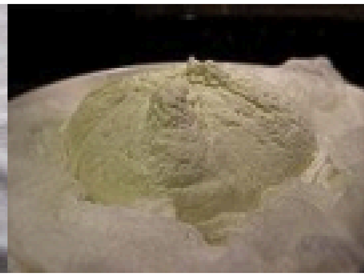
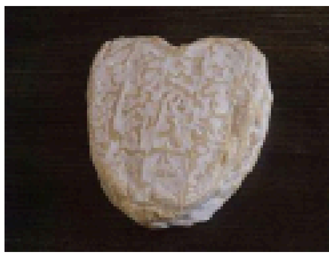
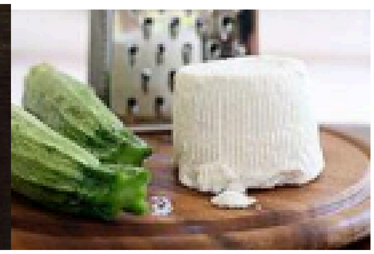
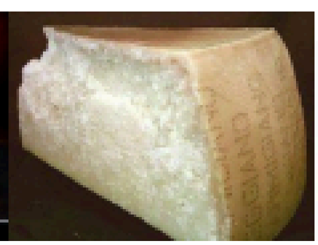
Introduction to Cheesemaking
The Artisan Cheesemaker

Copied from the websites The Cheese Wizard and the www.dairy01.co.uk. I tried to contact with The Cheese Wizard but e-mail address given is invalid. It is an old website so it may not be maintained at all. Dairy01.co.uk belonged to James Aldridge; cheesemaking guru and master who passed away. His web site is no longer maintained and deleted. I managed to find a copy on web.archives. I copied the information from these two websites and enhanced it with pictures and links from Wikipedia. I've also added some more information and converted measures. There is also an excellent log record form which I prepared at the end of the document. Enjoy and share this doco with the fellow Artisan Cheesemakers. Visit our Facebook page here.

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Cheese is a fermented milk product made from the curds produced when milk is coagulated. Usually it is made from cow's milk but there are many varieties made from sheep's milk and goat's milk. Cheese can also be made from the milk of various other animals. Real mozzarella, for example, is made from buffaloes' milk.

The Legend

Most cheese authorities and historians consider that cheese was first made in the Middle East. The earliest type was a form of sour milk which came into being when it was discovered that domesticated animals could be milked. A legendary story has it that cheese was 'discovered' by an unknown Arab nomad. He is said to have filled a saddlebag with milk to sustain him on a journey across the desert by horse. After several hours riding he stopped to quench his thirst, only to find that the milk had separated into pale watery liquid and solid white lumps. Because the saddlebag, which was made from the stomach of a young animal, contained a coagulating enzyme known as rennin, the milk had been effectively separated into curds and whey by the combination of the rennin, the hot sun and the galloping motions of the horse.

The History

In reality, it isn't known when cheesemaking was first discovered, but it is an ancient art. The first cheeses were not cheeses as they are now known, but curds and whey. Curds and whey result when milk is coagulated. The curd is solid and the whey is liquid. Curds and whey remained a common food (this is what Little Miss Muffet ate) until about 50 years ago. It is still eaten in some areas of the U.S. and in some third world countries.

Egyptian hieroglyphics depict workmen making cheese. In ancient times, the whey was consumed immediately and the curd was salted and/or dried to preserve it. The Roman Legion was instrumental in spreading the art of cheesemaking throughout Europe and England. During the Middle Ages, the art of cheesemaking was improved greatly in the monasteries and feudal estates of Europe. The monks became great innovators of cheese and it is to them we owe many of the classic varieties of cheese marketed today. During the Renaissance period cheese suffered a drop in popularity, being considered unhealthy, but it regained favour by the nineteenth century, the period that saw the start of the move from farm to factory production.

Basic Principles

The basic principle involved in making all natural cheese is to coagulate or curdle the milk so that it forms into curds and whey. As anyone knows who has left milk un-refrigerated for a period, milk will curdle quite naturally. The milk sours and forms into an acid curd.

Today's methods help the curdling process by the addition of a starter (a bacterial culture which produces lactic acid) and rennet the coagulating enzyme which speeds the separation of liquids (whey) and solids (curds). There are two basic categories of starter cultures. Mesophilic starter cultures have microbes that can not survive at high temperatures and thrive at room temperatures. Examples of cheeses made with these bacteria are Cheddar and Gouda. Thermophilic starter cultures are heat-loving bacteria. They are used when the curd is cooked to as high as 132°F. Examples of cheeses made from these bacteria are Swiss and Italian cheeses.

The least sophisticated cheeses are the fresh, unripened varieties typified by Cottage Cheese. These are made by warming the milk and letting it stand, treating it with a lactic starter to help the acid development and then cutting and draining the whey from the cheese. The cheese can then be salted and eaten fresh. This is the simplest, most basic form of cheese.

Acidification

Generally, cheesemaking starts with acidification. This is the lowering of the pH (increasing acid content) of the milk, making it more acidic. Classically, this process is performed by bacteria. Bacteria feed on the lactose in milk and produce lactic acid as a waste product. With time, increasing amounts of lactic acid lower the pH of the milk. Acid is essential to the production of good cheese. However, if there is too much acid in the milk the cheese will be crumbly. If not enough acid is present the curd will be pasty.

Rennet

After acidification, coagulation begins. Coagulation is converting milk into curds and whey. As the pH of the milk changes, the structural nature of the casein proteins changes, leading to curd formation. Essentially, the casein proteins in the milk form a curd that entraps fat and water. Although acid alone is capable of causing coagulation, the most common method is enzyme coagulation. The physical properties of enzyme-coagulated milk are better than that coagulated purely with acid. Curds produced by enzyme coagulation achieve lower moisture content without excessive hardening.

Enzymes used to coagulate milk come from a number of sources: animals, plants, and fungi. The traditional source of enzyme is rennet. Rennet is a preparation made from the lining of the fourth stomach of suckling calves or kids. The most important enzyme in rennet is chymosin. Today, most chymosin is a recombinant product made possible by genetic engineering. Until 1990, the only source of rennin was calves. Around 1990, scientists created a system to make chymosin that doesn't require calves. Using genetic engineering, the gene for chymosin was cut from a calf cell and inserted into the genomes of bacteria and yeast. The microbes make an exact copy of the calf chymosin. Microbes replicate and grow rapidly, and can be grown continuously. Thus, the supply of rennet is assured. Approximately 70% of the cheese made in the U.S. is coagulated using chymosin. The chymosin made by the yeast cells is the same as that made by the calf cells.

Cutting and Pressing the Curd

After the coagulation sets the curd, the curd is cut. This step is usually accompanied with heating the curd. Cutting the curd allows whey to escape, while heating increases the rate at which the curd contracts and squeezes out the whey. The purpose of this stage of the process is to make a hard curd. The term hard curd is relative; the cheese at this stage is still quite pliable. The main difference between a soft curd and a hard curd is the amount of water remaining in the curd. Hard curds have very little water left in them.

Once the curds have sufficiently hardened, salting and shaping begins. In this part of the process, salt is added to the cheese. Salt is added for flavour and to inhibit the growth of undesirable microbes. Large curds are formed as smaller curds are pressed together. This will often involve the use of a cheese press.

Ripening

The shaped cheese is allowed to ripen or age for various periods of time. During this time, bacteria continue to grow in the cheese and change its chemical composition, resulting in flavour and texture changes in the cheese. The type of bacteria active at this stage in the cheesemaking process and the length of time the cheese is aged determine the type and quality of cheese being made.

Sometimes an additional microbe is added to a cheese. Blue veined cheeses are inoculated with a Penicillium Roqueforti spore which creates their aroma, flavour and bluish or greenish veining. Such cheeses are internally moulded and ripen from the inside out. On the other hand, cheeses such as Camembert and Brie have their surfaces treated with a different type of Penicillium spore which creates a downy white mould (known as a bloomy or flowery rind) this makes them surface ripened cheeses.

Many surface ripened cheeses have their surfaces smeared with a bacterial broth. With others the bacteria is in the atmosphere of the curing chambers. These cheeses are called washed rind varieties as they must be washed regularly during their ripening period (longer than for Camembert or Brie) to prevent their interiors drying out. The washings also help promote an even bacterial growth across the surfaces of the cheeses. As this washing can be done with liquids as diverse as salt water and brandy, it also plays a part in the final flavour of the cheese.

Rinds

The rinds of the cheeses are formed during the ripening process, many quite naturally. Some are created artificially. Rinds may be brushed, washed, oiled, treated with a covering of paraffin wax or simply not touched at all. Traditional Cheddars are wrapped around with a cotton bandage. The rind's basic function is to protect the interior of the cheese and allow it to ripen harmoniously. Its presence thus affects the final flavour of the cheese. **Salting** plays an important role in rind formation. Heavily salted cheeses develop a thick, tough outer rind, typified by the Swiss range of cheeses. Cheddar, another natural rind cheese, is less salted than the Swiss varieties, and consequently has a much thinner rind.

I hope this introduction to principles of cheesemaking has been interesting and informative. As you begin to make home made cheese, I would advise to start with the simple quick cheese recipes. Then, move on to the soft cheeses and finally the hard cheeses. You'll find that you learn more about the process every time you try a recipe. Your final cheese is affected by many factors. I would advise using a log book in which you can record such factors as starter type and amount, inoculation time, temperature, etc. Each recipe will have different factors you'll need to look at. The use of a **log book** will help you reproduce your outstanding cheeses on command, while avoiding the many pitfalls that can ruin your hard work.

Mesophilic Starter Culture

Cheese cultures are necessary to inoculate the milk with friendly bacteria. These bacteria serve two functions. First, they cause the milk to become more acidic aiding its coagulation. Second, the bacteria help develop the flavour of the cheese.

Cheese cultures are divided into two basic type's mesophilic and thermophilic. These terms describes at the temperature the culture thrives at. ***Mesophilic*** (from the Greek words meso - meaning intermediate and philic - which means loving) cultures thrive around room temperatures. ***Thermophilic*** (from the Greek words thermo - meaning heat and philic - which means loving) cultures require a higher temperature. Professional quality cultures can be bought from a cheesemaking supply company. They are usually available in a freeze dried form. A home-spun method is to use cultured buttermilk as a mesophilic starter or fresh yogurt as a thermophilic starter.

This simplest of cultures can generally be used for all recipes requiring a Mesophilic Starter. The taste of the final product will vary slightly from that of a true cheese culture.

1. Start with 2 cups of FRESH store bought Cultured Buttermilk.
2. Let the 2 Cups of buttermilk reach room temp. (70°F / 21°C).
3. Then allow the buttermilk to ripen for about 6-8 hrs. (Store bought buttermilk does not have a high enough concentration of bacteria to serve as a starter culture without ripening.)
4. The resulting buttermilk will be much thicker and sour then what you started with. It should have the consistency of fresh yogurt, if it doesn't let it sit a few more hours.
5. Pour this culture into a full sized CLEAN ice cube tray and put into your FREEZER. As with all steps of cheesemaking, cleanliness is next to godliness.
6. Once frozen, remove the cubes and put into a CLEAN sealed container or plastic freezer bags. It is a good idea to label the container to distinguish it from your thermophilic culture.
7. The resulting ice cubes are each 1 oz of mesophilic starter.
8. Add these cubes (thawed) to your recipes as required. The cubes will keep for about one month.

To make more starter culture, simply thaw one cube and add into 2 cups of fresh milk. Mix thoroughly with a fork or a whisk. Allow the milk/culture to stand at room temperature (70°F / 21°C) for 16-24 hours or until the consistency of fresh yogurt. Then follow from step 5.

Thermophilic Starter Culture

Cheese cultures are necessary to inoculate the milk with friendly bacteria. These bacteria serve two functions. First, they cause the milk to become more acidic aiding its coagulation. Second, the bacteria help develop the flavour of the cheese.

Cheese cultures are divided into two basic type's mesophilic and thermophilic. These terms describes at the temperature the culture thrives at. Mesophilic (from the Greek words meso – meaning intermediate and philic – which means loving) cultures thrive around room temperatures. Thermophilic (from the Greek words thermo – meaning heat and philic – which means loving) cultures require a higher temperature. Professional quality cultures can be bought from a cheesemaking supply company. They are usually available in a freeze dried form. A home-spun method is to use cultured buttermilk as a mesophilic starter or fresh yogurt as a thermophilic starter.

This simplest of cultures can generally be used for all recipes requiring a thermophilic starter. The taste of the final product will vary slightly from that of a true cheese culture.

1. Start with 2 cups of FRESH milk. Heat it to 185°F (85°C) on the range top or in a microwave. Be careful not heat to high or the cream will separate.

