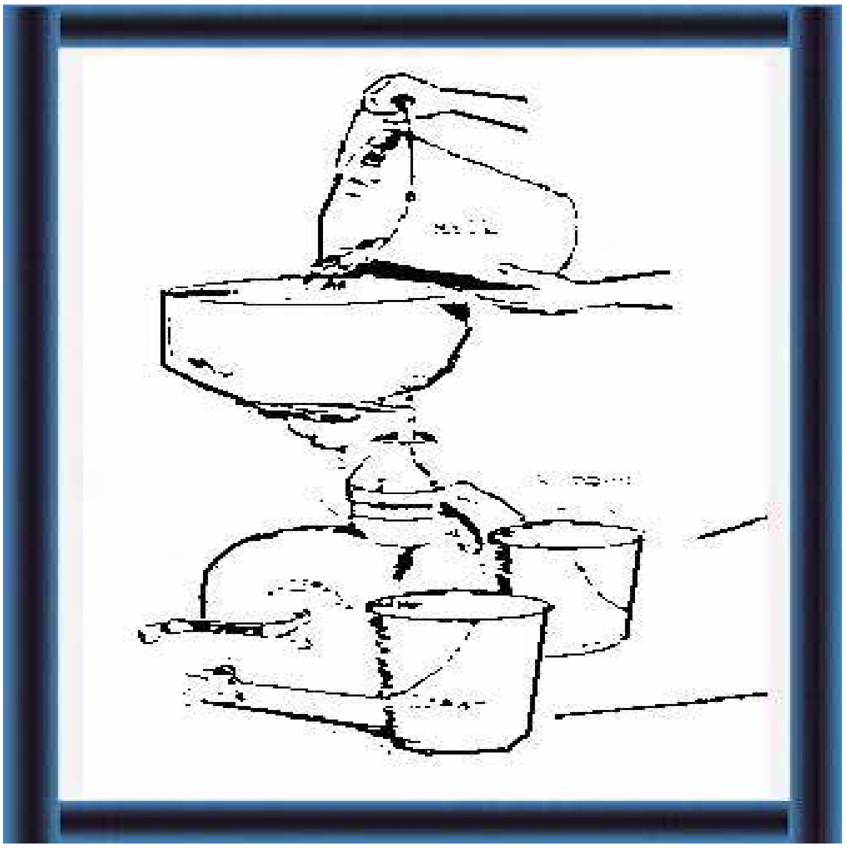
Name......................... No.................................... Week.................................

Day	Milk (l)	Fat (%)	Quality/ Class	Fat Units (fu)	Purchase (mu)
Tuesday	100	4.00	I	400.0	211
	95	4.10	I	389.5	
	98	3.90	II	382.2	
	97	3.90	I	378.3	
	100	4.00	II	400.0	

Total	**490**		**II**	**1,950fu**	**211 mu**

Note: 1 fu = 1 part fat in 100 parts milk

How can you calculate fat contents for standardization?

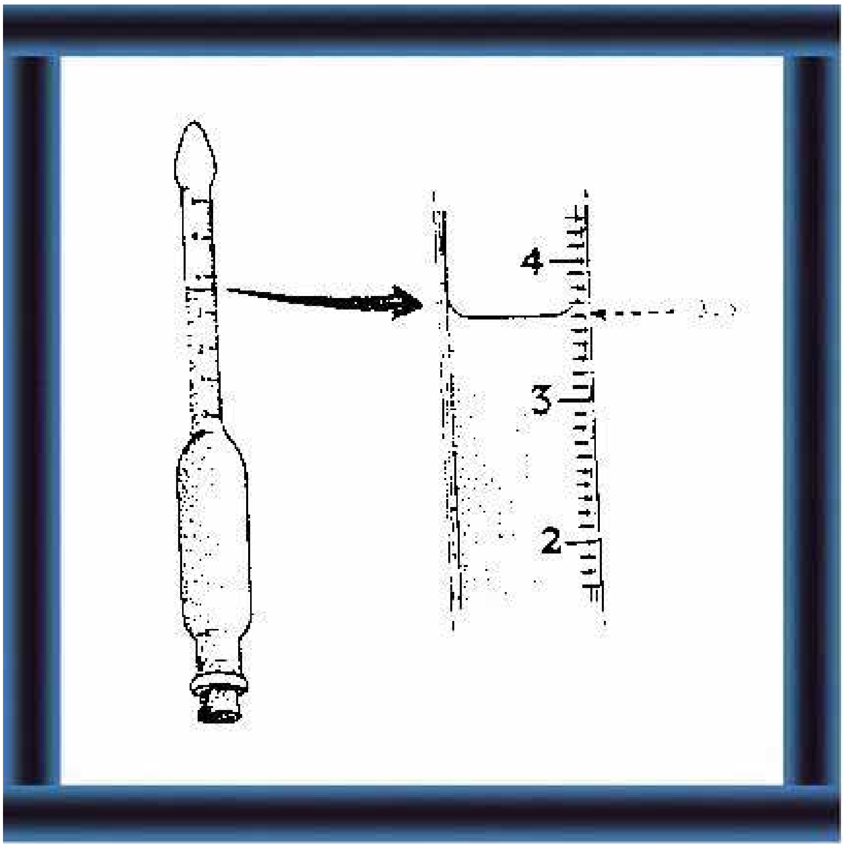


5 Before you can **adjust the fat content** (standardization), you must **separate:**

- the **cream** from

- the **skim milk**.

Note: *See also T8 Milk Payment.*



6 **Check** the **fat content** of your cream and whole milk or skim milk.

