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On-farm small scale cheesemaking – a beginner's guide



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Contents

Introduction	3
Section 1	4
1.1 The Cheese market	4
1.2 Summary of business plan	5
1.3 Capital plan	7
1.4 Production and sales	8
1.5 Technical requirements – Hazard Analysis Critical Control Points (HACCP)	9
Section 2 – The manufacture of artisan cheese	11
2.1 Setting up a cheesemaking business	11
2.2 Typical small cheese dairy layout	11
2.3 Ingredients for cheesemaking	12
2.4 The cheesemaking process	14
2.5 The hard cheesemaking process	15
2.6 The soft cheesemaking process	20
2.7 Cheese recipes	22

This booklet and the information within are intended as a guide only. Please seek detailed support from your accountant, bank, legal advisor or other specialist support organisations.

A list of useful contacts can be found in Section 6 of the DairyCo publication 'On-farm processing – a beginner's guide'.

Dairy UK has developed a comprehensive guide detailing information on where to source finance, products, training and knowledge for innovation that can be viewed at www.dairyukinfohub.com.

The Society of Dairy Technology can be contacted via their web site www.sdt.org

The British Cheese Board (BCB) has also produced an introductory CD aimed at Food Technology students in secondary schools – please contact them for a copy.

Introduction

This booklet is designed to give an overview of the requirements for the manufacture of artisanal hard cheeses.

Cheesemaking is hard physical work and demands continuous attention from the cheesemaker. It provides an opportunity to achieve better returns for the milk producer and with it a more secure future.

The last 20 years have seen a significant growth in the range of British cheese being made – many of these coming from new enterprises set up by dairy farmers looking to add value to their milk.

Any dairy farmer contemplating this type of diversification should understand that this is not an easy option. There have been many success stories and some less successful.

This booklet aims to provide a realistic guide to minimising some of the risks involved in investing in cheese processing. It sets out some of the steps needed to ensure production of the right product, at the right quality and marketed to the right people.

Section 1

1.1 The Cheese market

According to the British Cheese Board there are now over 700 named cheeses being made in the UK. Together with imported varieties – which account for close to 50% of the market – there is huge consumer choice. The total cheese market – including cheese that goes to catering outlets and cheese that is used in manufactured food products such as pizza – amounts to more than 700,000 tonnes a year and at retail prices is valued at more than £3 billion a year.

In the European league table of cheese consumption, the UK is near the bottom at just over 11kgs per person per year. This compares with levels more than double that in countries such as France, Germany, Italy and Greece.

Recent years have seen a surge in demand for cheese in the UK driven by rising household incomes, increasing choice through market segmentation, the development of strong brands, the growth of Farmers' Markets and until recently falling real retail prices. In 2008 that growth has almost certainly stopped as consumers adjust to a harsher economic climate and shrinking levels of real disposable income. However, there are clear trends within the cheese market, of which new entrants should be aware, driven by health, convenience or known provenance, for example:

- healthier eating options – in terms of reduced fat or lower salt levels, or with added benefits such as organic or cholesterol lowering properties
- convenience lines such as ready grated, or sliced or kids portion packs
- clear provenance – be they locally produced cheeses or cheeses with a protected food name

Identification of target markets and their requirements

It is sometimes said of the quest to add value to milk by making cheese, that cheesemaking is the easiest part and that selling and marketing that cheese is the most difficult. For that reason it is vital that significant research is done to identify the right cheese for the markets that you intend to enter.

Each segment of the market will have its own characteristics. Each part of the country may have slightly different taste preferences. So, your choice of cheeses to make should be based on in-depth research of your local market and an understanding of where there may be gaps or unmet demands. The possibilities are diverse but finding the right ones is crucial:

- organic versus conventional
- pasteurised versus unpasteurised
- hard, semi hard, soft, blue mould, white mould or washed rind
- where you will sell it – retail (to local retailers or farmers' markets) and/or catering outlets – and if so what are their requirements on unit size and packaging?

You should consider what your key point of difference is. Why will consumers want to buy your cheese rather than any other from the huge array of cheeses already on offer? You should be aware of potentially competitive products in your chosen sector and the various price points for similar cheeses and how you can present an even more attractive offering.

All these points need to be considered before you even think about some of the production issues. We will now look at some of these points in more detail.

Potential customers

The crucial part of the business plan is to determine what cheese to produce and to which customers/outlets. Successful on-farm processors must have a clear, well-researched vision of what they want to produce and who will want to buy it. They must identify a gap in the market for their chosen products based on thorough market research.

It is essential to visit all potential sales outlets in the locality to identify:

- Types of cheese sold and price
- Shops, pubs and restaurants prepared to stock and serve locally made cheese
- Prices these outlets will pay for cheese

Further assistance should also be sought to research the market and successfully brand the product. Initially, on-farm processors and small producers do not normally aim to sell through major retailers until they have established their products and gained some track record in successful local sales. Major retailers will require at least the Safe and Local Supplier Approval Certification (SALSA) before trading. A specific Specialist Cheesemakers Association (SCA) module is now available and has been incorporated into the Standard.

In general, success will depend on having a high quality product that:

- Has strong provenance attributes
- Is different in some way from mainstream cheese found in supermarkets
- Has a distinctive appearance and flavour, and is seen as good value for money

It is important to understand that there are different technical, business and financial requirements for different cheese types eg, soft mould ripened varieties or hard pressed varieties. Further information on this should be gained from the DairyCo *On-farm Processing Guide*, and from a specialised business advisor, before progressing too far into the project.

