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THE BASIC PRINCIPLE BEHIND DAIRY PRODUCTS

The production of yoghurt, cheese and fermented milk is simply a method of storing excess milk. An acid and / or salty product can be stored longer than a neutral nutritive product like milk.

Furthermore a dry product stores better than a moist product. Cheese is made by separating the solid part of milk from the liquid. The drier the cheese, the longer you can store your original milk.

COMPOSITION OF MILK AND ITS AFFECTS ON CHEESE

The composition and quality of the milk are important factors in the cheese making process. Milk is made up of the following constituents:

<table>
<thead>
<tr>
<th>CONSTITUENT</th>
<th>MEAN VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER</td>
<td>87%</td>
</tr>
<tr>
<td>TOTAL SOLIDS</td>
<td>13%</td>
</tr>
<tr>
<td>FAT</td>
<td>4.0%</td>
</tr>
<tr>
<td>PROTEIN</td>
<td>CASEIN 2.6%</td>
</tr>
<tr>
<td>OTHER</td>
<td>0.8%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3.4%</td>
</tr>
<tr>
<td>CARBOHYDRATES</td>
<td>LACTOSE 4.8%</td>
</tr>
<tr>
<td>MINERALS</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

The various constituents of milk and the ability to coagulate the milk will depend on many influences including the following:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td>Strain of the breed/breeding policy</td>
</tr>
<tr>
<td>Feeding routines</td>
<td>Nutritional value of foods</td>
</tr>
<tr>
<td>Stage of lactation</td>
<td>Number of previous lactation’s</td>
</tr>
<tr>
<td>Method of milking</td>
<td>Hand or machine</td>
</tr>
<tr>
<td>Method of storage</td>
<td>Cooled or direct from the cow</td>
</tr>
<tr>
<td>Heat treatment</td>
<td>Pasteurized milk or raw milk</td>
</tr>
<tr>
<td>Health of animals</td>
<td>Physical conformation of animal</td>
</tr>
<tr>
<td>Management of herd</td>
<td>Intervals between milking</td>
</tr>
<tr>
<td>Climate and season</td>
<td>Geographical region</td>
</tr>
</tbody>
</table>
An example of the effects of breed on milk composition are as follows:

<table>
<thead>
<tr>
<th></th>
<th>% FAT</th>
<th>% PROTEIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jersey</td>
<td>4.3 - 5.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Friesien</td>
<td>3.3 - 4.0</td>
<td>3.0 - 3.5</td>
</tr>
</tbody>
</table>

The effects of feed on milk composition, especially on the fat is noteworthy. Hay will cause the milk to contain fats with a higher melting point. Because hay has a low concentration of carotene, the fat will not be as yellow and therefore the cheese will have a pale colour. Green feed will have the reverse effects, i.e. the fat will contain more carotene and therefore the cheese will be yellow. Stage of lactation has an effect on milk composition. At the end of the lactation the milk has a higher percentage of solids and also changes in the reaction to enzymes (rennet)

**A general rule of thumb:** The more the milk is disturbed by pumping, cooling, heating and storing, the less easily the milk will coagulate.

A general rule of thumb: Ideally milk for cheese making should have a difference of 0.7% between the protein and fat content. Example: Holstein milk with a protein content of 3% and fat content of 3.7%. The difference is 0.7%.
COMPOSITION OF CHEESE

PROTEIN

Proteins are giant molecules built up of smaller units called peptides which in turn are built up of amino acids in a specific order. The milk protein casein is important in the manufacture of cheese. Other proteins, albumin, globulin and membrane proteins are largely left behind in the whey and are called whey proteins (used to make ricotta).

Casein constitutes about 78% of the milk protein. In milk it exists as calcium caseinate particles. These particles move freely in the milk. The rate at which they move depends on the temperature of the milk. They do bump into each other but are unable to “stick” to each other due to a protective shield on the outside of the particles. The particles are smaller than the fat globules which are also dispersed throughout the milk. Under the influence of rennet the casein particles lose their protective shield which keeps them apart. The casein is free to react with the calcium in the milk. The calcium forms bridges between the casein, linking the casein particles together to form a network, (calcium caseinate forms calcium paracaseinate). This gives the milk its solidity, the milk has formed a coagulum. The network of joined casein particles traps whey and all its constituents such as lactic acid, fat globules and bacteria inside it. During maturation the paracasein is broken down to smaller fragments called peptides and even smaller fragments called amino acids. The breakdown is caused by enzymes in the rennet and enzymes produced by the bacteria. From the above one can conclude that the higher the temperature of the milk, the faster the particles of casein move and the more likely they are to “bump” into each other and in the presence of rennet and to stick to each other forming paracasein. Furthermore the concentration of calcium ions in the milk has an effect on the formation of paracasein and thus a coagulum.

FAT

Fat globules are the largest particles in the milk. They are dispersed within the milk but rise to the top if the milk is left to stand. Each fat globule is surrounded by a skin or membrane consisting of protein and phospholipids. The skin plays an important factor in protecting the fat from being broken down by the enzymes present in the milk. Too much fat in the milk can have an effect on the final acidity of the cheese. During stirring of the curds the paracasein network contracts forcing the whey containing the lactic acid out. The fat particles are large and if there are too many of them, the paracasein network cannot contract as efficiently and more whey and lactic acid is trapped in the network. The result is a bitter and sour cheese. To prevent this occurring, the curds should be stirred for a longer period of time and more water at a lower temperature should be used to “wash out” the lactic acid.
During ripening, degradation of the fat is important for development of flavour in the cheese. The degradation of the fat is more important for flavour development than the degradation of the paracasein during ripening. The degradation of the fat is caused by an enzyme called lipase. Lipase is present in milk but is destroyed by pasteurization. Starter bacteria also produce lipases. However the natural lipases of the milk are more important for flavour development than the lipase’s produced by the starter bacteria.

**LACTOSE**

Lactose is a sugar and belongs to a group of chemical compounds called the carbohydrates. Lactic acid bacteria produce an enzyme called lactase which splits the lactose into glucose and galactose. These particles are further broken down by enzymes produced by bacteria to form various acids of which the most important is lactic acid. Lactose is water-soluble and therefore most of the lactose remains dissolved in the whey.
MICRO-ORGANISMS IN MILK

Micro-organisms are found everywhere where life is found; in the air, water and the soil. Many cause disease in people and animals while others are beneficial and even necessary for life.

Micro-organisms found in milk are:
- Bacteria
- Yeasts
- Moulds
- Viruses

“BAD” MICRO-ORGANISMS

“Bad” micro-organisms cause contamination of the milk making the milk unpalatable for human consumption. “Good” micro-organisms are used to culture the milk and mature the cheese and increase the storage capabilities of milk.

Some examples of the common “Bad” microorganisms found in milk:

<table>
<thead>
<tr>
<th>E. Coli</th>
<th>Manure</th>
<th>Forms gas and off tastes in cheese early blow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyric acid bacteria</td>
<td>Soil</td>
<td>Forms gas and off tastes in cheese late blow</td>
</tr>
<tr>
<td>TB</td>
<td>Infected cow</td>
<td>TB in humans</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>Infected cow</td>
<td>Abortions in humans</td>
</tr>
<tr>
<td>Staph. Aureus</td>
<td>Mastitis</td>
<td>Food poisoning in humans Cannot be seen or tasted in cheese.</td>
</tr>
<tr>
<td>Virus</td>
<td>Bacteriophage</td>
<td>Feeds on “good bacteria”</td>
</tr>
</tbody>
</table>

Some examples of “Bad” microorganisms found on cheese:

<table>
<thead>
<tr>
<th>Listeria</th>
<th>Wet planks in cold room</th>
<th>Can cause death in humans</th>
</tr>
</thead>
</table>
When milk is secreted in the udder it is normally sterile. But even before it is released through the teat, the milk is infected by bacteria which enter through the teat channel. Thereafter milk is infected by everything it comes in contact with.

**The bacteriological standards of MILK FOR THE PRODUCTION OF CHEESE set by the S.A.I.M.R. are as follows:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Viable organisms</td>
<td>&lt; 200000 / gm</td>
</tr>
<tr>
<td>Coliforms</td>
<td>&lt; 10/ml</td>
</tr>
<tr>
<td>Salmonella/Shigella/ Yersinia/ Campylobacter/ E. Coli/ Staph. Aureus</td>
<td>Nil</td>
</tr>
<tr>
<td>Antibiotics/ Antimicrobial substances</td>
<td>Absent</td>
</tr>
</tbody>
</table>

**The bacteriological standards of CHEESE set by the S.A.I.M.R. are as follows:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable organisms</td>
<td>&lt; 50000 / gm</td>
</tr>
<tr>
<td>Coliforms</td>
<td>In the case of ripened cheese 5 samples shall not exceed more than 100 coliforms/gm, 2 samples of which shall not exceed 500 coliforms/gm</td>
</tr>
<tr>
<td>Salmonella/Shigella/ Yersinia/ Campylobacter/ E. Coli/ Staph. Aureus</td>
<td>Nil</td>
</tr>
</tbody>
</table>
PRODUCTION OF “GOOD QUALITY” MILK

To make a good cheese or yoghurt requires good quality milk!!! Cows must be healthy and tested for TB and Brucellosis (ask your vet). Cows must be tested for mastitis on a regular basis before milking.

**Hand milking**
Ensure all utensils that come in contact with the milk are clean including the hands of the milker. Wash all equipment in a good detergent and sterilise in 5ml/L Sodium hypochlorite (JIK) solution. Air dry. Wash udders with warm water and dry each teat with a separate paper towel. Test for mastitis. Follow instructions of cleaning suggested by milking machine suppliers. Check all connections and rubbers on a regular basis. Clean udders well and test for mastitis.

**Machine milking**
Follow instructions of cleaning suggested by milking machine suppliers. Check all connections and rubbers on a regular basis. Clean udders well and test for mastitis.

**Pasteurization**
65°C for 30min or 72°C for 15sec

**Raw milk**
Milk that is not pasteurized. Addition of Potassium Nitrate at 12gram/100L milk for cheese production can retard the growth of Coli and Butyric acid bacteria. Potassium Nitrate serves as a “food” for the “bad” bacteria while the “good” bacteria consume the lactose in the milk. Hence there is less lactose available for the “bad” bacteria to multiply.

The best option for cheesemaking is to produce your own high quality milk and make cheese directly after milking. When buying in milk:

- Check the milking conditions of the farmer
- Check that the udders are well cleaned before milking
- Check that the cows have been tested for TB and brucellosis
- Check that the farmer tests for mastitis before milking
- Check that the farmer has no detergents in the milk from cleaning his equipment
- Check that there are no cows on antibiotics being milked
- Check that the farmer is not adding water to the milk
- Test the milk as per above S.A.I.M.R. standards milk on a regular basis
- Pasteurize the milk or at least add potassium nitrate to the milk at 12gram/100L
"GOOD" MICRO – ORGANISMS

The “good” bacteria, lactic acid bacteria, are found everywhere in nature but especially in milk. When making a dairy product you are in fact “farming” bacteria. However bacteria multiply much faster than what we are accustomed to in normal farming i.e. 2 bacteria to 10 million in 11 hours under the right conditions.

They use the milk sugar lactose as a food source forming lactic acid in the process. Other products such as CO2 (gas holes), acetic acid and hydrogen are also produced by some bacteria when they break down lactose. The lactic acid sours the milk necessary for the production of yoghurt, maas, cheese etc.

Lactic acid bacteria are facultatively anaerobic i.e. can grow with or without oxygen.

Lactic acid bacteria also require proteins for growth which they get from the milk protein casein. The bacteria produce enzymes to break down the proteins and fat. Products formed as a result of the break down of protein and fat are responsible for the flavour and aroma of the cheese.

Some examples of the good bacteria used for the production of milk products:

<table>
<thead>
<tr>
<th>Mesophilic Bacteria</th>
<th>grow best at temperatures of 20 - 37°C</th>
</tr>
</thead>
</table>

**Type O:**
Streptococcus cremoris
Streptococcus lactis

Produces no gas (CO2)
Used for Cheddar, Feta and Cottage Cheese

**Type LD:**
Streptococcus cremoris
Leuconostos cremoris
Streptococcus lactis
Lactococcus lactis Diacetylis

Produces aroma and gas (CO2)
Used for Gouda, Edam, Feta and Soft Cheeses
Thermophilic Bacteria grow best at temperatures of 37 - 45°C

Example 1
Streptococcus thermophilus Lactobacillus bulgaricus
Lactobacillus acidophilus Bifidobacteria

High viscosity and mild flavour of acetaldehyde
Stirred and set AB yoghurt

Example 2
Streptococcus thermophilus Lactobacillus bulgaricus
Lactobacillus lactis

Yoghurt, Emmental cheese, Italian Cheese

FACTORS INFLUENCING THE GROWTH OF MICRO–ORGANISMS

Temperature:

Bacteria are very sensitive to temperature variations and are classified according to their temperature sensitivity e.g. mesophilic, thermophilic. If the temperature is beyond the preferred temperature of an organism, growth will be retarded or non-existent. The storage of milk is based on the principal that most bacteria cannot grow at temperatures below 7°C. Therefore it is important to cool the milk to 4°C as soon after milking as possible if the milk is going to be stored.

The availability of nutrients:

Bacteria will keep on growing until the nutrients are depleted. Milk is an excellent source of nutrients, sugar in the form of lactose, protein in the form of casein as well as water.

Moisture:

Bacteria can only absorb soluble substances and therefore moisture is necessary for growth. Low moisture content in milk powder for example prevents any bacterial growth. High sugar or salt concentrations will also compete with bacteria for the available moisture in the environment with the resultant inhibition of bacterial growth.
Oxygen:

Aerobic bacteria grow in the presence of oxygen and anaerobic bacteria grow in the absence of oxygen. Lactic acid bacteria are facultative anaerobic bacteria and can grow in either the presence or absence of oxygen.