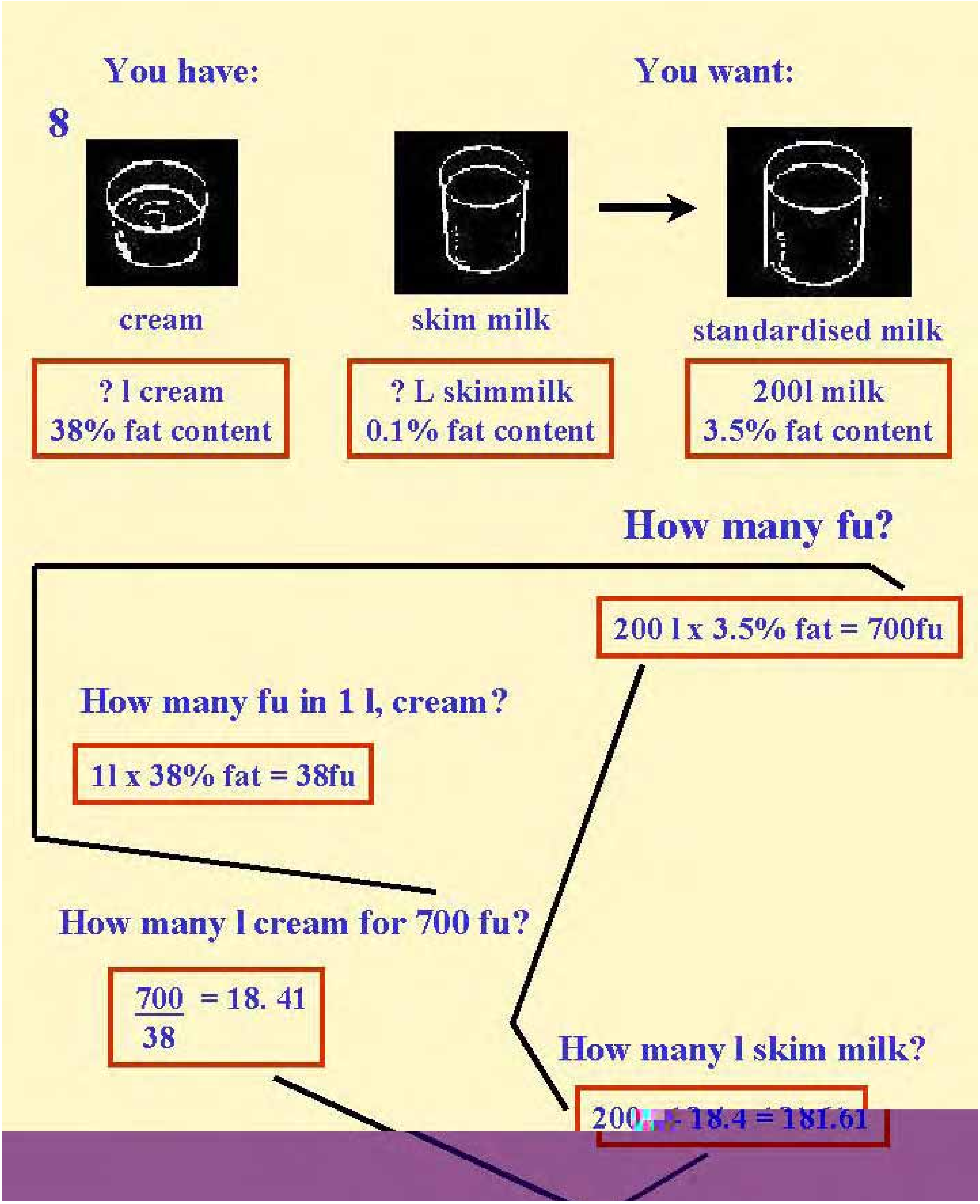
7 **Calculate** the **amounts** of:
- cream
- skim milk
- whole milk

you mix to get the **correct fat content** for your product.

Note: See T3 Milk Quality Control for a method of checking the fat content.

Example 1: Fat content of standardized milk

8


You have:
You want:
8
cream
skim milk
standardised milk
? l cream
38% fat content
? L skimmilk