2. Let the 2 Cups of milk cool to at least 125°F (52°C) room temp.

3. Add one heaping table spoon of FRESH yogurt (either homemade or store bought "live and active culture" type like Dannon plain).

4. Mix the yogurt into the milk thoroughly with a fork or a whisk.

5. Keep the mixture at 110°F (44°C) for 8-10 hours until a firm yogurt has set. This can be done by using a double boiler on a low setting or by placing the inoculated milk into a small CLEAN mason jar placed in a warm water bath. The bath can be kept warm by placing it on an electric range top at the lowest possible setting (so that 'ON' light is just on). Monitor the temperature closely the first few times you do this and you will become a better judge of the temperature settings of your range top. This way with future cultures you can set the process up and not worry about it for 8-10 hours.

6. Pour this culture into a full sized CLEAN ice cube tray and put into your FREEZER. As with all steps of cheesemaking, cleanliness is next to godliness.

7. Once frozen, remove the cubes and put into a CLEAN sealed container or plastic freezer bags. It is a good idea to label the container to distinguish it from your mesophilic culture.

8. The resulting ice cubes are each 1 oz of thermophilic starter.

9. Add these cubes (thawed) to your recipes as required. The cubes will keep for about one month.

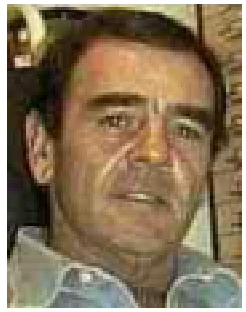
To make more starter culture simply thaw one cube and use it as the fresh yogurt used in step 3.

If you would like to know more about who is who, have a look at these links:

1. Bacteria chart
2. Mesophilic Bacteria: Lactococcus Lactis subsp. lactis, cremoris and biovar diecetylactis
3. Thermophilic Bacteria: Lactococcus thermophilis and Lactobacillus Helveticus

The Artisan Cheesemaker

Copied from web archives of the old www.dairy01.co.uk web site. The creator of this web site James Aldridge -cheesemaking guru and master, has passed away at 5 February 2001 but his memory lives. The information in this document is somewhat advanced and can be easily digested after reading the Introduction to Cheesemaking. There is no single recipe here but an entire story of "acidity control" throughout the cheesemaking. I have enhanced the information with links to Wikipedia; I advice to read it thoroughly and then have a look at the links later. Enjoy the document and share it as much as you can with the fellow Artisan Cheesemakers.



James Aldridge created a cheese called Tornegus. He bought an unpasteurised Caerphilly cheese from Chris Duckett in Somerset, which in its original state is delicate and crumbly. **(Here is a link for a Caerphilly recipe)** *He introduced a bacterium, R. lincus, spreading it over the young cheese with an English white wine brine, repeating the procedure every few days for seven weeks: "This is all important," he told the British food-guide writer Henrietta Green, "in the development of the thin apricot-coloured rind, the flavour and the softening of the interior." The cheese was finished with a scattering of herbs, which included lemon verbena and mint. The resulting Tornegus cheese was unctuous, with a rich and creamy texture and pungent flavour, more like analogous French cheeses than like any other British cheese being made then.*

Aldridge created a similar cheese, Celtic Promise, using a Caerphilly made in Wales by Patrice Savage, and washing it with cider. He had a sense of humour, and called his hard goats' cheese "Gruff".

What is Cheese?

The answer should be quite straightforward: "*Cheese is milk which has been concentrated and preserved.*" Preservation is, in a nutshell, the slowing down of the natural progression of putrefying organisms. In natural cheese-making one uses the following scientifically and historically sound methods of preservation:

Extraction of moisture: All organisms have a minimum required moisture intake necessary for survival. This requirement will increment relative to the energy used. Whilst a micro-organism is reproducing it will use more energy thus, by making less moisture available we restrict it's capability to reproduce, or even to survive at all if we so wish.

Removal of energy sources: In milk, the main energy source comes in the form of lactose (milk sugars). The lactose is dissolved in the water content of milk. If we reduce the moisture we also reduce the available energy.

The lactose is used mainly by the acid producing "starter" bacteria so, by encouraging the growth of these we reduce the lactose available to spoilage organisms.

Acidity balance: All organisms have an optimum acidity at which they will operate best. By controlling the acid production we, again, control the spoilage organism's survival and reproductive capabilities. We also control the actions of desirable organisms of course.

Salting: Salt inhibits the energy uptake of bacteria. The tolerance to salt will depend on the individual species of the bacterium and will vary from one species to another. The amount of salt used in cheese-making will depend on the type of cheese and the organisms that we wish to restrict. Salt is not used simply as a flavour enhancer.

Unfortunately, the answer is nowadays not so simple. Large-scale cheese production includes the use of a mind-boggling array of additives and preservatives. In Britain today at least 75% of our home production contains genetically modified material via G.M rennet. I would expect the percentage to be somewhat higher in the U.S.

Often the justification for genetically modified food production is that it helps to feed under-developed third-world countries. The other side of this argument is that it has lead to extreme unemployment in the agricultural sector. Smaller scale production would give us better quality and safer food and also a better quality of life for many.

Enough of that: on with the business....

First a few words of wisdom:

1. Your priority should be to make good cheese.

Profit should be a secondary consideration since; if you make good cheese you will make good money.

2. Always look for the cause rather than the cure.

James

Acidity Control – Part 1

The subject, which forms the basis of all cheesemaking, is extremely complex and you should accept these papers as a personal communication rather than as a definitive set of rules. They are a mixture of scientific facts, observations, examples, experience and a few opinions. They are intended to help shed some light on the way your cheese works and the ways in which you control it. Many of the following statements and descriptions of final results are conditional since: any reading of titratable-acidity can only carry a valid interpretation when related to a specific cheese, and the cheesemaker's daily log.

At first sight it may seem that I advocate a scientific approach to cheesemaking, in fact, nothing could be further from the truth. The great cheeses of the world are the sum of the experience of not one but generations of cheesemakers. In today's world this continuity of family pride, experience, and devotion to the traditional craft is not happening. Modern farming put paid to that.

So, what to do if we are not to loose these wonders of nature: cheeses whose flavours dance across the palette and are one of the joys of life?

Well, I hope to be able to help condense this experience by explaining much of what these people assimilated day by day. I certainly do not want to advocate the use of modern cheese-making short-cuts which exclude passion and dedication and place profit above quality.

My experience in the maturing and in the making of the many styles and varieties of cheese has taught me that, in traditional cheese-making, quality is inseparable from passion and that attention to detail is vital.

I have been described as "one of Britain's finest cheesemakers" however: I regard myself more as a fault-finder rather than as a cheesemaker, which is why I have worked with so many types and styles of making. I have made a deliberate study of cheese faults and have looked for the cures in the hands of the producer rather than in the use of modern technological "*cures*".

My desire is to see the survival of natural cheese-making; preferably using raw milk and organic practices.

What I ask is that you take all the following as a whole. There are no "*important*" parts. From the moment you take control of your milk everything you do, every time you move your hand, has a real effect on everything that comes afterwards.

Here we go then:

Milk, Lactic acid producing bacteria, Rennet (or other coagulant) and Salt. That's all we need...... Plus total dedication.

Oh, and one other thing...... you must be inquisitive.

Bacteria

From birth so to speak, take time to acclimatize themselves. If they then find themselves in a friendly environment they will reproduce and the numbers will increase rapidly. The numbers will reach a peak and then begin to decline. In cheesemaking this decline is the result of the bacteria themselves having used up all the available nutrients (there may be other reasons, which will be discussed). ***You,*** as the cheesemaker, will control the amount of nutrients available to your starter bacteria, and the suitability of the surroundings, and thus extend or limit their acid producing potential.

Lactose

Lactose is a disaccharide (two sugars) of glucose and galactose. It is dissolved throughout the milk fluid at a volume of around 5%. About 10% of the lactose is consumed during cheesemaking and the rest is lost into the whey. The lactose is the source of energy, in the form of carbohydrate, which is utilized by the lactic acid producing bacteria (starters). They consume lactose and exude lactic acid as a waste material. By the end of production most well made cheese will contain close to zero lactose. The starter bacteria will starve as a result and acid production will cease.

This activity also deprives many other bacteria of a source of energy, and this is one of natures "pathogen controls".

The acidity of the surroundings is all important in the world of bacteria and the absolute optimum acidity at which any given species of bacteria will operate at it's best is within a very small range: one step either way will be the optimum for another organism which will use the same energy source, and may possibly produce substances which are harmful to the competition.

E.coli is a bacteria which will utilize lactose as their energy source but, they will only reproduce at an acidity which is low in comparison to that favoured by your starter bacteria. You will find that most pathogens favour lower acid (higher Ph) conditions. A good starter will generate acid at an even rate (not necessarily fast), thus never allowing the *E.coli* to feel comfortable enough to start reproducing before the acid levels become too high for it to function at-all or, all the lactose has been used up by your starter and *E.coli* starves. Nature's pathogen control at work. Cheese, well made from good milk, will never present a risk to human health.

The principal of acid "control" is the basic principal applied throughout your cheesemaking. You control good cheese by controlling the optimums.

The rate and extent of acid production exert control over every aspect of your cheesemaking. This includes the viability of the **lipase** working in flavour production and in body structure. Lipase is an enzyme, which causes the break down of lipids into fatty acids and the fatty acids are major precursors of flavour. **Lipids** are fats. **Lysis** is the breakdown of a component. Lipid breakdown is known as **lipolysis.**

Although you can't see or measure the enzymes, you will find that the flavour profile of your cheese will change in relation to the rate and extent of your acid production, which controls the enzyme activity. When you change your acidity, or rates, (and throughout your cheesemaking you do just this) you change the optimums for the bacteria and their enzymes. Of course, this means that you are responsible for the flavour.

It follows, naturally, that the flavour profile of cheese made from pasteurized milk can never be as complex as that of raw-milk cheese. The enzymes are produced inside of bacteria. Raw milk may contain many hundreds of species of beneficial bacteria, and the only bacteria in pasteurized milk are those which are introduced as starters, or from post-pasteurization contamination. Though the use of enzyme "soups" which are added during cheesemaking in an attempt to re-create flavours and to accelerate ripening is now widespread in commercial cheesemaking plants. "Accelase" is an example. The "ase" ending tells us t hat it is an enzyme and "accel" is self-explanatory.

I notice that many novice cheesemakers in the USA are using what they call "flavour enhancers" along with their starters. These are the enzyme additives I refer to and are totally foreign to real cheese-making.

With freshly drawn cows milk you will expect to register a titratable acidity (TA) of 0.15 to 0.17. (This is a pH of about 6.7). Incidentally, you cannot compare "acidity" to "pH". You may know some points that match here and there simply from experience though. As milk passes naturally to the calf it will become contaminated with viable lactic acid producing bacteria (streptococcus thermophilous etc.) which thrive on the milk residue in the mouth of the calf and in the teat canal of the cow/goat/ewe etc. During the milk's passage through the stomachs of the calf these bacteria will begin to multiply - thanks to the availability of the milk lactose as an energy source and the close to optimum temperature for growth. Once in the abomasum (fourth stomach) the milk, now acidified, is ripe for the coagulating actions of the stomach enzymes, rennet.

So, we have a natural phenomenon: separation of solids from liquid: separated at a relatively low acidity by the effects of rennet and giving the calf a smooth, soft curd to digest (Cf. when a milk-fed baby burps up semi-solids). Without this "setting", the milk would pass through the animal's intestine too quickly and be only partly digested. Had the acidity been higher (faster) this milk would still have coagulated but the resulting curd would have had a grainier and less cohesive body, relative to the acidity, and not have been in optimum condition for absorption.

Milk will coagulate simply from the affects of lactic acid, without the benefit of rennet at pH 4.6. This is what is known as the *iso-electric point of casein.* At 20°C this will take around 24 to 36 hours depending on the starter. Fresh cheese made purely through this lactic coagulation will have high acidity and a very fragile body comprised of fine flakes or grains with little cohesion. The particles will be very porous and hold lots of moisture. These "lactic" spoon able cheeses are usually sold either absolutely fresh or, packed in airtight containers and chilled.

The elasticity (cohesion) of the curd is dependent on the mineral *calcium* and this is "fractured" by acid and will then drain from the curd along with the whey. The greater the acidity at coagulation time the less calcium will have been retained and the less cohesive will the resultant curd would be. It will also retain more moisture since it becomes more porous with the loss of calcium. You might think of calcium as the natural "glue". How much "glue" you allow your curd to retain will depend on how firm or soft, or dry or wet, you want the mature cheese to be. Commercial producers will add extra calcium to the cheese milk as it means that they can work at faster and higher rates of acidity than is traditional. They will give you other reasons but the truth is that fast acid rates upset the calcium balance and this needs to be restored artificially.