It is important to plan and research the proposed project thoroughly to avoid disappointment at a later date.

The first issue for the cheesemaker / owner is to ensure that all basic running costs, bank repayments and wages can be met. A direct sale at farmers' markets, local farm shops, delicatessens, pubs and restaurants offers the opportunity to achieve this when a focused approach is applied to developing sales through these outlets.

The emphasis is on selling hand-made, traceable, artisanal cheese of quality and distinction.

1.2 Summary of business plan (an example)

- The building in this illustration is approximately 6 by 5 metres with an overall cost of £12,500 assuming that the farmer will source and manage his own room conversion with help from a suitably qualified business advisor.
- This room size is suitable for a start-up situation only. Some on-farm processors may wish to start with a much larger facility to accommodate future developments.
- The product manufactured is a hard-pressed territorial cheese type with a yield of 9.3 litres/kg.
- Sales are via farmers' markets and equate to 10.5 tonnes in Year 4.
- Selling prices at market vary from ~£12.50 - £14.60/kg. This is a matter of judgement for individual cheesemakers.

Table 1.2 – Example cash flow forecast for project and trading

	April	May	June	July	August	September	October	November	December	January	February	March	Totals
Project CFF													
Payments													
Payments - capital													
Payments - revenue													
VAT on above													
TOTAL													
Receipts													
Capital introduced													
Grants introduced													
Loans													
VAT refund													
TOTAL													
Project cash balance													
Trading CFF													
Payments													
Milk and cream													
Ingredients													
Packaging													
Direct labour													
Labour support costs													
Whey disposal													
Laboratory costs													
Water and effluent													
Detergents													
Shows and events													
Rent													
Rates													
Heat, light, power													
Repairs and renewals													
Insurance													
Telephone													
Office costs													
Travel													
Audit and accountancy													
Legal and professional													
Corporation tax													
VAT paid													
Capital repayments													
Loan/a/diall interest													
Depreciation													
Total payments													
Receipts													
Sales receipts													
VAT reclaimed													
Monthly balance													
Opening balance													
Closing balance													

1.3 Capital plan

The following example demonstrates how a business plan for a cheesemaking operation can be built up. The individual elements will vary depending on the circumstances (eg, the cost of a new building compared to converting an existing one), the type of cheese to be made and the production capacity required.

It is also important to understand at this stage that the capital and revenue requirements of different cheese types and technologies will differ. The basic entry-level business model may suffice for sales to farmers' markets and local stores but it is unlikely to meet technical and volume requirements of larger sales outlets. It is therefore vitally important to determine the markets in which the business wishes to operate at an early stage as part of the project assumptions.

Cheese types, such as Brie and Camembert, and fresh cheeses like cream cheese or lactic curd cheese, have a relatively short shelf-life, and must be sold within weeks of being made. The benefit of this is that you get your money back quickly. The downside is that levels of wastage can be higher. These cheeses have relatively high levels of moisture and therefore the yield from a given amount of milk will be much better than that from a hard cheese. For example, 100 litres of milk will yield ~14 kg of Camembert.

These cheeses are technologically more difficult to manufacture, are more susceptible to spoilage and contamination and may require more expensive and specialised manufacturing equipment and facilities.

Hard and semi-hard cheeses like Cheddar, Cheshire, Red Leicester or Lancashire have a potentially long shelf-life, but can take months to mature. Wastage levels may therefore be lower as controlling the storage temperature can regulate ripening times. However, as the moisture levels in these cheeses are much lower than in soft and fresh cheeses, yields from a given amount of milk are much lower. For example, 100 litres of milk yields ~10 kg of Cheddar.

Example of basic hard cheese start-up investment

The capital investment in plant and buildings is based on the minimum start-up investment. A 750 litre capacity raw milk storage tank can be converted into a batch pasteuriser/cheese vat by removing the ice-block equipment and replacing it with heating elements to facilitate batch pasteurisation, and cooling water flows to achieve starter inoculation temperature of ~30 °C. Batch pasteurisation is a viable low cost option for the heat treatment of small volumes of cheese milk, but it is both time-consuming and less energy efficient compared to a high temperature and short time (HTST) pasteuriser plant.

Government grants may be available, but investors are advised to seek specialist business advice with what can be a very time-consuming process. Often these are not applicable to second-hand equipment. When considering an appropriate building and equipment, the Environmental Health Officer (EHO) and Planning and Building Regulations Control should be involved.

Table 1.3 – Capital costs – minimum requirements (including some second-hand /refurbished equipment)

Cheese vat conversion	£2,500
Cheese press	£1,500
Cheese cutting knife	£200
Small cheese mill	£1,000
Traditional moulds [7]	£700
Stainless steel table	£250
Sink for equipment washing	£500
Hands free sink	£500
Maturing room	£2,750
Refrigerator for retail cheese sales	£500
Special floor and walls	£1,250
Scale	£500

Note: buildings and equipment must be suitable for the type of product to be manufactured.

1.4 Production and sales

Table 1.4.1 – Sales volumes and prices will be dictated by the market requirement.

The following example uses farmers' markets as the outlets.