0.1% fat content
200l milk
3.5% fat content
How many fu?
200 l x 3.5% fat = 700fu
How many fu in 1 l, cream?
1l x 38% fat = 38fu
How many l cream for 700 fu?
700 / 38 = 18. 41
How many l skim milk?
200 18.4 = 181.6l

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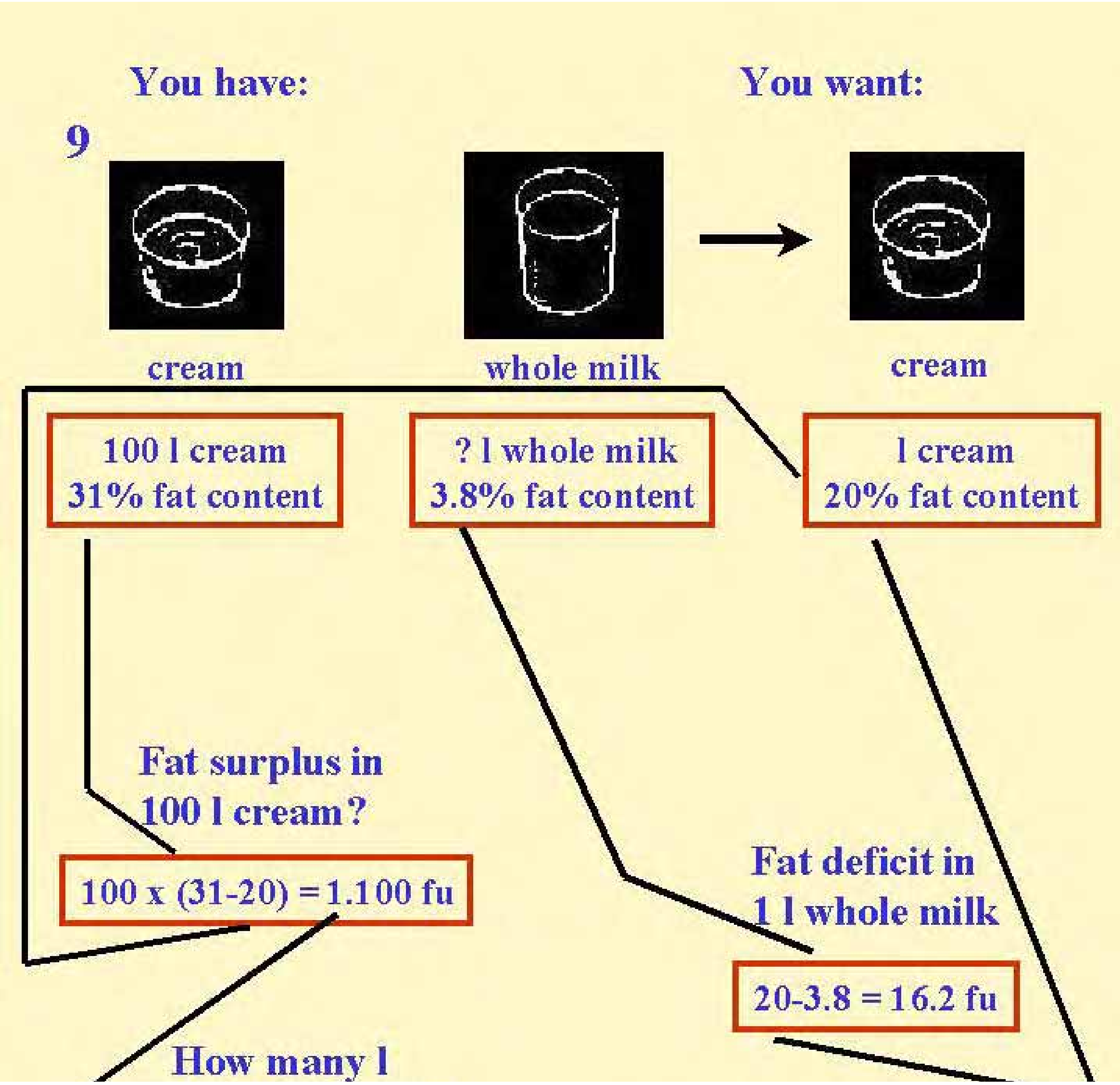
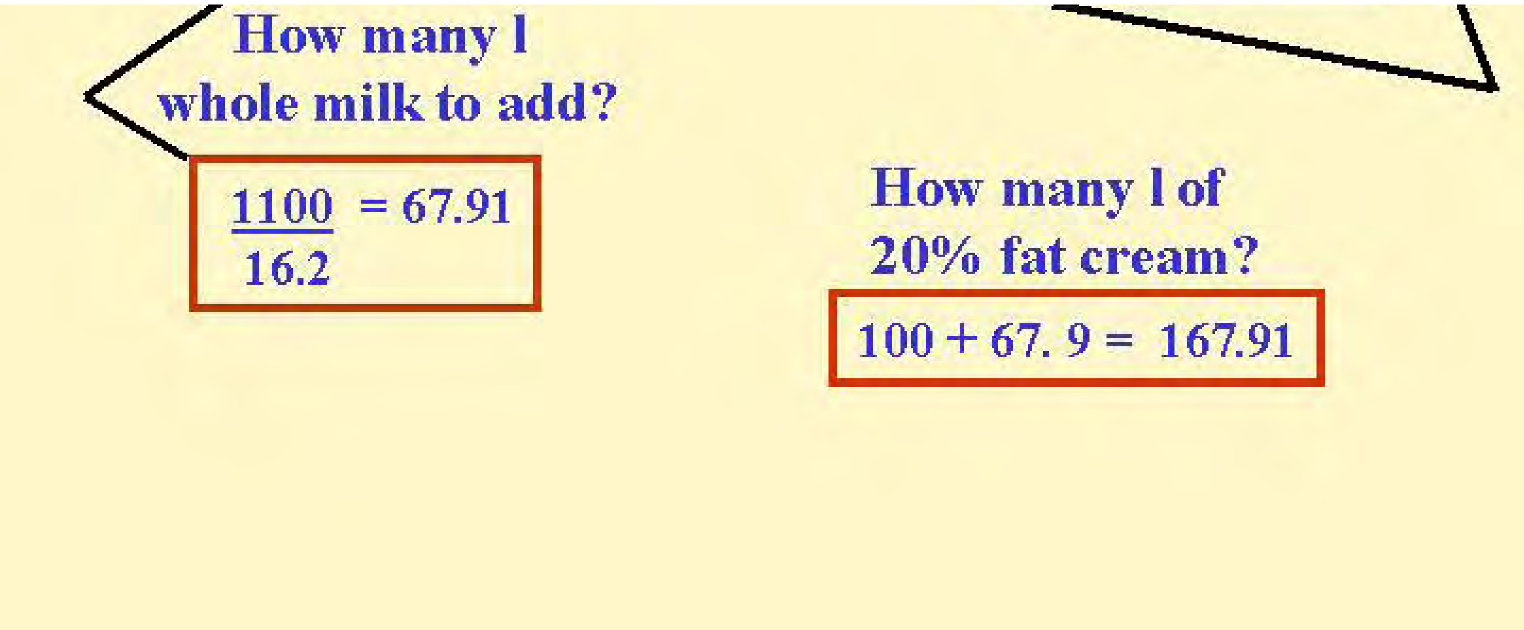
Example 2: Fat content of cream

