



# The Cheddar Cheese Manufacturing Process

## The composition of milk

**Water 87.0%** – Continuous medium in which all constituents are distributed either in solution or in suspension. Essential for bacterial growth and chemical reaction in manufacture and maturation. Affects the body of the cheese – soft high – hard low.

**Fat 4.3%** – Butterfat – minute globules held in suspension. Complex mixture of compounds – glycerides. Contains fat soluble vitamins A and carotene. Gives richness and smoothness of flavour. Fat breakdown by enzymes and bacteria leads to strong flavour development in maturation. Too much rancidity.

**Casein 2.7%** – Vital for coagulation of milk during which a fibrous network forms enmeshing all other constituents. Present in combination with calcium in colloidal particles – micelles. Casein matrix can hold water like a sponge. Shrinks and expels moisture in response to temperature and acidity. Means by which moisture is controlled during manufacture. Breaks down during maturation as does fat.

**Lactose 4.9%** – Milk sugar – water soluble – 90% lost in whey stream. Can be recovered in whey treatment, i.e. whey drying. Remaining lactose vital as it provides food for starter organisms that convert lactose to lactic acid. Fermentation is the key to the whole manufacturing process.

Lactic Acid in the Make;

- Aids coagulation by converting some insoluble calcium salts to soluble form
- Favours expulsion of moisture from curd
- Aids chemical changes and alteration of curd structure during cheddaring
- Retards growth of undesirable organisms
- Directly contributes to acid flavour component
- Converted by enzymes & bacteria to other flavour

**Whey Protein (Albumin etc.) - 0.7%** – Consisting of several proteins soluble in water. Not coagulated by rennet. Main protein Albumin. 70 deg. Celsius denatures these and react with casein where present or precipitate out in the whey stream where no casein present.

**Ash/(Mineral, trace Elements etc.) - 0.7%** – Present in very small amounts. Necessary for some stages of manufacture and maturation. Excesses or deficiencies can impair acid



formation. Full role in process not completely known. What is very complex.

## **Cheddar Cheese Ingredients**

The manufacture of cheddar cheese requires as its basic ingredients, milk, rennet, starter culture and salt.

## **Manufacturing Process**

The process of manufacture is quite technical but to simplify the process with a minimum of jargon the steps are as follows.

The milk which is derived from cows is collected and delivered to the manufacturing site by road tankers where the milk is stored in silos generally at  $<4^{\circ}\text{C}$  until it is ready for use in the manufacturing process.

The first step in the manufacturing process is the "Standardisation Process". This is where the components of the milk that contribute most to the "make" (manufacturing process) are standardised to the desired ratio for the "make", these components being protein and fat.

**Standardisation** requires the raw milk to be passed through a mechanical separator or centrifuge that separates the fat from the remainder of the liquid phase skim milk that contains protein made up of casein and whey proteins and water. The skim milk and cream then pass through an infrared spectrometer that measures the components of each liquid stream and by controlling a series of valves recombines the streams of fat and skim at the required ratio for the cheese make. This milk then can either be stored again for a period of time prior to use or the milk continues through the process to the pasteuriser.

**Pasteurisation** is the sterilisation step of milk required by legislation to ensure that all pathogenic bacteria are killed to make the milk and by-products safe for human consumption. The process of pasteurisation requires the milk to be heated to a minimum of  $72^{\circ}\text{C}$  for 15 seconds. To enable this process the milk passes through a series of plates under pressure where steam is used to heat water that heats the plates and in turn heats the milk to the desired temperature. The milk then continues through a further series of plates that are cooled by chilled water that in turn cools the milk to a "set temperature" prior to addition to the cheese making vats. The vats have a capacity of 14,000 litres each. By the time that the eighth vat is full, the first one has been emptied, washed and is ready to fill again.

Once the milk has begun to enter the cheese-making vat a lactic acid producing bacteria,



known as starter is added to the milk. This bacteria is added to produce the characteristic flavour in the final cheese. The vat then continues to fill and when complete a coagulating enzyme known as rennet is then added to the milk once it has become quiescent. The enzyme rennet then causes the milk to coagulate and become a gel-like mass similar to junket. This phase is referred to as the Coagulation phase.

The **Coagulation** phase occurs over a period of approximately 30 to 40 minutes at which time the cheese maker to determine whether the coagulum is ready to be cut tests the surface tension of the coagulum. This curd is then cut into small particles to release the whey.

Cutting takes place within the cheese vat via a series of rotating knives which also when operating in the other direction stir the coagulum/curd. The cutting takes approximately 5 - 10 minutes dependent upon the desired moisture the cheese maker requires in the end product. Once cutting is complete the coagulum has disappeared and what remains is referred to as the curds and whey. The freshly cut curds are allowed to rest (heal) for a few minutes to allow the newly cut surfaces to form a skin prior to the cooking phase.

Cooking of the curds is carried out by continually stirring the curd whilst applying heat indirectly via the cheese vat surface that is heated using steam or hot water. The cooking phase generally takes place over a 40-minute period where the temperature of the curd is raised from approximately 31°C (set temperature) to 38°C. During this period of time moisture is expelled from the curd particles and the curds begin to firm up. After the cooking phase has ended the curd continues to be stirred until a desired level of pH is achieved. At this time the vat is emptied into a machine called an Alfomatic which automatically completes the remainder of the process. The Alfomatic is basically a big stainless steel box that contains a number of conveying belts contained within.