Farmers markets' attended per month	
Year 1	4
Year 2	6
Year 3	8
Year 4	12

Table 1.4.2 – Example of weekly work requirements selling through farmers' markets giving sufficient cashflow to pay all bills and wages with a small profit (based on 50 weeks)

Year 1	
Total cheese sales	1632 kg
Weekly cheese sales	33 kg
Weekly work	1 day cheesemaking 1 day cheese handling, cutting and packing 1 day at farmers' market Total = 3 days per week
Year 2	
Total cheese sales	4752 kg
Weekly cheese sales	95 kg
Weekly work	1 day cheesemaking 1 day cheese handling, cutting and packing 1 day at farmers' markets per 2 weeks and 2 days at farmers' markets per 2 weeks Total = 3 days for 2 weeks and 4 days for 2 weeks or 3.5 days per week average
Year 3	
Total cheese sales	6672 kg
Weekly cheese sales	133 kg
Weekly work	2 days cheesemaking per week 1.5 days cheese handling, cutting and packing 2 days at farmers' markets per week Total = 5.5 days per week
Year 4	
Total cheese sales	10,560 kg
Weekly cheese sales	211 kg
Weekly work	3 days cheesemaking 3 days cheese handling, cutting and packing 3 days at farmers' markets per week Total = 9 days per week

Note: (a) staff were given cheesemaking training over a two-day period before attending a market. The cheesemaker accompanied staff to the first market to demonstrate how to sell the product by explaining the characteristics and profiles of the cheese to the customers, (b) markets typically run for 3 - 6 hours per weekend, weekly or monthly depending on the size of the local population. Most farmers' markets charge £25-35 per market stall. London has a range of markets attended by cheesemakers from as far away as Cheshire and Lancashire, and (c) not all farmers' markets will generate sufficient income to cover costs.

1.5 Technical requirements - Hazard Analysis Critical Control Point (HACCP)

HACCP or equivalent system for safe cheese production is required by law. Specialist advice will be required in the preparation of this part of the project.

Introduction

Having decided to make cheese, the next step is to prepare the HACCP system for the type of cheese to be manufactured. Soft cheeses require a more rigorous HACCP system than hard cheeses, as they are more susceptible to hazardous bacteria owing to their higher moisture content.

The preparation of the HACCP documentation assists in the design of a cheese room that is safe and appropriate for the type of cheese to be made.

Some of the key HACCP areas to be considered are given below. This is not meant to be a comprehensive HACCP description for the cheese but a general overview.

Purpose

The purpose of a HACCP system is to ensure the production of safe food. Potential hazards to food safety relating to all aspects of the manufacturing process are identified as Critical Control Points (CCPs) and suitable records must be produced to prove that they are controlled.

Some benefits of HACCP

- Preventative system
- Systematic approach
- Assists due diligence defence
- Facilitates verification activities
- Demonstrates management commitment

The HACCP system

The first task is to address the HACCP prerequisites, and these are:

- Food manufacturing practice (hygiene)
- Good laboratory practice
- Calibration
- Pest management systems
- Incident and recall management systems
- Preventive maintenance programmes
- Training
- Supplier quality assurance

The next task is to identify the process / product hazards, and document the CCPs on a process flow diagram.

Hazard analysis overview

- Good personal hygiene
- Correct cleaning and disinfection
- Adequate pest control
- Trained and aware operatives

Key process controls

- Pasteurisation / cooling
- Correct development of acidity
- Correct storage temperature

Table 1.5 – Examples of hazards and recommended food safety principles to consider in relation to milk and cheese production

Hazard	Source/Cause	Control/Evidence
Raw milk contamination by harmful bacteria / other substances	Poor animal husbandry (eg, animal disease, udder infections.) Milk from treated animals not segregated. Contaminated animal feed.	Herd health and veterinary records. Medicine/movements book records. Milking machine test reports. Feed supplier assurances. Good herd records and practices. Periodic raw milk antibiotic tests.
Growth of harmful bacteria in cheese milk after pasteurisation	Inadequate pasteurisation. Post pasteurisation contamination.	Pasteurisation records. Calibration certificates. Plant and equipment cleaning and inspection records. Hygiene training records. Laboratory results.
Growth of harmful bacteria in cheese	Starter inactivity. Poor salting. Dirty plant and equipment. Poor personal hygiene. Poor manufacturing practice. Incorrect maturation temperature.	Starter batch code/dates, stock records. Cheesemaking log. Plant and equipment cleaning records. Use of correct practices and procedures. Training records.

Note: if raw milk cheese is to be made, very specific herd knowledge and control is required.

Key CCPs in cheesemaking

- **Pasteurisation** – Milk is heat treated at a minimum temperature of 65°C for 30 minutes (batch pasteurisation) or 71.7°C for 15 seconds (HTST pasteurisation) to kill off pathogenic bacteria. The verification is carried out by alkaline phosphatase (ALP) testing – a simple but accurate test.
- **Acidity development during manufacture** – Development in acidity will vary according to the type of cheese. However, all cheeses require a certain level of developed acidity to assist microbiological safety. Typically for UK varieties of hard and soft cheese a final pH 24 hours after salting would be pH 5 or less.
- **Salting** – Even distribution of salt in the curd is a critical factor for the effective control of pathogens and the correct maturation of the cheese.

There are a number of useful sources for HACCP and good manufacturing process guides.

For example:

- Dairy UK website (Technical Guidance)
- Food Standards Agency Version 1, March 2001 “Food Safety Workbook for the Manufacture of Specialist Cheese”. This workbook was developed in co-operation with the Specialist Cheesemakers Association supported by the Local Authorities' Co-ordinating Body for Food and Trading Standards (LACOTS).
- Basic Food Hygiene Level 2 & 3, and HACCP, and Hygiene in Focus series produced by the Society of Food Hygiene and Technology (SOFHT).
- Specialist Cheesemakers Association web site.