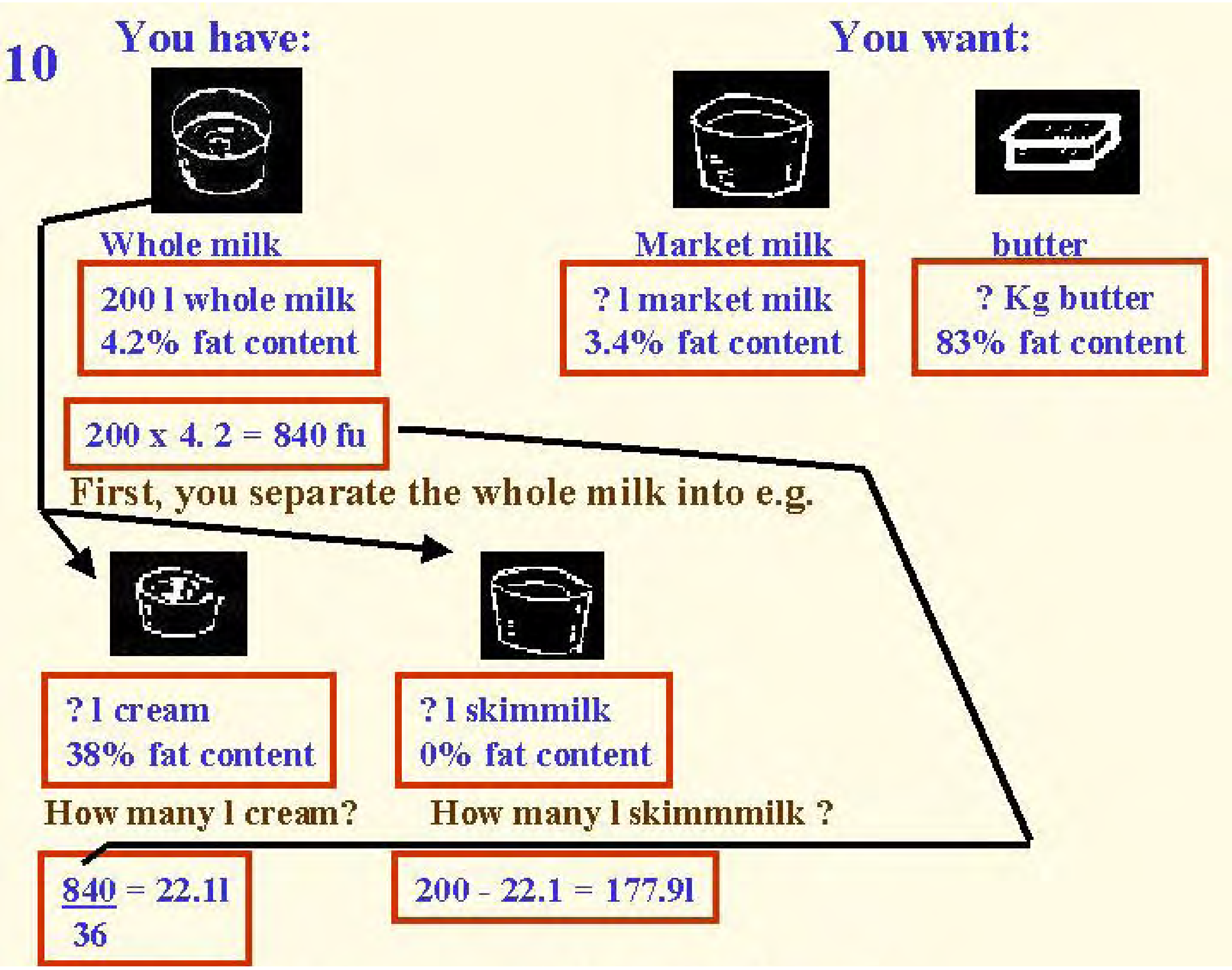
9



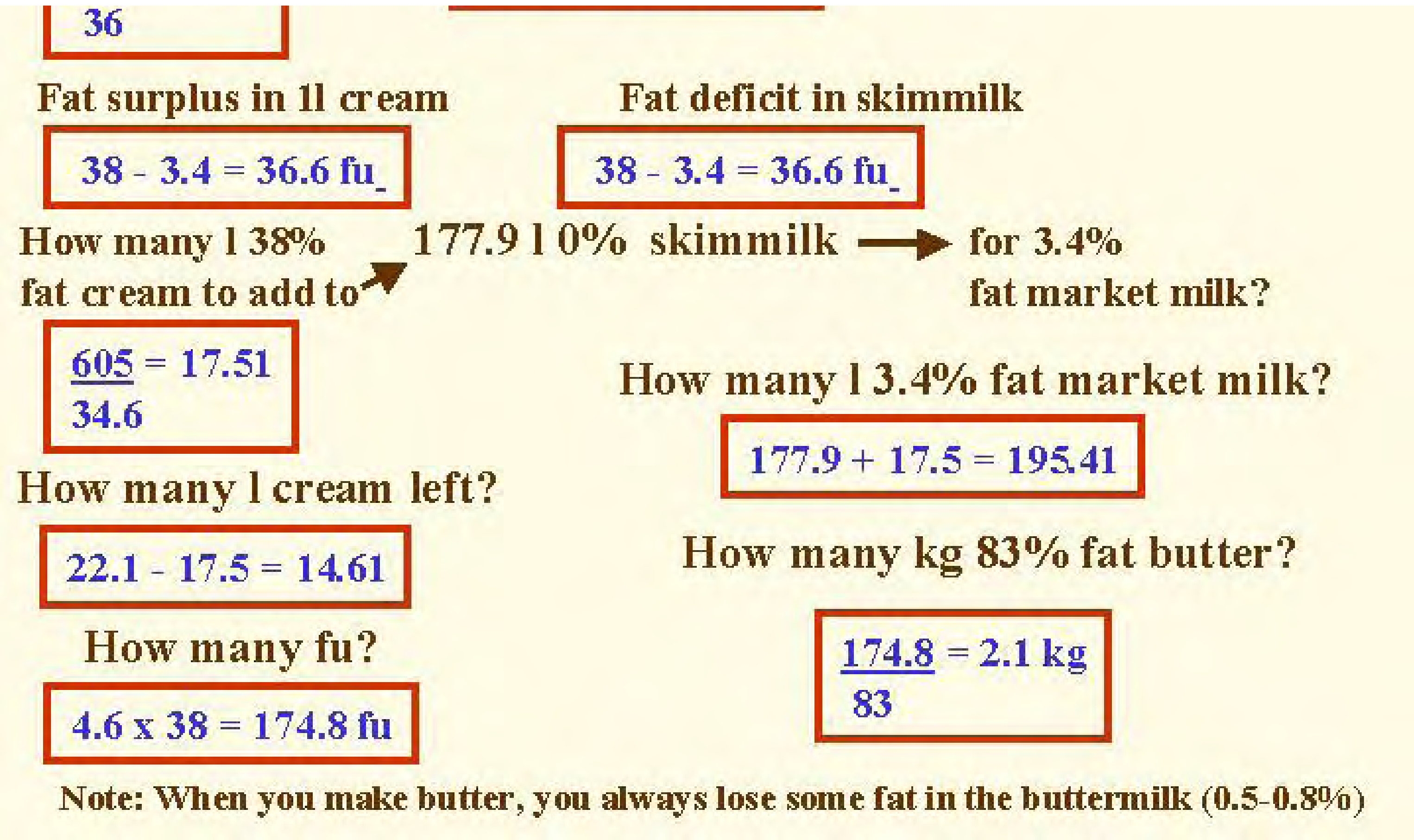


How many l
whole milk to add?
1100 = 67.9 l
16.2
How many l of
20% fat cream?
100 + 67. 9 = 167.9 l

10



10
You have:
Whole milk
200 l whole milk
4.2% fat content
200 x 4. 2 = 840 fu
You want:
Market milk
? l market milk
3.4% fat content
butter
? Kg butter
83% fat content
First, you separate the whole milk into e.g.
? l cream
38% fat content
How many l cream?
840 = 22.1 l
36
? l skimmilk
0% fat content
How many l skimmmilk ?
200 - 22.1 = 177.9 l



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How can you calculate production costs?

11 **You know:**

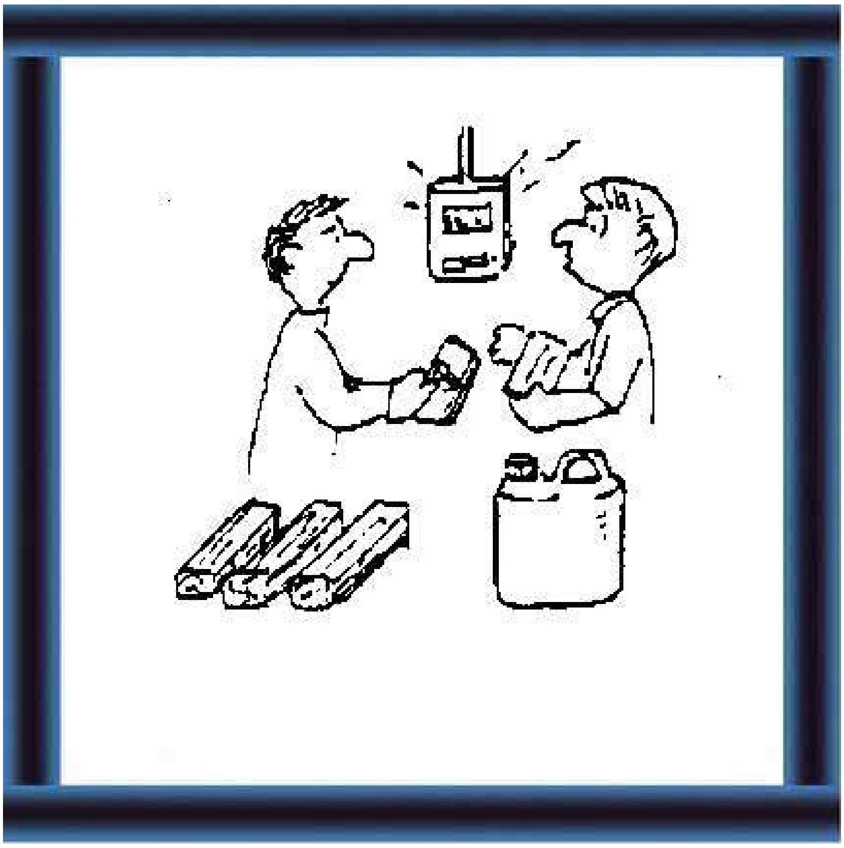
- **how much** you pay farmers for their

milk from

the **milk payment scheme**

12

- **how many l of milk** you buy from the farmers **every week** or **everymonth**