The Artisan cheese-maker should beware of using commercial cheesemaking practices as criteria for their recipes. You do so only at the cost of complexity of flavour and personality. This will lead to a devaluation of your products as commercial plants continue to "improve" the flavour profiles of cheese made from pasteurized milk.

Lactic Cheese: is coagulated slowly, 24 to 36 hours, at high acidity and low temperature; it lacks calcium, has high moisture content, a loose and inelastic body, and a very short shelf life. It will desiccate very quickly if left exposed.

Renneted Cheese: coagulates quickly (20 minutes to 2 hours usually) at lower acidity and higher temperatures, it retains more calcium, has lower moisture content, an elastic body, is often pressed and has greater keeping qualities.

Where lactic coagulation & rennet coagulation meet is *your* cheese. You are constantly working with a balance within these two extremes.

If you make soft or pliable cheese types you will be attaining a fairly high acidity (low elasticity) but relatively slowly. If acid production is too high, or fast, you will make hard dry cheese lacking in flavour. If it is too low, or slow, you will make a sticky mess prone to gas formation, or, a hard wet cheese.

If you make a hard-pressed cheese you will be working towards a lower acidity (high elasticity) but faster. If it is too fast you will make a hard dry cheese lacking in flavour. If it is too slow you will make a soft bodied, poor flavoured cheese prone to gas formation.

Rennet: is a concentration of live chymosin and pepsin enzymes extracted from the dried vells (stomach membranes) of un-weaned ruminants. It will cause milk to coagulate quickly at, and below, pH 6.5 (TA ≈ 0.18). How; is another story.

Similar coagulation can be achieved by stimulating certain moulds or yeasts to produce large numbers of other enzymes which will coagulate milk, often known as "vegetarian rennet" (Modilase, Renilase etc.). There is now also the laboratory produced "Chymogen" which is a genetically engineered synthetic chymosin enzyme (the base DNA used in these genetically engineered coagulants is usually derived from *E.coli* or from the mold *Aspergillus Niger*, both of which can produce toxins). "Chymogen" is a trade name but other companies produce and market these genetically modified coagulants under similar names. The use of these is illegal in some countries, though (at the time of writing) they are used in around 80% of British cheesemaking. Personally, I find the use of genetically modified organisms in food to be quite frightening.

The coagulant you use will help determine the flavour, aroma and body structure of your cheese.

Cynara Cardunculus

The plant "Cardoon" naturally produces an enzyme *(Cardosine A)* which will coagulate milk. This is a true vegetable coagulant and is used by most Artisan cheesemakers in Portugal. It is a member of the artichoke/thistle family. The flowers are plucked and dried then infused in warm water into a tea which is then used in the same way as one would use rennet: I usually use around 25 grams of dried flowers, twisted into a bag of cheesecloth, to a large cup-full of warm water to make up mine. I am not sure that it would be suitable for a cheddar-type cheese as it produces a more delicate set and, in my experience, seems to be rather more proteolytic than rennet. It has a quiet different life about it and it needs a perceptive person to work with it. *{The amount you use will vary for many reasons... try 5 ml. of the mixture per litre of milk as a jumping in spot}*. It grows fine in the U.K. and is perennial.

The coagulum of milk set mainly by the action of rennet (or other enzyme coagulants) will be so homogenous as to be jelly-like, since it will have set quite quickly at relatively high temperature: it will not be very acidic and will not have lost much calcium "glue". It will have shrunk slightly, and enclosed a lot of moisture within itself. That is, within it's mass, not within the actual particles. All of the lactose will be accessible to the starter and the main acid production will start during coagulation. It is at this time that the acid producing starter bacteria are most active: it is warm and there is a high concentration of lactose available in the moisture to supply the energy to reproduce.

If we simply leave this coagulum undisturbed for some hours it will become very acidic.

If we cut or break the coagulum so as to cause it to loose moisture, and lactose, then the resulting curd will be less acidic in the same number of hours.

If we actually remove some of the moisture (whey) then the resulting curd will be even less acidic.

The amount of acid produced within the curd from now on, *you* control through temperature and the rate at which it is applied, the time that you allow the moisture to remain in the curd, your cutting, stirring, pitching, texturing, room temperature, milling, pressing, molding, type of mold, humidity, turning, salting. These are all acidity control points and will all influence body and flavour. *If you make cheese already you are using these controls.*

If you take 20 litres of milk, take it to 20°C / 21°C centigrade, add 1% starter (this is about equivalent to what would be used in the average British hard cheese) and leave it undisturbed in an ambient temperature of 20°C / 21°C, it will coagulate in 20 to 24 hours.

It will form a very delicate curd. If you handle it gently you can scoop the curd into a coarse muslin cloth which you should tie and hang to drain for a further 24 hours at 20°C / 21°C, then hang in a fridge at 4°C for 24 hrs to produce a wonderful Quark Cheese. It is usually lightly whipped before serving or potting.

This is lactic cheese. In other words, the coagulation results purely from the effect of lactic acid and is rennet-free.

If you add just one drop of rennet to the milk you are taking the first step towards rennet cheese: the curd will set sooner and will be more cohesive, and will be closer to the modern *Fromage Frais*. One more drop and the curd will be stiffer and more suitable for cheesecakes etc. There's a limit of course.

The acidity must still be allowed to rise for the full term before the curd is disturbed. The more acid the curd the deeper will be the surface layer of free whey, and the more likely you are to observe cracks in the curd surface.

You will probably find that when the ideal acidity is attained you will see that the curd is just beginning to shrink away from the sides of the vessel, and there are perhaps just one or two small cracks in the curd surface. The acidity at which you disturb this curd is extremely important to the quality.

You should take a reading of the whey acidity before you disturb the curd, then when you make a first rate cheese curd (not too acidic and fragile, and not under acid and stodgy) you will have a guide for every make. In fact, you will have a recipe and in future you will ladle/cut according to acidity and use time merely as a guideline.

You may increase or decrease the acidity simply by extending or decreasing the time, or by increasing or decreasing the amount of starter. Temperature changes will affect acidity rates but will also affect the curd shrinkage and body.

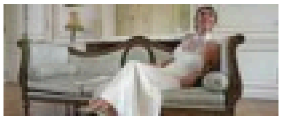
The most common causes of failure are poor temperature control and poor starter management.

The whey in which your cut curd is floating contains lactose; if you reduce the lactose available to the bacteria within the curd then you reduce their life span and acid producing ability. The point at which you remove the whey is a major acidity control. The sooner you remove it the slower will be the rate of acid production during the rest of the make. The smaller you cut or break the curd the slower will be the rate of acid production. This applies whatever cheese type you are making. If we were to cut our curd into 1 inch cubes each cube would have 6 square inches of surface area from which to loose moisture. If we cut these cubes in half we will now have 8 square inches of surface area, and so on.

As the available lactose decreases the bacteria recognise this and will reproduce ever more slowly to avoid over- producing competition for the failing nutrients.

The curd shrinks and looses moisture through the influence of heat, acid, and of rennet: and through physical pressure (stirring etc.). With any cheese, the way in which you handle the curd throughout cheesemaking will influence the acidity of that days make. The more roughly, or firmly, you handle your curd the faster it will loose moisture (containing lactose), and therefore will have a lower potential to produce acid. The more you leave it undisturbed and the more gently you handle it the more it will acidify.

The French have a wise old saying that it should be handled "like a bride".



Pressure at any stage before salting will influence acidity. In fact, any physical action which assists drainage will reduce the acidity potential by reducing the amount of moisture in the curd and, along with it, the lactose which is the energy source for the remaining starter organisms.

With experience, you will eventually be able to quite easily "read" the acidity of the day's curd simply by the feel of it related to time. The more fragile the more acidic. The more stodgy the lower the acidity; as a basic. Don't kid yourself too soon though.

As you will see, what you do at any given point usually has no immediately apparent influence on your cheese: it all takes time. This is where your acidity readings and log becomes your back door into what is going on in there. Once you know what the acidity should be at certain stages then, in the midst of a make, you will be able to decide whether or not you need to increase or decrease the rate from then on in order to maintain the right balance for your cheese.

How do you find out what the acidity should be at these "stages"?

Well, first off, you make a cheese, whilst being guided by a recipe from whatever source that is somewhere in your mind around what you would like to make.

You will see cheese grow in your hands. Study what is happening, study your curd, take acidity readings and you will begin to recognise *"high" and "low", "fast" and "slow", "wet" and "dry"*. If you can follow a cheese throughout its life you will begin to assimilate all, from the milk to the end effect.

Don't worry too much about *mistakes*, there is no such thing. It is all learning, and every *mistake* adds to your experience.

When, one day you make a "great" cheese, you will know how you did it, and you will keep that basic record come hell or high water. When your readings wander from the norm, and what you make is not great or it just doesn't feel right today, ask yourself why? Compare the logs and see what is different. Listen to what your cheese is telling you, feel it, talk to it, and assimilate everything you can from it at every stage. Cheesemaking is not something you can do now and then… you must live with it! Then you must learn how the seasonal deviations in milk and weather will call for changes in your making.

If you have come this far then you realize that you have not set yourself an easy task. The rewards though, of working with nature, are overwhelming.

Try not to make more than one change at a time to your recipe.

You have a limitless number of possible combinations to work with but one group will apply uniquely to your cheese, and you will get to know them much sooner simply by listening to what your log has to say. The variations can often produce favourable end results but, if you have no record of what you did it can take years before you are able to repeat it, and it is so easy to get lost by wandering further and further in the wrong direction.

You probably won't see the end results of your actions for some weeks or months even, and it is extremely unlikely that you will remember every one of your actions over this period. You must keep an honest Log!

You should be aiming always for that "golden" cheese, and a good cheese-maker is able to control the make to such an extent that any deviation is minimal. This is not standardization; this is simply good cheesemaking practice.

All this may seem rather nebulous to some of you but, we'll get there.

Acidity Control - Part 2

Enzymes are catalysts; they initiate innumerable reactions in your milk and in your cheese. Distinct enzymes tend to initiate definite reactions. Lipase, as we have seen, causes the breakdown of fats.

Protease causes the breakdown of protein. This is proteolysis (protein - protease - lysis - proteolysis).

Casein is the major protein found in milk or cheese, and this forms the greatest bulk of the cheese body.

Lactase causes the breakdown of lactose and also contributes to flavour and aroma.

Enzymes are vital to the body and flavour changes in the milk and in the ripening or maturing cheese. They are produced inside of bacteria and, whilst some are released when a bacterium is still functioning, most are released on its death, throughout cheese-making *and* maturing.

Bacterial, and therefore Enzyme, actions, or non-action, are controlled by acidity, temperature and available moisture.

It's the enzymes that cause the breakdown of a "wet acid" cheese like Camembert into a soft, putrefying mess within two to three months. It's the enzymes that cause the transformation of a lumpy, low acid, curd into smooth "dry" Cheddar in nine months. It's the enzymes that help produce good flavours and to produce poor flavours.

So, although the milk will supply the initial ingredients for flavour, it is you the cheese-maker that will control the actual flora and flavour production. Not that you will do this consciously at first.

The controls for enzyme action in maturing cheese are temperature and moisture.

The higher the humidity of your maturing room the more moisture will be retained by your cheese. The more moisture retained by your cheese the more rapid will be the breakdown. The higher the temperature the faster the breakdown. The lower the cheese acidity the faster the breakdown. (*This has to be qualified, later).*

Fast breakdown may be desirable in some cheese and these are stored at high humidity in order to retain the moisture content throughout maturing. Other, dry-rind, cheese would be kept at a relatively lower humidity so as to discourage surface breakdown due to mold, bacterial and enzyme action, and to ensure that flavour reactions take place at a rate suitable for that cheese. The bandage on traditional Cheddar is part of a carefully controlled moisture loss system.

I use the word "traditional" in its true sense, not, as it is used nowadays, to elevate the marketing image of a factory cylindrical cheese above that of a factory block cheese.

Acidity Control – Part 3

The Makings – Milk, Starter, Rennet, Salt

Milk: Poor milk will make poor cheese; however, good milk will not necessarily make good cheese. It is the diligent cheese-maker who makes good cheese. Good milk is that which is hygienically drawn from healthy animals.

Every pasture will present a different array of vitamins, minerals, proteins, fats, acids, bacteria and enzymes. The more natural the pasture the more diverse the basic ingredients which the cheese-maker has to work with. Consequently, the more complex are the flavour and aroma compounds available to the cheese-maker.

Every animal will add its own system to the chain and produce milk that is distinct from another's. The possible variations are limitless but will produce a unique consistency throughout a herd or flock.

Sheep's milk will contain between 60% and 100% higher total solids than will cows milk. Goat's milk will generally contain 1 or 2 percent lower total solids than cow's milk.

