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Cheese and cheese-making

With a special emphasis on Swedish cheeses

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Ancient origins

Cheeses are found in almost all cultures throughout the world and cheese is one of our oldest food items. The method of making cheese ancient. In the past, milk was a seasonal food and cheese-making was a method of conserving the milk and avoiding waste at times of surplus. The production of cheese using rennet has been known for at least 5 000 years and dates back to the ancient Mesopotamia and Egypt.

The history of cheeses parallels with that of wine and in both cases there are more or less trustworthy stories about the origin. One story tells how our ancestors discovered that rennet had the effect of precipitating casein (milk proteins) from the milk when milk was found in the stomach of a slaughtered calf. Another story tells how the first cheese was created around 9 000 years ago when an Arabian merchant was riding on a camel through the desert. He had brought with him a bag made from skin and filled with goat-milk. When he opened it to drink, he found that the heat and the rocking of the camel had turned the milk into solid cheese and liquid whey. The merchant tasted it and found it palatable. He and his collegues seem to have helped in spreading cheese production throughout the world.

A variety of different cheeses from around the world. Some are still made in bags, hence their spherical shape.

Different Swedish cheeses

There are many different kinds of cheese in Sweden and around the world. A type which is manufactured and eaten in many different countries is usually described in *Codex Alimentarius*, which is a book of standards. There is a description of what the cheese looks like, its smell and taste. The book of standards is there to avoid uncertainties about the cheese in the context of international business. Examples of cheeses described in *Codex Alimentarius* are Emmentaler, Edam and Cheddar.

Five basic types of cheeses are made in Sweden:

- **Hard cheeses** can be cut by a cheese-cutter *e.g.*, Herrgård®, Hushållsost;
- **Soft-cheeses** (also called dessert-cheeses) *e.g.*, soft blue cheeses, Camembert;
- **Fresh cheeses** are supposed to be eaten immediately, and are unripened *e.g.*, Keso, Mozarella;
- **Smältost** is made from hard cheese, which has been melted together with certain salts *e.g.*, cheese spread, shrimp-flavoured cheese;
- **Mesost** is an unusual product made from boiled whey.

Trademark-protected cheeses

Many Swedish hard cheeses are part of the country's culture and the names and origin of these traditional cheeses are often protected by trademarks.

Trademarks are written in capital letters on Swedish cheese labels together with the symbol ® or ™ . ® means that the trademark is registered and ™ that owner has applied for a trademark, but that it has not yet been granted.

Trademarks are registered by the Swedish Patent and Trademark Registry and by the European Union trademark authority in Alicante, Spain. When a trademark is granted the name can be used only by the owner of that trademark.

The Swedish Herrgård® (Figure 1) has been made since the 18th century and started as an attempt to manufacture Swiss cheese, using Emmentaler as a model. Herrgård® was EU-registered at the beginning of 2001.

The Swedish 'Prästost' (Figure 2), nowadays simply called Präst®, has been made since the 16th century and was used by farmers to pay their tythes to the minister in the area (präst is Swedish for 'preist'). This custom continued until to the 19th century. Präst® was granted an EU trademark at the beginning of 2001.

Grevé® (Figure 3) is a relatively new cheese. It was launched in 1964 after an intense period of development work at the dairy in Örnsköldsvik, Sweden. Grevé® was granted a European trademark in 2000.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Origin-protected cheeses

In many countries there is a long tradition of protecting the origin of their national and regional cheeses by law. Such protection dates back to the Middle Ages. Well-known origin-protected cheeses are Parmigiano-Reggiano ('parmesan') from Italy, Comté and Roquefort from France and Danblu ('Danish blue') from Denmark.

Svecia (Figure 4) is a geographically origin-protected trademark according to EU regulations. This means that it can only be manufactured in Sweden and only in accordance with old traditions. Svecia is the Swedish cheese that represents many of the traditions of the old country cheeses. The name Svecia comes from the latin word *Suecia*, which means Sweden. After a decision in 1920 Svecia became the common name for all cheeses manufactured and sold locally. Previously, most cheeses were named after the village in which they were made.