Acidity

For most bacteria the optimum pH is between 6.5 and 7.5. pH is a measure of acidity or alkalinity. pH of 7 is neutral with pH of 1 being very acid and pH of 14 being very alkaline. The pH of milk is 6.65. Bacteria do not normally grow at a pH below 4. Hence if your product becomes too acid, it will kill the good bacteria. Yeasts and moulds (Camembert mould) grow at low values.

Osmotic pressure

High sugar and salt concentrations will inhibit bacterial growth. Hence the addition of salt to cheddar slows the lactic acid bacteria.

The presence of other organisms

Organisms compete with one another for the same food source and one type of bacteria could be eliminated by pressure from the other. Hence if the milk is contaminated with “bad” bacteria, these might outgrow the introduced “good” bacteria. Furthermore, the sooner after milking the good bacteria are introduced, the less access the “bad” bacteria have to the available nutrients. Reproduction is very rapid under the right conditions, 2 bacteria can divide into 10 million in 11 hours leaving little “space” for the “good” bacteria.
DAIRY CULTURES

The “good” bacteria used to produce dairy products are also called cultures or starter cultures and are supplied by Finest Kind in two forms namely:

- Direct Vat Set (DVS) (e.g. Chr. Hansen’s CHN22 (mesophilic) and YC180 (thermophilic) )
- DriVac (Rademaker’s mesophilic or thermophilic )

DVS (Direct Vat Set) CULTURES

**Description:** Finest Kind supplies Chr.Hansen’s DVS cultures. DVS is a highly concentrated and standardised freeze dried dairy culture for direct inoculation of milk. Each alufoil bag contains 50U (units) of culture. DVS cultures needs no activation or other pre-treatment prior to use.

Product range: The following cultures are produced as freeze dried DVS cultures.

**Mesophilic Aromatic Cultures**

The LD cultures are characterised by producing CO2 and aroma during acidification. Mesophilic aromatic cultures are applied in the production of gouda, feta, camembert, blue cheese, fromage frais, maas and lactic butter. Examples are Flora Danica and CHN22.

**Mesophilic Homofermentative Cultures**

These “O” cultures are characterised by producing lactic acid only, and are primarily applied in the production of cheese types with closed textures, e.g. Cheddar. Examples are R708, R704.

**Thermophilic Cultures**

Thermophilic cultures are applied in the production of fermented milk products, such as yoghurt but also Italian and Swiss cheeses. Examples are STI-12, TCC3, YCX11, ABT-5.
Combination Cultures

A mixture of thermophilic and mesophilic cultures is sometimes applied. Examples are RST743 for cheddar.

Storage: Freezedried DVS cultures should be stored at -18°C or below (deepfreeze). The freeze dried DVS cultures are supplied in alufoil bags. If a portion of the culture is used, the packet should be closed immediately and taped down with sticky tape and placed back in the deep freeze. If too much culture is poured out the excess should not be returned to the packet. The culture must be kept dry. The culture must not be dispensed into another container.

Packing: Freeze dried DVS cultures are supplied in alufoil bags and are available in the following standard sizes:
- 50 unit bag – 10 bags per box
- 500 unit bag – 20 bags per box

Shipment: Freeze dried DVS cultures may be transported at room temperature for up to 10 days without the quality of the cultures being reduced.

Application: DVS for fermented milk products, e.g. maas. The cultures are added directly to the milk after which fermentation takes place according to normal procedure.

DVS for cheese
The cultures are added directly to the milk. Pre-ripening of the cheese milk for 30-60 minutes is sometimes needed before the application of the rennet.

Dosage:
- Cheese 50-150 units per 1000L
- Yoghurt 200 units per 1000L
- Fermented products 100 units per 1000L
- Probiotic products* 200 units per 1000L
As a principal rule 1 unit of freeze dried DVS culture inoculates 10 litre of milk to be fermented, corresponding with a 1% inoculation. For a 2% inoculation, 2 units are required per 10 liters milk. One packet contains 50 units which is enough for 500 liters milk at 1% inoculation.

**DRI – VAC CULTURES**

Drivac cultures are freeze dried cultures for the production of bulk starter by the traditional propagation of a mother culture. One packet is enough to make 1 liter

**Storage:** Dri-vac cultures should be stored at 5°C or below (the fridge). When stored under the above conditions, Dri-vac cultures remain active for 12 months.

**Application:** Absolutely fresh and healthy milk, free from antibiotics and other acidification inhibitory ingredients should generally always be used in the production of bulk starters from Drivac cultures. Place 1 litre milk in an Consol bottle. Place the bottle in a pot of water and heat to 90°C for 30 minutes. Place the bottle in cold water and cool to the temperature as below. To check the temperature of the milk use a thermometer which has been sterilised in water at 90°C.

Add one packet of the culture to the bottle and mix well. Maintain the temperature of the bottle (incubate) at temperatures and times as below by placing the bottle in a box with cushions (hay bag).

**Mesophilic Aromatic Cultures (LD cultures) (H070)**

<table>
<thead>
<tr>
<th>Cultivation temp</th>
<th>20 - 23°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation time (coagulation)</td>
<td>16 - 20 hours</td>
</tr>
</tbody>
</table>

**Thermophilic Cultures (H073)**

<table>
<thead>
<tr>
<th>Cultivation temp</th>
<th>40 - 44°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation time (coagulation)</td>
<td>7 - 14 hours</td>
</tr>
</tbody>
</table>
The culture is ready when it has the consistency of yoghurt and separates cleanly from the sides of the bottle and the surface is shiny. It should have a sweet, sour smell. If there is a layer of green liquid on top it means that the culture has been incubated too long or at too high a temperature. The pH of the finished culture is 4.6 – 4.7 for mesophilic culture and 4.2 – 4.4 for thermophilic culture. The culture should be cooled rapidly to 5°C. The culture maintains its activity for up to 24 hours at 5 - 7°C.

The above is known as a mother culture. One has a choice of either of the following procedures from here on:

**Method 1**  Freeze the mother culture in sterilised ice trays and store in the deep freeze in airtight plastic bags. Use an iceblock or 20ml per liter milk to make your next batch.

**Method 2**  **New mother culture:**
Remove 20ml from the mother culture with a sterilised spoon and add to a 1 litre sterilised (90°C for 30 min.) bottle of milk and incubate at times and temperatures as for the mother culture above. This will produce a new liter of mother culture. Use the balance of the product for consumption.
RENNET

Rennet is the ingredient added to milk in order to coagulate the milk thereby separating the solid part from the liquid part of the milk. Coagulation of milk is the fundamental process of cheese making. Rennet is a complex set of enzymes produced in the stomachs of ruminant mammals. Chymosin, its key component, is a protease enzyme that curdles the casein in milk. In addition to chymosin, rennet contains other enzymes, such as pepsin and a lipase. Coagulation takes place in two steps: Conversion of the protein casein to paracasein by chymosin. Precipitation of paracasein in the presence of calcium ions.

The coagulation process is governed by temperature, acidity and calcium ion concentration.

Animal Rennet. Rennet extracted from the stomachs of calves is known as animal rennet. Available from Finest Kind codes H064 and H065. The rennet is liquid. Small quantities are available in dropper bottles for easy dispensing.

Dosage: 4 drops or 0.25ml rennet are required to coagulate 1 liter milk in 1 hour at 30°C. 1 drop of rennet is required to coagulate 3 liters milk in 16 hours at 18-24°C.

Microbial rennet is produced by a fungus such as mucor miehei. Available from Finest Kind codes H066A, and H066B as liquid microbial rennet.

Dosage: 4 drops or 0.25ml rennet are required to coagulate 1 liter milk in 1 hour at 30°C. 1 drop of rennet is required to coagulate 3 liters milk in 16 hours at 18-24°C.

Bear in mind that if your cows are on dry land you may need to add , H214 Calcium Chloride to the milk for a firm coagulation. Suitable for vegetarians

Powder microbial rennet is available from Finest Kind code H068A. Recommended for the larger producer. The type of powder rennet stocked by Finest Kind, Ceska-Lase is particularly known for producing cheese with minimal bitter flavours. (Microbial rennets can tend to result in bitter flavours in cheese.) 500gm is enough for 25000 liters milk. Dissolve the rennet in a little cool water before adding to the milk. Bear in mind that if your cows are on dry land you may need to add , H214 Calcium Chloride to the milk for a firm coagulation.

Dosage: 2 grams rennet are required to coagulate 100L milk in 1 hour at 30°C.

Rennet Storage: Store in the fridge but not in the door of the fridge.
CHEESE MAKING

The manufacture of cheese involves separating the solid part of the milk from the liquid part. Once the solid part has coagulated it is known as curd and the liquid part as whey.

The process of cheese making involves the following steps:
- Addition of culture
- Rennetting
- Curd cutting
- Stirring
- Heating
- Whey drainage
- Moulding
- Pressing
- Brining
- Maturing

It is important to make notes whilst making cheese. Every detail such as the weather, stage of lactation of the cow, grazing, type of culture etc. should be recorded and the cheese marked with the same date as the notes. When it comes to tasting the cheese, the mistakes can be rectified by checking the notes.

ADDICTION OF CULTURES

Dairy cultures consist of bacteria which break down the carbohydrate lactose in milk and form lactic acid. Rennet requires an acid environment for optimum coagulation. Acid in itself can cause the coagulation of milk as in the manufacture of soft cheese. The bacteria also produce enzymes which break down proteins and fat during maturation and are therefore the prime ingredient responsible for the cheese’s final aroma and flavour. Problems in cheese making more often than not relate back to the bacteria. Hence eradicate the bad bacteria which are competition for the good bacteria by milking under very hygienic conditions and making cheese directly after milking, or adding Potassium Nitrate at 12 gram per 100 liter milk or pasteurizing and give the good bacteria optimum conditions to grow in. It is possible to check the process of bacterial growth by monitoring the production of lactic acid. The lactic acid test is used, Finest Kind code H200 which works on the principle that one molecular weight of sodium hydroxide neutralises one molecular weight of lactic acid.
NaOH + CH₃CH (OH) COOH = CH₃CH (OH) COONa + H₂O

It is necessary to change the strain (e.g. mesophilic LD type CHN22 to mesophilic LD type Flora Danica of bacteria used from time in order to confuse the bacteriophage virus. The bacteriophage virus invades the good bacteria and destroys it.

RENNETTING

Rennet causes the proteins in milk to stick together in an acid environment, at an optimum temperature and in the presence of calcium ions. The proteins form a lattice work entrapping the fat and whey. The whey contains the lactose and therefore the bacteria and lactic acid.

When cows are on dry feed or under feedlot conditions, there may be a lack of calcium in the milk in which case Calcium Chloride must be added to the milk Finest Kind H₂14. A lack of calcium in the milk gives a soft, sloppy curd which is difficult to cut. Dosage: The CaCl must be added to the milk before rennetting at a rate of 15ml per 100 liters milk.

CURD CUTTING

When the milk has coagulated in a solid mass (which takes one hour in most cheeses) the protein lattice work must be cut to let out the entrapped whey. To establish that the curd has the desired consistency and strength before cutting, a dairy thermometer is inserted into the curd. As its bulb end is lifted upward, the curd surface breaks. If the cleavage is clean and sharp, the curd is assumed to be ready for cutting. A knife can also be used by cutting an area and checking if the curd comes away form the surface of the knife, when twisted. The curds are then cut evenly and slowly to prevent proteins being lost into the whey. Cutting should not take longer than 15 minutes.

The character of cheese is ultimately as a result of a delicate balance of the amount of whey left in the curd and the amount drained out. The bigger the curd is cut, the more whey is left in the curd, the more moist the cheese. However, lactose is dissolved in the whey together with the associated bacteria and lactic acid. Therefore the more whey left entrapped in the curd also results in a more acid cheese.

The amount of fat in the milk affects whey drainage. Fat globules are large and can block the holes through which the whey drains.
Therefore too much whey is left in the curd resulting in an acid cheese. Therefore the curd of a fatty milk should be cut smaller to allow greater whey drainage.

**STIRRING & HEATING**

Stirring the curd keeps the holes in the curd open for whey drainage. The more stirring, the more whey is released from the curd, the drier and less acid the cheese. Stirring should be gentle at first in order not to break the curd. The firmness of the curd is determined by the stirring time and rate, which is an important consideration in the moulding of the cheese. The stirring is halted when the desired levels of whey has drained from the curd which can be measured by measuring the lactic acid present in the whey with the lactic acid test kit H200.

Heating of the curd accelerates the release of whey, but should be gradual to prevent contraction of the curd surfaces, which would affect the loss of whey. Heating must be accompanied by stirring to ensure equal distribution of heat and prevent curds settling to the bottom and being squashed.

The final temperature is determined by the desired moisture of the finished cheese – the higher the temperature; the lower the moisture content of the final cheese. If heating to temperatures above 44°C, a thermophilic bacteria culture must be used.

The temperature and the time the bacteria are exposed to it are of great importance. The bacteria may be inhibited at low temperatures or killed or shocked at higher temperatures. This sensitivity to heat makes it possible to regulate the rate of acid development in cheesemaking.