Therefore, a recipe designed for cows milk cheese will need to be quite drastically re-vamped in order to produce a similar cheese using either sheep or goat's milk.

Starter: There are many possible natural variations of bacterial mixes. The bacteria naturally occurring in the milk from one area, or farm, are likely to be quite distinct from those found in milk from another site. If you were to rely purely on these bacteria then you would be rather more restricted in what type of cheese you could produce. There are many species and sub-species of lactic acid producing bacteria and some will have very distinct optimums for growth. Some of these will produce other things aside from lactic acid. They will produce other acids, at various rates, gases (useful for Emmental, Gouda, Blues etc.) and, different enzymes - which all serves to create distinct reactions in the cheese-making and cheese ripening. You also need to consider the temperature range of your cheese-making - for example - the Gruyere, Emmental and Italian types are taken to high temperatures during the making (Gruyere will be taken to around 55°C) and this calls for the use of a "thermophilic" (high temperature) starter, whereas the majority of cheese-making uses "mesophilic" (lower temperature) starters, these will be damaged or killed at temperatures above 40°C.

Whatever system of starter you may use the even distribution of the organisms throughout the milk is vital to good cheese-making. In other words, don't skimp on the stirring when adding starter.

If you were to propagate the lactic acid producing bacteria naturally occurring in your own milk you would have a starter which was unique. If you use a frozen or freeze-dried starter then this may be either propagated or, inoculated directly into your milk. It makes no difference to the quality of your cheese whether you propagate this daily or use it for direct inoculation, provided you stick to one method. However; a propagated starter will be already active, and we shall see as we progress how this will affect the cheese-making recipe.

If you are not intending to produce your own *natural* starter then you need to take advice on which commercial mix to use. This will depend on the style of cheese that you hope to make.

If you take pot luck with your neighbour's starter you will be restricted within a range of styles. This doesn't mean you can't make a cheese that is very different to your neighbour's, simply that there will be cheeses that you can't make.

In Britain it is still possible to buy what are known as *"frozen pints";* these should be historical mixes which originated on the farm and have been propagated and maintained as pure for many years; however, these mixes were developed only as a basis for hard Cheddar-type cheeses and would be quite unsuitable in many other styles of cheese-making which are now practised by our Artisan cheese-makers. Just as the Dutch Gouda equivalent or the Swiss Gruyere would be unsuitable for Cheddar making.

Whatever type or method of starter addition you employ you must treat your starters with as much respect as you should the rest of your cheese-making. I mean absolutely must! So many silly problems stem from starter ill-treatment.

I have a French cheese-maker friend who does produce his own, natural starter, as do many European cheese-makers (though I know of none in the U.K. who do so except on the odd experimental basis).

This calls for the hand milking of a prime animal, which has not been treated with any anti-bacterial teat applications, and allowing the milk to acidify naturally from the effects of the endemic teat bacteria. After splitting and propagating this milk for the first few days in order to detect any obvious problems, one uses a percentage of it to produce *the required acidity in the required time in a specific amount of milk* (easy aye?). This can then be used to start the cheese-making, whilst the required amount is propagated in more milk for the next day, and so on. (A common-sense follow-up would be to have the early "starter" tested for possible contaminants).

Another method is to allow the evening milk to acidify naturally and mix it with the fresh morning milk. It requires a cheese-maker of great experience to make cheese in this fashion, and even then will produce extremely variable cheese, requiring intensive care in the maturing room.

Another method is to "start" your milk with a specific amount of live whey from the previous day's make. This method is usually only employed where the cheese-making involves overnight coagulation and fresh whey is directly available to inoculate the fresh new milk, as with much Goat cheese-making.

"Natural" starter production is a practice that is frowned upon nowadays since during propagation the milk is highly susceptible to contamination. These starters will gradually become less active and knowing when to change them is almost pure art. Natural propagation should only be employed by a very experienced producer. Animal health, milk and hygiene have to be immaculate and it would be most unsound to even consider producing a starter from bought in milk. Experience is the main factor - and this doesn't come without a price.

If you intend to make cheese commercially on even a small-scale basis then it is unrealistic to consider producing your own starter. Unless you have two or three generations of experience to call upon in your cheese-making.

Changing from your own, *natural*, starter to a commercial one would change the characteristics of your cheese and would necessitate changes in the recipe, which would still result in a noticeably different cheese.

It is for this reason that many small-scale makers in Europe have the benefit of derogations under E.C law, from the T.b.c standards for raw milk for cheese-making. *(In Britain our own Ministry of Agriculture decided that the small-scale makers should not be granted these derogations, which, effectively, makes it illegal in Britain to produce many of the traditional Goat-milk cheese styles). (fu) (sic)*

The D.V.I. starters (direct vat inoculation) are pretty consistent, and variations are minimal. If you don't use a whole sachet the rest must be stored in an airtight container and kept dry, cold and dark, or discarded; folded over is not good.

The average Dairy microbiologist will tell you that you should never split sachets but discard any unused culture. This is purely academic hygiene since, for your culture to become contaminated in the dairy, conditions would need to be such that your milk would be already contaminated. The least intrusion of moisture from the atmosphere will weaken the culture (it will get lumpy) and in this case it should indeed be discarded. Ultra-violet light will kill bacteria in seconds, so sunlight and fly-zappers are particularly to be avoided. This applies to rennet as well. Phenolphalien, which you use with your acidometer, is also affected by light. You should store it cool and dark.

Wearing my "purist" hat I would like to see more use of natural starters; however, my realist's hat tells me that this is not something which I should encourage. The reasons for this are numerous, and are based neither on legislative nor on hygiene considerations. Someday I may get around to explaining the reasoning on paper but, as I said, it is extremely complex and involves every aspect of cheese-making from pasture to maturing.

Rennet: We have pretty well covered, unless anyone is considering treating their own vells. The effects of rennet will be discussed later. The amount of rennet you use will affect the final cheese so this will depend on the type, or style of cheese you intend to produce. You must measure the quantity accurately for each make.

Salt: Salt restricts bacterial growth. For the starter bacterium to obtain lactose it must absorb it through its cell wall. If you could block its pores it would starve to death. This is more or less what salt does.

Different bacteria have different tolerances to salt. Starter bacteria are (in general) restricted by around 5% salt. That is salt percentage in moisture, not in the whole cheese (this would be around 2% in a 40% moisture cheese).

Salting too soon can produce a low acid cheese and leave residual lactose available as an energy source to many undesirable organisms.

In British territorial cheese-making (Cheddar, Cheshire etc.) the salting stage is reached in just a few hours, and salt is deliberately used as a bacterial control. Fast acid production is employed and the lactose level is further reduced by cooking, stacking, cheddaring, salting, and milling the curd and then subjecting it to high pressure. Stilton is the exception and still retains ties to its French origins, as did Wensleydale Cheese until the early years of this century when the process became heavily mechanized and the recipe was bastardized.

In most cheese-making styles salt is applied much later, usually from 1 to 3 days after moulding, and the salt is applied either on the outside of the fresh cheese or by immersion in a salt (brine) bath. In such cases the cheese-maker relies on control of the starter bacteria for the job of lactose removal since these types are rarely heavily pressed, and many are not pressed at all.

Camembert cheese is not pressed at. *Stilton* is not pressed. *Parmesan* is very lightly pressed for about an hour, if at all. *Manchego* is lightly pressed by stacking one mold on top of the other and inverting them frequently. Most *Tomme type cheese* is pressed simply by hand pressure, or a weight of less than the cheese. (In all cases we are talking of traditionally made cheese).

Remember, the starter bacteria are still functioning since these cheeses have yet to be salted so, pressure, or the lack of it, is an important part of the acidity control.

Acidity Control - Part 4

You should use an acidometer and learn to understand the implications of the readings. Once you do this then you will know how to steer your cheese in the right direction or at least, away from something that is obviously not what you want. You can compensate for hic-cups, and make minor changes, if you understand what effect they are likely to have on the following stages.

Even if you don't understand technically you should soon begin to associate fluctuations in the log with fluctuations in your cheese.

Acidometers are very simple to use and will cost you around 60 pounds sterling If you don't use an acidometer it will take many years of trial and error before you are confident that your cheese is good, and fairly consistently so.

During this time you are assimilating masses of information and learning to interpret them through personal feelings of touch and smell and the look of things. This learning is a great experience. Full of frustrations of course - and lots of pretty dismal cheese. If you start with a little more information many of the frustrations are minimized, and the dismal cheese periods are reduced.

If you are making cheese for the right reasons you will eventually get there anyway but this will take you many years, and every hic-cup is a costly headache and a waste of good milk.

I have known many cheese-makers who did not, and do not, use an acidometer. Some of these have long term experience and make cheeses that have earned their place in history.

When these same people had little experience and were making cheese of variable quality the market was tiny, or local. Most of you now are aiming at a wider market, which means that the majority of your cheese will be handled by people with little experience, and a greater consistency in the quality of your cheese-making is required. Sooner.

You should keep a fairly detailed log when learning, or developing a new cheese. (If you don't have a record of what you did last month, and you have gone down the wrong road, you will get lost trying to get back).

Once you are happy with your cheese the log becomes a very brief record. Ideally, you should learn the basics by working alongside an experienced cheese-maker. The more you can work with, the more you will be influenced by the diversity of styles.

A log is a simple affair. It is a record of time, temperatures and acidities (and a few cryptic notes). Not complicated, and not a bother at all. Particularly, if you are making just one variety and use a large diary as a log. You must be able to easily compare today's make with the previous ones.

The layout of your log is up to you. You need to record temperatures and acidities related to time. You can buy printed log sheets for the standard British cheese varieties, but the layout of these is not suitable for the majority of Artisan makers. You can easily design one that suits you though.

Something on the lines of the one below can be used for any type of cheese. *Another more comprehensive form designed by Gurkan Yeniceri is at the end of the document.*

You will need a clock. Preferably one that is easy to reset, as it is much easier to compare one make with another if you time each make from zero, or 12 o'clock.

Type/Quantitiy of milk:		Litres/Gallons	
Starter per 100 Litres/22 Gallons=			
Rennet per 100 Litres/22 Gallons=			
Starter this make=			
Rennet this make=			
Time	**Temperature**	**Acidity**	
0.00	30°C	0.18TA	Starter in
0.45	30°C		Rennet in
1.30	30°C		Cut
Rest			Heat on
1.40	31		Stir
Etc	Etc	Etc	Etc

Example Artisan Cheesemaker Record form

Acidity Control - Part 5

Let's Make a Cheese

I think the best way to continue is for us to run through a simple recipe. I must first assume that the milk is of good quality and that you are using good (realistic) hygiene practices. Without good hygiene you will not make good cheese. We will discuss hygiene elsewhere but for the moment we must assume that you already have an understanding of the subject.

Ready ?.... O.K.

We will take 100 litres of milk. Let's make it sheep's milk as we can then include some discussion of the differences you will encounter with milk from other species.

(Sheep's milk contains almost twice the total solids of cow's milk. Goat's milk will generally contain a little less total solids than cow's milk. As acidity is read as a percentage in moisture the differences in solid content will affect the reading of fresh milk, not the actual pH though.).

We will take this milk to 28°C. If we were using cow's milk this temperature would probably need to be around 30°C, you may have worked out why already.

We want the milk temperature to stabilize at 28°C, and to achieve this we will need to cut off the heat supply a **few degrees before** that. Just when you cut the heat will depend on your heating system. You will generally find that you need to cut it at 2 to 3 degrees below the desired temperature and then wait for it to stabilize. The faster you heat the sooner you will need to shut it off.

Starter addition is next. We are going to use a medium to slow mesophilic D.V.I (Direct Vat Inoculation) starter. We will use 8 ml per 100 litres of milk. We need 8 ml today then. Do this right. If you change it you make a different cheese: maybe something nice or maybe not. Either way, your cheese will change because ***you*** tell it too.

I find that the easiest way to measure D.V.I starter is to use a set of small kitchen spoons. (Buy a set for a few pence from any kitchenware shop). These will measure in millilitres but, the object is to find a way to add a measurable amount of starter, and this is an easy method when using small amounts.

The reaction from a starter is never going to be precisely the same in each make but your cheesemaking will fix this.

Sprinkle the powder over the surface of the milk and stir well in for a few minutes. There must be no sign of any grains when you are done.

Cover the vat, bucket or pan and leave it for 1 hour. Give it a stir occasionally when you are passing.

Providing you have the room at around 20c there will be little or no heat loss.

You now need to take a T.A. (reading of titratable acidity). You should have a fairly high reading of around 0.26 as it is ewes milk (the acid/whey concentration is higher because of the higher solids). If you do not then you have a problem; either your milk is contaminated or you have mishandled the starter or you did not attain the desired temperature.