An application for EU-protection for Hushållsost (Figure 5) has also been made. This cheese originates in Sweden where it has a long history of production.

Manufacturing

Cheese is essentially concentrated milk. To make 1 kg of hard cheese 10 kg of milk is required. Swedish cheese is usually made from a cow's milk, but milk from other animals *e.g.*, goats, sheep and buffalo can be used.

Sweden has a large selection of hard cheeses. The ingredients in all cheeses are the same — milk, bacterial starter cultures, protein-coagulating enzymes ('rennets') and salt. Variations of starter cultures, times, temperatures, stirring during processing and storage conditions produce different types of cheeses.

All hard cheese manufactured in Sweden and sold in grocery stores is made from pasteurised milk. There is no legal requirement in Sweden for milk used for hard cheeses to be pasteurised, but there is an agreement among the manufacturers to use pasteurised milk. During Pasteurisation, the milk is heated for 20 seconds to 72–75 °C. This kills harmful bacteria and the safety and uniformity of the matured cheese is improved.

In Sweden, milk used for fresh cheeses must be pasteurised by law. Livsmedelsverket (the Swedish National Board of Food and Agriculture) permits a few farms to sell cheese made from unpasteurised milk directly from the farm

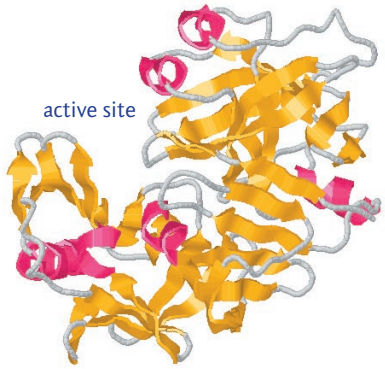


Fig. 6
A computer-generated model of chymosin.

Premanufacturing

The fat content of the milk is adjusted to that required in the finished product, then the milk is poured into large containers for coagulating. Carefully-prepared cultures of lactic acid bacteria are added. These are important for the development of the cheese, its taste and ripening. The milk is heated to 30 °C and rennet is added. Rennet is extracted from stomachs of calves and cows and contains an enzyme chymosin (Figure 6), which causes the protein in the milk (casein) to coagulate, giving the curd a smooth texture. This technique has been used for thousands of years. About 30 ml of rennet is added to 100 litres of milk. This yields about 10 kg cheese and 90 litres of whey. Most of the chymosin is removed with the whey.

Fig. 7
An English cheese made with chymosin from genetically-modified yeast.

Chymosin can also be produced by genetically-modified bacteria and yeasts (Figure 7). Here, the gene encoding chymosin has been transferred into microorganisms. Such chymosin is not used in Sweden.

Some fungi produce proteases that act in a similar way to animal chymosin. This enzyme has some different functional characteristics compared to animal chymosin and is therefore used only in certain circumstances *e.g.*, in the production of 'vegetarian' cheeses.

Coagulation

The milk has to set for about 30 minutes after the rennet has been added. The milk coagulum is cut into cubes with special tools. The size of the cubes differs depending on the kind of cheese that is being made.

Heating and stirring

The cubes are stirred and heated for about an hour. During this process water (whey) is extracted from the cubes, which then changes into semi-solid 'curds'. The heating influences the balance between the different bacterial cultures in the curds and is of great importance to the end result.

Shaping of the cheese

The liquid is removed from cheese curds. At the same time, lactose and whey-proteins are separated. The method is used for separating the curds and whey influences the texture of the finished cheese. Holes sometimes arise during the ripening of the cheese because the bacterial culture produces carbon dioxide.

Pressing

The curds are put into moulds and pressed into the shape of the finished cheese.

Salting and preparation of the surface

The pressed cheeses are stored from between hours to many days in salted water. This influences the cheese's durability, consistency and taste. It is also possible to salt directly into the whey or the curd. After the cheeses have been in the salty water they are stored. Some cheeses are treated on the surface with a special kind of bacterial culture to give special taste and aroma. Sometimes these cheeses are called 'kittostar' in Sweden.