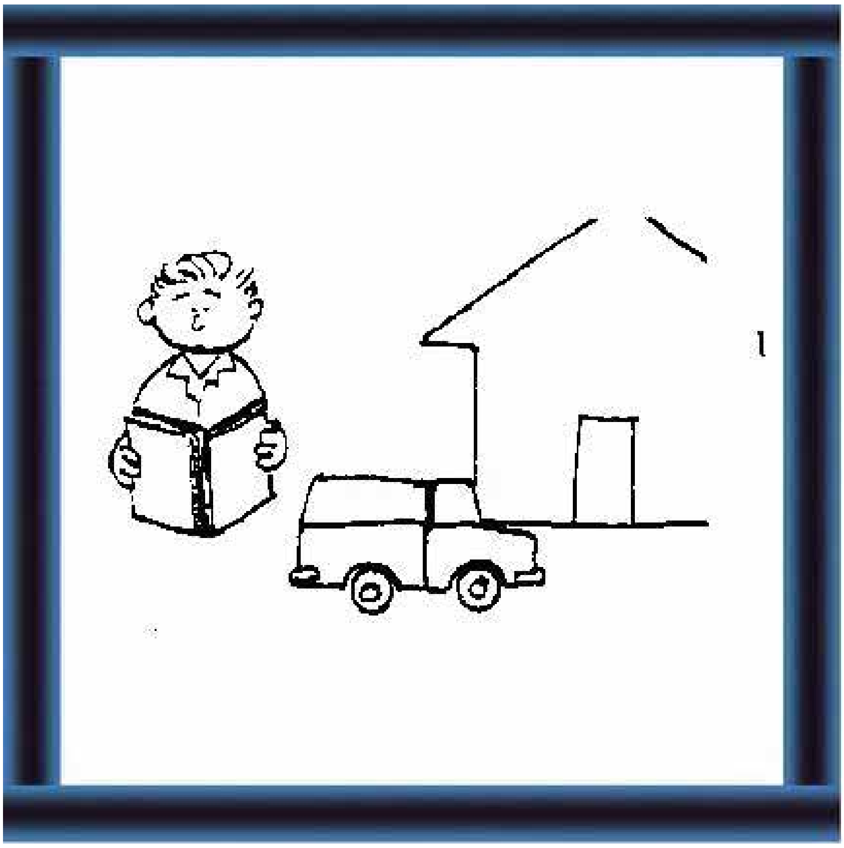


13

- **how much** you pay for **electricity** or for **wood, fuel oil** etc.

14

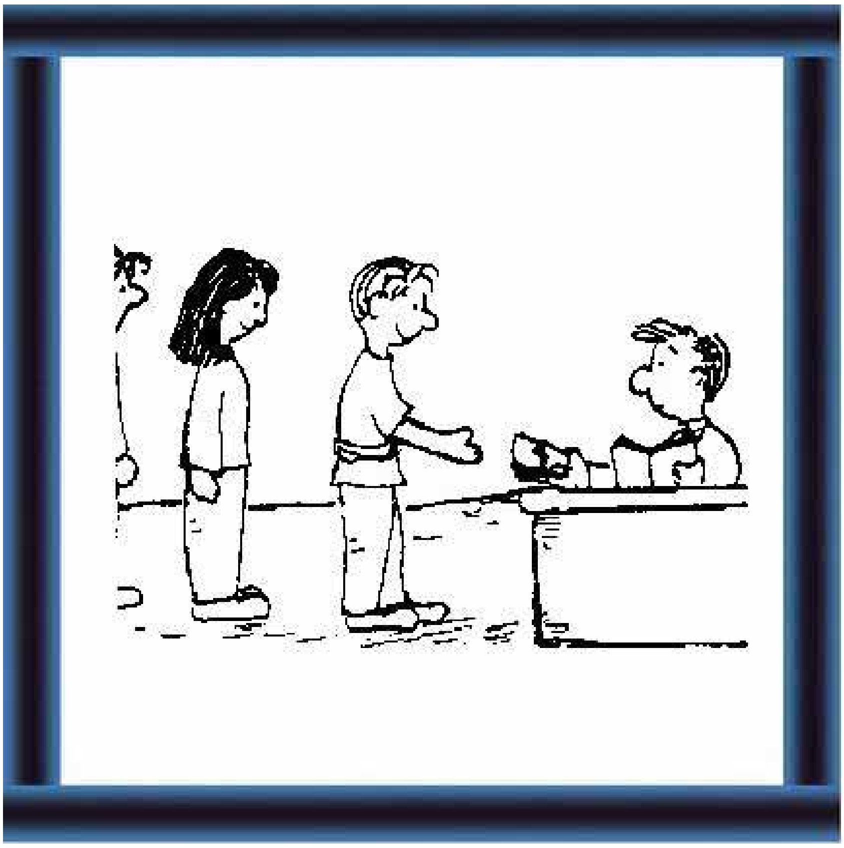
- **how much** you pay for **processing aids** e.g. starter culture, detergents, rennet, salt etc. from the bills