Rennet addition: We will use 20 ml. per 100 litres. This is around average for a British style cheese. The rennet needs to be mixed in about six to ten times its own volume of sterile cold/tepid water. This will help to distribute it evenly throughout the milk.

Stir it thoroughly into the milk for about 2 minutes (with cows or goat's milk you may stir for a little longer, though if you are working with small quantities 2 minutes is sufficient). Do not stir for to long but make sure that you stir upwards from the bottom to ensure a good distribution. If you continue to stir once the rennet takes its first bite you will ruin your cheese irretrievably.

Cover the vat again and leave for around 27 minutes. You must not disturb the forming curd in any way during this period. If you uncover the vat do so very gently as any vibration will shatter the curd and cause it to release moisture which will result in a slower acid production, and you will then have a different curd to deal with throughout the rest of the make.

(If you were using cow's milk it would take at least another 30 minutes before the curd was ready to cut. Not that a cows milk cheese can't be made using the same style of cheesemaking).

What we now have is a nicely acidifying curd that presents an environment that is unsuitable for the growth of pathogens. It will have lost some calcium and the minute particles will have become absorbent and will retain moisture throughout the making and maturing.

If you were to use more starter the acid production would be faster and the particles would retain too much moisture. This will lead to a cheese that will leak moisture at the beginning of the maturing period. It will then gradually become hard and grainy as it ages. A very similar end result can result from the use of too little starter also, as we will see.

You now need to check if the curd is ready for cutting. To do this you should push your dairy thermometer, finger or a small rod a few inches down into the curd and lift it gently up and away from you. When the curd is ready for cutting it should break evenly across the rod. If it breaks unevenly and sticks to the rod it is too soon to cut and you must try again in a few minutes. Do not leave it longer than is necessary or the resulting curd mass (not the particles) will retain too much moisture and the cheese will be sour.

The smaller you cut the less will be the acid production in the later stages. The type of knives you use are usually an important consideration, but in this case we are going to cut very small so almost any style of knife will be ok.

You must be very gentle with the curd from now on. Cut as gently and as evenly as possible. Ideally you want a series of vertical cuts followed by horizontal cuts and keep repeating this procedure. This will depend entirely on what type of knife is available to you but aim gently towards a uniformity of curd piece size.

Take your time and get the curd pieces down to about 3/8 of an inch cubes (1 cm) in 20/25 minutes. Now take 5 to 10 minutes and clean and sanitize your knives, and your hands and arms. Now stir the curd, preferably by hand. Start gently from the top and gradually work your way down to the vat bottom without crushing the curd, then stir for a few minutes until the pieces are all separated and floating freely.

Now apply just a little heat (you are looking to raise the temperature to just 30°C in 20 minutes) continue a cutting and stirring motion with your vertical knife. The curd should still be quite tender an easy to cut. You must keep an eye on the temperature during this period and, soon after it starts to rise turn off the heat. You do not want it to continue rising and go above 30°C or you will make a chalky cheese. Keep up a gentle cutting and stirring action until the pieces resemble peas and rice (perhaps another 20 minutes). Stir to float the curd and then allow it to settle. (Apart from the cutting, the curd pieces will be reduced in size by the shrinking effect of heat).

Now, leave it to rest (pitch) until 2 hrs and 35 minutes have elapsed since you put in the starter. {start time}.

Then stir for a few minutes to float the curd again. Now take another T.A. It should be around 0.17. This appears to be lower than when renneted. *(Don't worry about that for the moment, as I shall explain it later in the pages)*. Record it though.

Cover the vat again and leave (pitch) until it is 3 hours from start time. Take a T.A. This should now be at 0.22 to 0.25.

You have almost finished the actual make now. Give it a good stir to separate the curd pieces. It should still be easy to crush the curd pieces at this stage.

You now need to remove most of the whey from the vat. {*Not all, as you would in cheddar making.}*

An easy way to do this is to put a sanitized basket of some sort into the vat (perhaps a plastic colander) and scoop the whey off, from within the basket, with a small bowl. From 1 hundred litres of ewe's milk you get very little whey and it takes maybe five minutes to take off the desired amount.

Stop when you have the level of whey just below the settled curd level.

It is now time to fill the molds.

There is a picture on the previous page of the type of mold that I use (plenty of drainage holes) so try to get hold of something similar. If you can get some that are just slightly tapered all the better as you can stack them 2 to 4 high rather than use weights. You don't have to use cloths in the molds since these are virtually "basket mold" cheese, but if it suits you to use cloths it is better not to do so until after the first turn. (I simply place a cloth under the follower when the weight is applied).

After the first turn you will need to place a follower on the cheese unless you are using tapered molds.

Fill the molds to the top as quickly as possible without rushing, and as soon as you have them all filled start with the first one and invert it onto a table. The cheese will drop out in one piece (if it tends to break up at all you probably took the temperature up too high in the vat and dried the curd out too much). Pick up the cheese gently, holding only the sides and drop it back into the mold.

When you have them all turned place your follower on the cheese and then an 8 to 10 Kilo weight (a clean plastic bottle filled with water? 1 litre weighs 1 kilo). Repeat this procedure after about 20 minutes, then 15 mins, then after 30 mins and again at gradually longer intervals for about 5 hours. ***The trick is to get both ends uniformly smooth.***

You should watch the rate of whey expulsion from the molded cheese and when it is barely perceptible take an acidity reading from it (take lots of them at different stages at first, watch them increase and record them. This will teach you how to recognize the *rate* of increase). This should be done at the same time, from start, on each make. Be sure to use fresh whey. (I use the first molded cheese on a separate draining tray, to catch the whey from for reading). These reading are important clues to the consistency of the quality of your cheesemaking and will assist you in making variations to the recipe in future.

Remove the weight as late as possible and leave the cheese in the mold overnight with the least smooth side down. Room temperature should not drop below 18°C /21°C during this time.

Turn in the molds as early as possible next morning.

At around 22 to 30 hours from starter (this will have to simply be juggled to fit in your day) place the cheese in a 20% brine solution. You need to sprinkle the top of the floating cheese liberally with salt or the upper surface will retain too much moisture, which will cause this side of the cheese to soften during maturing due to excess enzyme action.

The 2 kilo cheese will need to stay in the brine for about 19 to 24 hours. A larger or denser cheese would need relatively longer, and vice versa. A small, fresh goat cheese style would brine-salt in 1 minute.

On removal from the brine bath the cheese should be placed on a clean wood board, which is set at a slight angle to assist drainage, and turned onto a fresh, dry board, every few hours for the next two days, The humidity of the room should be in the region of 75% Rh (relative humidity) this may call for the use of a fan or dehumidifier at times.

Once the cheese surface is fairly dry to the touch then the cheese should be taken to the maturing room (at an Rh of around 86%) and turned daily for the first ten days. After this it should be turned regularly to ensure an even moisture balance throughout the cheese for the rest of the maturing period (10 to 20 weeks at 15°C /58°F).

This will be your interpretation of the cheese below. But what you make will be ***your*** cheese and in subsequent makes you will refine your making and stamp your soul on it. This is where your understanding will come into play; you know you can communicate with your milk and with the curd. Think about what your hands are doing, store every feeling, record as much as possible, and ask yourself ....WHY?

The answers are in your log. When the cheese is different next time, *and you are keeping an honest log,* it will show in the entries. Just try a rise of 2°C in your heating and see the difference (you will need a good deal more weight when pressing though). Try reducing the milk ripening time and you will have a different cheese again. Stir for longer and pitch for less time, and you will have another cheese. Cut the curd larger... another cheese.

Every time you move your finger you are affecting it as only you will ever be able to. It's ***your*** cheese. Only total dedication will make it consistently good.

In fact I filched the recipe style from a Westmoreland farmer and it is very much a "Northern" cheese.

100 litres of ewe's milk will make up to 22 kilo / 48 LB of mature cheese.

Well cared for, the cheese should be best at about four months +, but is also nice as a young fresh cheese.

Matured, it should have a thin sturdy rind and a very slightly open texture barely tending towards flakiness. The body should be firm yet smooth and light after the onset of homogenization, or enzymatic breakdown, at about three months. It should not show any signs of distinct breakdown under the rind.

After a month or so in the maturing room the cheese will have formed a fairly firm mould-covered rind. If this mould growth is allowed to proliferate uncontrolled it will cause the rind to soften. (The mould will reduce the acidity of the rind and this will then lead to excessive enzyme action). To prevent this you must at first rub the rind vigorously by hand now and then to restrict the moulds and, as the cheese ages, gradually progress towards an occasional vigorous brushing with a stiff bristled brush.

Matured Cheese

Although it will be a good keeping cheese it should always be light and quite moist nonetheless. It is just a simple cheese, yet the making embodies the basis of all cheese- making.

This recipe, with very little variation, also makes an excellent Blue cheese. You will simply need to include a little "penicillium roqueforti" with the starter, do not cut so small in the later stages, press very lightly, pierce the cheese at around 3 weeks and do not allow the humidity to drop below 90% in the maturing room until the cheese is at least 8 weeks old. You may need to run a hot knife over the cheese on the second or third day in order to smooth the surface. You are aiming for a Stilton-like rind finish eventually or, if you film-wrap it, pierce it at around 4 weeks, still in the film, and store it at 4°C for 4 months you will have a very different but equally nice cheese.

Notes: This recipe is kept simple for those of you who have no mechanical press. If you do have pressing facilities then applying a few basic changes will give you a smoother, lower acid, cheese (does not apply to Blue cheese).

Do not cut the curd quite as small: reduce the pitching time and increase the stirring times: and increase the scald temperature by 2 to 3 degrees (ideally at a rate of about 1°C per 10 mins). You will need to apply just a little pressure initially and use cloths in the mold after the first turn, when you can then increase the pressure progressively.

Your log will, of course, look quite different and you should by now be able to work out how these actions affect the acidity readings and the body and texture of the cheese.

Remember: personal attention to detail (smell, feel, taste and look of the curd) in each make is vital if you are going to make a consistently good cheese. Your readings are just a powerful tool in learning how to talk to your cheese.

If you use the fresh whey from this make (it will become too acidic if left for long), and you have the facilities, you may like to take the whey temperature up to around 90°C (just below boiling), turn off the heat and then leave for about 40 mins. You will see that the remaining protein will flocculate and float to the surface. Scoop this off into a basket with a fine strainer and allow it to cool and set. You now have the finest ricotta.You need to use a Bain-Marie style of heating... not direct heat. When I make for the family I use a stainless bucket inside a larger one part filled with water, and heat on a gas ring.

Brine Baths

The older cheesemakers will tell you that you should not renew your brine but simply add more salt as required, and they have very sound reasons for this.

However; in today's climate of hygiene hysteria it is advisable to change your brine solution periodically.

When you first make up a fresh solution the pH of this will be around pH. 7.00. (Neutral).

Now, the average pH of any cheese, which you are going to float in this solution, will be around pH 5.00. When you use this new bath the pH of the brine will try to level out and this will increase the pH (in other words, reduce the acidity) of your cheese. This will lead to many possible defects:

Usually they will manifest themselves most visibly in rind defects. You will feel a greasiness of the rind at first. This will develop into areas of sticky and discoloured patches, with the discolouration varying from straw colour to bright orange, red or brown. The surface will be prone to show growths of the black or grey mucor molds (*poille de chat*). The body of the cheese will be weaker and softer than desired. The low acidity will favour the growth of spoilage organisms, flavour will suffer and the keeping quality of the cheese will be reduced considerably.

No problem:... there is an answer to this. As any Dutch Gouda maker can tell you. You simply add acid to the fresh solution and from there on both the brine and the cheese are happy. This can be done with lactic acid but the cost is a little high. I use the same acid as the cow does in its digestive system: hydrochloric acid (which you can buy from a chemists / local pharmacy).

Right, let's make up a brine bath.

You need a 20% solution. We will work with 100 litres, just to make things easy, but you will make up what is required for the amount of cheese you usually make per batch.

1 litre of water weighs 1 kilo. 100 litres of water: 100 kilo. So, for a 20% solution you will need 20 Kilo of salt. (If you work in pounds and ounces: a Gallon weighs around 10 lb.). I usually find that I need one for the pot as well. Particularly if one uses sea salt as this is not so purified.

Dissolve the salt in the water. It will take some time so leave it to soak before you really do a lot of stirring.

Once it is dissolved you need to measure both the salt solution and the pH. A very fresh egg will float in a 20% solution and this is a very reliable method in home-production but what you really need is a Brine weight. You simply float the weight and read the percentage that is marked in gradients on the side. Then add either more salt or more water as may be necessary.

The pH can be measured with a pH Meter, expensive and unreliable for the small producer.

What you need is a pack of pH Dip papers (litmus paper). You simply dip one of these strips into the solution and then read the pH off against the colour chart on the packet.

The reading is going to be far too high, so now reduce it.