Section 2 – The manufacture of artisan cheese

2.1 Setting up a cheesemaking business

Cheesemaking courses are run on a regular basis at colleges across the UK (eg, Reaseheath College, Nantwich). Anyone who is serious about starting a cheesemaking enterprise should attend one of these courses at an early stage of the planning process.

All cheese staff must be suitably trained to ensure product quality and safety. Regular cheese technology courses are run by a number of colleges and food development centres. Cheesemaking staff must also be trained on-site and training records kept.

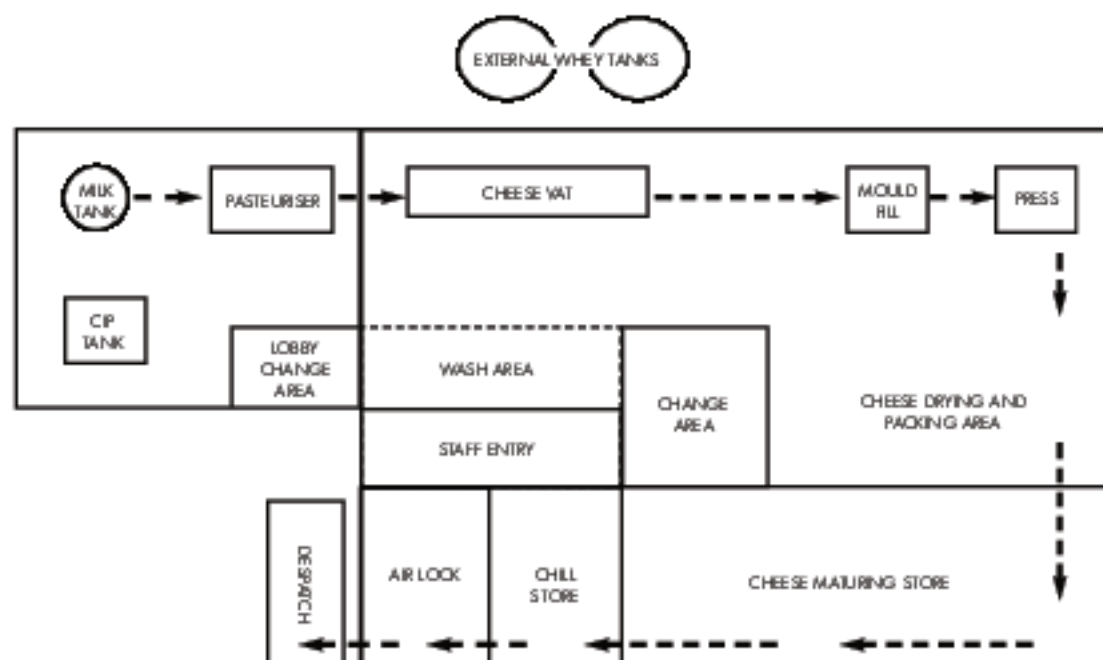
Activities, such as milking cows and cheesemaking, are difficult for one person to carry out alone due to the potential for cross contamination. It is, therefore, recommended that they should be carried out and seen as separate activities.

It is essential to involve the Environmental Health Officer (EHO) at the earliest stages of setting up a cheese manufacturing business. It is also strongly recommended that an appropriately qualified and experienced cheese technology consultant is used. This can save many headaches and lost time in progressing planning permission, building regulation approval and also preparing a robust HACCP for review with the EHO.

Some projects have reported 12-month delays from the start of building to having a 'health-marked and saleable cheese'. Normally, planning of the cheese room, types of cheeses to make, capital and revenue costs, discussions with EHO, Trading Standards Officer (for cheese label information) and builder, take place over a 6-month period. When the cheese room is set up, the 'health-mark' is awarded in the same time span and all cheeses made are saleable from the start, eg, soft cheeses in a few weeks, hard cheeses in 2 - 12 months depending on the maturing period of the cheese. The correct business and technology advice at an early stage can reduce costly delays to your project.

Do not forget that significant quantities of whey will be produced (approximately 80-90% of milk throughput) and this will need to be disposed of in an environmentally and legally acceptable manner depending on the location of the production site. EHO and Trading Standards can provide some guidance. In some cases, the local water treatment authority will need to be consulted.

2.2 Typical small cheese dairy layout



2.3 Ingredients for cheesemaking

2.3.1 Milk, the basic material

Milk from different species of mammals has been used for the manufacture of cheese. Table 2.3 illustrates the major differences in the chemical composition of these milks. As a result, variations in the quality of the cheese do occur, depending on the type of milk used. For example, milk containing high total solids (eg, sheep) increases cheese yield. Conversely, milk high in fat produces softer cheese, but improves the mouth-feel of the product. Thus the cheesemaking process has to be modified in relation to the type of milk used.

Table 2.3 – Chemical Composition [% w/w] of milks of selected species of mammals

Animal	Fat	Protein	Milk Sugar	Minerals
Cow	3.9	2.7	4.6	0.75
Goat	6.0	3.3	4.6	0.84
Sheep	9.0	4.6	4.7	1.00
Buffalo	6.0	3.8	4.5	0.75

Robinson R.K. & Wilbey R.A. (1998) *Cheesemaking Practice*, 3rd Edn. Aspen Publishers Inc, Gaithersburg .

Milk for cheesemaking is carefully selected to make sure that there are no antibiotics or harmful agents that could affect the process. Cheese may be made from either raw or pasteurised milk.

2.3.2 Starter cultures

Starter is a culture of harmless micro-organisms, which convert the milk sugar, lactose, into lactic acid. The starter is added to the warm milk at the beginning of the process and is the key to a good quality cheese.