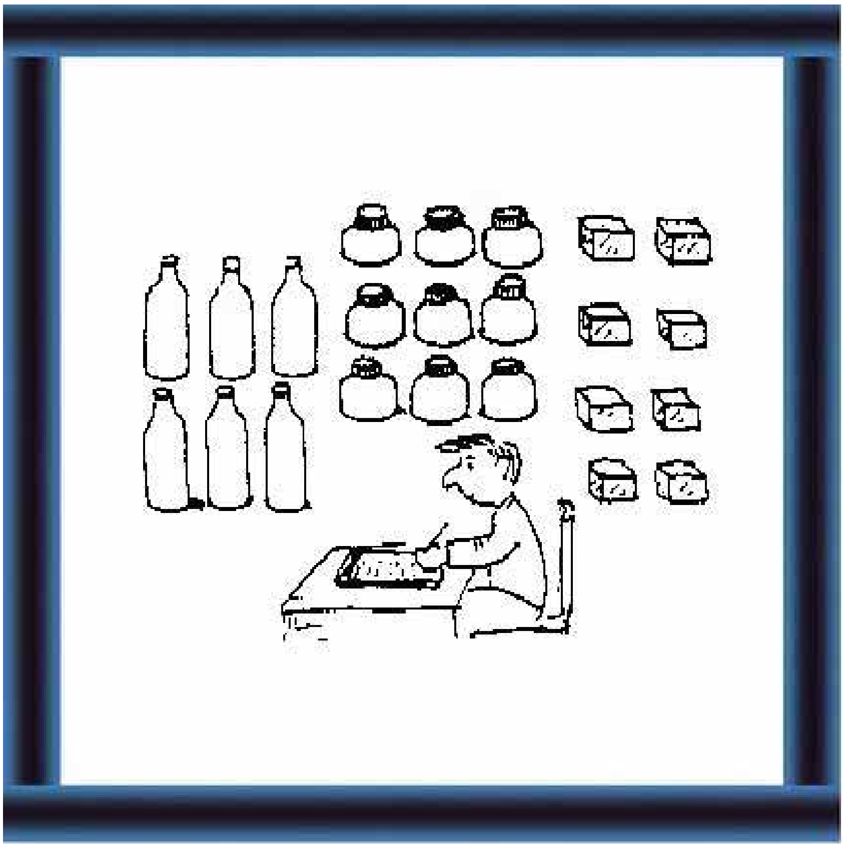
15

- the **costs** of **equipment** e.g. trucks, tanks

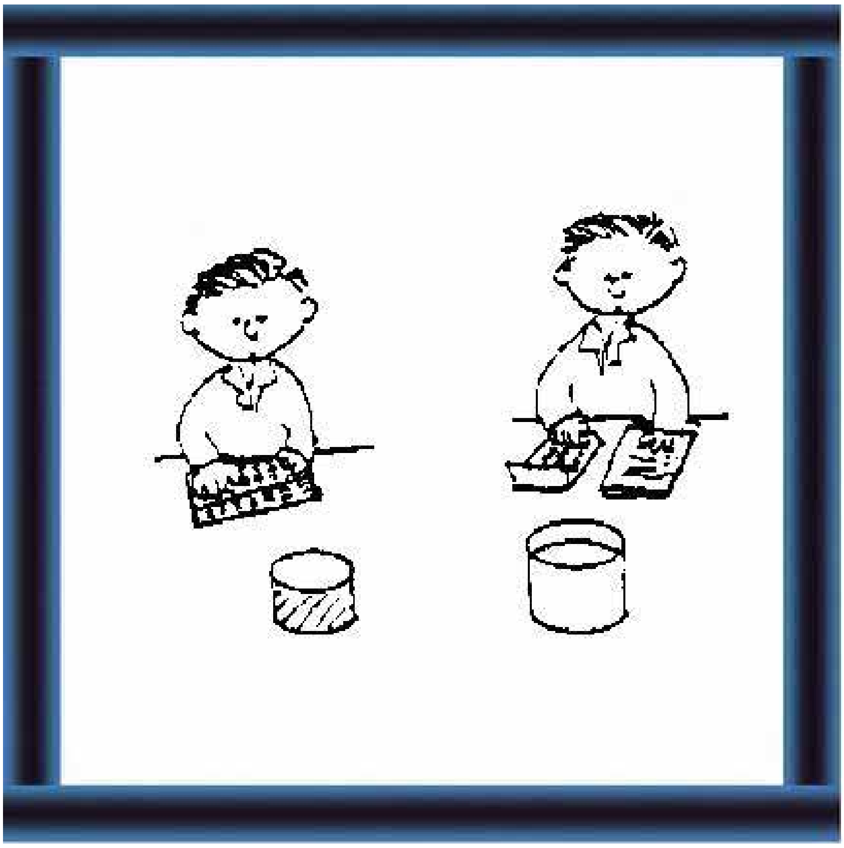
- **buildings**



16
- **the wages** you pay your **workers**



17
- **how many units** you produce of **each product.**



18 When you **calculate** the costs of each product

remember:

fat is **more expensive** than skim milk.

Example 4:

Production costs of market milk and butter

This month, the prices are: Milk price: 10 mu/l
fat content: 4.2%
18

Assuming fat value is 50 % of the milk price

The cost of 1 fu is:
10 mu x 50% x 1 = 1.19 mu/fu
4.2 mu

From Example 3, each day:

you receive: **you produce:**

200 1.2 fat whole milk > 195.4 13.4% fat + 2.1 kg 83% fat
pasturized market milk butter

Your daily payment to the farmer for milk is:

200 1x 10mh = 2000 mu/day

Cost of l milk: **Cost of 2.1 kg**

milk (50%)=5mu **fat 4.6 kgx38%vfat**
x 1.19mu = 208 mu

+ **+**

fat 3.4 fu x 1.19mu/fu **milk 4.6 x 5 mu**
=4.05 mu **=23 mu**

=9.05 mu **=231 mu**

Cost of 195.4 l milk

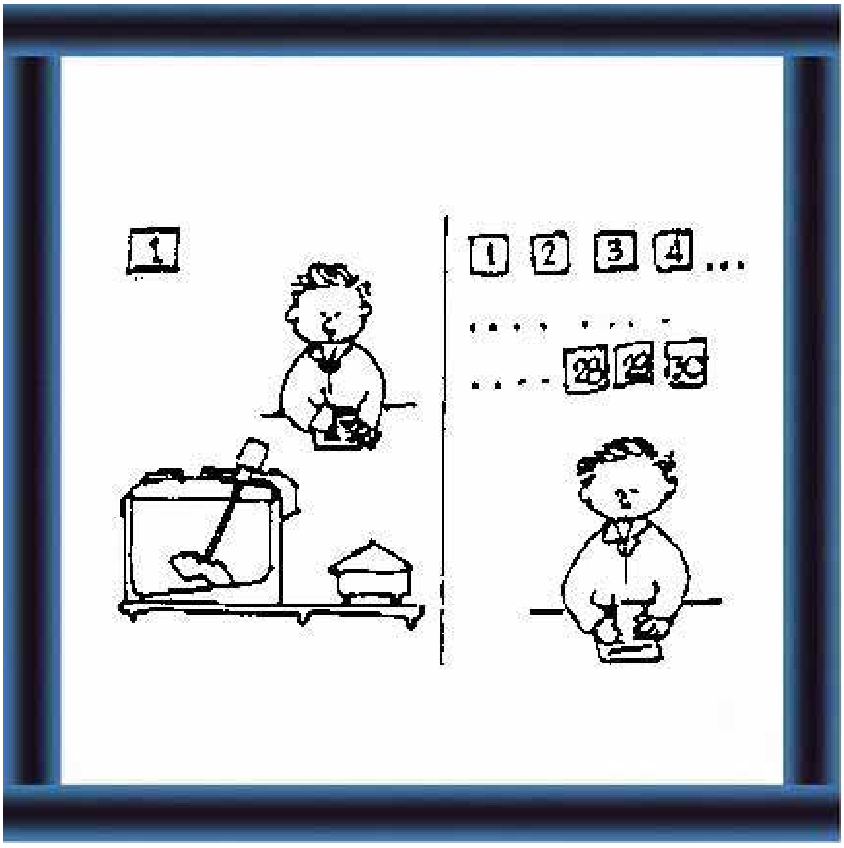
195.41 x 9.05 mu

= 1,768 mu 1,999 mu ~ 2,000 mu

Cost 1 kg <u>231 mu</u> = 110 mu

2.1 kg

You can calculate costs for each litre of milk you receive.