**MOULDING**

The method of moulding the cheese determines the texture of the end product. It is important to be gentle so as not to damage the curds. If the curd is moulded under the whey, no air will be trapped between the curds and will result in a cheese with a closed texture with a few mechanical holes. The gas evolved during ripening will collect in these and form round eyes. If the curd is moulded and pressed in such a way that air is trapped between the curds, they will not fuse completely, and a large number of elongated eyes will be formed giving the cheese a granular texture.
PRESSING

Pressing gives the cheese its finished shape and a firm surface (rind) as well as its correct final moisture content. The mould must be perforated to allow drainage of the whey expressed from the cheese. Pressing parameters such as pressure, time, pH and temperature must be kept at constant specified values to ensure a correct result. For instance, pressing a cheese too long or with too much weight or too high a temperature will result in a thick rind. However if the cheese cools down during pressing it will not form a nice closed rind. The cheese can be washed in hot water of 50°C and pressed again. A closed rind is important since the rind protects the cheese from mould growth during maturation. After pressing the cheese can be left in the mould overnight to secure a nice shape. Furthermore, the lactose in the rind can be fully utilised overnight leaving no lactose for the bad bacteria and moulds to utilise on the rind during maturation.

BRINING

The addition of salt increases the firmness of the cheese, the firmness of the rind helps to conserve the cheese and influences the flavour. The activity of lactic acid producing bacteria, is noticeably retarded at salt concentrations above 0.5% if the salt is added at an early stage. Butyric acid fermentation can be prevented to some extent by salt and therefore it is an excellent agent for regulating gas evolution in cheese to the correct degree. During brining the cheese takes up salt and releases water at the same time. The duration of brining depends on the degree of moisture in the cheese, the fat content of the cheese, the temperature of the brine and the concentration of the brine.

- A moist cheese absorbs salt more quickly
- A fatty cheese absorbs salt more slowly
- At higher temperature absorbs salt more quickly

MATURATION

Maturation results mostly from the action of enzymes which originate from raw milk, rennet, bacteria and moulds. The action of the enzymes is affected by temperature, acidity of the cheese, salinity and moisture content. During maturation lactose is broken down to lactic acid. After the first day the lactose has been converted. Lactic acid is also broken down to a degree.
The breakdown of proteins has a marked affect on the flavour and structure of the cheese. Proteins are broken down to peptides by the rennet. These peptides can have a bitter flavour. The peptides are broken down further by the enzymes produced by the bacteria. The pH and salt content of the cheese affects the action of the enzymes. A too acid cheese can retard the action of certain enzymes resulting in a cheese with a different flavour. Due to the breakdown of proteins the cheese becomes more crumbly with age.

The breakdown of fat by lipases results in some fatty acids that give cheese a “cheese type” flavour. Raw milk in particular has natural lipases which are deactivated by pasteurization. However, if fat globules are mechanically broken during milking or manufacture this leads to a rancid rather than cheese flavour.

During maturation the cheese looses moisture and thus weight. The amount of moisture that is lost by the cheese is affected by:

- The moisture content of the cheese – higher moisture content results in greater loss.
- The shape and size of the cheese – the smaller and flatter the cheese the greater the loss.
- The relative humidity of the cold room – the drier the air the greater the loss.
- Air movement in the cold room – the greater the air movement the greater the loss.
- The temperature of the cold room – the higher the temperature the greater the loss.
<table>
<thead>
<tr>
<th>CHEESE</th>
<th>TEMPERATURE(°C)</th>
<th>HUMIDITY</th>
<th>MATURING RATE IN DAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camembert</td>
<td>10 days 11-14°C thereafter completely packed &amp; stored at 4°C</td>
<td>85-90</td>
<td>21-35</td>
</tr>
<tr>
<td>Roquefort</td>
<td>7-10°C</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>Gorgonzola</td>
<td>12°C</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Mozzarella</td>
<td>4°C</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Gouda and Edam</td>
<td>12-16°C</td>
<td>85-90</td>
<td>28-300</td>
</tr>
<tr>
<td>Tilsiter</td>
<td>12-16°C</td>
<td>90-95</td>
<td>150</td>
</tr>
<tr>
<td>Gruy`ere</td>
<td>2 weeks 1014°C</td>
<td>90</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>4+weeks at 14°C</td>
<td>80-85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3-12 months 7°C</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Emmentaler</td>
<td>2 weeks 1216°C</td>
<td>90</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>36 weeks 2024°C</td>
<td>80-85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-12 months 10-14°C</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Cheddar</td>
<td>2 weeks 1216°C, extra time 5-7°C</td>
<td>75-80</td>
<td>150</td>
</tr>
<tr>
<td>Parmesan Cheese</td>
<td>1 year 16-18°C</td>
<td>80-85</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>1 year 10-12°C</td>
<td>85-90</td>
<td></td>
</tr>
</tbody>
</table>
CHEESE TYPES

SOFT CHEESES

Soft cheeses are high moisture cheeses. Cows or goats milk are used depending on the cheese variety, and can be eaten fresh or under refrigeration for a short time. They are divided into two categories, namely bag cheeses and cottage cheeses. In the case of bag cheeses, an acid causes coagulation and not rennet. Soft cheeses have the advantage of greater return (more cheese per unit liter of milk) but the disadvantage of short shelf life. Economically the increased return is offset by the need for expensive packaging and high transport costs in getting the cheese to the market. Soft cheeses need to be made under extremely hygienic conditions since they are susceptible to spoilage.

Examples of soft cheeses: Queso Blanco, large and small curd Cottage Cheese, cooked curd or uncooked curd Cream Cheese, Swiss and French cream cheese, Gervais, Neufchatel, Bondon, Kefir, lemon and yoghurt cheese.

HARD & SEMI-HARD CHEESES

These include cheeses which are pressed and form a rind on the outside of the cheese, although some like Mozzarella do not. Cows or goats milk are used depending on the cheese variety. The starter culture used depends on the cheese variety. Certain processes require excessive heating or cooking of the curds, and in these cheeses a thermophylic starter culture is used. Rennet is added to the milk to cause coagulation in all hard cheeses.

Examples of hard & semihard cheeses:
Using Mesophylic culture – Cheddar, Derby, Leicester, Gouda, Colby.
Using Thermophylic culture – Swiss, Emmenthaler, Parmesan, Romano, Montasio.

WHEY CHEESES

These are produced from the whey (from either cows or goats milk), which separates from the curd during cheesemaking. They contain starter culture from the curds and only require the addition of an acid while heat is applied. The yield is not great and whole milk can be added to increase the yield. It is usually hung in a bag or placed in a typical Ricotta mould to drain.

Examples of Whey cheeses: Ricotta, Mysost, Gjetost and Ziegerkase.
BACTERIAL AND MOULD-RIPENED CHEESES

These are cheeses which have a special mould or bacteria applied. The mould can either be added to the milk, sprayed onto the formed cheese or mixed into the curds before moulding.

The moulds give the cheeses their particular aroma, texture and flavour. They also require the addition of a starter culture and rennet.

Examples of Mould ripened cheeses:
White mould – (Penicillum Candidum) – Camembert, Brie and Coulommiers.
Blue mould – (Penicillum Roqueforti) – Gorgonzola, Stilton and Blue.
Bacterium Propioni – Emmenthaler.
Bacteria Linens – Limberger.
MARKETING AND EQUIPMENT

Market research is essential before embarking on a business. It is important to do research at the local supermarkets and find out which type of cheeses or yoghurts are the most popular or in short supply and the average price per kilogram. When choosing a product take into account that yoghurts, maas and soft cheeses have good returns but require expensive packaging and high transport costs due to frequent trips to the market as compared with semi-hard cheese. Make a decision on a particular product and experiment making notes as you go. The experimental products can be used to test on friends and family and when perfected used as samples when setting up an agreement with a supermarket or agent.

Research the type of equipment required and the set up cost of the production room. Take into account that it is very difficult to milk the cows, make the product and market the product on your own. It is often advisable to leave the marketing to a good agent. Research the agents in your area such as companies that supply hotels and restaurants. It is an excellent idea to ask them which products are in short supply. However, if starting small with an unusual cheese do not be deterred by too much negative input.

Some options on the type of business in the dairy industry are as follows:

- Small amounts of an unusual cheese such as gorgonzola, goats or sheep’s milk cheese, gruyere sold at a high price. The market normally requires education with unusual cheeses and thus it is advisable to start small and grow with the market.
- A popular cheese such as gouda and cheddar but with a slight variation such as adding herbs to the gouda or maturing the cheddar well or making small whole cheeses. These cheeses can be sold at a premium but again it is advisable to grow with the market.
- A popular cheese such as feta, gouda or cheddar made slightly better and/or slightly cheaper than what is on the market. Can be made in large quantities but it is advisable to get a contract or agreement from a supermarket first. It is not easy to compete on price with the big companies.
- A popular cheese that is made on the farm and sold retail directly to the public. The farm should be easily accessible on a well-used route and well sign posted. This is the best option.
- Excess milk that fetches a low price in any event can be stored as a simple cheese.
Common errors in setting up:

- Over capitalization without a ready market. Make sure to do your market research before investing in expensive equipment.
- Manufacturing cheese with a long maturation period such as cheddar. It must be taken into account that income is delayed by three months due to the maturation period of cheddar.
- Purchase of poorly made or incorrect equipment which then has to be replaced. It is advisable to start small but start right.

The quality of dairy products are not quite up to the standard of for instance the wine of South Africa. Try to make a good quality product with an attractive label and general appearance. Take care in choosing the colours of your label – the consumer tends to like blue and green rather than for instance black on the labelling. Good service and communication also adds value to your product.

POINTERS FOR CHEESE AND COLD ROOMS

Cheese room:

- The floor and walls of the cheese room should be smooth and washable.
- The whey by product from cheese is acid and does affect cement. Apoxi (Apidemix 215) can be used on floors.
- The floor of the cheese room should have proper drainage. It would be best if the cheesevat were placed in the middle of the room with the drainage sump close by. The drainage sump should be 25 to 30cm diameter and the pipe leading the whey and wash water away should be standard sewerage piping. Bear in mind whey and washing water must be lead away. If the whey is to be kept for feeding to calves there should be a stopcock at some point on the drainage pipe so that the whey is fed to a tank and the wash water to a soak away..
- There should be a curve where the floor and the walls meet.
- Keep tables or racks away from the walls. Nothing should be attached to the walls.
- All equipment and tables to be made of stainless steel.
- Electrics must be fed through the ceiling and not the floor. Plugs at table height.
- Fly screens for windows.
- Good ventilation due to heat and steam build up.
• Hot and cold running water from taps situated close to the vat for easy cleaning.
• A good deep wash and rinse basin with hot and cold taps for washing moulds
• Ceilings should be made from cold room paneling.
• If the budget allows a fan should force air into the cheeseroom through a filter such that air is forced out through doors and windows. This stops dust and microbes entering the cheeseroom.

**Coldroom:**

• The walls and floor of the coldroom must be smooth and washable.
• The coldroom must have no items in it where mould can grow. Mould growth is difficult to get rid of and any hidden corners will add to the problem of mould growth. All items in the coldroom must stand away from the walls.
• Racks inside the coldroom must be made of smooth iron uprights with well dried untreated solid pine planks.
• Planks inside the coldroom should be removable so that they can be washed down and placed in the sun to dry. The racks must stand loose from the walls
• Coldrooms for cheese normally run at 12°C.
• The humidity normally runs at 85-95%
• The airflow from the fans must run through the length of the planks such that all cheeses have a certain amount of airflow over them.
MAAS

Milk: Whole milk with approx. 3.5 – 4% cream. Use milk not more than an hour after milking. If you need to store the milk, cool it down to 4°C as quickly as possible. If possible homogenise the milk at 200 - 220kg/cm² and 65°C.

Additives: **Finest Kind stabiliser:** 1 - 2% or 20 - 40 gram per liter milk. Slowly add a little warm milk to the stabiliser while stirring. Add to the milk before heating. Skim milk powder: 1% or 10 gram per liter. Add a little milk slowly to the skim milk powder while stirring. Add to the milk before heating. Stir the milk while heating. Either of these products or both can be used to improve the viscosity of the maas. It may not be necessary if the milk has a high solid count.

Heat: Heat treatment is essential for a thick end product. Heat milk to 90°C for 5 minutes or 95°C for 3 minutes in heat exchange pasteurizer (or microwave) or 80°C for 30 minutes in a batch processor. Cool milk to 22°C.

Starter: **DVS:** 1% LD type mesophilic culture either Chr.Hansen’s CHN22 or Flora Danica. 1% means one 50 unit packet culture inoculates 500 liters milk.

**Dosage:** 1 x 50U CHN22 or Flora Danica per 500 liter milk
1/3 tsp 50U CHN22 or Flora Danica 10 liters milk

Colouring: **Annatto (ANS)** 0.5ml – 7 ml per 100 liters. Required only if the consumer finds a more orange coloured maas appealing. Add at the same time as the culture.

Incubation: Maintain the milk at 22°C (culture/incubate) for 12 – 18 hours or until the pH of the milk is 4.6.
**Cooling:** Cool the maas to 4°C quickly. Take care in moving the maas to the cold room or fridge. Any movement of the warm maas can cause the maas to separate.

**Packing:** Mix well and pack into bottles. Packing must occur within an hour.
FROMAGE FRAIS (CREAM CHEESE)

Fromage Frais is a soft fresh cheese similar to smooth cottage cheese or quarg. It is easy to make but because of its high moisture content it has a short shelf life.

ADDITION OF CULTURE AND RENNET

**Milk:**
3 liters full cream milk (3.5% butterfat). Use milk directly after milking or use fresh pasteurized milk.

**Milk temperature:**
18°C - 24°C

**Culture:**
Add a teaspoon tip of Flora Danica culture to the milk.

**Rennet:**
Add 1 drop of rennet, H064 or H066, to 50ml cool water and add 25ml of this solution to the milk.
Dosage: ½ a drop rennet

STIR WELL !!!!

Let the milk stand undisturbed and covered at 18°C - 24°C until it has set like jelly and a little whey has appeared on the surface. It should have a dull appearance. This should occur within 12 – 24 hours, usually 16 hours.