In earlier starter cultures, the existence of bacteria and how they worked was not known. The first breakthrough came when a French scientist, Louis Pasteur, was able to show their harmful effect in wine and later in milk. In 1873, Lister, a Scottish scientist, isolated a mesophilic bacterium, which he named *Bacterium lactis*. This was later known as *Streptococcus lactis* but the correct designation is now *Lactococcus lactis* subsp. *lactis* and is the main organism in UK starter cultures.

Until the middle of the 19th Century, cheesemakers on farms simply held over a portion of soured milk or whey in a small jug or churn and used it the following day to make cheese. In Scotland pure cultures were used in the South West in 1895.

Today, starters are generally supplied pre-packed in freeze-dried form or frozen for direct-to-vat inoculation (DVI) or for incubating before use to produce a more traditional liquid 'bulk' starter. The packs of freeze-dried culture can be stored for long periods in a domestic freezer.

DVI starter is added directly to the warm milk in the cheese vat at around 30°C.

Bulk starter is made by incubating freeze-dried or frozen culture in sterilised milk at around 27°C for 12 hours. A starter culture resembling natural fermented yogurt is produced and this is added to the warm milk in the vat at a rate of 1 to 4% depending on cheese type.

2.3.3 Annatto

Some cheese varieties are coloured by adding annatto to the cheese milk before the renneting stage. Annatto is a dye which is extracted from the seeds of a South American shrub. In cheesemaking, it becomes a protein dye attached to the casein, and it has no effect on the flavour of the cheese.

Traditionally, Red Leicester is deep red in colour and coloured Cheddar and Double Gloucester a medium orange colour. The intensity of the colour produced is governed by the amount of annatto used and the acidity of the cheese.

2.3.4 Rennet / coagulants

Rennet is used to coagulate the warm milk in the cheese vat prior to the cutting operation which produces curds and whey.

Rennet contains a proteolytic enzyme, chymosin, which hydrolyses the k-casein in the milk to destabilise the micelles to form a coagulum or junket in around 40 minutes. The reaction starts quickly so it is essential that mixing of the rennet is completed within two to three minutes after addition to the milk to prevent damage to the curd.

Traditionally, rennet was derived from a calf's stomach, but microbial vegetarian rennets are now more commonly used.

2.3.5 Salt

The salt used in cheesemaking is sodium chloride, the common salt used at home for cooking and seasoning. Salt plays a number of roles in cheesemaking:

- It slows down or stops the action of the lactic acid producing bacteria
- It aids the expulsion of surplus whey
- It acts as a preservative and inhibits the development of certain undesirable bacteria
- It adds flavour

Salt is added to the cheese curd after milling to inhibit acid development and provide an element of flavour. The amount of salt varies by cheese type but is around 1.5 to 3.0% (w/w).

In traditional cheesemaking, the salt is added by hand. This is essential to thoroughly distribute the salt evenly over the curds and also mix into the milled curds in an even manner. Failure to do this will result in variable cheese quality.

Cheese may also be salted by immersing the pressed block of cheeses in a brine bath. This is carried out, for example, in Denmark for Havarti, Danbo and other varieties.

Some soft cheeses are dry salted by rubbing salt on the outer surfaces of the cheese. This method of salting also helps to form a 'hard' rind.

2.3.6 Moulds

Moulds are a key ingredient in some cheese varieties as they assist the ripening process and impart characteristic flavours and aromas.

The white mould seen on the surface of Camembert cheese helps to hydrolyse the protein in the final cheese by working from the outside in. In Stilton manufacture, blue moulds can be added with the starter, and help to break down the curd produced from the inside of the cheese outwards.

For soft white mould ripened cheese varieties, the mould culture is *Penicillium candidum*, and is usually added with the starter culture. Alternatively, a suspension of mould culture can be sprayed onto the surface of the finished cheese after brining. A coat of white mould then develops on the surfaces of the cheese during the first two weeks of ripening.

Blue veined cheeses are normally of the semi-hard type and have little or no scald applied to enable a dry open textured acid curd to form.

Some varieties rely on environmental contamination to provide the blue veining, but mould spores, *Penicillium roqueforti*, can be added to the milk or to the curd during draining.

The curds are not usually pressed as the air spaces between the curd particles encourages the blue veining to develop.

During maturation the cheese is normally pierced with stainless steel wires to let in more air, which helps the mould to spread. The enzymes produced by the mould growth break down the milk components to give the characteristic sharp, tangy flavour associated with blue cheeses.

2.4 The cheesemaking process

All cheeses are made using the same basic ingredients and technology:

- Good quality raw milk
- Pasteurising the milk (optional)
- Acidifying the milk through the addition of lactic acid producing bacteria (starter cultures)
- Coagulating the milk by the addition of rennet (historically animal rennet but nowadays mostly microbial vegetarian rennet)
- Cutting, stirring and heating the curds to release whey as required
- Draining the whey from the curd
- Salting
- Moulding in shaped cheese moulds

Fig 2.5 – The basic stages of making a full-fat hard cheese (eg, Cheddar)



2.5 Cheesemaking stages for hard full-fat cheese

2.5.1 Pasteurisation

The purpose of pasteurisation is to destroy pathogenic bacteria, which cause disease and infection. Other bacteria in the milk, which can cause faults and taints in cheese, are also destroyed enabling the starter bacteria to work uninhibited.

Milk can be pasteurised in batches or continuously.