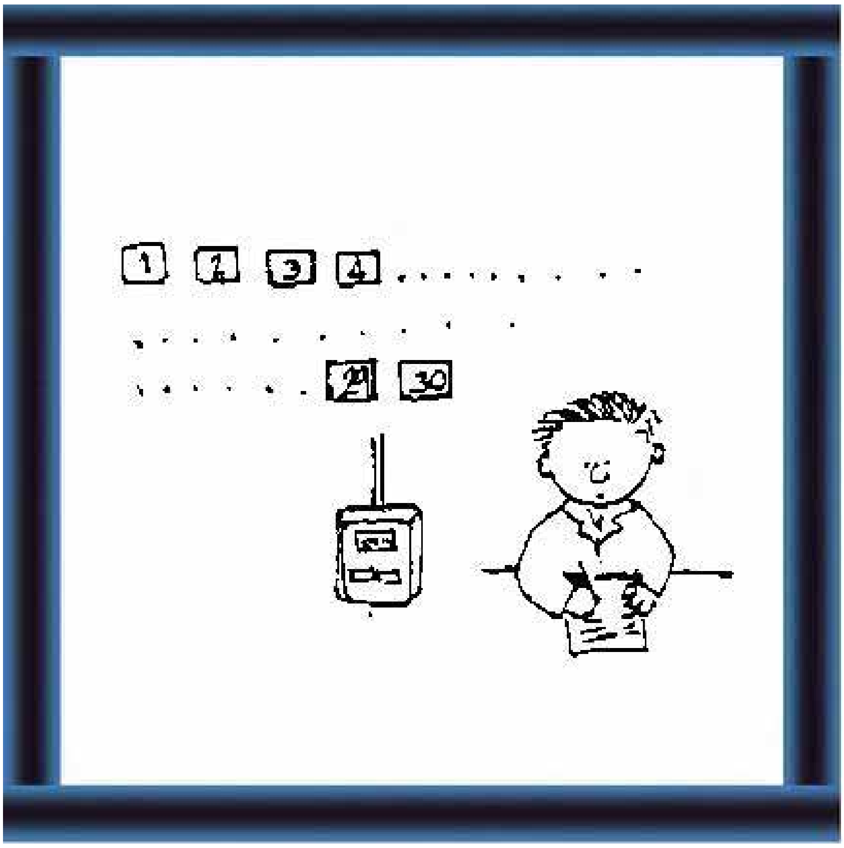
19

Each day you receive 200 l milk.

Each month you receive:

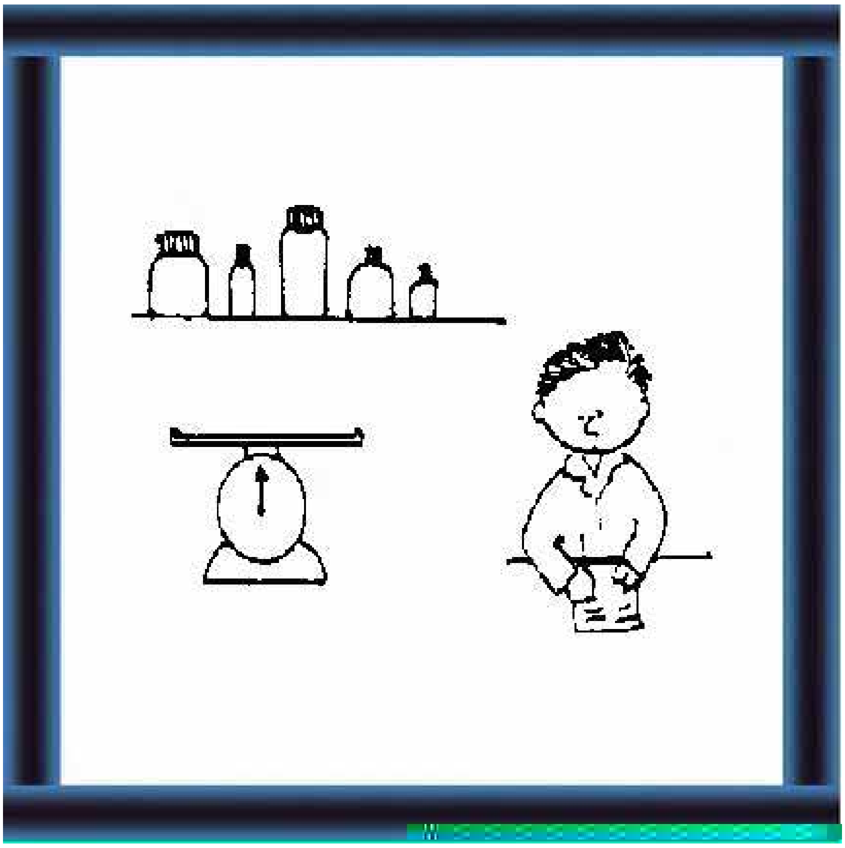
200 l x 30 days = **6,000 l milk**.

Electricity costs



20 If your electricity bill for 1 month is 6,000 mu, your **electricity costs** are:

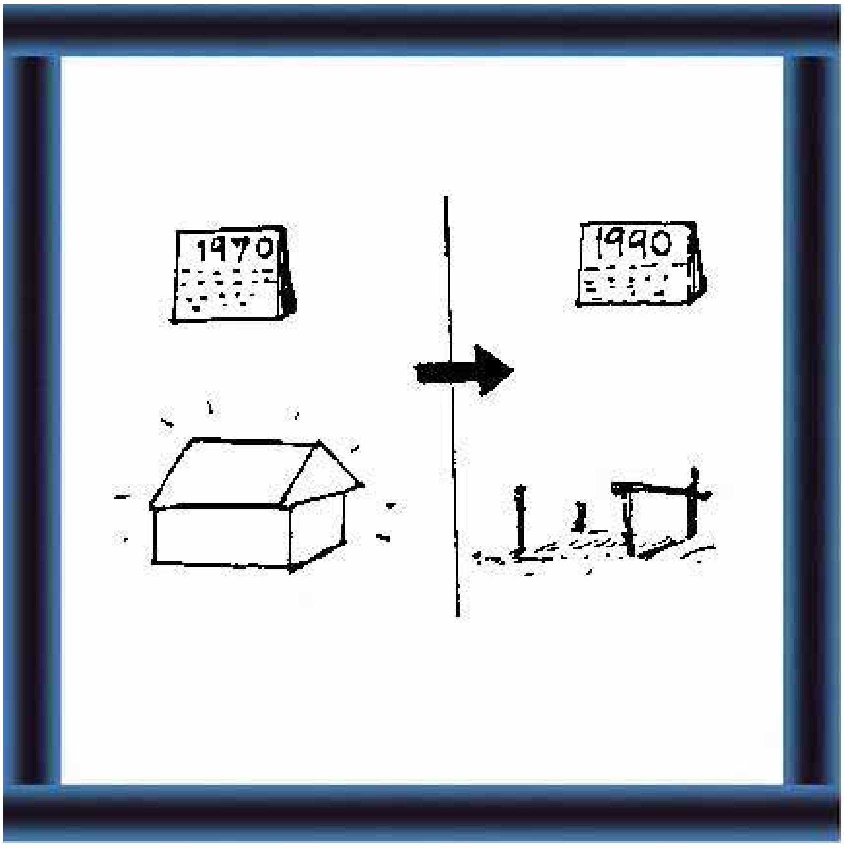
$\frac{6,000 \text{ mu/month}}{6,000 \text{ l/month}}$ = **1 mu/l milk**.



