



Swiss Cheese

Protecting High-Quality Food Exports
of Switzerland

Objective

The aim of this study case is to present findings about Ambrosus being used in the Swiss cheese industry (1) to assure the quality, (2) to protect the Swiss premium label, and (3) to demonstrate logistics conditions.

Swiss Cheese

Switzerland currently produces more than 450 cheese varieties. 80% of agricultural land is used in to breed livestock, and half of the Swiss milk production is used in cheese manufacturing. Cheese produce represents 6.8 percent of the organic product market in Switzerland. Each year, 200,000 tonnes of cheese are made in Switzerland, of which approximately 70,000 tonnes are exported, mostly to Germany, Italy, USA, France, and Benelux. These figures demonstrate the high importance of cheese production to Switzerland's economy.

Swiss cheese is known internationally for its excellent quality. Made only with natural products, and tightly regulated through strict laws and quality controls, Swiss cheese seeks to mitigate ecological concerns and meet the market's demands for a more eco-friendly product.

The production of Swiss cheese involves many steps: curdling, draining, heating, pressing, salting, fermenting, refining, and controlling. Each step is vitally important and is submitted to strict regulations in order to assure safety and high-quality.

Safety

Safety is of the highest importance in the manufacture of food products. We all want to consume safe and healthy products. In order meet safety demands, many technological devices have been

developed, and strict regulations have been put in place. However, in recent years numerous food scandals have reminded us that safety remains a major issue in food manufacturing.

The primary sanitary concern in the production of cheese is the development of harmful bacteria. High ripening and storage temperatures, as well as hygiene issues, are the principal causes of contamination. Using raw-milk heightens the risk of bacteria proliferation. Between 1993 and 2006, the consumption of nonpasteurized cheeses caused 121 outbreaks, leading to 3,000 people falling sick, 140 hospitalizations, and more than 50 deaths. Since these outbreaks, the Swiss Federal Regulation has changed, and specific production conditions for raw-milk cheese have been imposed. However, safety remains a paramount concern, and numerous factors—including sanitary conditions, temperature, fermentation, and the origin of the milk—remain important in assessing risk and determining suitable controls.

Quality

Food quality includes external factors such as the appearance, texture, flavour, and internal factors including chemical, physical, and microbiological composition. But as consumer demands evolve, the term 'quality' also broadens to include ethical and environmental aspects. Thus, when we talk nowadays about a food product of high quality, consumers may think of produce created using eco-friendly procedures, robust employment conditions, and the welfare of the animals involved in the manufacturing process.

Determining the quality of cheese requires consideration of three key parameters: the taste, the aroma, and the texture. The quality of cheese is further informed by the livestock's living conditions, its diet, the strict hygiene standards followed, and the various processes that the cheese has gone through until it arrives to the end-consumer.



Quality parameters affecting food safety

The strict production standards imposed on the production of Swiss cheese ensures the safety of the produce. Bacterial contamination mostly occurs during ripening and storage at high temperatures. Four main germs are responsible for many of the cheese-related bacteria outbreaks: *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli* and *Listeria*.

These bacteria are originally present in milk products, but become dangerous once their numbers exceed a certain amount. Every cheese product must, therefore, be tested in order to assure its safety to the consumer. However, thanks to high hygiene standards, Swiss cheeses are known to be safe produce.

Quality parameters affecting the taste and aroma

Taste and aroma are complex mixes of odorant and gustatory chemical components.

They mostly develop during the maturing stage, during which bacteria transform the proteins and fat carbohydrates into aromatic substances. Temperature and humidity during this stage determine which bacteria are developing most, and are therefore of vital importance for the final quality.

The salting stage also creates influences the cheese's aroma. Taste and aroma further depend on the quality of the milk used in production. Milk from animals fed with silage brings an unpleasant flavour and cracking in the cheese. Raw-milk cheese has more taste shades than cheese processed with pasteurized milk, and is more aromatic.

Milk that coagulated through renneting give less acidity than milk coagulated through lactic curdling. Cheeses with high fat content have more scent than other cheeses due to the fact that the aromas attach themselves to the fats. Given that the water volume in the cheese determines the fat content, the draining and dewatering processes also significantly influence the final product's quality.