In batch pasteurisation, the milk is heated and held at a minimum temperature of 65.6 °C for 30 minutes and then cooled, usually in the cheese vat.

Continuous pasteurisation takes place in a HTST plant where the milk is heated to 71.7 °C minimum in a plate heat exchanger and held at that temperature for 15 seconds before cooling.

Milk for cheesemaking would normally be cooled to around 30 °C in readiness for starter inoculation.

2.5.2 Starter addition

Starter is a culture of harmless micro-organisms, which convert the milk sugar, lactose, into lactic acid. Starter is added to the warm milk at the start of the process and is the key to a good quality cheese.

2.5.3 Ripening

The starter culture ferments some of the lactose in the milk into lactic acid. This controlled souring or ripening of the milk continues until a pre-determined acidity, for the type or variety of cheese being made, has been achieved.

Lactic acid development during the cheesemaking process is measured by titration (ie, titratable acidity - T.A.) or by pH meter.



Adding rennet to ripened milk

2.5.4 Renneting

When the desired acidity has been reached, a measured volume of rennet is mixed into the milk. This produces a coagulum similar to a thick jelly in about 40 minutes. The reaction starts quickly so it is essential that mixing of the rennet is completed within two to three minutes after addition to the milk to prevent damage to the curd.



Cutting coagulum with vertical knife

2.5.5 Cutting

When the coagulum is sufficiently set, it is cut into small particles using special knives. This action releases much of the liquid whey held in the curd. After cutting, the resulting curds and whey are stirred gently to prevent the particles from settling. The particle size helps to determine the moisture content of the curd and consequently varies for different cheese types. The textural quality of the cheese starts to be determined at this stage.

2.5.6 Scalding

The curds and whey are heated (scalded) slowly to a pre-determined temperature by applying hot water or steam to the jacketed vat in a controlled manner. During scalding, the curds and whey are stirred continuously. The increase in temperature causes the curd particles to shrink and firm and acid development is retarded. The scald temperature and time profile, usually around 37 to 40°C in 30 to 60 minutes, varies depending on the type of cheese being made.

2.5.7 Stirring

After scalding the curds and whey are stirred for up to one hour to condition the curd. Acid development continues and the curd particles continue to shrink and firm.

2.5.8 Pitching

Stirring is stopped at this stage and the curd particles are allowed to settle in the bottom of the vat where they start to fuse together forming a mat of curd.



Checking acidity before turning whey

2.5.9 Whey removal

Whey is drained from the vat leaving the curd mass behind.

2.5.10 Texturing / cheddaring

The curd mass is cut into slabs (or broken by hand) in the vat, and then turned and piled at regular intervals. This allows the curd particles to mat together (cheddar) and more whey to be expelled as the acidity increases. The type of cheese being made determines the method of texturing employed. (Eg, Cheddar cheese curd is encouraged to fuse into solid slabs by turning and piling to give a closer texture, while Cheshire cheese curd is broken by hand and kept free and open to produce a grainy open textured cheese.)



Milling the curd ready for salting

2.5.11 Milling

The curd is cut into small pieces (milled) in preparation for salting. Milling also has some effect on the texture of the finished cheese (eg, Cheddar is usually milled into large chips while a finer cut, or double milling, is employed for open textured varieties).

2.5.12 Salting

Salting preserves the cheese, by inhibiting the growth of undesirable organisms, and adds flavour during maturation. It also controls the rate of acid development by inhibiting starter bacteria growth, and increases whey drainage by shrinking and firming the curd particles. The usual rate of addition is around 2 - 3% (w/w) and accurate mixing is very important to ensure even distribution throughout the curd.

2.5.13 Moulding

Prior to mould filling, the salted curd is again mixed and allowed to cool and drain. It is then packed into cloth lined metal moulds or unlined plastic moulds, which provide the final shape of the cheese, usually cylindrical or rectangular. A follower or lid is then applied to allow the curd to be compacted under pressure.



Filling traditional moulds with curds



A selection of cheese moulds for hard and semihard cheese

2.5.14 Pressing

The filled moulds are put into a press and pressure applied. This can be done manually or pneumatically and the moulds are usually left in press until the following day. Surplus whey is extruded through the perforations in the mould as the salted curd compacts and fuses.

2.5.15 Packing / bandaging

After removal from the cheese mould, the cheese can be prepared for maturation in a number of ways.

A traditional method is to submerge the cheese for one minute in hot water (50 to 60°C) to remove surplus fat and help form a rind. Then return it to a clean, lined mould and press it for a further day. The cheese is then bandaged using calico or similar material. Two circular overlapping end caps and a strip to encircle the sides is applied to the cheese using melted lard or paste. This prevents the surface of the cheese from cracking and allows the formation of a rind. To produce a rindless product, the cheeses are vacuum packed in specially manufactured food grade plastic bags prior to storage. Coating in wax is also an option.

2.5.16 Maturation

Cheese stores must be maintained at a constant temperature (normally around 10°C for hard cheese) to produce a consistent product.

For traditional cheese, the humidity of the store must also be controlled around 80 to 90% to prevent the rinds from drying and cracking.

The maturation period is specific to each variety of cheese. For example, Caerphilly and white Wensleydale may be ready in about two weeks, but a mature Cheddar may take 12 months before being ready for sale.

To ensure even maturation cheeses need to be turned at regular intervals.

2.5.17 Grading, quality inspection and product release for packing and distribution

During maturation the cheeses develop their final characteristic texture and flavour as a result of bacterial and enzymic action.