DRAINING OR MOULDING

At this point one can either use:

A. BAG METHOD
Carefully ladle the curds into a cheesecloth lined colander, tie the four corners of the cheesecloth together and hang the cheese to drain over the sink. Once the cheese has drained, 1 – 2 days, mix the cheese with some salt and place in a 250gm plastic container for resale. A cake mixer can be used to give a smooth finish. One can also add fresh or dried herbs as required.

B. MOULD METHOD
Carefully ladle the curds into 3-4 soft cheese moulds, H932. Fill the moulds to the top, wait a while and fill them some more. Place the moulds on a cake rack which is placed over a container so that the whey can drain into the container.
DILUTING A DROP OF RENNENET IN WATER
SALTING THE CHEESE

Salt the surface of the cheeses. Turn the cheeses after 8 hours or when they are firm enough to be turned. Turn the cheese after salting by removing it from the mould onto the palm of your hand, turning it around by letting it fall into your fingers, and placing it back into the mould.

If you are using a pyramid or roll mould it is not possible to remove and turn them. Simply let them drain as is. Salt the other side of the cheese.

Turn the cheeses twice more with intervals of 8 hours. If you have a very hot climate you can place the cheeses in the fridge to drain. The cheese should drain in their moulds for a total of 24 – 36 hours or until they are firm enough to be removed from the moulds. Place the cheese on the draining gauze, H050, in the fridge or on gauze on wooden shelves in a drafty cellar or cold room at 10°C to dry. Make sure you do not have mouldy vegetables or strong smelling food in the fridge. Spores from the moulds that travel unnoticed through the air land on your cheeses! Turn the cheeses after 6 hours and then every 12 hours.

MATURING THE CHEESE

This cheese can be eaten at various stages:

SOFT

While still draining in the moulds with jam or sugar and fruit.

SEMI – SOFT

When it has air dried for a few days it can be eaten as a spread on bread or crackers. It can be rolled in dried or fresh herbs such as origanum, black pepper or chives. To make the cheese more interesting one can use different shaped moulds, such as H984, H901, H986, H985.

If you add a little more cream to the milk before starting and use heart shaped moulds, you will have a Neufchatel cheese. If you use a roll mould, and spray the penicillum candidum, H060, mould onto the cheese while it is drying, you will have a Saint Maure cheese. Here you must be careful as the mould prospers on all the cheeses in the fridge. The cheese can also be preserved in olive oil with a few dried herbs – ½ tsp.
Thyme, ½ tsp. Rosemary, 4 black peppercorns and 1 clove of garlic per liter of olive oil. The cheese can also be preserved in olive oil with a few dried herbs – ½ tsp. Thyme, ½ tsp. Rosemary, 4 black peppercorns and 1 clove of garlic per liter of olive oil.

MOULDY

The cheese can be left to dry for some time. It will become quite hard and first get a white mould then a blue mould. The French love it like that, but it is an acquired taste! For resale purposes the cheese can be wrapped in H206 butter paper cut to size and tied with a thin blue ribbon (available at C.N.A) or natural raffia. One can even wrap them in vine leaves and tie them with raffia – soak the vine leaves in brandy overnight before wrapping – it gives the cheese a wonderful taste!

Serve the cheese with crackers and some crisp white wine in summer or a fullbodied red in winter. Your friends will love it.
THE BAG METHOD - DRAINING THE CURD.
THE MOULD METHOD
DIFFERENT SHAPED MOULDS FOR FROMAGE FRAIS
FETA CHEESE

Recipe for smaller Cheese Producers

Summary:
3.5 – 4% milk at 32°C Set 1 hour.
Add 2% mesophilic culture Cut 5 minutes
Add additives Stand until ½ curd, ½ whey
Add rennet Mould until pH 4.6
Stir 2 minutes Brine

Milk:
Full Cream milk with approx. 3.5 – 4% cream.
Use milk not more than an hour after milking.
If you need to store the milk, cool it down to 4°C as quickly as possible. Do not use cooled milk that is more than 24hrs old. Alternatively pasteurize the milk: 63°C – 30 min. or 72°C – 20 sec. Shop bought full cream milk can also be used for Feta.

Temperature: Adjust the milk temperature to 32°C.

Starter:
2% inoculation with LD type mesophilic culture. Chr.Hansen’s White Daily, Flora Danica or CHN22

Dosage: 1 x 50U White Daily per 250 liter milk
1tsp tip 50U White Daily per 10 liters milk

Let the milk stand at 32°C (pre ripen) for 30 minutes.

Additives:
Calcium Chloride 15ml per 100 liters. Required only if the milk has a low calcium content resulting in a soft, sloppy curd. May also be required when using microbial rennet for a good coagulation.

Rennet:
Use either powdered microbial rennet OR liquid microbial rennet OR liquid animal rennet
**Dosage:**

- Powdered microbial rennet  2g / 100L
- Liquid microbial rennet  4 drops/L or 25ml/100L
- Liquid animal rennet  4 drops/l or 25ml/100L

Dilute the rennet in a little cool water before adding to the milk.

Stir well!!! Let the milk stand at 32°C for 45 - 60 minutes or until the milk has set like jelly. Test the curd to check whether it has set by inserting a knife and pulling it to one side. The knife should make a clean cut.

**Cutting:**

Cut the curd into 12mm cubes. For small quantities use a sharp knife or use a curd cutter

Knife: cut down and across and at an angle as pictured below. Curd cutter: use a figure of eight movement.

Cut for 5 minutes.

![Curd Cutting Diagram]

**Resting:**

Let the curds rest for 1 - 2 hours or until there is as much whey as curd.

**Moulding:**

Drain the whey and fill moulds H932 or H980 to the top with curd. One H932 per one liter milk or one H980 mould per 10 liters milk. Use a H932 mould to fill the moulds. Handle the curds gently. Herbs can be mixed into the curd before moulding. Let the cheese drain at room temperature for 12 - 48 hrs or until the pH of the whey is 5 - 4.6 (H202A). Turn the cheese 3 times while draining.

It is important that the cheese is not placed in the brine before the pH is at least 5. The cheese will melt in the brine if the cheese does not have the correct pH. In winter the cheese can take a number of days before it reaches a pH of 5 - 4.6
**Brining:** Place the cheeses in a saturated 10% brine solution. Make up the brine by adding 100 gram salt and 15ml Calcium Chloride to every liter water. Correct the pH of the brine to pH 4.4 by adding Citric Acid in small quantities and testing with the pH sticks as you go. The pH of the brine must be lower than that of the cheese. The cheese must be totally immersed in the brine and the buckets should be filled to the top with brine. Keep the buckets well closed.

**Ripening:** Allow the cheese to mature at 10 - 14°C for 1 - 3 months. Remove the cheese from the brine. Place in 250 gram containers in a fresh 5% brine for resale.

**Cleaning:** Clean all equipment well after and before use. Rinse in warm water, wash in warm water with a good detergent and sterilise in a weak solution of sodium hypochlorite (25 ml Jik/5 liters water). Air dry. Before use rinse well in clean water and towel dry with paper towel. Take care not to leave sodium hypochlorite residue on the equipment.
TESTING THE pH OF FETA BEFORE PLACING IN THE BRINE
FINEST KIND GOUDA CHEESE

Recipe for smaller Cheese Producers

Summary: 3.5 – 4% at 29 - 32°C
Add 1% mesophilic culture
Add additives
Add rennet
Stir 2 minutes
Set 1 hour
Cut 5 minutes
Stir 20 minutes
Remove 1/3 whey
Wash and heat with 30% water to 35°C
Stir 20 minutes
Stand 15-30 minutes
Mould
Press at 5 times weight of cheese
Right 12 hours
Brine
Ripen

Milk: Whole milk with approx. 3.54% cream. Use milk not more than an hour after milking. If you need to store the milk, cool it down to 4°C as quickly as possible. Do not use cooled milk that is more than 24hrs old. Alternatively pasteurize the milk at 63°C for 30 min or 72°C for 20 sec. Take into account the size and number of moulds you have available before deciding on the quantity of milk. Example: 4.5 liters milk makes one 450 gram economy mould or 500gram Kadova Mould, 9 liters makes 1kg cheese etc.

Temperature: Adjust the milk temperature to 32°C for home use OR to 29°C in the cheesevat

Starter: 1% inoculation with LD type mesophilic culture. Either Chr. Hansen CHN22 or Flora Danica
One 50U packet inoculates 500 liters milk at 1%. 
TESTING THE CURD TO CHECK IF IT HAS COAGULATED.
Dosage:  
1 x 50U Flora Danica packet per 500L milk  
1/3 tsp 50U Flora Danica per 10 liters milk

Let the milk stand at 32°C (pre ripen) for 30 minutes.

Additives:
Natural colouring: Annatto (ANS) 0.5ml per 100 liters. Required only if the consumer finds a more orange coloured cheese appealing. Calcium Chloride (H214) 15ml per 100 liters. Required only if the milk has a low calcium content resulting in a soft, sloppy curd. May also be required when using microbial rennet for a good coagulation. Sodium Nitrate (H215) 25 grams per 100 liters. Required only if the milk is unpasteurized. Reduces growth of unwanted bacteria.

Rennet:
Use either Chr. Hansen’s Powdered Microbial Rennet OR Liquid Microbial Rennet OR Liquid Animal Rennet

Dosage  
Powdered microbial rennet (H068A) 2g /100L  
Liquid microbial rennet  4 drops /L or 25ml /100L.  
Liquid animal rennet  4 drops/L 25ml/100L

Dilute the rennet in a little cool water before adding to the milk.

Stir well!!!! Let the milk stand at 32°C for 45 - 60 minutes or until the milk has set like jelly. Test the curd to check whether it has set by inserting a knife and pulling it to one side. The knife should make a clean cut.

Cutting:  
Cut the curd into 12mm cubes. For small quantities use a sharp knife or curd cutters (H015, H017).  
Knife: cut down and across and at an angle.  
Curd cutter: use a figure of eight movement.
Cut for 5 minutes. Allow to stand for a few minutes to reduce fat loss in whey.

Stirring: Stir the curd (gently at first) for 15 - 20 minutes.

Drainage: Drain 1/3 whey until curds are just evident through the whey surface.
Example: When making cheese from 9 liters milk 3 liters whey must be removed.
Place a mould net or colander on the curds and use a cup to scoop the whey off.
Or place a curd-collecting hoop in front of the outlet of the cheesevat and drain the whey through the outlet.

Washing: Slowly add warm water to the curd in order to dilute the lactic acid and raise the temperature of the curd to 35°C while stirring. The amount of water added is 30% of the left over mass. The temperature of the water is worked out with the formula.

TW = FT + 100/P (FT – T)

TW= Temperature of Water FT = Final Temperature of curd P = Percentage Water added T = Temperature of Curd
Example: When making cheese from 9 liters milk and 3 liters whey has been removed, 6 liters will remain. Therefore 1.8 liters water is added (30% of 6 liters). The Curd Temp. T = 30°C. Final Temp. curd FT = 35°C.
Percentage Water added P = 30%.
Temperature of water TW = 35 + 100/30 (35 – 30) = 50°C

Thus in order to raise the temperature of the curd from 30°C to 35°C the temperature of the water added must be 50°C.
Stirring: Stir 15-20 minutes from the time the water was added.

Resting: Let the curds rest for 15-30 minutes or until the curd is not shiny anymore but has a dull yellow appearance.

Moulding: The curds are ready for moulding when a handful of curds can be squeezed together to form a ball and separated again. Scoop off all the whey. Place a sieve in the whey and scoop from the inside of the sieve with a jug so as not to waste curds. Fill the moulds with the curd. All the curds might not fit into the mould immediately in which case keep pressing down the curd and filling. If using a cheese vat, pull the curd to one side with the curd collecting hoop and drain the whey before filling the moulds. If not using mould nets, remove the moulded curd from the mould, wrap in the cheesecloth and return to the mould. A 1kg Kadova Mould (H027) is required for every 10 liters milk, a 2kg Kadova Mould (H028) for every 20 liters etc.

Pressing: The filled moulds are left to stand for 15 minutes. Then Press for 2 hours at 2 - 3 times the weight of the cheese. Remove the cheese from the moulds and turn it over. Press for 2 hours at 4 -6 times weight of cheese. Example: If using a 2.5kg mould, press directly with 5kg the first press and then with 10kg. When using the Finest Kind Press work out the weight to press with by placing a scale under the plunger and hanging a bucket of water from the lever and adjust the water in the bucket until the weight is correct. Make sure curds do not cool down too much while pressing.

Righting: Remove the moulds from the press. Remove the nets or cheesecloth from the moulds. Turn the cheese over and place back in the mould. Leave at room temperature (15 - 20°C) overnight.

Brining: Next morning place the cheeses in a saturated 20% (200 gram salt per liter water) brine solution for 24-72 hours depending upon size of the cheese.
Temperature of brine 10 -15°C. See page 38 for brine method.

500 gram  4-8 hrs  
1kg        12 - 24 hrs 
2kg        36 - 48 hrs 
4.5kg      48 - 60 hrs 

Ripening:  
Gouda should ideally be ripened at 12-16°C and a relatively humidity of 85-90%. Remove the cheese from the brine and let it dry for two to three days, turning it every day. If desired paint the cheese with H075 cheese paint. Paint on one side and when it is dry, paint the other side. A label H003 can be placed under the paint with the date cheese was made. Apply another layer of cheese paint 4-7 days later. Thereafter paint the cheese whenever the cheese becomes dull. Wax (H076) the cheese 2 weeks after manufacture if desired. NB The cheese must be painted with cheese coat first before it is waxed. Heat the wax to 120°C, dip one side of the cheese in the wax for 1-4 seconds, remove and dip the other side of the cheese. Make sure the cheese has no mould before painting or waxing. Paint allows the cheese to breath and retards mould growth whereas the wax prevents the cheese from drying out. Turn the cheese every day for the first week and thereafter once a week. Mould on unpainted cheese can be brushed off under a running tap with eco gel.