Before the cheeses leave the dairya layer of paraffin or wax is applied or they are packaged in a plastic film. The method used varies with the type of cheese. The cover protects the cheese from drying, moulding and other pollutants in the environment. Cheese which is packaged in plastic film does not develop a crusty surface.

Fig. 8

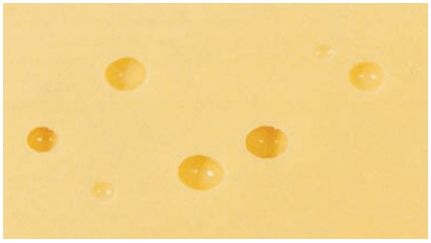


Fig. 9

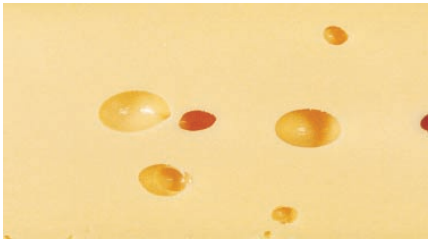
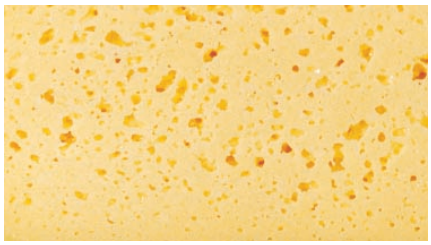


Fig.10

Fig. 11



The texture of the cheese and the appearance of the cut

'Rundpipig cheese' has few, big, round holes. The texture becomes 'rundpipig' when the curd is pressed under the whey, so air is absent. The pressed curd is put into the moulds for final pressing and then it is transferred for storage. Herrgård® (Figure 8) and Grevé® (Figure 9) are examples of 'rundpipiga' cheeses.

'Grynpipig cheese' has many small, grain-like holes. The cheese gets a grain-like texture when the whey is drained from the curd, so air is coming in when cheese is formed. Svecia (Figure 10) and Präst® (Figure 11) are examples of 'grynpipiga' cheeses.

Cheese will develop a dense texture if the curd is left in the cheese container for acidifying after the whey has been drained. The curd is then cut (the 'cheddaring' process) before it is put into a mould for pressing. Since carbon dioxide is released in the cheddaring process, such cheeses will have a firm texture with only a few flat holes. As the name suggests, cheddar is an example of a dense cheese made in this way.

Storage and maturation

During storage a complex ripening process takes place, which requires different times for different sorts of cheese. The storage time can vary from a couple of months to up to a year or more, to give the cheese the right taste and consistency. However, a cheese cannot been stored indefinitely. Like wine, it reaches its 'highpoint' after a certain time, it is fine for a while, but starts to deteriorate and will eventually lose its specific character. During storage the cheese becomes a deeper yellow colour, the consistency becomes softer and the taste stronger. What happens during maturation depends on many factors such as storage temperature, humidity, the wrapping of the cheese and so on. Throughout this period the milk proteins are broken down into peptides and then to free amino acids. The more the protein molecules are broken into shorter polypeptide chains and volatile molecules the stronger the taste will be. Lipids also break down into smaller molecules and fatty acids. Because these are very aromatic they are of great importance to the taste and smell of the cheese.

The maturing of cheese is influenced by many factors such as pH, water content, salinity, microbes and storing temperature. The most important process during maturing is the degradation of the casein molecules. Chymosin starts the proteolysis by breaking down the kappa-casein of the milk to peptides and this process continues during the whole maturing time. The enzymes of the added bacterial cultures, the proteases, continue the degradation to amino acids and other small nitrogen compounds as dipeptides and sometimes all the way to ammonia compounds. It has been shown, that especially the presence of non-volatile peptide-fractions are of great importance for the taste. Gas — especially carbon dioxide — is formed at the same time as lactose is broken down to lactic acid and this makes the pipes in the cheese. Since lactose is broken down during maturing of the cheese, people with lactose-intolerance can often eat cheese. The pH is lowered by the formation of lactic acid which also adds to maturing of the cheese. In a Camembert cheese the pH becomes 4.6 or lower. This means that the calcium phosphate of the cheese is being dissolved, which is of great importance, since calcium makes the cheese compact.