Taste can be improved through various procedures. Flavouring bacteria, natural additives, spices, spice extract, or other natural flavouring ingredients—such as grape or fruit marc—can be added to the cheese. The cheese can also go through the smoking process. During the refining period, its surface can be treated with spirits, wine, cider, vinegar, or rubbing solutions such as salt, whey, natural yogurt, herbs decoctions, or vegetable oils. Cheese can also be washed with fresh or salty water, or with lactoserum. The mechanical processes of rubbing the cheese with a brush or a cloth can also bring more flavour.

Quality parameters affecting the texture

Cheese texture is defined as its external aspect, its firmness, friability, and elasticity in the mouth. There are two major factors influencing the cheese's texture: pH and humidity. Of these, pH has the biggest influence, as it is principally responsible for the paste's damping.

The cheese's humidity depends mostly on the pressing step. Moreover, during ripening, the room's humidity impacts the cheese's texture.

Quality parameters affecting the health

Not only of exceptional aromatic and gustatory quality, Swiss cheese is also a very healthy product. Firstly, it has a high content of ALA (Alpha-Linolenic Acid), an acid that lowers blood pressure and decreases the risk of heart disease and stroke.

Secondly, Swiss cheese has a high content of CLA (Conjugated Linoleic Acid), which also lowers the heart attack risk.

Thirdly, it has a significant calcium content, an important factor for the development and strengthening of bones, teeth, and muscles. Calcium is also essential for the good functioning of the nervous system.

Fourthly, the consumption of Swiss cheese covers a large part of the body's daily need for vitamins A, D, B2, and B6. Those vitamins are important for the skin and cell defences, as well as for the brain and nervous system. One 40g piece of Swiss hard cheese covers 15 percent of the body's need for vitamin A and B2.

Finally, Swiss cheese is a good source of calcium for lactose intolerant people. Indeed, the extra-hard and hard cheeses do not contain any lactose, as it is transformed into serum during manufacturing—and then completely destroyed during refining. Semi-hard cheeses only have a trace amount of lactose, and are therefore well tolerated by lactose intolerant persons.

The Swissness regulation for cheese

To be qualified as Swiss cheese, many different parameters have to be respected.

First of all, the milk used in its production must originate from Switzerland, and all the cheese manufacturing processes have to take place in Switzerland.

Then, another regulation concerns the cow's diet and life conditions. Cows must be fed with natural products—grass in spring and straw in winter. No additives or granulates for herbivores are permitted. The cows must also live in open spaces and undergo regular health controls.