Minimum Ripening times are as follows:
500 gram  34 weeks 
1kg        34 weeks 
2kg        46 weeks 
5kg        68 weeks 

Cleaning:  
Clean all equipment well after and before use. Rinse in warm water, wash in warm water with iodine based anti-bacterial detergent. Air dry. Before use rinse well in clean water and towel dry with paper towel. Take care not to leave detergent residue on the equipment. Make sure to clean Kadova moulds in water not higher than 40°C.
CHEDDAR CHEESE

Rich, nutty flavour with a close, creamy texture and may be eaten young (<3 months ripening) or mature (>6 months ripening)

**Milk:** Whole milk with approx. 3.54% cream. Use milk not more than an hour after milking. If you need to store the milk, cool it down to 4°C as quickly as possible. Do not use cooled milk that is more than 24 hours old. Alternatively pasteurize the milk: 63°C – 30min or 72°C – 20sec.

**Temperature:** Adjust the milk temperature to 32°C.

**Starter:** 1% inoculation with O type mesophilic culture. Chr.Hansen’s **RST743**.

**Dosage:** 1 x 50U RST743 packet per 500 liter milk
Or 1 tsp tip 50U RST743 per 10 liters milk

Let the milk stand at 32°C (preripen) for 30 minutes.

**Additives:**
- **Natural colouring:** Annatto (ANS) 0.5ml per 100 liters. Required only if the consumer finds a more orange coloured cheese appealing. Calcium Chloride (H214) 15ml per 100 liters. Required only if the milk has a low calcium content resulting in a soft, sloppy curd. May also be required when using microbial rennet for a good coagulation.
- Sodium Nitrate (H215) 25 grams per 100 liters. Required only if the milk is unpasteurized. Reduces growth of unwanted bacteria.

**Rennet:** Use either Chr. Hansen’s Powdered Microbial Rennet OR Liquid Microbial Rennet OR Liquid Animal Rennet

**Dosage:**
- Powdered microbial rennet (H068A) 2g /100L
- Liquid microbial rennet 4 drops /L or 25ml /100L
- Liquid animal rennet 4 drops/L or 25ml/100L

Dilute the rennet in a little cool water before adding to the milk.
Stir well!!! Let the milk stand at 32°C for 45 - 60 minutes or until the milk has set like jelly. Test the curd to check whether it has set by inserting a knife and pulling it to one side. The knife should make a clean cut.

**Cutting:** Cut into 7mm blocks. Cut down and across and at an angle with a sharp knife. Or cut with a curd cutter (H015, H017) using a figure of eight movement. Cut for 5 minutes.

**Stand:** Allow the curds to set for 15 minutes.

**Heating:** Heat the curds to 37°C, increasing the temperature no more than one degree every 5 minutes. This should take about 30 minutes. Stir gently to keep the curds from matting. (One could use our 27 liter enamel digital pasteurizing pot (H012) which has a built in thermostat to slowly increase and maintain temperature) (Or a cheese vat with its own elements)

**Stirring:** Once the curds reach 37°C, maintain the temperature and continue stirring for 30 minutes. Let them rest for 5 minutes.

**Draining:** Drain off the whey. Pour the curds into a large colander and drain for several minutes. Do not drain too long or the curds will mat. Pour the curds back into the pot and stir them briskly with your fingers, wooden spoon or big plastic fork, separating any curd particles that have matted.

**Salting:** Add 20 gram salt per 10 liter milk and blend well. Do not squeeze the curds; simply mix the salt into them.
Stirring: Keep the curds at 37°C for 1 hour, stirring every 5 minutes to avoid matting. The curds can be kept at 37°C by resting the cheese pot in a sink or bowl full of 40°C water or using the Pasteurizing pot with thermostat H012 pot or a cheese vat.

Moulding: Line a mould with cheesecloth (H168) and place the curds into the mould. The Kadova moulds (H028) can be used without the nets. It is probably the best shape and size at 1.5 – 2.5 kilogram (15 – 25 liters). Small cheeses tend to dry out

Pressing: Press the cheese overnight with ten times the weight of the cheese directly on the cheese.
Example: 10 kilogram is placed on a 1 kilogram cheese.
When using the Finest Kind Press work out the weight to press with by placing a scale under the plunger and hanging a bucket of water from the lever and adjust the water in the bucket until the weight is correct. Make sure curds do not cool down too much while pressing.
Ideally a hydraulic press is used with stainless steel moulds.

Maturing: Remove the cheese from the press. Place the pressed cheese on draining gauze on clean wooden shelves in a coldroom or converted fridge at about 14°C and 70% Relative Humidity (H112) for 3 days. Paint the cheese with cheese coat. Allow a few days and then Wax (H076) the whole cheese to prevent the cheese from drying out. NB Remove the cheese from the coldroom, make sure to remove mould with eco-gel and a brush under running water and allow to dry well before painting or waxing. Mature the cheese at 12-14°C for 3 -12 months, depending upon size. Turn the cheese daily at first and then weekly.

Cleaning: Clean all equipment well after and before use. Rinse in warm water, wash in warm water with iodine based anti-bacterial detergent. Air dry. Before use rinse well in clean water and towel dry with paper towel. Take care not to leave detergent residue on the equipment. Make sure to clean Kadova moulds in water not higher than 40°C.
MOZZARELLA

**Milk:** Whole milk with approx. 3.6% cream.

**Temperature:** Adjust the milk temperature to 32°C.

**Starter:**
- DVS: 1% inoculation with LD type thermophilic culture.
- Either Chr.Hansen’s [STI-12](#) or [TCC-3](#) or [TCC-4](#)
  - STI-12 gives fast development of acidity
  - TCC-3 and 4 gives a slower development of acidity but more flavour.

**Dosage:**
- 1 x 50U STI-12 or TCC-3 or TCC-4 packet per 500L milk
- 1tsp tip 50U STI-12 or TCC3 or TCC4 per 10 liters milk

**Pre-ripen:** Let the milk stand at 32°C (pre ripen) for 45 minutes.

**Additives:**
- **Calcium Chloride** (H214) 15ml per 100 liters milk.
  - Required only if the milk has a low calcium content resulting in a soft, sloppy curd. May also be required when using microbial rennet for a good coagulation. Required if using shop bought pasteurized and homogenized milk.
- **Citric Acid**: Required if the acid development is slow. Up to 1tsp/10 liters milk can be added. First dilute in a little water before adding.

**Rennet:**
- Use either Chr. Hansen’s Powdered Microbial Rennet OR Liquid Microbial Rennet OR Liquid Animal Rennet

**Dosage:**
- **Powdered microbial rennet**  2gm /100L
- **Liquid microbial rennet** 4 drops /L or 25ml /100l.
- **Liquid animal rennet** 4 drops /L or 25ml /100l.

Dilute the rennet in a little cool water before adding to the milk.
Cutting: Cut into 12mm blocks. Cut down and across and at an angle with a sharp knife. 
Or cut with a curd cutter (H015, H017) using a figure of eight movement. 
Cut for 5 minutes.

Stirring: Stir the curd (gently at first) for 5 - 15 minutes with intervals of 5 minutes while slowly heating to 38°C.

Draining: Drain the whey and let the curd matt together.

Acidity: Keep the curds at 38°C until the pH is 5.3. Place the pot in another pot with water at 40-45°C. Or place the pot in a hay bag. Or use the pasteurizing pot with its own thermostat. Or maintain temperature in the cheese vat. 
Measure the whey with pH sticks. The pH must be between 5.3 – 4.9 before the curds will stretch.

Stretching: Cut a slice off the mass of curds and cut this into 12mm cubes. 
First do a test with a few curds to make sure they are ready to stretch by placing them in hot water at 76 -82°C and see if the curd stretches. When ready, place the curds in a stainless steel bowl and cover them with water at 76 -82°C, pouring the water down the sides of the bowl. Use a wooden spoon to work the curd by pressing them together into one another to form a ball, shaping it under the water. Once it has formed a loose ball, lift it and stretch it into a rope. Then fold it in on itself and stretch again until it is shiny and smooth. Make sure the cheese does not cool down as it will become brittle. Place it in the water to warm if it does cool. And make sure your water remains at the correct temperature.
Cheese is ready when it has a bright, shiny sheen and it stretches easily. Work into a bright shiny ball by folding it in on itself. Have a look at "BelGioioso Fresh Mozzarella Curd Stretching Instructions" on YouTube for some stretching tips. Place the cheese into cold water to harden and to retain its shape for 30 minutes.

**Salting:**
Place the balls in a cold 20% brine (100gm salt per 500ml water) for ½ hour. Remove the cheese from the brine, dry it with a paper towel and wrap it in Saran Wrap.

**Storage:**
Refrigerate cheese at 4°C. Store it in its whey or in the brine. But it is best eaten on the same day. Shelf life of Mozzarella is approximately 2 - 3 weeks at 4°C. The shelf life can be extended by freezing the cheese.

**Tip:**
If it takes more than 2 - 3 hours for the acidity to reach pH5.3, you can add 1 -2 tsp citric acid per 10 liters milk at the same time as the rennet.

**Cleaning:**
Clean all equipment well after and before use. Rinse in warm water, wash in warm water with iodine based anti-bacterial detergent. Air dry. Before use rinse well in clean water and towel dry with paper towel. Take care not to leave detergent residue on the equipment.
CAMEMBERT CHEESE

Recipe for smaller Cheese Producers

**Milk:**
Full Cream milk with approx. 3.5 – 4% cream.
Use milk not more than an hour after milking.
If you need to store the milk, cool it down to 4°C as quickly as possible. Do not use cooled milk that is more than 24hrs old. Alternatively pasteurize the milk: 63°C – 30 min. or 72°C – 20 sec. Shop bought full cream milk can also be used for Feta.

**Temperature:**
Adjust the milk temperature to 32°C.

**Starter:**
2% inoculation with LD type mesophilic culture. Chr.Hansen’s Flora Danica or CHN22

**Dosage:**
1 x 50U Flora Danica or CHN22 pkt /500L milk
1tsp tip 50U Flora Danica or CHN22 / 10L milk

Let the milk stand at 32°C (pre ripen) for 30 minutes.

**Additives:**
Calcium Chloride 15ml per 100 liters. Required only if the milk has a low calcium content resulting in a soft, sloppy curd. May also be required when using microbial rennet.
Penicillium Candidum (H060) 1 packet per 500L milk. Or a pinch per 10L. Add directly to the milk. Open one corner of the packet. Dispense a pinch onto a sterile teaspoon, close the packet with sticky tape or a clothes peg and store in a container in the deepfreeze.

**Rennet:**
Use either Chr. Hansen’s Powdered Microbial Rennet OR Liquid Microbial Rennet OR Liquid Animal Rennet

**Dosage**
- **Powdered microbial rennet** (H068A) 2g /100L
- **Liquid microbial rennet** 4 drops /L or 25ml /100L.
- **Liquid animal rennet** 4 drops/L 25ml/100L

Dilute the rennet in a little cool water before adding to the milk.
Stir well!!! Let the milk stand at 32°C for 45 - 60 minutes or until the milk has set like jelly. Test the curd to check whether it has set by inserting a knife and pulling it to one side. The knife should make a clean cut.

**Cutting:**

Cut the curd into 12mm cubes. For small quantities use a sharp knife or curd cutters (H016, H017).

Knife: Cut down and across and at an angle.

Curd cutter: Use a figure of eight movement.

Cut for 5 minutes. Rest for 5 minutes.

**Resting:**

Let the curds rest for 1-2 hrs or until there is as much whey as curd and the pH of the whey is 5.5 (H202A).

**Moulding:**

Drain the whey. Ladle the curds into open ended moulds (H904). One mould is required per liter milk. The mould is placed on a draining mat which is placed on a wooden board on a draining table or tray. Let the curd drain for 3 hours, turn the cheese over and drain for a further 3 hours or until the cheese has a height of 20 mm.

It is important that the cheese has a height of 20mm. If the finished height is more or less than 20mm it might be necessary to increase or decrease the milk quantity and therefore increase or decrease the quantity of curd per H904 mould. This variation is due to the variation in the solid content of milk. Let the cheese stand in the mould overnight.
**Brining:**
Place the cheeses in a saturated 10% brine solution. Make up the brine by adding 100 gram salt and 15ml CaCl (H214) to every liter of water. Correct the pH of the brine to pH 5 by adding Citric Acid in minute quantities (a pinch at a time) and testing with the pH sticks (H202A) as you go. Brine for 10 minutes, turn the cheese over and brine the other side for ten minutes. Let the cheese dry at room temperature until the following day. At this stage it is optional to roll the cheese in ash (available from Finest Kind). The ash makes the outside of the cheese alkaline which helps the camembert mould to grow.

**Ripening:**
Place the cheese on draining mat in a cool room at 13-15°C and 95% relative humidity. Leave the cheese undisturbed until fine white whiskers are noticeable after 5-7 days. Do not allow the cheese to become dry. Spray with a fine mist of distilled water if necessary. Turn the cheese. At 12-14 days the cheese should be covered with mould. It is easier to mature camembert in a coldroom specific to camembert where the mould is well established and growing on the planks and walls.

**Wrapping:**
Wrap the cheese in camembert foil paper. The foil has micro-pores which allows the cheese to “breath”. The foil wrap must be pressed firmly against the cheese OR wrap in brown paper or wax paper.