An Emmentaler-cheese has a relative high calcium content, around 1%, and also a very different consistency than a Camembert with a calcium content of about 0.2-0.3%. The role of lipids is important for both the consistency and taste. The higher the lipid content and also the longer the lipid-molecules (milk from the summer has longer lipid-molecules), the softer is the cheese. The lipids add an agreeable taste, which makes it difficult for manufacturing cheese with a low lipid-content. The lipids also dissolve some taste-molecules, which increases the taste-experiences with cheese high in lipid-content. The breaking down of the lipid-molecules occurs with the help of lipases, but lipids can also be oxidised and then the result of this is other products and also other tastes.

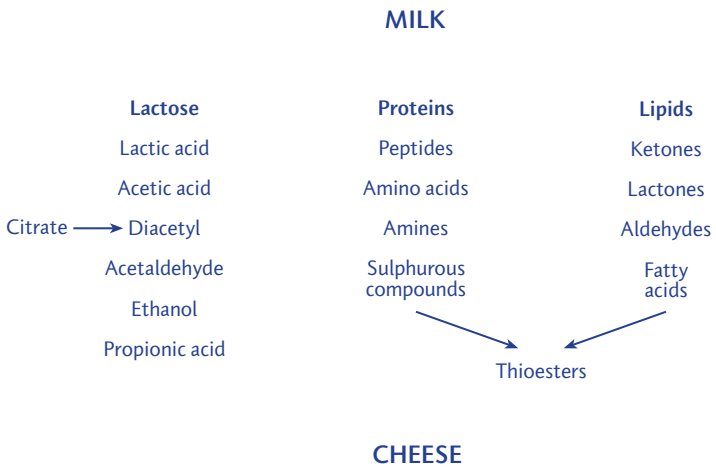


Fig. 12
Some chemical changes during the ripening of cheese.

The cheese master is responsible for the maturing of the cheese

The storage of cheese is an art, which requires careful temperature control and handling. Many cheeses need to be turned in a particular manner to mature correctly.

The cheese master walks around the storage rooms every day to control the cheeses. Just by looking at the cheeses, an experienced and skilful cheese-master can judge whether the cheese are maturing as planned. The cheese master monitors the surface and form of the cheese (Figure 13).

When the cheese ought to be ready for consumption the cheese-master makes a more thorough investigation with the help of a special tool — a cheese drill. Using the cheese drill he carefully removes about a core about 10 cm long from the cheese. He judges its aroma, taste, tenderness, humidity and also how the holes have developed. Is the cheese not ready, it has to be stored for a little longer. The cheese master repeats the procedure until the cheese meets the desired characteristics.

Durability and storage

Hard-cheese has a long durability if it is stored in the right way. Compared to milk, cheese has a lower content of water and a higher salinity. In the correct environment microorganisms will not survive and not increase in numbers as fast as in milk.

All cheeses should be kept at low temperatures and some may have to be stored in a fridge. Cheese should be stored in a plastic box with a lid, a plastic bag or plastic wrapping, except for those cheeses with a very strong aroma. This kind of cheese is best stored in aluminium foil. All cheeses should be stored separately since they can get taste from each other. Only dry wrappings should be used. In other packaging the cheese can easily mould.

Cheese can be frozen and stored, but keeps better if it is grated first. Whole pieces of cheese can easily be crumbled when thawed. Frozen cheese is excellent for cooking and if the cheese is to be grated it can be taken directly from the freezer. Cheese should not be stored in a freezer for more than three months. With a longer storage time the taste of the cheese can change.

Fig. 14
Ripening cheeses.

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