Put a couple of litres of water in a jug and add the equivalent of 3 or 4 teaspoons of the acid to it. If you are using Lactic acid you will need a good deal more. Pour about half of this into the bath and stir for a few minutes. Then take another pH. reading.

Continue to add until you have a pH of 5.00.

You should be using the solution at a minimum of 15°C (60°F) and maximum of 20°C. 18°C is the norm. Below this temperature the salt will not be properly absorbed and, the low temperature will restrict or kill many of the flavour producing organisms in your cheese. Store it at room temperature and keep it covered and clear of any cheese particles and it will be fine for the whole season.

Done.

When you use this bath the cheese will absorb salt and reduce the solution %. Every time you put fresh cheese into the solution you must give them a liberal sprinkling of salt to compensate for this. The cheese should be flipped over in the brine halfway through the brining period and sprinkled again with salt or you will find that the upper side of the cheese will soften as it ages because it will retain more moisture. Measure the salt solution

% occasionally by all means, but once you have a little experience this will only be necessary about once a month.

I keep a very fine mesh gadget to hand (a plastic swimming pool skimmer) and skim the surface of the brine shortly after each use. This removes any cheese particles and helps to keep the solution clear.

Periodically you need to filter the solution thoroughly. I do this by either pumping or bucketing it from one container to another and back again.

You can make up a simple yet effective filter by lining a basket or colander with cheese muslin and passing the solution through this. This gives you the opportunity to clean the bath and surrounding area. Do not allow a smear of slime to develop on the sides of the bath above the water line... this will be fat and bacterial growth.

A note on pH. If you do not set the pH. of your brine solution it will gradually level itself out as it takes acid from your cheese so, after a period of time the pH will be correct. However, this will depend on how often you use it and how much cheese you float in it so it will take some time and in the meantime you will be reducing the acidity of your cheese. This is why the older cheese-makers did not change their solution.... in most cases, for many, many years.

A Word about Tornegus

Washed-rind and Smear-ripened cheese.

These are the types of cheese in which I particularly specialise.

Most of the work published in regard to this style of cheese ripening is pretty misleading.

This is probably so because the ripening of smear and washed rind cheese is a very labour intensive and complex operation. This makes it hard for writers of technical papers, or general food journalists, to ever get close to the actual process.

First one needs to grasp a little of the background and history of these cheeses:

Although the soft, orange rind, cheeses are generally referred to as being of the washed-rind variety, the term "washed-rind" should correctly be applied to the firmer, lower moisture, alpine cheeses: Beaufort, Gruyere, Appensaller, Tomme d'Abondance etc, and Fontina, from the Pyrenees and, although this may be seen as an exception at first sight, to the old Goudas of Holland.

"Smear-ripened" should strictly apply to the softer cheeses from the lower slopes, valleys and plains. (Not that I would be pedantic about it).

To understand this one needs to look back to the origins of the traditional cheeses.

When cheese was made in the high mountain areas transportation to the market was only viable if one could ship quantities, consequently, the mountain cheeses tend to be large lower moisture rounds with good keeping qualities.

In the more densely populated lower slopes and plains areas the market was more accessible and it was possible to sell the higher moisture, softer bodied, cheeses and attain a faster turnover.

In the mountain areas, of high humidity, washing of the rind to restrict mould growth would be a common practice. High acid, low moisture, cheese would simply develop a firm, hard, rind or crust.

The lower acid low moisture types would support and exhibit bacterial growth as well mold growths. (Bacteria favour low acid conditions and, optimally, high moisture conditions. Moulds favour the higher acid and lower moisture conditions.)

As you consider the different styles of cheesemaking you begin to see how the making, and the maturing conditions, will influence what happens on the cheese surface. Both the moisture content of the cheese and that of the atmosphere must be considered, along with the pH. (or acidity) of the cheese.

Cheese such as Beaufort of Haute Savoie is relatively low acid and firm and is matured under conditions of high humidity. The Gruyeres are very similar but tend to be a little more acidic and the maturing conditions a little less humid. Both will have their rinds periodically wiped or washed to restrict mould growth.

Here we see part of the explanation for the flavour differences between these very similar varieties.

The surface growth will be a mixture of both moulds and bacteria.

Beaufort will exhibit a greater surface bacterial growth than will Gruyere. If the bacteria include Brevibacterium linens we then get the background of flavour production which B.linens initiates.

(Parmesan, another relatively low acid cheese, will exhibit bacterial growth but, because the humidity of the maturing area is lower and that of the cheese also, it will not generally include B.linens. There will still be the orange/brown colour pigmentation from other bacterium but not the flavour production).

As we come further down to the more densely populated areas we come across cheese such as Reblochon: closer to the markets and of higher moisture content than the high mountain cheeses.

We still have a cheese which is influenced by the ripening styles of the Haute Savoie but, because of the eventual lower acidity, and higher moisture content, we get a higher balance of bacterial growth.

All these bacteria produce proteolitic and lipolytic enzymes so; we get a far more pronounced breakdown of the curd.

The Reblochon are still washed-rind rather than smear ripened cheese, since the main objective is to restrict surface mold growth.

However; B.linens do tend to be present in some sites and we get a slight background flavour influence from these on some farms, though this is not the deliberate intention of the traditional makers.

The Reblochon are, in cases of true traditional production, washed with pure mountain-spring water. (We will see the importance of this later).

Next we find the monastery cheeses such as Muenster and then, further down on the plains. Pont l'Eveque, Maroilles, Port du Salut, Trapiste de Belval etc. and across the borders, Herve and Limburger.

These are the smear-ripened cheeses.

Why do we find so many of the smear-ripened cheeses originating from the monasteries?

Contamination is the answer. Washing the cheese with anything other than a sterile liquid is likely to introduce pathogenic bacterium such as Listeria monocytogenes.... and you kill off your customers.

The monasteries would also produce wines, beers and spirits so had available to them sterile solutions with which to wash the cheese.

These cheeses would be washed more frequently so as to deliberately encourage heavy bacterial growth and almost totally restrict mould growth.

There are around 100 strains of B. linens so there will certainly be some variation in the strains present in different maturing areas. This is what most technical papers tend to attribute the variation in rind colour to.

However: the main reason for the colour differences lays in the moisture activity and acidity differences in the actual cheese. Depending on the balance of these criteria different strains will be dominant on the surface.

The lower the acidity of the cheese the paler the colour tends to be. (This sort of knowledge can be of tremendous assistance to the maturer, or affineur, when dealing with batches, and helps with feed-back to the producer.)

Slow cheese, which continues to exude moisture, will also tend to be pale, but in this case the surface will be fragile and slimy due to the growth of other bacteria such as Geotrichum lactis (oidium). Drying, in the early stages, can help in this sort of situation but, because the excessive enzyme action will weaken the surface, the rind will crack during further maturing or storage if the cheese encounters low humidity conditions.

End of the text copied from Dairy01.co.uk. Thanks to Master James Aldridge, Rest In Peace.

Two simple Recipe

Queso Blanco Recipe

This is by far the easiest cheese to make. Called Queso Blanco in the Spanish speaking (it means "white cheese") world it is used throughout the world by different names. It can be eaten strait or mixed in with various dishes. Try it in your lasagne recipes instead of Ricotta or in addition to it. Yum!

Ingredients

1 Gallon Whole Milk (3.78L)

1/4 Cup White Vinegar (60ml)

1. Heat milk to 180°F (82°C) stirring constantly. Be careful not to burn the milk.
2. While mixing with a whisk, slowly add the white vinegar. You will notice the milk begins to curdle.

3. Keep stirring for 10-15 minutes.

4. Line a colander with fine cheesecloth.

5. Pour the curdled milk through the colander.

6. Allow the curds to cool for about 20 minutes.

7. Tie the four corners of the cheese cloth together and hang it to drain for about 5 - 7 hours (until it stops dripping).

8. The solidified cheese can be broken apart and salted to taste or kept unsalted.

The juice of 3-5 lemons may also be used in substitute or addition to the vinegar. The resulting cheese will have a much more tangy flavour.

Mascarpone Cheese Recipe

Mascarpone cheese is used in various Italian pastries and desserts. It also tastes great on a piece of toast with sprinkled sugar!

Ingredients

1 qt Light Cream (940ml)

1/4 teaspoon Tartaric Acid** (5ml)

1. Heat 1 qt of LIGHT CREAM to 180°F (82°C)

2. Add 1/4 teaspoon TARTARIC ACID

3. Stir for about 10-15 minutes

4. The cream should thicken with small flecks of curd.

5. Using a DOUBLE layer of FINE cheesecloth in a strainer, pour off the whey and let it drain for about an hour.

6. Put the strainer in a bowl and place it in the refrigerator to drain overnight (or 12 hours).

7. In the morning, scoop out the cheese and put into an airtight container.

** Tartaric Acid is available from any cheesemaking supply company and most wine making companies. Since at home winemaking is much more common, look in your phone book for a local winemaking supply store. Many wine and liquor stores carry wine making supplies and may have tartaric acid.

Soft Cheeses

Cottage Cheese Recipe

Cottage Cheese also known as pot cheese or farmer's cheese, this type of cheese derived its name from the cottages it was produced in. This cheese tastes great by itself or with fruit added to it right before it is served

Ingredients

1 Gallon Fresh Milk (3.78L)

4 oz. Mesophilic Starter Culture (118ml)

1/4 tab Rennet (or 0.7ml vegetarian liquid rennet)

1. Mix 1 gallon fresh milk with 4 oz. of mesophilic starter.
2. Mix 1/4 tab Rennet into two tablespoons of COOL water. Mix this into the milk thoroughly using a whisk and stirring for at least 5 minutes.
3. Cover and set aside to ripen for about 20 hours at room temp (70°F / 21°C).
4. The milk should be a firm curd within 20 hours, however the full 20 hours is needed to develop the correct flavour.
5. After 20 hours cut the curd into 1/2 inch cubes.
6. Allow the curds to firm up for 15 minutes.
7. Over the next 30 minutes slowly raise the temperature of the curds to 110°F (43.5°C).
8. Cook for an additional 45 minutes at 110°F (43.5°C).
9. Stir the curds often to prevent them from matting.
10. The curds should have greatly shrunken and sunk to the bottom of the pot.
11. Line a colander with cheesecloth and drain the curds.
12. Allow the curds to drain for 5 minutes.
13. Lift the curd filled cheese cloth from the colander and repeatedly dunk into a bowl of ICE COLD water for at least three minutes.
14. Drain the curds and place in a bowl.
15. Season the curds with a teaspoon of salt, herbs, etc. Use more or less to taste.

Place the cheese into a sealable container into a refrigerator. A few tablespoons of cream may be added if desired.

Cream Cheese Recipe

This farmhouse classic is used in many recipes and many desserts. This particular recipe makes a creamy sweet cheese that is worthy of your best cheese cake recipe. Of course it also tastes great on a hot piece of toast covered with slices of ripe strawberries!

Ingredients

1/2 Gallon Fresh Cream (1.89L)

4 oz. Mesophilic Starter Culture (118ml)

1/4 tab Rennet (or 0.7ml vegetarian liquid rennet)

1. Mix 1/2 gallon fresh cream with 4 oz. of mesophilic starter.
2. Mix 1/4 tab Rennet into two tablespoons of COOL water. Mix this into the milk thoroughly using a whisk and stirring for at least 5 minutes.
3. Cover and set aside to ripen for about 12-15 hours at room temp (70°F / 21°C).
4. The milk should be a firm curd within 15 hours, however the full 12-15 hours is needed to develop the correct flavour.
5. After 12-15 hours, gently ladle the curds into a colander lined with a FINE cheese cloth.
6. Allow the curds to drain for awhile then tie the four corners of the cloth together. Hang it to drain 6-8 hours.
7. After the curds have drained, place the curds into a small bowl.
8. Mix by hand until pasty.
9. Add salt, herbs, etc. to taste.

Place the cheese into a sealable container into a refrigerator. The cheese will firm up a little once under refrigeration.

Neufchatel Recipe

Neufchatel originated in Normandy France. It is a very soft, spreadable cheese similar to cream cheese. It differs from true cream cheese because it is made from whole milk and not cream. Neufchatel can be molded into many shapes and is traditionally molded in a heart shape. However, in North America it is more commonly found in a brick form. This cheese tastes great on a toasted bagel!

Ingredients

1/2 Gallon Fresh Milk (1.89L)

2 oz. Mesophilic Starter Culture (60ml)

1/4 tab Rennet (or 0.7ml vegetarian liquid rennet)

1. Mix 1/2 gallon fresh whole milk with 2 oz of mesophilic starter.
2. Mix 1/4 tab Rennet into two tablespoons of COOL water. Mix this into the milk thoroughly using a whisk and stirring for at least 5 minutes.
3. Cover and set aside to ripen for about 15-20 hours at room temp (70°F / 21°C).