Full-fat hard cheeses usually take from three to 12 months to mature depending on the variety and flavour profile requirement. At two months of age the cheese is graded to determine the state of development and keeping qualities. Using a cheese iron, a plug (sample) is taken from a representative cheese from each vat made and points are awarded for flavour and aroma, body and texture, finish, and colour.

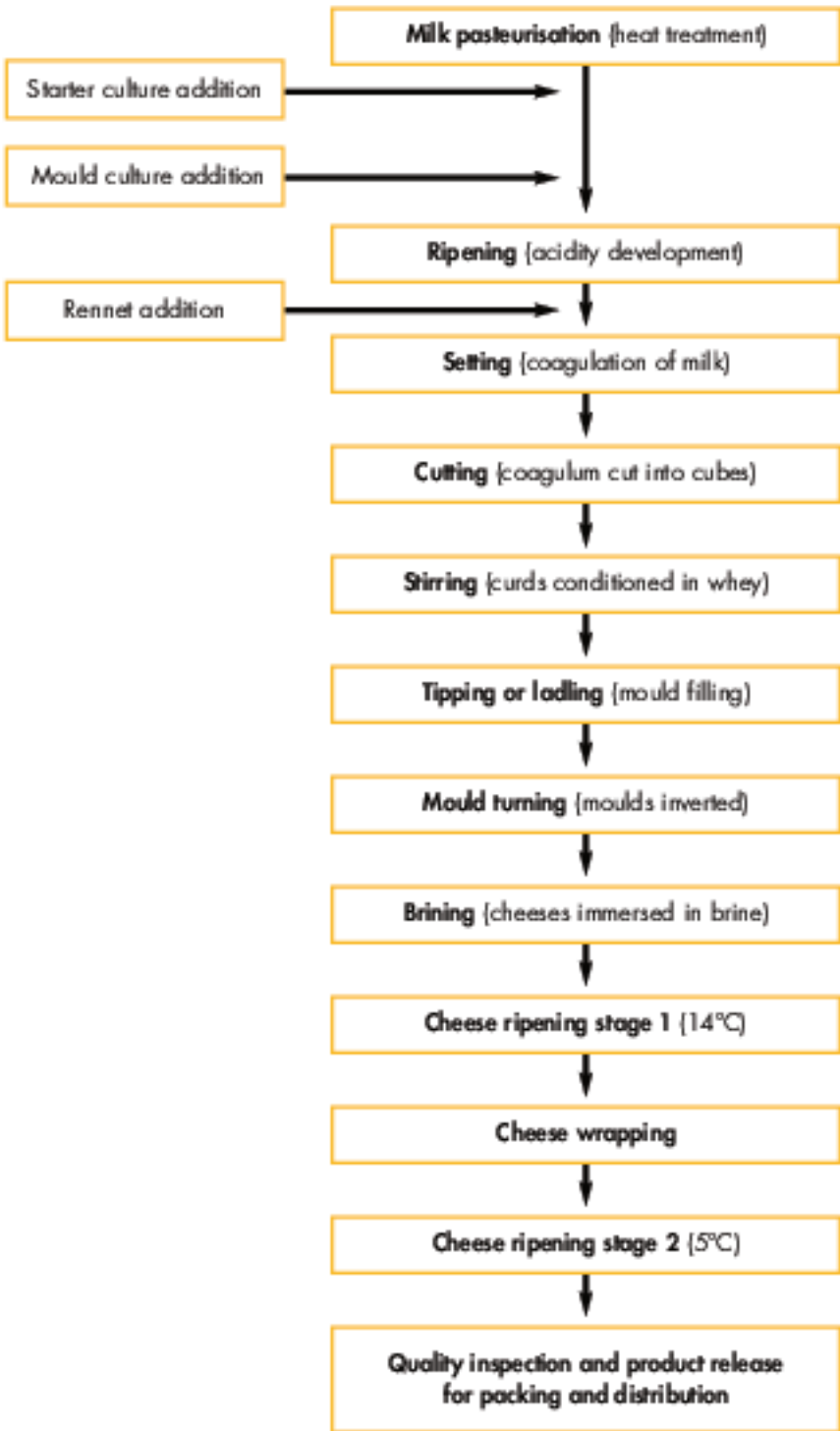
Further grading is carried out at two-month intervals for long maturing cheeses. A final product release quality check is carried out when the cheeses are cut and packed for sale.

2.5.18 Hard cheese yield

A typical yield for a hard cheese manufactured from cow's milk is in the region of 9000 - 10,000 litres of milk per tonne of cheese.

To produce cheeses of quality in body and texture, the casein/fat ratio has to be in range 0.69:1 to 0.71:1. Normally artisanal cheeses are made directly from the milk available without attempting to standardise. This will affect yield, quality and consistency.

Fig 2.6 – The basic stages of making a soft mould ripened cheese (eg, Brie)



2.6 Cheesemaking stages for mould ripened soft cheese (eg, Brie)

2.6.1 Pasteurisation

The pasteurisation process is the same as that for hard cheese but the milk temperature for starter addition tends to be higher (around 32°C.)

2.6.2 Starter addition

Different starter strains are used for soft cheese and a white mould culture, *Penicillium candidum*, is usually added at this stage of the process. Alternatively, a suspension of mould culture can be sprayed onto the surface of the finished cheese after brining.

2.6.3 Ripening, renneting, and cutting

The ripening, rennet addition, setting, and cutting stages are also similar to those for hard cheese.