**Ripening:**
Place the cheese in a cold room or fridge at 4°C. The cheese continues to ripen. The cheese can be eaten at 21 days, 28 days or 35 days depending on the consumers preference. The cheese should be light yellow, smooth and bulge when cut.

**Cleaning:**
Clean all equipment well after and before use. Rinse in warm water, wash in warm water with iodine based anti-bacterial detergent. Air dry. Before use rinse well in clean water and towel dry with paper towel. Take care not to leave detergent residue on the equipment.
HALOUMI CHEESE

Recipe for smaller Cheese Producers

**Milk:** Full Cream milk with approx. 3.5 – 4% cream. Use milk not more than an hour after milking. If you need to store the milk, cool it down to 4°C as quickly as possible. Do not use cooled milk that is more than 24 hrs old. Alternatively pasteurize the milk: 63°C – 30 min. or 72°C – 20 sec. Shop bought full cream milk can also be used for Haloumi.

**Temperature:** Adjust the milk temperature to 32°C.

**Starter:** 2% inoculation with LD type mesophilic culture. Chr.Hansen’s Flora Danica

**Dosage:**
- 1 x 50U Flora Danica pkt /500L milk
- 1 tsp tip 50U Flora Danica / 10L milk

Let the milk stand at 32°C (pre ripen) for 30 minutes.

**Additives:** Calcium Chloride 15ml per 100 liters. Required only if the milk has a low calcium content resulting in a soft, sloppy curd. May also be required when using microbial rennet for a good coagulation.

**Rennet:** Use either Chr. Hansen’s Powdered Microbial Rennet OR Liquid Microbial Rennet OR Liquid Animal Rennet

**Dosage**
- **Powdered microbial rennet** (H068A) 2g /100L
- **Liquid microbial rennet** 4 drops /L or 25ml /100L
- **Liquid animal rennet** 4 drops/L 25ml/100L

Dilute the rennet in a little cool water before adding to the milk.
Stir well!!! Let the milk stand at 32°C for 45 - 60 minutes or until the milk has set like jelly. Test the curd to check whether it has set by inserting a knife and pulling it to one side. The knife should make a clean cut.

**Cutting:** Cut the curd into 12mm cubes. For small quantities use a sharp knife or curd cutters (H016, H017).

Knife: Cut down and across and at an angle.

Curd cutter: Use a figure of eight movement.

Cut for 5 minutes. Rest for 5 minutes.

**Heating:** Heat curd to 40°C very slowly over 10 - 15 minutes on low heat while stirring gently. Leave for 45 minutes at 40°C and stir every 5 - 10 minutes. Keep the curds warm by placing pot in a water bath or using the pasteurizing pot with its own thermostat or place the pot in a hay bag.

**Draining:** Pour curds into a mould or colander. When drained, wrap curd in cheesecloth and place on a board. Place a board on top of the cheese and a 1 - 2 kg weight on the board. Press for 1 hour or until the cheese is flattened to a desirable height for frying.

**Boiling:** Return collected whey to original pot and heat to 90°C. When curds are well-drained and compact, cut into strips and carefully put pieces into whey. When cheese floats lift out each piece and place on a plate.

**Storing:** Cheese may be eaten when freshly made, or allowed to mature in salty whey for 6 weeks. Sprinkle salt on both sides of the cheese if frying immediately. Or place in a sterilized jar, dissolve 4 tablespoons salt per liter whey and pour over cheese. Seal and store in a cool place at approx. 12°C or in the fridge.
BRINE RECIPE

FUNCTION OF THE SALT

- The cheese becomes firmer and retains its shape better.
- The rind becomes firmer – this is important.
- The cheese is preserved and less susceptible to bacterial infestation.
- The taste of the cheese is improved – the more mature the cheese, the saltier it becomes due to the loss of water.

PREPARATION NEW BRINE

- Use a plastic, enamel or st/steel container.
- Fill the container with the right quantity of water at 12 - 15°C.
- Add salt at the rate
  - 20% solution: 2kg. per 8-9 liter water e.g. gouda cheese
  - 10% solution: 1kg. per 8-9 liter water e.g. feta cheese
  - 5% solution: 5kg. per 8-9 liter water e.g. feta cheese
- Stir well.
- One can control the strength of the brine with the brine meter (Finest Kind H110).
- Now add 150ml. Calcium Chloride (Finest Kind H214) per 10 liters brine.
- Measure the pH of the brine with pH sticks (Finest Kind H202A). The correct reading is pH 5 and not higher than 5.2. To obtain this pH you can add Citric Acid

MAINTENANCE OF BRINE

Brine can be used for years if it is properly maintained.

- Keep the brine at 12-15°C
- Check the salt content with the brine meter (H110) on a daily basis. It should read 18-20 for a 20% solution for instance. Add salt on a daily basis.
- Measure the pH on a regular basis. Keep the pH at 5 or below.
- Keep the brine clean by lifting out any floating substances like insects.
- Keep the edge of the brine bath clean.
- A clay like substances can collect at the bottom – this is not serious but one can remove this layer by filtering the brine.
- The brine should be clear and will be clear if the salinity and pH is correct.

REFERENCE: Rondom Boerenkaas
STIRRED YOGHURT WITH OPTIONAL FRUIT - LONG SET

Milk: Standardized milk to a fat content of 1 - 2%, (Example: separate ½ of 4% milk to obtain 2% milk). If possible homogenise at a minimum of 150kg/cu.cm. If full cream milk is used, stabiliser and skim milk powder do not have to be added.

Optional Additives: Sugar:3.5% 0r 350gram Sugar per 10 Litres
Finest Kind Stabiliser 1-2% (100-200gram per 10 Litres) and/or Skim milk powder at a 1 - 2% addition rate (100 - 200gram per 10 Litres).
Mix stabiliser and/or milk powder with a little milk at 40°C (NO LUMPS).
Add the sugar to this mixture.
Mix into the rest of the milk. Make sure that the milk temperature is at 40°C before the dry ingredients are mixed with the milk.

Temperature: Heat treatment is essential for a thick end product. Heat milk to 90°C for 5 minutes or 95°C for 3 minutes in a heat exchange pasteurizer or microwave or in a double boiler on the stove. Or heat to 80°C for 30 minutes.
Cool milk to 45°C.

Starter: 2% inoculation with thermophilic culture. Either Chr. Hansen’s DVS YCX11, YFL811, or ABT-5 (pro-biotic)

Dosage:
1 x 50U YCX-11 or YFL-811 or ABT-5 pkt /250L milk
1tsp tip YCX-11 or YFL-811 or ABT-5 / 5L milk

Incubation: Add the culture to the milk and mix for 3- 5 minutes. Let the mix stand at 35°C for 10 - 12 hours or until the yoghurt is thick and the pH measures 4.6 - 4.5. There must be no water on top which is called syneresis – this means the yoghurt has become too acid.
Cooling: Let the yoghurt cool to 25°C. During this cooling the yoghurt may become more acid which you do not want. Acid yoghurt separates. Therefore incubate the yoghurt for a shorter time to a pH of 5. The pH should then decrease to 4.6 while the milk cools from 35°C to 25°C. If unhomogenised milk was used, there may be a thin layer of cream on top of the yoghurt. Scoop off this thin layer of cream. Mix in the fruit concentrates at a rate of 10-20% (100 gram - 200 gram / 1 liter yoghurt) at 25°C. Carefully fill the product into the final containers. Fill containers within the hour or the yoghurt will become thin. Cool the product in the fridge/cold room at 4°C for 12 hours. The yoghurt re-sets while cooling. Too rapid cooling may prevent the yoghurt from reestablishing its texture.

For home use: 1} add fresh fruit such as banana, grated apple, nuts and honey or strawberries, vanilla and sugar etc. 2} milkshake mixes 3} chopped tinned fruits and thickened syrup. Heat the syrup with a little stabiliser. For commercial use: fruit mixes are available from Finest Kind which contain sugars and preservatives. Add 10-20%, (100 gram - 200 gram / 1 liter yoghurt).
SET YOGHURT - LONG SET

**Milk:** Standardized milk to a fat content of 1 - 2%,
(Example: separate ½ of 4% milk to obtain 2% milk). If possible homogenise at a minimum of 150kg/cu.cm.

If full cream milk is used, stabiliser and skim milk powder may not have to be added.

**Optional Additives:**

Sugar: 3.5%. 350gram Sugar per 10 Litres
Finest Kind Stabiliser 1-2% (100-200gram per 10 Litres) and/or Skim milk powder at a 1 - 2% addition rate (100 - 200gram per 10 Litres).
Mix stabiliser and/or milk powder with a little milk at 40ºC (NO LUMPS).
Add the sugar to this mixture.
Mix into the rest of the milk. Make sure that the milk temperature is at 40ºC before the dry ingredients are mixed with the milk.

**Temperature:** Heat treatment is essential for a thick end product. Heat milk to 90°C for 5 minutes or 95°C for 3 minutes in a heat exchange pasteurizer or microwave or in the Finest Kind pasteurizing pot or in a double boiler on the stove. Or heat to 80°C for 30 minutes.

Cool milk to 45°C.

**Starter:** 2% inoculation with thermophilic culture. Either Chr. Hansen’s DVS YCX11, YFL811, or ABT-5 (pro-biotic)

**Dosage:**
1 x 50U YCX-11 or YFL-811 or ABT-5 pkt /250L milk
1 tsp tip YCX-11 or YFL-811 or ABT-5 / 5L milk

**Inoculation:** Add the culture to the milk and mix for 5 minutes. Fill the final containers with the mixture. The filling process should not take longer than 30 - 45 minutes.
Incubation: Place the filled yoghurt containers in a warm room or polystyrene boxes at 35°C. The containers should be left undisturbed for 10-12 hours or until the pH of the yoghurt is 4.6.

Cooling: Cool the containers quickly to below 6°C to stop the growth of the bacteria. If the product becomes too acid, the yoghurt will separate.

If it is not possible to cool very quickly, incubate the yoghurt for a shorter period of time and to a higher pH of say 5. The yoghurt containers should be handled with care while still warm since movement will cause the yoghurt to separate. Store the containers at 4°C for 12 hours before use.
HAY BAG KITCHEN YOGHURT WITH PRO-BIOTICS

PREPARATION IN BRIEF
- Heat one liter milk to 95°C
- Cool the milk to 45°C
- Add three to five kernels DVS ABT5 culture to the milk
- Incubate at 35°C for 10-16 hours
- Cool to 4°C
- Leave undisturbed for 12-18 hours at 4-6°C

METHOD OF PREPARATION
Sterilize all equipment well. Heat one liter of milk to 95°C. Cool the milk to 45°C. Cut one corner of the culture packet open, three to five granules ABT5 culture onto a spoon and add to the milk. Invert the yoghurt container a couple of times to mix the milk. Place the yoghurt container in a Hay Bag (or a box or cool box filled with Hay or cushions) and leave the yoghurt to stand for 10-16 hours or until the milk has just set. If there is a layer of whey (greenish liquid) on top of the yoghurt, the yoghurt has been left in the Hay Bag for too long. Place the yoghurt container in the fridge overnight until cooled to 4°C. Add your own fruit such as grated apple, sliced banana and honey or freshly cut strawberries and castor sugar. Tinned fruit can also be used. Thicken the syrup of the tinned fruit with a little stabiliser before adding.

The yoghurt culture packet must be closed by turning over the open corner a few times and sticking it down with sticky tape or a clothes peg. If, when dispensing the culture, you pour out too many kernels, do not add these kernels back to the packet. You will contaminate the packet of culture. The culture should be kept dry and sterile and at -18°C (deepfreeze).

The following bases can be used to make yoghurt:
- 2% fat milk
- Milk to which 1% (100 gram per 10L milk) skim milk powder has been added
- Milk to which 1% (100 gram per 10L milk) Finest Kind stabiliser and / or 1% skim milk powder has been added for extra body
CALCIUM CHLORIDE

To manufacture 1 liter:

**Method:** Place the calcium chloride flakes in a 1 liter measuring jug. Add water exactly up to the 1 liter mark whilst stirring. Continue to stir from time to time.