4. The milk should be a firm curd within 24 hours, however the full 15-20 hours is needed to develop the correct flavour.

5. After 15-20 hours, gently ladle the curds into a colander lined with a FINE cheese cloth.

6. Allow the curds to drain for awhile then tie the four corners of the cloth together. Hang it to drain 8-12 hours.

7. After the curds have drained, place the curds into a small bowl.

8. Mix by hand until pasty.

9. Add salt, herbs, etc. to taste.

Place the cheese into a sealable container into a refrigerator. The cheese will firm up a little once under refrigeration.

Ricotta Recipe

Ricotta is made from re-cooked whey. In fact the word "ricotta" means "re-cooked." It forms when proteins from the whey separate, rise and coagulate. There are three distinct varieties of ricotta: ricotta salata moliterna (ewe's milk whey), ricotta piemontese (cow's milk whey + 10% milk) and ricotta romana (a by-product of Romano cheese production). This recipe adds additional milk to raise the yield (it is a variety of ricotta salata moliterna. Regardless, this recipe will not yield much more then a cup of cheese.

Ingredients

Whey from the making of a one gallon cheese recipe.

1 Quart Milk (0.94L or 1L)

1/3 Cup White Vinegar (79ml)

1. Mix the quart of milk with the whey.

2. Warm the mixture to 100°F / 38°C. Keep it at this temperature for about an hour. The milk might curdle, do not worry.

3. After an hour, bring the temperature of the milk mixture to 200°F / 93.5°C. Do not allow it to boil.

4. While stirring with a whisk, slowly add the white vinegar.

5. Stir for an additional five minutes then remove the mixture from the heat.

6. Cool the mixture in the refrigerator for at least 8-10 hours.

7. Line a colander with a double layer of a very fine cheese cloth or butter muslin.

8. Pour the mixture through the colander.

9. Allow the cheese drain for several hours.

10. Salt the ricotta cheese to taste.

11. Place the cheese into a sealable container in your refrigerator.

Hard Cheeses

Gouda Recipe

Gouda is a Dutch cheese made from cow's milk (of course you may use any type of milk you would like). It has a mild taste and an even texture. What is great about Gouda is that unlike most pressed cheeses, it only has to age for 25 days, during this time an outer rind develops. Gouda can be aged for a longer period and if done so, it must be waxed. Traditionally it is waxed bright red. If you age the cheese for up to 6 months it will develop a stronger flavour and harder texture. This cheese tastes great on dry crackers with a glass of Chardonnay to wash it down!

Ingredients

1 Gallon Fresh Milk (3.78L)

4 oz. Mesophilic Starter Culture (118ml)

1/4 tab Rennet (or 0.7ml vegetarian liquid rennet)

1. Warm the milk to 85°F (29.5°C).
2. Add 4 oz of mesophilic starter culture and mix thoroughly with a whisk, the culture must be uniform throughout the milk.
3. Dissolve 1/4 tab rennet into 3-4 tablespoons COOL water. Hot water will DESTROY the rennet enzymes.
4. Slowly pour the rennet into the milk stirring constantly with a whisk.
5. Stir for at least 5 minutes.
6. Allow the milk to set for 1-2 hours until a firm curd is set and a clean break can be obtained when the curd is cut.
7. With a long knife, cut the curds into 1/2 inch cubes.
8. Allow the curds to sit for 10 minutes to firm up.
9. Slowly raise the temperature of the milk to 102°F (39°C). It should take as long as 45 minutes to reach this temperature. During this time, gently stir the curds every few minutes so they don't mat together.
10. Once the curds reach 102°F (39°C), allow the curds to settle, and then carefully remove 3 cups of whey from the top surface.
11. Replace the lost whey with 3 cups of 102°F (39°C) water.
12. Cook the curds at 102°F (39°C) for another 45 minutes. Every 15 minutes remove 3 cups of whey and replace with 102°F (39°C) water.

13. At the end of the process, you will have removed whey three times.

14. Drain the whey by pouring through cheesecloth lined colander.

15. Carefully place the drained curds into your cheesecloth lined mold.

16. Press the cheese at about 20 lbs. (9 kg) for 45 minutes.

17. Remove the cheese from the press and flip it.

18. Press the cheese at about 40 lbs. (18 kg) for 3 hours.

19. Remove the cheese from the press, careful it is still very soft.

20. Float the cheese in a COLD brine solution for 3 hours. Be certain to flip the cheese over every 45 minutes or so to ensure even rind development.

21. Pat dry the cheese, you will notice the outer surface has begun to harden.

22. Place the cheese in your refrigerator to age for 25 days. You will need to flip the cheese over every day or it will dry unevenly.

23. If too thick a rind begins to develop, place an overturned bowl on top of the cheese, or place it in a covered container. However, continue to turn the cheese daily and do not wrap it in plastic.

24. Inspect daily for mold. Should mold develop on the cheese surface, simply remove it using a paper towel dipped in white vinegar.

25. At the end of 25 days you can age it further by waxing it or you may use it immediately.

If you wax the cheese, continue to flip the cheese every 3 days or so.

Brine Solution

1. Dissolve 1.5 cups of salt into one quart warm water.

2. Cool the brine in your freezer, some salt will precipitate out.

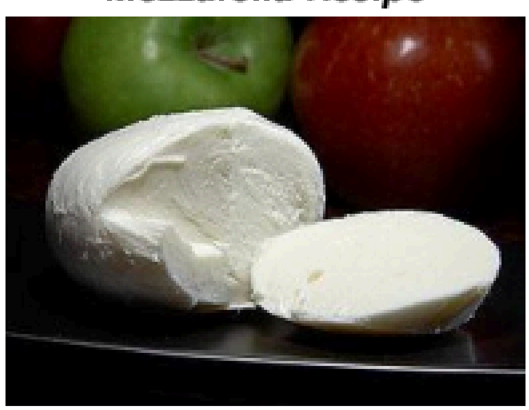
3. To use the solution, simply place it in a bowl and place your cheese into it.

4. After you are done with the brine, you can store it in a container in your freezer.

5. With each new cheese, you will need to add additional salt so that the solution is saturated.

6. The solution is saturated with salt when no additional salt can be dissolved no matter how long you stir.

Mozzarella Recipe



Although Italian in origin, this classic string cheese is famed for its use in many North American favourites such as pizza. It is not really a hard cheese as it is never pressed. It is actually categorized as a fresh cheese. This is because it is never aged. You can eat the cheese the same day you make it. An interesting note about mozzarella is its ability to be frozen and stored for up to six months and then thawed and used, with little loss in flavour.

True Italian Mozzarella is made from Buffalo milk, however most U.S. mozzarella is made using skim cow's milk. In reality you can use any type of milk, although the taste and texture will vary.

Ingredients

1 Gallon Milk (some use skim, I like whole) (3.78L)

2 oz thermophilic culture (60ml)

1/2 tab rennet (or 0.7ml vegetarian liquid rennet)

Litmus paper or another way to measure pH

1. Heat the milk to 90°F / 32.5°C.
2. Add 2 oz. thermophilic culture.
3. Ripen the milk for 45-60 minutes.
4. Dissolve the 1/2 tab rennet into 4 tablespoons water and then stir into the milk for at least 5 minutes to ensure even distribution.
5. Let the milk set for 60 minutes.
6. Once the milk has set, cut it into 1/2 inch cubes.
7. Let it cook at 90°F / 32.5°C for another half hour.
8. Over the next half hour slowly raise the temperature of the curds to 105°F / 40.5°C.
9. Let it cook at 105°F / 40.5°C for another 5-10 minutes.
10. Drain the whey by pouring through cheesecloth lined colander.
11. Place the curds into a double boiler with the bottom pot filled with water maintained at 105 F / 40.5 C.
12. You'll need to periodically drain the whey while the curds are cooking.
13. Flip the curds periodically so they are evenly heated. They should mat together.
14. Let the curds cook at this temperature for 2-3 hours.
15. When the curds are done cooking test the pH, it should be 5.2-5.3.
16. If the pH isn't 5.2-5.3, it won't spin. Allow it to cook a little longer.
17. Cut the curd mass into 1/2 inch cubes.
18. Drain off any excess whey.
19. Place the curds directly into water that is 170°F / 76.5°C. don't overheat!!
20. Use two large wooden spoons and work the curds by pressing them together.
21. A ball of cheese will begin to form.
22. When the ball is the right size, take it out and work it with your hands, stretching the mass over itself.
23. Do this several times with each ball. If necessary the ball can be put back into the water to warm it up so that it can be stretched further.
24. Then immediately dunk the cheese into a COLD brine solution.
25. Let the cheese soak for 60 minutes.

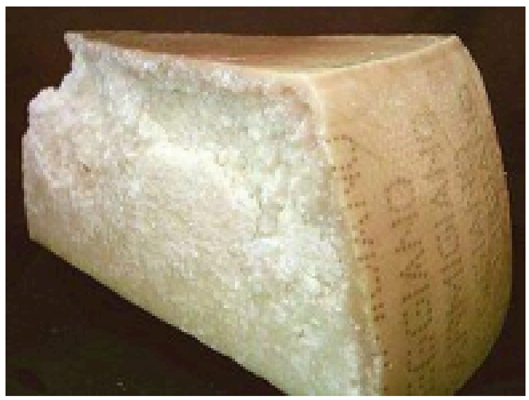
The cheese can be eaten fresh, kept in plastic wrap in the refrigerator for about 10 days or frozen for several months. The cheese does taste better if it is allowed to rest in the refrigerator for 24 hours before eating.

By far the hardest step is the stretching, spinning step. If you just can't get it to work right, you might try putting the cheese mass into a microwave at a low setting for several seconds. Warm it up, and then work it.

Brine Solution

1. Dissolve 1.5 cups of salt into one quart warm water.
2. Cool the brine in your freezer, some salt will precipitate out.
3. To use the solution, simply place it in a bowl and place your cheese into it.
4. After you are done with the brine, you can store it in a container in your freezer.
5. With each new cheese, you will need to add additional salt so that the solution is saturated.
6. The solution is saturated with salt when no additional salt can be dissolved no matter how long you stir.

Parmesan Recipe



Parmesan is named after an area in Italy called Parma. Original name of this cheese is Parmigiano-Reggiano. It is one of the world's most popular and widely-enjoyed cheeses. Made from skimmed milk, this cheese must age at least 5 months and usually no less then 10. Often this cheese will be aged for up to two years. It is important to remember, when grating this cheese not to grate any more then you will use. This will keep the cheese flavour fresh. For a more flavourful cheese use goat and cow's milk in equal proportions.

Ingredients

1 Gallon Fresh Skim Milk (no more then 2.5% butterfat) (3.78L)

1/4 Tablet Rennet (or 0.7ml vegetarian liquid rennet)

3 oz. Thermophilic Starter Culture (90ml)

1. Warm the milk to 100°F / 38°C.
2. Add thermophilic starter and allow the mixture to ripen for 45 minutes
3. Dissolve 1/4 tab rennet into 3-4 table spoons COOL water. Hot water will DESTROY the rennet enzymes.
4. Slowly pour the rennet into the milk stirring constantly with a whisk.
5. Stir for at least 5 minutes.
6. Allow the milk to set for 45-90 minutes until a firm curd is set and a clean break can be obtained when the curd is cut.
7. With a long knife, cut the curds into 1/4 inch cubes.

8. Allow the curds to sit for 10 minutes to firm up.

9. Slowly raise the temperature of the milk to 124°F (51.5°C). It should take as long as 45 minutes to reach this temperature. During this time, gently stir the curds every few minutes so they don't mat together.

10. Keep the curds at this temperature for another 15-30 minutes until very small and firm.

11. Drain the whey by pouring through cheesecloth lined colander.

12. Carefully place the drained curds into your cheesecloth lined mold.

13. Press the cheese at about 10 lbs. (4.5 kg) for 30 minutes.

14. Remove the cheese from the press and flip it.

15. Press the cheese at about 25 lbs. (11.4 kg) for 12 hours.

16. Remove the cheese from the press, careful it is still very soft.

17. Float the cheese in a COLD brine solution for 30 hours. Be certain to flip the cheese over at least three times to ensure even rind development.

18. Pat dry the cheese, you will notice the outer surface has begun to harden.

19. Place the cheese in your refrigerator to age for at least five months (longer for stronger flavour). You will need to flip the cheese over every day for the first two weeks and then at least once weekly or it will dry unevenly.

20. Place an overturned bowl on top of the cheese after two days. Do not wrap it in plastic or it will not dry properly

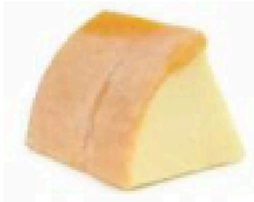
21. Inspect daily for mold. Should mold develop on the cheese surface, simply remove it using a paper towel dipped in white vinegar.