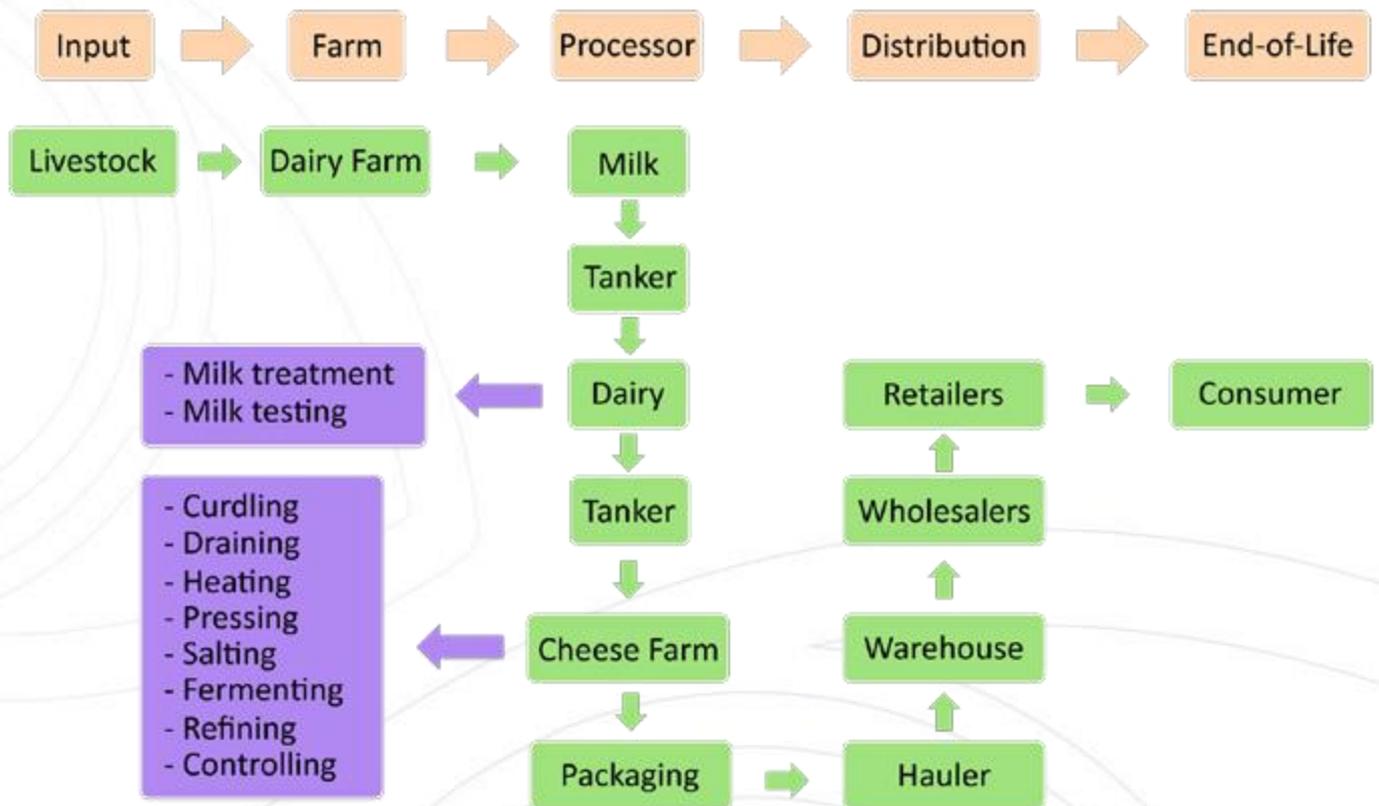
Regulations also govern the timing of milk delivery, as well as the treatment and transformation of the milk into the final product. Specific temperatures and humidity conditions have to be followed during the different manufacturing processes. Finally, artificial additives, colourings and preservatives are prohibited in the cheese production. If the cheese follows all those conditions, it can be branded as a Swiss product.

Supply chain and logistics

The first actors of the supply chain are the farmers. They assure the milk production—the cheese’s raw material.

Cheese Production and Life Cycle

Manufacturers are then responsible for its transformation. Firstly, they treat the milk and test its content to ensure its safety. Afterwards, the



milk is transported to the cheese farm to go through the second transformation, where it is manufactured into cheese. The milk goes through curdling, is then drained, heated, pressed, salted, fermented, and refined. The final product is once again controlled. The cheese is then packaged in paperboards and plastic containers specially designed to keep it fresh, clean, and wholesome.

The produce is then warehoused before being shipped to wholesalers. They distribute the products to retailers of all different sizes, from convenience stores, groceries, large discount stores, and warehouse outlets.

Other actors in the supply chain are the service providers. They either promote the product, design the packaging, or work in market research.

The last stakeholders are the consumers. They are composed of the whole community, including the export market and manufacturers—who use the cheese for “ready to consume” products.

Issues

Even though Swiss cheese is internationally recognised as a high quality product, scandals taint its reputation, making consumers more sceptical concerning the produce’s real origins. Purchasers, but also producers, cast doubt on many aspects of its production. Does this product really originate from Switzerland? Have the different regulations been respected (safety, Swissness, organic, PGI, PDO)? How can I be sure that I am not buying a counterfeited product? How can I be sure that the product has no safety or quality defects? How can I be sure that this product has been manufactured in good working conditions, respecting animals, workers, and the environment?

Producers themselves can question the origins of the products they receive. Is the milk I receive good quality? Have the cows been properly bred and fed? Many producers would like to know whether the next manufacturer in the process will have negative impacts on their produce, or if the quality product they have manufactured will be sold at its real value.