**Dosage for cheese:** 15 ml per 100 liter milk
Add to milk before the rennet
Stir well
Improves the coagulation of milk especially when using microbial rennet or when cows are on dry food

**Dosage for brine:** 15 ml per liter water prohibits calcium leaching from the cheese in the brine

**IMPORTANT:**

Only high quality water to be used to make the solution. If you are unsure of the quality of your water, use distilled or purified water obtainable from your chemist. The solution will get hot as it dissolves. The solution will appear quite murky – this is normal.
<table>
<thead>
<tr>
<th>Variations in basic stages</th>
<th>pH</th>
<th>Ca</th>
<th>Syn</th>
<th>W/vk</th>
<th>Rennet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Fat content in cheese milk (higher)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2) Pasteurization temperature (higher)</td>
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<tr>
<td>3) Storage temperature raw milk</td>
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<tr>
<td>(lower/longer)</td>
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<tr>
<td>4) Addition of calcium chloride (more)</td>
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<tr>
<td>5) Addition of starter (more)</td>
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<tr>
<td>6) Preripening of cheese milk (longer)</td>
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<tr>
<td>7) Coagulation time (longer)</td>
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<tr>
<td>8) Coagulation temperature (higher)</td>
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<tr>
<td>9) Size of curds (bigger)</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>10) Intensity of stirring whey-curd mix</td>
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<tr>
<td>11) Percentage whey drained (more)</td>
<td></td>
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<tr>
<td>12) Stirring time whey-curd mix (longer)</td>
<td></td>
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</tr>
<tr>
<td>13) Scalding temperature whey-surd mix (higher)</td>
<td></td>
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</tr>
<tr>
<td>14) Added water to whey-curd mix (more)</td>
<td></td>
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<tr>
<td>15) Addition of salt to whey-curd mix (more)</td>
<td></td>
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</tr>
<tr>
<td>16) Processing the curd (longer)</td>
<td></td>
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<tr>
<td>17) Prepressing dry curd (higher)</td>
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<tr>
<td>18) Pressure time of the cheese (longer)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Ph : acidity
Ca : calcium content
Syn : syneresis or expulsion of whey W/vk
      : moisture content in cheese
Rennet : quantity rennet remaining in cheese
## TROUBLE-SHOOTING CHART II

<table>
<thead>
<tr>
<th>PROBLEMS</th>
<th>POSSIBLE CAUSES</th>
<th>POSSIBLE SOLUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheese tastes very bitter</td>
<td>Poor hygiene in handling the milk and/or cheesemaking utensils</td>
<td>Keep the milk in a cold sanitary environment until ready for cheesemaking. Keep all utensils absolutely clean and free from milkstone. (Milkstone is a milk residue which is deposited over a period of time on the surface of utensils. It can be removed by using a dairy acid-type cleaner.) Sterilize all utensils. If using raw milk, and cheeses are bitter, you should pasteurize the milk prior to cheesemaking Reduce the amount of rennet used Take steps to reduce acidity. See below. Increase the amount of salt added to the curds at salting</td>
</tr>
<tr>
<td></td>
<td>Excessive rennet may have been used</td>
<td></td>
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<tr>
<td></td>
<td>Excessive acidity may be developing during the cheesemaking process</td>
<td></td>
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<tr>
<td></td>
<td>Too little salt may have been added to the curd after milling</td>
<td></td>
</tr>
<tr>
<td>Cheese tastes quite sour and acidic</td>
<td>The cheese contains too much moisture</td>
<td>Take steps to reduce the moisture content during cheesemaking. Cut the curd smaller &amp;/or heat the curd to a higher temperature &amp;/or stir the curd for a longer period of time</td>
</tr>
<tr>
<td>The cheese has little to no flavour</td>
<td>The cheese was not aged long enough</td>
<td>Age the cheese the proper amount of time</td>
</tr>
<tr>
<td></td>
<td>Insufficient acidity was produced during cheesemaking</td>
<td>Take steps to increase the acidity during cheesemaking. Cut the curd bigger &amp;/or heat the curd to a lower temperature &amp;/or stir the curd for a shorter time</td>
</tr>
<tr>
<td><strong>The milk does not coagulate into a solid curd</strong></td>
<td><strong>Too little rennet was used</strong></td>
<td><strong>Increase the amount of rennet used</strong></td>
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<tr>
<td>-------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td>Poor quality rennet was used</td>
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<tr>
<td></td>
<td>Rennet activity was destroyed by mixing with very warm water when diluting</td>
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<td></td>
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</tr>
<tr>
<td><strong>The milk does not coagulate into a solid curd</strong></td>
<td><strong>Rennet was mixed in same container as was cheese colour</strong></td>
<td><strong>Do not contaminate rennet with cheese colouring</strong></td>
</tr>
<tr>
<td></td>
<td>Dairy thermometer is inaccurate and the setting temperature was actually too low</td>
<td>Check accuracy of dairy thermometer</td>
</tr>
<tr>
<td><strong>Rennet was mixed in same container as was cheese colour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dairy thermometer is inaccurate and the setting temperature was actually too low</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Milk contains colostrum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>After adding rennet the milk almost instantly coagulates into a curd of tiny grains while the rennet is still being stirred into the milk</strong></td>
<td><strong>Excessive acidity in milk</strong></td>
<td><strong>Take steps to reduce acidity. Milk should not start to coagulate until about five minutes after adding rennet</strong></td>
</tr>
<tr>
<td><strong>The finished cheese is excessively dry</strong></td>
<td><strong>May be caused by insufficient rennet</strong></td>
<td><strong>Add more rennet</strong></td>
</tr>
<tr>
<td></td>
<td><strong>May be caused by cutting the curd into particles which are too small</strong></td>
<td><strong>Cut the curd into larger pieces</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Curds may have been cooked to an excessive temperature</strong></td>
<td><strong>Lower the cooking temperature</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Curds may have been overly agitated</strong></td>
<td><strong>Treat curds gently</strong></td>
</tr>
<tr>
<td><strong>Mould growth occurs on the surface of the airdrying cheese or a waxed cheese</strong></td>
<td><strong>May be due to unclean aging conditions and/or too high a humidity in the aging room</strong></td>
<td><strong>Clean all cheese aging shelves thoroughly with an antifungal such as Delvocid. Lower the humidity of the cheese storage room</strong></td>
</tr>
<tr>
<td>Issue</td>
<td>Cause</td>
<td>Solution</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>The cheese is quite difficult to remove from the mould after pressing</td>
<td>It may be that coliform bacteria and/or wild yeast have contaminated the milk and the curd. They have produced gas which has swelled the cheese during pressing. This production of gas makes it difficult to remove the cheese from the mould after pressing.</td>
<td>Pay strict attention to hygiene. Clean all utensils scrupulously. Sterilize all utensils in boiling water or in a sterilizing solution. Keep the milk clean and cold prior to cheesemaking. If using raw milk start to pasteurize the milk.</td>
</tr>
<tr>
<td>The cheese, when cut open, is filled with tiny holes, giving the cheese the appearance of a sponge</td>
<td>May be coliform bacterial and/or wild yeast contamination. Such a contamination will be noted during the cooking process. The curds will have an unusual odour very similar to the smell of bread dough.</td>
<td>Pay strict attention to hygiene.</td>
</tr>
<tr>
<td>The cheesecloth removes with great difficulty from the cheese after pressing</td>
<td>Coliform bacterial and/or wild yeast contamination. The cheese was not redressed in a fresh cheesecloth when needed. This is particularly true for cheeses made with a thermophilic culture.</td>
<td>Pay strict attention to hygiene. Redress the cheese promptly as the recipe states.</td>
</tr>
<tr>
<td>Pieces of the cheesecloth may rip off when the cheese is removed</td>
<td>The cheese was stirred to vigorously The curd was heated to too high a temperature</td>
<td></td>
</tr>
<tr>
<td>Cheese becomes oily when air-drying</td>
<td>Cheese is being air-dried at too high a room temperature The curd was stirred to vigorously The curd was heated to too high a temperature</td>
<td>Remove the cheese to a cooler room. The temperature should not exceed 16°C Handle the curd more gently Lower the cooking temperature</td>
</tr>
<tr>
<td>Moisture spots are observed on the surface of the aging cheese beneath the wax. The wet spots can begin to rot and ruin the cheese</td>
<td>Cheese was not turned often enough Cheese contains excessive moisture Water has condensed on the cold cheese</td>
<td>Turn the cheese at least daily when it first starts to age Take steps to reduce the moisture content of the cheese Let the cheese reach room temperature before waxing</td>
</tr>
</tbody>
</table>
| Lack of acid development | The starter culture is not working | Antibiotics may be present in the milk. Do not use milk from animals receiving antibiotics or any other contamination.  
The starter may be contaminated.  
Use a new starter.  
The presence of cleaning agents residue on utensils particularly chlorine. Rinse all utensils thoroughly. |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Bacteriophage contamination</td>
<td>There may be water present in the milk</td>
<td>Change the starter</td>
</tr>
</tbody>
</table>
| Excessive acid development during cheesemaking | Too much starter is being added  
Ripening period is too long  
Excessive moisture present in cheese | Reduce the amount of starter used.  
Reduce the ripening time and add rennet sooner.  
Take steps to reduce moisture in cheese. |
| Excessive moisture in cheese | Inadequate acid development during cheesemaking  
Using milk which has too high a fat content | Increase acidity during cheesemaking.  
The butterfat content of milk should not be much higher than 4.5%. If fat content is higher than this and excessive moisture is a problem remove some cream prior to cheesemaking. |
<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>May be caused by heating the curds too rapidly. Too fast an increase</td>
<td>Do not heat the curd too fast.</td>
</tr>
<tr>
<td>in cooking temperature develops a membrane around the curd particles</td>
<td></td>
</tr>
<tr>
<td>which does not allow the moisture to leave the curd particles</td>
<td></td>
</tr>
<tr>
<td>May be caused by the retention of too much whey in the curd</td>
<td>Cut the curd into smaller sizes.</td>
</tr>
<tr>
<td>May be caused by heating the curd to too low a temperature during</td>
<td>Heat the curd at cooking to a somewhat higher temperature.</td>
</tr>
<tr>
<td>cooking</td>
<td></td>
</tr>
</tbody>
</table>

Ref: Cheesemaking made Easy By Ricki & Robert Carroll
APPENDIX C
MILK SAMPLING

It is expensive to analyse all milk supplies on a daily basis for all parameters. To avoid this, you can sample the milk and place it in sample bottles with preservatives added. Potassium dichromate can be added to keep the samples in a good condition. Testing can be done on a mix of these samples. Alternatively, milk can be sampled and tested on a random basis. Always try to keep milk samples cool, but make sure the milk is heated to 40°C and then cooled to 20°C and mixed before testing. Milk must be thoroughly mixed before sampling to make sure that the fat is dispersed throughout the container. Make sure the samples are labelled and carefully recorded to avoid confusion.

TESTS

1. Taste, smell, visual observation and temperature
This should always be the first screening of the milk, since it is cheap, quick and does not require any equipment. These tests are also called ‘organoleptic tests’. It is also reliable if the person carrying out the tests is experienced. The tester smells the milk, observes the appearance, tastes if necessary, checks the can of cleanliness, looks for sediment, and filters the milk to check its cleanliness. If doubts arise after the examination about the quality of the milk, other tests can be done to determine the quality.

2. Density meter or lactometer test
With a lactometer specific density of milk is measured. At 15 degrees Celsius, the normal density of the milk ranges from 1,028 to 1,033 g/ml, whereas water has a density of 1,0 g/ml. So when you read the lactometer, you can determine whether water has been added to the milk. It is best to combine the lactometer reading with the fat test: If the results of the fat test are low and the density is high (e.g. 1,035), then the milk might have been skimmed. If the results of the fat test are low and the density is low (e.g. 1,027), then water might have been added to the milk.

3. Clot on boiling
The clot on boiling test is simple, cheap and quick. If the milk is sour or if the milk is abnormal (colostrum or mastitis milk) the milk will not pass this test. Place test tubes with 5ml of milk for 4 minutes in boiling water or in a flame. Examine the tubes and reject the milk if you can see the milk clotting. Please note that at higher altitude milk boils at a lower temperature. This test is not very sensitive to slightly sour milk and an alternative is an alcohol test.
4. Alcohol test
If the milk is sour or if the milk is abnormal (colostrum or mastitis milk) the milk will not pass the alcohol test. You carry out the test by mixing equal amounts (2ml) of milk and a 68% ethanol solution (made by mixing 68ml of 96% alcohol with 28ml distilled water). Milk that contains more than 0.21% acid will coagulate when alcohol is added.

5. Acidity test
This test measures the lactic acid in the milk. If the acidity is higher than 0.19%, then the milk quality is poor and cannot be processed. If the acidity is lower than normal (e.g. 0.10% lactic acid) then the milk is of poor bacterial quality or sodium hydroxide/bicarbonate might have been added. For this test you would need a white porcelain dish, a 10 ml pipette, a 1 ml pipette, a burette (0.1 ml graduations), a glass rod for stirring, a phenolphthalein indicator solution (0.5% in 50% alcohol) and a 0.1N Sodium hydroxide solution. Measure 9 ml of milk into the dish. Add 1 ml of phenolphthalein from the burette, slowly add the 0.1 N sodium hydroxide solution while mixing continuously, until a faint pink colour appears. The more sodium hydroxide you gave to add before it turns pink, the more acid the milk.

6. Gerber test for fat
This test is used to measure the fat content of the milk. 10.94ml of milk at 20 degrees Celsius is added to a butyrometer together with sulphuric acid and amyl alcohol. After centrifugation, the sample is put in a 64 degrees Celsius water bath and read after 3 minutes. The fat content from this reading should not be less than 3%.
APPENDIX D
PERSONAL HYGIENE

It is very important that procedures of making food products should take place hygienically. One's own body is a great source of micro-organisms and therefore it is necessary to look at personal hygiene.

1. Hand washing
All employees must wash and sterilise their hands when entering the milk factory and during production. The sterilising solution must be maintained clean. An iodine solution may be used for a sterilising solution.

2. Illness
If an employee is ill, it is necessary to be reported. Micro-organisms are transferred very easily through coughing, sneezing, etc. If an employee is ill with an airborne (can be transferred via coughing and sneezing) illness, the specific employee should stay away from highrisk production areas until he/she has recovered.

3. Cuts and grazes
Accidents happen very often. It is necessary to cover any cuts or grazes with plaster. This will prevent contamination of food products.

4. Eating and drinking
Eating and drinking in production areas is not at all allowed. An adequate resting facility should be provided where employees can rest, eat and drink during break times.

5. Jewellery, nail varnish and false nails
Workers must wear no jewellery. Microorganisms can enter food products via jewellery and therefore it must be avoided. Nail varnish and false nails are also not allowed and should not be worn by workers.

6. Protective clothing
It is necessary to cover all body parts that is likely to be a great source of microorganisms, for example hair and feet. Mop caps should be worn to cover the head while producing food products and clean boots should also be worn to cover feet.
APPENDIX E

PESTS

A food plant must be free of rodents, flies and insects.

Rodents
Rats and mice are disease carriers and destroy food and cartons. It is recommended that the services of a professional exterminator or pesticide control operator be utilized to trap mice and rats.
The building should be rat proofed. The floor and foundations should be made of concrete. Old buildings should be observed for rat openings and then be covered with a hardware cloth or metal screening of ¼ inch mesh.