22. After three, six and nine months of aging, rub the surface of the cheese with olive oil. Do not wax this cheese.

Brine Solution

1. Dissolve 1.5 cups of salt into one quart warm water.
2. Cool the brine in your freezer, some salt will precipitate out.
3. To use the solution, simply place it in a bowl and place your cheese into it.
4. After you are done with the brine, you can store it in a container in your freezer.
5. With each new cheese, you will need to add additional salt so that the solution is saturated.
6. The solution is saturated with salt when no additional salt can be dissolved no matter how long you stir.

Romano Recipe



Romano is one of the world's oldest cheeses. It has been made near Rome since the time of Christ. Like Parmesan, this cheese must age at least 5 months. A longer time is used to produce a hard grating cheese. This cheese can be used in many recipes that call for Parmesan if a more delicate taste is desired. For a more flavourful cheese use goat and cow's milk in equal proportions.

Ingredients

1 Gallon Fresh Whole Milk (3.78L)

1/4 Tablet Rennet (or 0.7ml vegetarian liquid rennet)

5 oz. Thermophilic Starter Culture (147.8ml)

1. Warm the milk to 90°F / 32vC.
2. Add thermophilic starter and allow the mixture to ripen for 15 minutes
3. Dissolve 1/4 tab rennet into 3-4 table spoons COOL water. Hot water will DESTROY the rennet enzymes.
4. Slowly pour the rennet into the milk stirring constantly with a whisk.
5. Stir for at least 5 minutes.
6. Allow the milk to set for 45-90 minutes until a firm curd is set and a clean break can be obtained when the curd is cut.
7. With a long knife, cut the curds into 1/4 inch cubes.
8. Allow the curds to sit for 10 minutes to firm up.
9. Slowly raise the temperature of the milk to 115°F (46°C). It should take as long as 45 minutes to reach this temperature. During this time, gently stir the curds every few minutes so they don't mat together.
10. Keep the curds at this temperature for another 30 - 45 minutes.
11. Drain the whey by pouring through cheesecloth lined colander.
12. Carefully place the drained curds into your cheesecloth lined mold.
13. Press the cheese at about 10 lbs. (4.5 kg) for 30 minutes.
14. Remove the cheese from the press and flip it.
15. Press the cheese at about 25 lbs. (11.4 kg) for 3 hours.
16. Then press the cheese at about 40 lbs. (18 kg) for 12 hours.
17. Remove the cheese from the press, careful it is still very soft.
18. Lightly pierce the surface of the cheese with a fork, so that the entire cheese is covered in small shallow holes spaced about 1/2 inch apart.
19. Float the cheese in a COLD brine solution for 12 hours. Be certain to flip the cheese over at least three times to ensure even rind development.
20. Pat dry the cheese, you will notice the outer surface has begun to harden.
21. Place the cheese in your refrigerator to age for at least five months (longer for stronger flavour). You will need to flip the cheese over every day for the first two weeks and then at least once weekly or it will dry unevenly.
22. Place an overturned bowl on top of the cheese after two days. Do not wrap it in plastic or it will not dry properly
23. Inspect daily for mold. Should mold develop on the cheese surface, simply remove it using a paper towel dipped in white vinegar.

24. The surface may be rubbed with olive oil after three months if so desired. Do not wax this cheese.

Brine Solution

1. Dissolve 1.5 cups of salt into one quart warm water.
2. Cool the brine in your freezer, some salt will precipitate out.
3. To use the solution, simply place it in a bowl and place your cheese into it.
4. After you are done with the brine, you can store it in a container in your freezer.
5. With each new cheese, you will need to add additional salt so that the solution is saturated.
6. The solution is saturated with salt when no additional salt can be dissolved no matter how long you stir.

Feta Recipe

Feta, a cheese of Greek origin was originally made with either sheep's or a mixture of sheep's and goat's milk. Today most groceries sell a variety made using cow's milk. The cheese gets its salty flavour from aging in a brine bath for up to a month. If a crumbly version is desired it can be aged even longer. This is a great salad cheese.

Ingredients

1 Gallon Fresh Milk (3.78L)

2 oz. Mesophilic Starter Culture (60ml)

1/4 tab Rennet (or 0.7ml vegetarian liquid rennet)

1. Warm the milk to 85°F (29.5°C).
2. Add 2 oz of mesophilic starter culture and mix thoroughly with a whisk, the culture must be uniform throughout the milk.
3. Allow the milk to ripen for two hours
4. Dissolve 1/4 tab rennet into 3-4 table spoons COOL water. Hot water will DESTROY the rennet enzymes.
5. Slowly pour the rennet into the milk stirring constantly with a whisk.
6. Stir for at least 5 minutes.
7. Allow the milk to set for 1-2 hours until a firm curd is set and a clean break can be obtained when the curd is cut.
8. With a long knife, cut the curds into 1/2 inch cubes.

9. Allow the curds to sit for 10 minutes to firm up.

10. Stir the curds gently and cut any pieces that are bigger then 1/2 inch cubes.

11. Allow the curds to sit for 30 minutes, stirring every so often.

12. Drain the whey by pouring through cheesecloth lined colander. Tie the corners of the cheesecloth together and allow the curds to drain for 5 hours.

13. Remover the cheese from the cloth and stuff it into a rectangular container, so that it is about an inch thick, and put a cover on it (Tupperware works well for this).

14. Chill in your refrigerator for about 90 minutes.

15. Remove the cheese from the refrigerator and cut into 1 inch cubes.

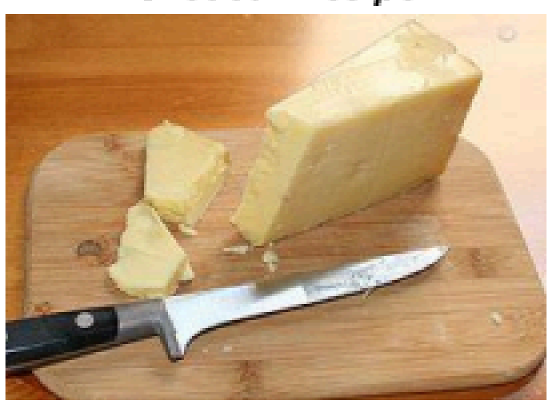
16. Place the cubes in a COLD brine solution for 5 to 30 days and store in your refrigerator. The longer you age it like this the crumblier it will be.

After aging in the brine, remove the cubes and pat dry with a paper towel. The cheese can now be served or stored in an air tight container.

Brine Solution

1. Dissolve 1.5 cups of salt into one quart warm water.
2. Cool the brine in your freezer, some salt will precipitate out.
3. To use the solution, simply place it in a bowl and place your cheese into it.
4. After you are done with the brine, you can store it in a container in your freezer.
5. With each new cheese, you will need to add additional salt so that the solution is saturated.
6. The solution is saturated with salt when no additional salt can be dissolved no matter how long you stir.

Cheddar Recipe



One of the most widely enjoyed cheeses; cheddar is a personal favourite of the Cheese Wizard's wife. Traditionally this cheese was shaped into large drums and aged with a loose cloth covering it rather then a wax. This recipe is a slight variation of traditional cheddar recipes. The difference is it includes a stirring step instead of a traditional cheddaring step that involves cutting the curds into strips and draining them. The results are almost identical but it saves the cheesemaker a couple of hours of time. As with many hard cheeses, this cheese must be aged at least 3 months and 9 months or more will produce a superior quality cheese as it will get sharper with age. One final note: don't expect this cheese to be bright orange; the color seen in grocery stores is usually artificial.

Ingredients

1 Gallon Fresh Milk (3.78ml)

1 oz. Mesophilic Starter Culture (29.5ml)

1/4 tab Rennet (or 0.7ml vegetarian liquid rennet)

1 tbsp Salt

1. Using a double boiler, warm the milk to 90°F (32.25°C).
2. Add 1 oz of mesophilic starter culture and mix thoroughly with a whisk, the culture must be uniform throughout the milk.
3. Allow the milk to ripen for one hour.
4. Dissolve 1/4 tab rennet into 3-4 tablespoons COOL water. Hot water will DESTROY the rennet enzymes.
5. Slowly pour the rennet into the milk stirring constantly with a whisk.
6. Stir for at least 5 minutes.
7. Allow the milk to set for 1-2 hours until a firm curd is set and a clean break can be obtained when the curd is cut.
8. With a long knife, cut the curds into 1/4 inch cubes.
9. Allow the curds to sit for 15 minutes to firm up.
10. Slowly raise the temperature of the milk to 102°F (39°C). It should take as long as 45 minutes to reach this temperature. During this time, gently stir the curds every few minutes so they don't mat together.
11. Cook the curds at 102°F (39°C) for another 45 minutes. During this time, gently stir the curds every few minutes so they don't mat together.
12. Drain the whey by pouring through cheesecloth lined colander. Do this quickly and do not allow the curds to mat.
13. Place the curds back into the double boiler at 102°F (39°C). Stir the curds to separate any particles that have matted. Add the tablespoon of salt and mix thoroughly.
14. Cook the curds at 102°F (39°C) for one hour, stirring every few minutes.
15. Carefully place the curds into your cheesecloth lined mold.
16. Press the cheese at about 20 lbs. (9 kg) for 45 minutes.
17. Remove the cheese from the press and flip it.
18. Press the cheese at about 40 lbs. (18 kg) for 3 hours.
19. Remove the cheese from the press and flip it.
20. Press the cheese at about 50 lbs. (22.75 kg) for 24 hours.
21. Remove the cheese from the press. Place the cheese on a cheese board and dry at room temperature for 3-5 days, until the cheese is dry to the touch.
22. Wax the cheese and age it in your refrigerator for 3-24 months. The longer the cheese is aged the sharper the flavour it will develop. Be sure to flip the cheese every few days.

Appendix

The log form below is designed by Gurkan Yeniceri. Print it out for every cheesemaking and use it to record what you have done.

Date: __________________ **Cheese:** ____

Milk: 8Litres %Fat: _____ **Source:** _____________ ☐**Pasteurized** ☐**Homogenized** ☐**Raw**

INSTRUCTIONS			*time*	*pH*	*°C*
☐ ***$CaCl_2$*** ¼ tsp - *Diluted in* 60 ml of water added to cold milk					

			time	pH	°C
Starter	Temp: _____°C	Ripen: ______min			
Select Culture(s):	☐ Thermophilic	☐ Mesophilic			
	☐ Yogurt	☐ Citric Acid			
	☐ Buttermilk	☐ Tartaric Acid			
_______tsp/ml in _________ ml of milk at room temperature					
prepared one day before. Stir for 3 min and mix it well.					
☐ Penicillium Roqueforti ☐ Propionibacterium Shermani					

				time	pH	°C
Rennet	Type:		Measure:			
Make sure rennet is distributed evenly	☐Animal	☐Vegetarian	___ ml in ___ml water			
	☐ Lipase: 1/10 tsp in 60ml of water					
	Wait for 45 min to 1 hour or until the curd forms					

			time	pH	°C
Cut	Size: _______cm^3	Rest ____ minutes			
Stir: ________minutes					
Raise temp to _____°C in _____ minutes gradually					
Stir for _______ minutes and rest for _____ minutes					
Pitch at ________ pH. Check firmness.					

			time	pH	°C
Remove Curd	_______ pH				
Select appropriate processes	☐ Remove whey to the level of curd				
	☐ Scoop the curd to colander				
	☐ Tip the boiler to colander				
	☐ Add ____°C water to reduce the temp to ____°C				

			time	pH	°C
Salt	CW: ____ kg	Salt: _____ gram			
Curd Weight (CW) * %2 = grams of salt					
☐ ***Cheddaring***	_____ min at _____ pH				
☐ ***Mold Type***					
☐ ***Brine***	_____hrs				

Press/MW	Weight (kg)	Hours/Mins	time	pH	°C
1					
2					
3					
4					

NOTES

Starter: It can be prepared one day before with 160ml milk and 1/10 tsp starter culture. It will turn to yogurt like consistency in 24 hours under room temperature. Break it down with added milk and add it to 8 litres of milk; mix well.

Water: All waters used should be chlorine free. Filter some tap water and expose it to sun light for 15 minutes or boil it for 15 minutes.

Sterilization: All equipment should be thoroughly clean and kept in boiling water for 2 seconds just before use. Muslin and colander are no exception. No bleach used for the equipment that are in contact with your milk but you can wipe down kitchen bench, sink and cook top with 1 part bleach 20 parts water solution. A wide enough saucepan with boiling water should always be ready. Hands should be washed or a surgical latex glove recommended.

Measures: All measures given for 8 litres of milk

Notes: Herbs, other ingredients & processes, kneading, drying time, waxed date, aging time, first tasting date etc.