Stakeholders and their benefits in using Ambrosus

Our data platform is created to enable all actors to participate in better supply chains. We collect all necessary data to provide transparency to production processes, making them visible to everyone. Finally,

information is collected with a view to responding to the different issues concerning food traceability, such as safety, quality defects, and counterfeiting.

Producers will be able to know that the product they handled has correctly followed regulation through the different manufacturing stages. They will also see that the milk they receive is safe and of good quality. If there is any problem during production, the issue can be immediately detected and resolved before the product reaches the end consumer.

Retailers will, through our platform, rest assured that the product they sell is of the quality and safety that they expect. Their brands will be protected. They will also be able to detect manufacturing problems or counterfeited products and take measures accordingly.

Our platform will also provide benefit to consumers, who will be assured of the high quality of products with the Swiss Label. They will be able to confirm that regulations and safety measures have been followed correctly, from the raw material through to the moment that they buy the product. They will finally be able to trust the whole supply chain and regain faith in Swiss products.

Key parameters to be measured

Various parameters will have to be tracked to assure the correct labelling of Swiss cheeses:

The first concerns the milk. Its origin, as well as its content, will have to be tracked. We will need to prove that the milk has been produced by Swiss cows, on Swiss territory, and that all the different transformation processes have taken place in Switzerland.

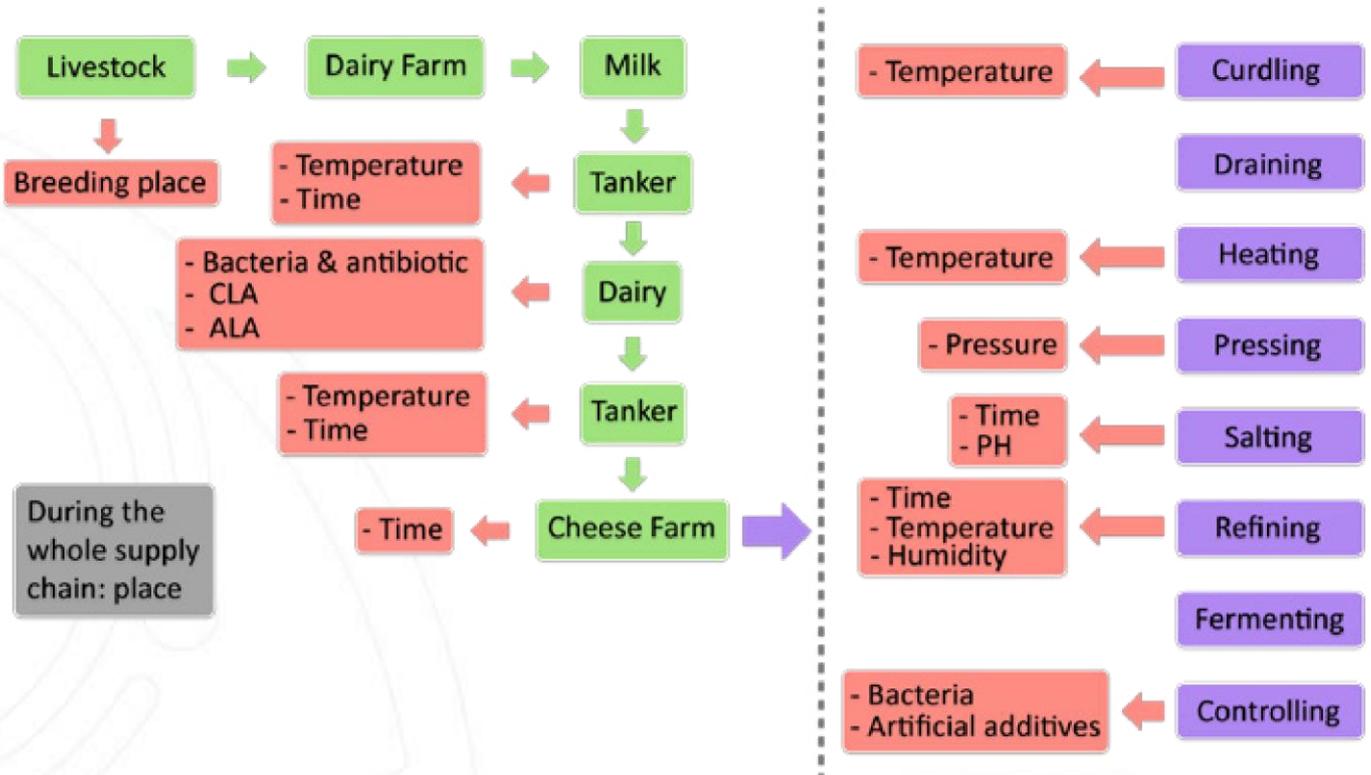
The content of the milk can be determined by reference to hygiene procedures, as well as the cow's living conditions and correct feeding.