Flies and roaches
Flies and roaches in a food plant are intolerable because of their potential disease and filthcarrying roles. The best defence against flies is to screen the building entries and windows, sometimes with electrical screens and air curtains, to keep all garbage receptacles covered and to eliminate nearby dumps. Warm, most weather leads to heavy fly populations and this is the period when the most stringent control is needed. To get rid of roaches, it is necessary to eliminate their hiding places, which include crevices and cracks in walls and wooden benches. When the room contains only sanitary metal equipment, direct hot water and steam sterilization is effective.

Cheese mites and cheese skippers
The presence of these pests leads to physical deterioration of cheese and cheese producing and storage facilities. If these mites are consumed in large quantities by humans, it can lead to inflammation or irritation of the stomach lining. Cheese invaded by mites assumes a distinctive "mitey" or burnt flavour and the physical appearance of the cheese is changed adversely.

Food inspectors interpret the presence of these pests as evidence of unsanitary storage conditions.

Cheese mites and skippers can be destroyed by a deadly gas, methyl bromide. Professional exterminators equipped with gas masks must apply this and the cheese needs to be removed from storage rooms during gassing.

Practising the principles of good sanitation and housekeeping be keeping food unexposed, by keeping shelves and walls clean and by rejecting cheese boxes for reuse, helps keep out mites and skippers.
# APPENDIX F

Disinfectant comparison

++ = quick killing  
+  = killing  
= non killing

<table>
<thead>
<tr>
<th></th>
<th>Bacteriophages</th>
<th>Small Virus</th>
<th>Large Virus</th>
<th>Gram-positive Bacteria</th>
<th>Gram-negative Bacteria</th>
<th>Spore Forming Bacteria</th>
<th>Yeasts</th>
<th>Moulds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Chlorine</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>+</td>
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<tr>
<td>Hydrogen</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>+</td>
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<tr>
<td>Peroxide Peracetic Acid</td>
<td>++</td>
<td>++</td>
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<td>++</td>
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<td>Q.A.C.</td>
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<tr>
<td>Iodophors</td>
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<td>Aldehydes</td>
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</tbody>
</table>
APPENDIX G
MASTER CLEANING SCHEDULE 1

Cleaning of floor

Instructions:
- Clean floors daily after processing
- Rinse floors with hot water
- Pour Diokem powder (alkaline based hot wash) onto floors (±200ml)
- Scrub floors
- Rinse with hot water

Month: __________________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Floors cleaned</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
MASTER CLEANING SCHEDULE 2

Cleaning of equipment
Equipment must be cleaned on a daily basis, before and after use. Equipment also needs to be sterilized with an appropriate sterilizing agent.

Instructions:
- Dilute Diokem (alkaline based hot wash) in hot water (510g/l).
- Wash and scrub equipment after wash
- Sterilize equipment after wash
- Sterilize equipment in a 1% sterilizing agent (use an iodine based/chlorine based agent e.g. Perasan 1ml/l)
- Rinse equipment with clean water.

Month: __________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Cleansed before use</th>
<th>Cleansed after use</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
MASTER CLEANING SCHEDULE 3

Cleaning of truck
Transport trucks must be cleaned before and after use.

Instructions:
- Rinse truck with hot water
- Pour Diokem powder (alkaline based hot wash) onto floor of truck (±200ml)
- Scrub surfaces of truck
- Rinse with hot water

Month: ________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Cleansed before use</th>
<th>Cleansed after use</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
## APPENDIX H
### FROMAGE FRAIS

<table>
<thead>
<tr>
<th></th>
<th>Date: ___________________</th>
<th>Liters: ___________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Batch No:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>c. Test Acidity:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>d. Temp:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>e. Culture:</td>
<td>___________________</td>
<td>Rennet: ___________________</td>
</tr>
<tr>
<td>f. Time/Date added:</td>
<td>___________________</td>
<td>Time/Date Finished:__________</td>
</tr>
<tr>
<td>g. % Acidity:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>h. No moulds filled:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>i. Time drained:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>j. Salted:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>k. Time/date remove mould &amp; refrigerate:</td>
<td>___________________</td>
<td></td>
</tr>
<tr>
<td>l. Time/date sold:</td>
<td>___________________</td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

____________________________________________________
____________________________________________________
____________________________________________________
____________________________________________________
____________________________________________________

**Weather conditions:**

____________________________________________________
____________________________________________________
____________________________________________________
____________________________________________________
____________________________________________________
700 LITER 1 kg Floor Plan
APPENDIX I
INFORMATION ON DIRECT VAT SET / DVS

DESCRIPTION

DVS is a highly concentrated and standardized freezedried dairy culture, used for direct inoculation of milk. DVS cultures need no activation or other treatment prior to use.

APPEARANCE

Freezedried DVS cultures are watersoluble granules, 25 mm in diameter, with an offwhite to slightly reddish/brown colour. The granules have a slight peptone like odour.

TECHNICAL DATA

Chr. Hansen’s DVS cultures rely only on lactic acid bacteria internationally approved for the dairy industry. Our cultures are all of natural origin, and are produced using the latest production technology. In freezedried DVS cultures the number of viable cells is min 5 x 100 cfu per gram.

PURITY

Chr. Hansen’s DVS cultures comply with IDF 149A (Internationally Dairy Federation) standards regarding maximum contaminant content.

FREEZE-DRIED DVS

Yeast and mould <10 cfu/g
Coliforms <10 MPN/g
Staph.aureus <10 cfu/g
Enterococci <100 cfu/g
Non lactic acid bacteria <500 cfu/g
Salmonella* <absent in 25g
Listeria* <absent in 1g

*analysed on a regular basis
STORAGE AND STABILITY

Freezedried DVS cultures should be stored at 18°C or below. If freezedried DVS cultures are stored correctly, the shelf life is at least 24 months. At +5°C the shelf life is at least 6 weeks.

PACKING

Freezedried DVS cultures are supplied in alufoil bags and are available in the following standard sizes:

- 50 unit bag – 10 bags per box
- 200 unit bag – 25 bags per box
- 500 unit bag – 20 bags per box

SHIPMENT TERMS

Freezedried DVS cultures may be transported at room temperature for up to 10 days without the quality of the cultures being reduced.

APPLICATION

DVS for fermented milk products
The milk is inoculated with the culture in the process tank. Fermentation of the milk then proceeds according to normal procedure.

DVS for cheese
The cheese milk is inoculated with the culture in the cheese vat or tank. The cheese milk may require 2040 minutes of preripening before applying rennet. However, normal cheesemaking procedures and time limits can be obtained by adding appropriate amounts of Calcium Chloride to the cheese milk.

DOSAGE

Recommended standard inoculation rates are given below. However, specific usage rates should be determined experimentally prior to any new application.

<table>
<thead>
<tr>
<th>Application</th>
<th>Freezedried DVS Cheese</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50-150 units per 1000L</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>200 units per 1000L</td>
</tr>
</tbody>
</table>
Fermented Products  100 units per 1000L  
Probiotic products*  200 units per 1000L  

*For inoculation based on cell count, please contact your local Chr.Hansen representative

GUARANTEE

Chr. Hansen’s dairy cultures are produced in strict conformity with the regulations of Danish and local health authorities.
APPENDIX J
PVA CHEESE COATINGS

CHEESEX cheese coatings are manufactured using synthetic acrylic (PVA) co-polymer emulsions. They contain various antimycotic ingredients that inhibit the growth of yeasts and mold of the surface of the cheese during the natural ripening process. They are supplied in colours of clear, yellow or red.

It is generally accepted that cheese, vacuum packed in plastic bags, has a different flavour to the naturally ripened cheese using PVA cheese coatings. Cheese that is sealed in vacuum plastic bags is impermeable to moisture and gasses and hence maintains the same moisture, salt and gaseous content as the time of vacuum packing. When using cheese coating the ratio of salt to moisture changes constantly and has an effect on proteolysis and fat hydrolysis. As part of the maturation process volatile gases are allowed to escape from the cheese and conversely oxygen can penetrate into the cheese. These processes are definitely going to influence the flavour development of these naturally ripened cheeses.

Reasons for using cheese coatings:

- It reduces to loss of moisture from the cheese.
- It inhibits the growth of yeasts and molds on the surface of the cheese but does not influence the ripening process.
- It forms a clear, flexible film on the surface of the cheese. This protects the rind from mechanical damage. It maintains the shape of the cheese and reduces sagging.
- It gives a firm, dry base for the overcoating with coloured paraffin cheese waxes. Paraffin wax will not adhere directly to a cheese surface. One has to use a barrier coating such as a PVA cheese coating.
- It is permeable to gases (Oxygen, Carbon Dioxide etc) which influences the ripening process.
- It has no taste and does not effect the flavour of the cheese. CHEESEX does not contain any plasticisers such as Citroflex, which is currently not permitted in EU countries. Citroflex leaves a bitter after taste in the throat but is still used by some local companies.
- It gives the cheese a fine glossy appearance
- Used to apply and coat over paper labels.
**Application of cheese coating**

The cheese is removed from the brine bath and allowed to dry for 1-2 days to form a suitable rind. The cheese should change from a pale to a darker yellow colour. The rind should be firm and slightly rough to the touch. If the cheese coating is applied too soon it will take a lot longer to dry.

**If the rind stays soft and is slimy this could be due to:**
- High humidity in ripening store
- High brine pH
- Low concentration of Calcium chloride in the brine
- Low concentration of Sodium Chloride in the brine

The first half of the cheese is coated 12 days after being removed from the brine tank. After 12 days of drying the cheese is turned and the other side is coated. A second coat should be applied from day 10. The cheese is then waxed at 3-4 weeks. For cheeses ripened for a longer period, 45 coats of cheese coating can be applied. A 4kg round cheese will require about 40g of cheese coating for a complete application on both sides. The temperature, humidity and air flow are important parameters to control during this period. Temperatures of 10°C - 12°C and relative humidity of 85 - 95% are normal.
Precautions and General Comments

Cleanliness and sterilization of the cheese store is of paramount importance. One of the most common source of mold contamination of cheeses is from the wooden planks the cheeses are stored on. If there are high concentrations of visible mold on the shelves, no matter how high the level of Natamycin in the cheesecoating, mold will still grow on the surface on the cheese. We have supplied a cheese coating to one customer that contained only 60ppm of Natamycin with no mold growth problems. His housekeeping was of a high standard and he had a very stringent plank washing schedule. There are customers in Scandanavia that use cheese coating with absolutely no preservative but they then have to have a very high standard of cleanliness.

WAXES FOR THE COATING OF CHEESES

A general composition of a cheese wax is:

- **m.** Paraffin wax melting point 58-60°C cheap but very brittle
- **n.** Microcrystalline wax meltin point 70°C more expensive but more flexible and pliable
- **o.** Mineral oil liquid paraffin oil to make wax softer, more peelable
- **p.** Polyethylene PE, ethylene vinyl acetate EVA polymers added to improve flexibility, tensile strength
- **q.** Colourant

Functions of cheesewaxes

- Prevents moisture loss from the cheese
- Reduces mechanical damage
- Prevents mold growth
- Marketing appeal of different colours of wax.

Problem identification

- Water contamination Standard cheese wax do not like water!
- If the wax tank has foam on the surface this indicates water contamination in the tank.
- When the cheese is waxed under these conditions the foam bubbles break as the wax cools and gives a melted wax finish. To rectify one should drain the water from the bottom of the tank and heat the wax to 115°C to boil off the water.
- The surface of the wax tank should be smooth and free of any bubbles or foam.
Water contamination in the wax tank can also form large craters 2mm or bigger in the wax coating where the cheese remains uncoated.

If the cheese is brought out of the 10°C cold room and waxed in another area at room temperature moisture will condense on the surface of the cheese. It is difficult to see this moisture but it will cause fine pine holes in the wax. Take the wax off a cheese and hold it up to the light to check for pine holes. Cheese should ideally be waxed in the coldroom.

**The cheese coating should be dry before waxing.** If there are still spots of white cheese coating these areas can cause craters in the wax. The adhesion will also be poor and in 3 weeks time the wax will come off. If you peel off the wax you will be able to see the water and the cheese coating will have turned white. This problem can be lessened by first waxing at 105 - 115°C (to flash off the moisture) followed by a second waxing at 75-90°C.

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The gloss of a cheese wax can be increased by cooling the wax in chilled water directly after waxing. The faster the wax cools the higher the gloss.

The wax tank temperature should be thermostatically controlled. This will result in an even wax coating and reduce the chance of waxing at too low a temperature and causing poor wax adhesion problems.

The wax tank should be drained and cleaned out every 3 months. Cheese fat and small bits of cheese accumulate in the bottom of the tank and cause surface defects in the wax and can cause the wax to go rancid and smell. If these cheese particles get stuck in the wax on the surface of the cheese it gives ideal spots for mold to grow and penetrate into the cheese.
APPENDIX K

Wooden cheese press instructions

Place the cheese mould on the platform and let the pressing plate rest on the mould.

Match the hole on the lever with a hole on the upright pressing arm. When doing this make sure, make sure that the lever at approx. a 45° angle

Press the pin through the holes to keep the lever in position.

Use a small plastic bucket filled with water as a weight and hang it on the lever.

**TIP – to determine the pressing weight:**

- Place a bathroom scale on the platform
- Let the pressing plate rest on the scale
- Insert the lever according to the above instructions
- Hang the plastic bucket from the lever while filling the bucket with water
- keep reading the weight (pressure) of the water on the scale until you have the appropriate reading

**NB** A 1 kg gouda requires 35kg direct weight, but because you are using a lever you will use less than 35kg.

For gouda the pressing weight is 3-5 times the weight of the cheese, for cheddar it’s 8-10 times the weight of the cheese.