2.6.4 Stirring

After cutting, the curd is conditioned in the whey by gently stirring at 10 to 15 minute intervals. As soft cheese curd is usually not scalded it is very fragile and great care must be taken to avoid damage.

The curd is then allowed to settle in the vat and a portion of the top whey is removed by pouring or ladling.

2.6.5 Tipping or ladling

The remaining curds and whey is tipped or ladled into perforated cheese moulds, which allow the whey to drain from the curd. Moulds are filled to the top and as the curd drains it settles to around one quarter of its original height. Consequently, soft cheese moulds must have a capacity that is four or five times greater than the finished cheese.

2.6.6 Mould turning

After approximately 30 minutes the moulds are inverted by turning onto perforated mats and whey drainage continues. This turning process is repeated two to three times in the next eight hours. Keeping the cheese warm during this period is essential for good drainage.

2.6.7 Brining

The following day the cheeses are removed from the moulds and immersed in a 20% (w/v) brine solution for about one hour. The actual brining time is dependent upon a number of factors including cheese size, moisture content and temperature, brine strength, brine temperature and pH. Alternatively, dry salt can be rubbed into the surfaces of the cheese.

2.6.8 Cheese ripening (stage 1)

The racked cheeses are placed in a ripening room at around 14°C and 85% relative humidity (RH) for 14 days to allow a coat of white mould to develop. Occasional turning prevents the cheese from sticking to the racks and encourages an even mould growth on all surfaces of the cheese.

2.6.9 Wrapping

When satisfactorily moulded, the cheeses are wrapped in perforated wrapping paper, which allows the ripening process to continue. They are then returned to clean wire racks for further ripening.

2.6.10 Cheese ripening (stage 2)

The racked cheeses are transferred to a refrigerated ripening room at 5°C for a further two to three weeks. During this time, the ripening process continues as the white mould helps to hydrolyse the protein in the cheese by working from the outside towards the centre.

2.6.11 Quality inspection and product release for packing and distribution

At four to five weeks of age, the cheese is ready for sale. Samples are taken to ensure that the product meets quality and shelf-life criteria prior to weighing and labelling the individual cheeses.

2.6.12 Soft cheese yield

A typical yield for a soft cheese manufactured from cow's milk is in the region of 7000 – 8500 litres of milk per tonnes of cheese.

Table 2.7 – Cheese recipes – UK Regional Varieties (Dairy Microbiology – National Dairy Council 1981)

CHEESE	MILK TEMP. WHEN STARTER IS ADDED	QUANTITY OF STARTER ADDED	RIPENING PERIOD (H)	AT TIME OF RENNETING	QUANTITY OF RENNIN ADDED (ML PER 1000 L OF MILK)	TIME REQUIRED TO REACH DESIRED COAGULUM	SCALD TEMP.	MAKE TIME (RENNIN TO SALT TIME)	ACIDITY AT SALTING (%) LACTIC ACID)	MATURING TIME (APPROX)
Caerphilly	31°C	1.0%	2 1/4 - 1	0.20 - 0.22	200-250	40 mins	32°C - 34°C	2 1/4 - 2 3/4 hrs	0.51 - 0.55	2 weeks
Cheddar	30°C	1.0 - 1.5%	1/2 - 1	0.19 - 0.21	220-250	45 mins	38°C - 42°C	3 3/4 - 4 1/4 hrs	0.60 - 0.70	3-5 months (mild) 5 months or more (mature)
Cheshire	30°C	1.5 - 2.0%	1 - 1 1/2	0.19 - 0.21	180	30 mins	32°C - 34°C	3 - 3 1/2 hrs	0.60 - 0.70	1 - 3 months
Derby	29°C	1.5%	1/4 - 1/2	0.20	300	45 mins	36°C - 38°C	3 1/4 - 4 1/4 hrs	0.65 - 0.70	3 - 4 months
Double Gloucester	30°C	1.0 - 2.0%	1	0.18 - 0.19	220-300	40 mins	37°C - 38°C	3 3/4 - 4 1/4 hrs	0.58 - 0.65	3 - 6 months
Lancashire	30°C	2.0 - 2.5%	1/2 - 1	0.185 - 0.220	220 - 250	50 mins	34°C - 38°C	3 1/4 - 3 3/4 hrs	0.80 - 0.85	4 - 8 weeks or more
Leicester	30°C	1.0 - 1.5%	1 h	0.20	300	45 mins	36°C - 38°C	3 3/4 - 4 1/4 hrs	0.55 - 0.60	10 - 12 weeks
Silton	30°C	0.01%	1/2 - 1 h	Must not exceed 0.17	200	60-90 mins	Not scalded	Overnight (22 - 24 hrs)	1.10 - 1.30	3 weeks (white) 3 - 6 months (blue)
Wendydale	30°C	1.5%	1 - 1 1/2	0.19	120 - 180	45 mins	32°C - 34°C	2 3/4 - 3 1/4 hrs	0.52 - 0.62	3 weeks (white) 6 months (blue)

These are the original '9 varieties' of English/Welsh cheese. Many modern cheeses may not fully align with these figures. Therefore, this table should be used as a guide. The cheese composition must be legal in terms of fat-in-dry matter (FDM) (ie, moisture/fat%) in relation to it being described as full-fat hard cheese/full-fat soft cheese. Note: Higher milk temperatures should be used for DVI cultures.

This booklet and the information within are intended as a guide only. Costs stated are approximate and were felt to be representative at time of going to press.

Please seek detailed support from your accountant, bank, legal adviser or other specialist support organisations available in pdf and printed copy format from the DairyCo, formerly the Milk Development Council

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