This can be demonstrated by the absence of bacteria, as well as by a high rate of CLA and ALA in the milk.

The second key parameter involves assuring the hygiene conditions and non-harmfulness of the cheese. For that purpose, we will track the amounts of the four main bacteria present in cheese: Staphylococcus aureus, Bacillus cereus, Escherichia coli and Listeria. Staphylococcus aureus and Bacillus cereus contents must not exceed 104 cfu (colonies) per gram. The Escherichia coli content shall not be more than 100 MP per gram.

Timing in the production process should also be monitored. Time until the milk's delivery and its treatment will have to be tracked and conform to maximum tolerance hours. It must also be demonstrated that the cheese arrived at the farm no later than 18 hours after it was treated, and that the milk's freshness has not exceeded 24 hours. Moreover, the timing of the different cheese manufacturing processes must be tracked. This timing hinges on the type of cheese, as well as specific regulations. The refining process must last a minimum period of 60 days for raw-milk cheeses to assure the elimination of harmful bacteria.

Quality Influencing Parameters



Temperature is another parameter that will need to be monitored throughout the entire manufacturing process. The cold chain must be maintained at a temperature of 4°C for the milk. For the cheese, the temperature depends on the particulars of the cheese and the manufacturer's recommendations. Storage temperatures are also very important. During the whole manufacturing procedure, precise temperatures have to be respected. Through the curdling step, the milk must be heated at an approximate temperature of 32°C. The heating process must not exceed a maximum temperature of 57°C, and during refining the cheese must be kept at a temperature greater than 1.6°C in order to eliminate the proliferation of harmful bacteria.

Another important test will concern the composition of the cheese. In order to be recognized as Swiss cheese, its content must be entirely natural. Therefore, additives are forbidden, with the exception of

natural ones. Artificial additives used to prevent fermentation such as Nisin (E 234), Lysozym (E 1105), Sodium nitrate (E 251), and Potassium nitrate (E 252) will need to be tracked to ensure that the cheese meets the highest natural quality. Moreover, artificial colourings are prohibited and could be tracked through the detection of Natamycin (E 235). Finally, of the detections of any preservative additives included in the makeup of the cheese is paramount, as such additives are banned.

A further key parameter is the pH tracking through the maturing stage. It is the factor with the biggest influence on the cheese's texture, given that it impacts the paste's damping.

The humidity during the refining stage is also a main factor regarding the cheese's safety and the quality of the product. Indeed, this parameter affects the taste, aroma, and texture of the final product, as well as the level of bacteria present. Measuring the pressure during the pressing step could be another way to determine the water content of the product.