The remainder of the process is divided up into 5 further phases; Draining, Cheddaring, Milling, Salting and then Mellowing.

Draining is the first of these phases. This is where the curds are separated from the whey via a draining screen. As the curd passes over the screen the whey (liquid) drops through and is no longer required for the cheese making process. The curd continues to fall over the screen onto a conveyor belt where it is stirred by a number of mechanical stirrers which break up the curd bed and allow the free moisture/excess whey to drain off. After approximately 15 minutes the curd then falls onto a second conveyor belt travelling in the opposite direction and forms a curd bed/matrix. This phase is known as the Cheddaring phase and the time the curd spends on this belt is approximately 20 minutes until it reaches the Milling phase.



Milling is where the curd bed passes a rotating cylindrical knife which cuts the curd bed into chips similar in size and appearance to potato chips from the Fish and Chip shop. The chipped curd then drops onto another belt where salt is added and is known as the Salting phase.

Salting is where a predetermined amount of salt is added to the chipped curd to act as an agent to expel any further excess moisture but primarily to act as a natural preserving agent. The salt is sprayed onto the curd by an automatic air driven device. The salted curd chips then travel along the conveyor where they are stirred by a number of mechanical stirrers which assist to distribute the salt evenly and to allow the excess moisture expelled to drain from the curd. This is the final step in the cheese making process. From here the curd travels from the Alfomatic to the Block Forming Towers through a number of vacuum lines.

The Block Forming Towers accumulate the curd chips under vacuum and form them into 20kg blocks which are automatically press and cut within the tower and then ejected into a plastic bag. The size of the block is approximately 185mm x 270mm x 340mm. Once in the plastic bag the fresh cheese is conveyed to an automatic vacuum sealing machine that seals the open end of the bag.

After the vacuum sealing of the bag the fresh cheese continues to be conveyed automatically to the automatic cartoning machine where it is surrounded in a cardboard carton for protection during storage and maturation. Each carton of cheese is then stacked onto a pallet containing approximately 60 blocks and then transported by forklift to the storage and maturation cool stores.

For the first 48 hours of its life in the maturation rooms it is stored at around -2°C in a blast chiller to remove as much of the heat from the block as possible. At the time of the cheese being placed into the carton the cheese is still approximately 30°C±. From the blast chiller the cheese is transferred to a maturation room where the cheese spends the rest of its life prior to being cut for retail sale. The cheese is matured at a temperature of approximately 8°C for anywhere from 2 months to 24 months depending upon the type of cheddar cheese required.

Cheddar cheese can be matured for periods of time as indicated above, to produce different flavour profiles.

Mild Cheddar	2 months maturity
Tasty Cheddar	6 to 9 months maturity
Extra Tasty	9 to 12 months maturity



Extra Matured 9 to 12 months maturity

Vintage Cheddar 12 to 24 months maturity

The next stage in the life of a block of cheese is where it is chopped up into retail pack sizes and sold in supermarkets. This process is carried out in a specifically designed and built Cutting and Packaging Plant.

## **Cutting and Packaging**

The continuing life of a block of cheese finds our cheese transported from the maturation room to the cutting and packaging plant where it first enters the cool room storage facility until it is called for cutting. The pallet is transferred to the cutting line where it is placed on a conveyor and then presented to the robotic picker.

The robotic picker then removes the cartons on sequence and places them on to the conveying system. The cartons then proceed along the conveyor to the De-cartoning Machine that as the name suggests removes the carton that is then sent off for recycling. The stripped block is then conveyed to the sterile area where the only protection it now has the plastic bag is removed.

The cheese then passes through a wall into the cutting room where it is delivered to the automatic cutter that depending on the day can cut the cheese into retail sizes that range from 250g to 1kg. From the cutter the cheese pieces are conveyed along to the automatic over-wrapper where the plastic retail pack is placed around the small pieces and sealed and flushed with a mixture of nitrogen and carbon dioxide that ensures the cheese is stored in a sterile environment until it reaches the supermarket shelves and ultimately your fridge.

From the over-wrapper the cheese passes through a check-weigher that ensures the pack is of the correct weight and it then passes through a metal detector or an X-ray machine to ensure that there are no contaminants or foreign material in the cheese. The cheese is then conveyed to the boxing area where it is placed in a protective carton for storage and transport to the supermarket. The cartons are then placed on pallets and transferred to the finished goods storage area until they are required for despatch. To despatch cheese to the supermarket firstly there must be an order received by the sales department that in turn generates an internal sales order. This sales order then is sent to the storage area known as the Logistics Department that then issues a pick list that contains the number of cartons of cheese to be despatched. The cheese is then selected and prepared for loading onto the delivery vehicle to take it to you the consumer. Behind all of the above sequences there are a series of quality control steps that take place. Things like testing the cheese to ensure that it



is free from microbial contamination and testing it for the chemical composition to ensure that it meets legislative requirements.