Costs of chemicals

21 If your bill for chemicals is 1,500 mu for 1 month. Your **chemicals costs** are:

$\mathbf{\frac{1,500 \text{ mu/month}}{6,000 \text{ l/month}} = \frac{1}{4} \text{ mu/l milk.}}$



Depreciation costs
22 When **new**, your **buildings** cost 100,000 mu.

After **20 years**, you assume:
- their value is **0 mu.**

They lose value each year: **annual depreciation**.

Assuming they lose the **same value** each year, **depreciation costs/month**:

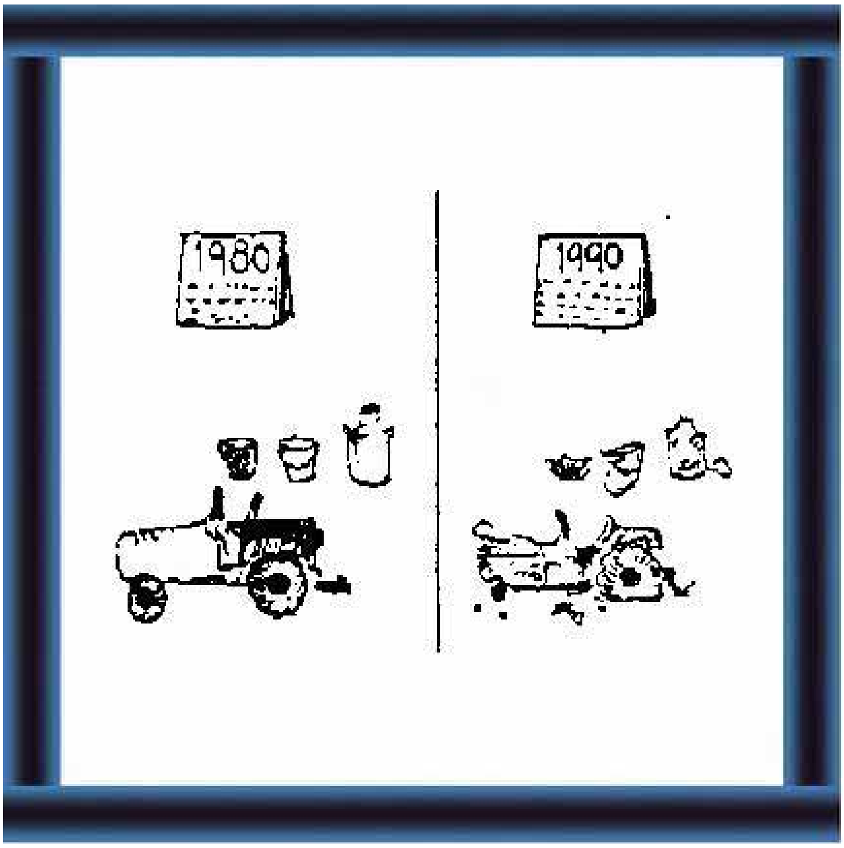
$$= \frac{100{,}000 \text{ mu}}{20 \text{ years} \times 12 \text{ months}} = \mathbf{417\ mu/mon}$$

You assume your milk production stays the same.

Therefore **depreciation costs/l milk**:

$$= \frac{417 \text{ mu/month}}{6{,}000 \text{ l/month}} = \mathbf{0.07\ mu/l}.$$

23



When new, your **equipment costs** are:

300,000 mu.

After **10 years**, you assume:
- its value is **50,000 mu**.

Assuming it loses the **same value** each year, **depreciation costs/ month** =

300,000 - 50,000 mu = **2,083 mu/mon**
10 years x 12 months

Therefore, **depreciation costs/l milk**:

= 2,083 mu/month = **0.35 mu/l**.
6,000 l/month

Example 5: Total milk production costs of market milk
See Example 4 where 3.4 % pasteurized market milk cost 9.05 mu/l.
Your **total production costs** for 1 l market milk are:

24

	mu
Milk	9.05
Electricity	1.00
Chemicals	0.25
Depreciation	0.44 (0.07 + 0.37)
Wages	0.50 (estimate)
Packing materials	0.25

Total production costs for

1 l 3.4 % pasteurized milk = 11.49mu

Note: For your own production,add all of your other costs e.g. Transport, water etc.

25

You must add your **profit** to the total production costs.

mu
Total production costs of

1 l market milk
11.5

30 % profit ($\frac{11.49 \times 30}{100}$) 3.5

Sale price
15.0 mu

Example 6: Total production costs of butter
See Example 3 where you need:

4.6 l of cream to make 2.1 kg of butter

So for 1 kg of butter, you need $\frac{4.6}{2.1}$ = **2.2 l cream**.

Your **total production costs** for 1 kg butter are:

26

mu

butter
110.30

electricity
(2.2 l cream x 1 mu) 2.20

chemicals
0.25

depreciation
(2.2 l cream x 0.44) 0.97

wages
(2.2 l cream x 0.50) 1.10

packing materials 0.25

Total: 115.07mu/kgbutter

27

Total production costs mu

of 1 kg butter
115.00
+
30 % profit
35.00

Sale Price
150.00 mu/kg

What do you know about basic production and business calculations?

Keep accurate reception records	**(4)**

Standardization

Separate milk **Whole**

into: cream skimmilk **(5)**

Check for contents and calculate amounts for: **(6-10)**

products: market market butter milk cream **(7)**

Calculate production costs

Cost of: (11-12)

raw milk (13)
electricity (14)
processing aids (15)
buildings and equipment (16)
wages

Divided by:----------------------------= Unit Production Cost (17-21)

amount of butter produced

+

Other costs

(22-23)

= Total Production Costs (24-27)

+

Profit

Sale Price

Examples **Page**

Example 1	Fat content of standardized milk	(8)
Example 2	Fat content of cream	(9)
Example 3	Fat content of market milk and butter	(10)
Example 4	Production costs of market milk and butter	(19)
Example 5	Total production costs of market milk	(25)