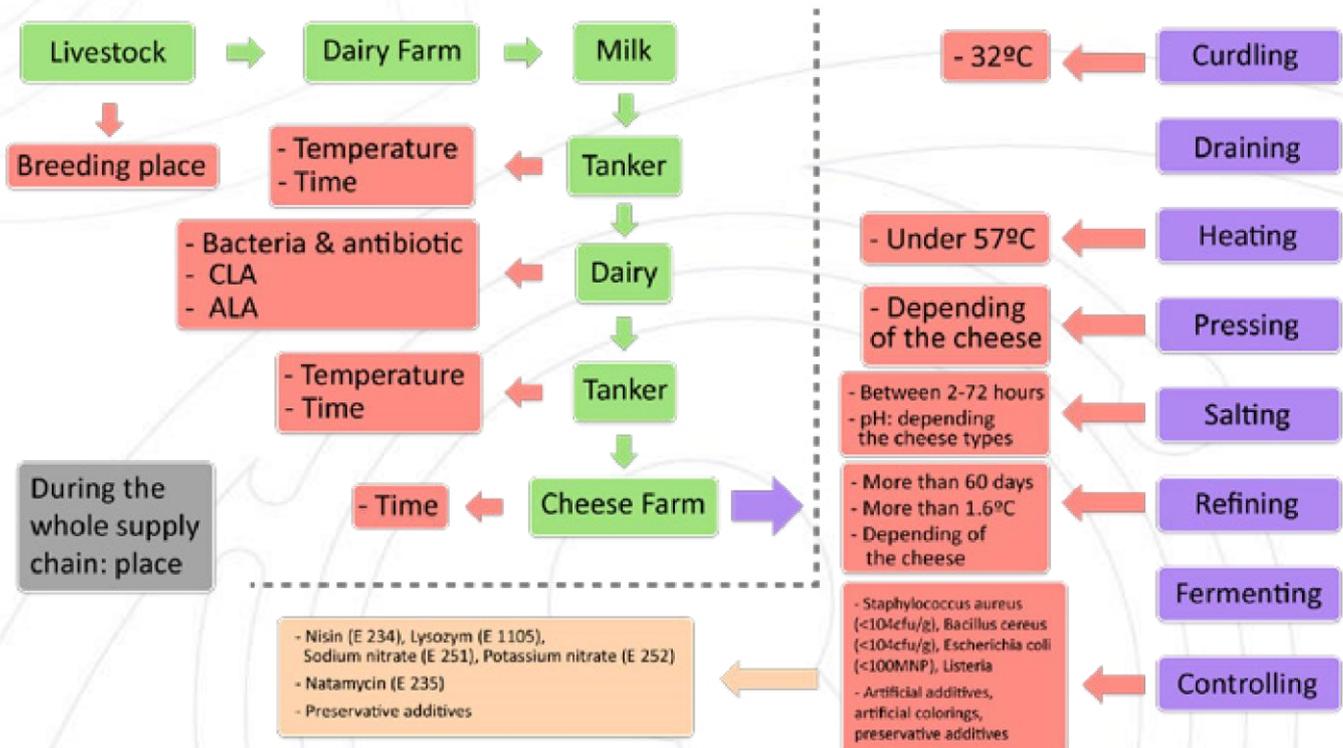
Incremental progress of solution implementation

The first sensor we aim to implement would be a GPS, allowing us to track the milk's origin and where the transformations it goes through have taken place. The next step would be the implementation of temperature sensors, which would give us continual feedback during the different stages—including at what time these stages occur. After those measures, other sensors will progressively be implemented to prove, step by step, all the cheese's Swissness characteristics.

Stakeholder's benefit of our solution

Once our solution is deployed, brands will get more protection and counterfeiting will become more and more difficult—and easier to spot. Moreover, consumers will have access to information about the production processes of the cheese they buy. This will mean consumer assurance of, and confidence in, the origin, safety, and quality of the cheese. In turn, this will enable them to fully trust in supply chains and to regain faith in Swiss Labelled produces.

Comprehensive Quality Assurance



Supply chain once our solution is deployed

Our platform will also present many benefits for the supply chain. It will enable different actors along the line to have more visibility, and

to interact with others. Providers will know if their product has successfully been transformed and retailers will be aware of where the cheese is coming from and if it is of high quality.

Many processes, such as temperature measurements, will be automatized and require less paperwork.

When a problem does occur, it will be a very fast and easy process to spot the origin of the issue, and to find a solution. Furthermore, problems will be tracked before huge consequences could reach the consumer—such as an outbreak of bacteria-related illness.

Finally, our database will demonstrate manufacturers' good processes, including organic production, animal welfare conditions, and ethical production. This will create more visibility on the market for manufacturers.

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