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Wooden Boards for Aging Cheese

Manufacture, handling and treatment of wooden boards for aging smear-ripened cheeses

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Summary

Wood plays an important role in the aging of smear-ripened (washed-rind) cheese. It regulates humidity levels on the surface of the cheese, and in addition, the biofilm that forms on it encourages the growth of smear flora.

In Switzerland, the spruce logs used to manufacture cheese boards are selected with great care. They are then calibrated, cut and chamfered to produce the shape required by the cheese. The final stage is drying; either naturally or over several days in a kiln at 55–60 °C, until the board reaches a humidity level of 12–14%. This stage is very important as it reduces the risk of mould formation. Then the board must be stored in a dry, well-ventilated place until use.

On taking delivery of new boards, careful attention must be paid to their storage and handling before using them for the first time. These boards have not yet developed a protective biofilm and contain very little moisture. The absence of biofilm enables the growth of undesirable flora such as moulds, while the low moisture level causes the boards to absorb moisture from the cheese. This dries out the rind and encourages the growth of a smear flora similarly contaminated with moulds. Before using boards for the first time, it is advisable to wet them thoroughly with water enriched with a surface culture or a high-quality cheese smear. Several hundred mature cheeses can be stored in a new cellar equipped with new boards to facilitate the integration of a healthy ripening flora.

Figure 1: Cutting the spruce logs

1 Introduction

1.1 The role of wood in cheese aging

Wood makes a valuable contribution to the typicity of smear-ripened cheese. The Norway Spruce in particular is a characteristic feature of the most important Swiss AOP cheeses. In fact, its use is often explicitly stipulated in production specifications.

Wood has hygroscopic properties which enable it to regulate humidity levels on the surface of the cheese. At the start of aging, its task is to absorb water produced by the cheese. Later, it supplies moisture to the rind to promote the growth of microbial flora.

The roughness of the wood allows air to circulate, which is essential for the smear flora, which comprises mainly aerobic microorganisms.

The hygroscopic properties and surface roughness of the wood facilitate the growth of a biofilm. This beneficial biofilm comprising bacteria, yeasts and moulds supports the colonisation of the cheese surface, facilitating the formation of the cheese smear.

In addition, board humidity is involved in regulating humidity levels in the smear. In turn, their intensity determines the rate of cheese proteolysis, which is closely associated with the development of flavour.

This paper uses examples to explain how high-quality aging of smear-ripened cheese can be controlled and achieved using wood – an auxiliary material indispensable to cheese making.

Figure 2: Drying the cheese boards

2 Producing a cheese board

2.1 Choice of wood

The quality of the wood varies greatly depending on the geographical location. The Norway Spruce adapts its growth in response to climatic conditions. Optimal climatic conditions accelerate growth, producing a grain characterised by wide growth rings. This wood is less dense and more brittle, but has a greater capacity for water absorption than wood with narrow growth rings. The quality of the wood is also influenced by other factors, for example the timing of felling, the meteorological climate during outdoor storage of the wood or the number of knots. Today, the choice of wood is largely determined by sawmill availability. To achieve good results in terms of cheese aging, it is important that the sawmill has experience of making cheese boards. Nowadays, sawmills often have drying kilns, which help standardise humidity level in the boards and facilitate preparation of the cheese boards.

2.2 Storing the wood before cutting

Prior to felling, the Norway Spruce has a humidity of 60–75%. At this time, it is vulnerable to attack by different insect species and microorganisms, so it produces resin to protect itself. Resin production ceases after felling, leaving the cut timber prone to damage; for example 'blue stain', a discolouration caused by certain types of fungi. Fungal spores are transported to the wood by air or by different species of beetle such as the bark beetle. The wood must be dried quickly to prevent damage, especially in summer.

Figure 3: Blue stain caused by fungi

2.3 Cutting

Between four and six cheese boards can generally be cut from the diameter of a large log. The central core is not used as this carries too high a risk of the board warping or splitting.

Figures 4 and 5: Example of the number of boards that can be cut from one log.

Figure 6: Cutting the boards

Figure 7: Storing the boards

2.4 Drying kiln

When the boards have been roughly cut, they are transferred to the kiln for drying. The drying kiln standardises the water content of the boards. The aim is to achieve 12–14 % humidity after treatment, causing the dimensions of the boards to shrink to the standard size for sale. This drying process prevents the boards shrinking significantly during use.

The boards are heated to between 55 and 60 °C for four days. Although these parameters do not constitute microbiological sterilisation as such, they have a significant influence on the hygienic properties of the wood. It should also be borne in mind that the wood still requires final finishing. Since this work is not done in a controlled microbiological environment, boards delivered to the cheese dairies are not sterile.

Figure 8: Checking the humidity of the boards

Figure 9: Drying kiln

2.5 Finishing the cheese boards

Any boards with too large knots are excluded during an initial screening. As a general rule, knots should be no larger than 3 cm. When a cheese is placed on a knot, the smear develops less well in this area because the knot, unlike the rest of the board, is unable to absorb moisture. The boards are cut to precise dimensions. The final finish can take different forms, depending on the type of cheese and the cheesemaker's specifications:

- rough, planed, smooth or even grooved surfaces
- chamfered or rounded edges
- solid wood or glued board

A certain amount of surface roughness is nevertheless required to enable aerobic smear flora to grow on the surface of the cheese.

The advent of automated cheese maturation has made precise board dimensions even more important. Furthermore, boards have become thicker to prevent them warping and disrupting the cheese-turning robot's sensors.

For the sawmill, the challenge is to obtain the best possible yield of unglued boards from a log.

Boards should always be ordered at the earliest opportunity, because delivery times can amount to several months, or even a year for large orders.

Figure 10: Selection of cheese boards with different surface finishes at the specialist sawmill Betschart Holz in Muotathal

Table 1. Cheese board dimensions in mm

Cheese type	Length	Width	Thickness
Tête de Moine	1160	245	16
Appenzeller	1000-1150	300	18
Raclette	max. 1500	320	18-24
Vacherin Fribourgeois	1200	350	18
Gruyère	approx. 2075	290	33-36
Emmental	approx. 2050	280-310	36-40

The dimensions apply to boards in dried condition (<15 %). It should be borne in mind that board widths can increase by up to 8% with increasing board humidity.

3 New cheese boards: receipt, storage and cleaning

Despite heat treatment (55–65 °C) to dry the raw material, new wooden boards are not germ-free. At the time of delivery, the boards have a moisture content of around 15%. Wood is hygroscopic, which means that it adapts to the relative humidity and temperature of the surrounding air. Inappropriate handling or storage of new boards can rapidly lead to undesirable mould growth. The following points must be considered when storing new, unwashed wooden boards:

- Storage at <10 % ambient humidity: the wood roughens and warps; any knots present may detach.
- Storage at higher relative humidity: the risk of mould growth greatly increases. Storage in a well-ventilated room sheltered from the weather is ideal.

It is advisable to be well prepared when using new wooden boards. Failings during the first two to three uses can lead to subsequent impairment of cheese quality and entail several hours of extra work. Sharing experiences with the board supplier can be very worthwhile in this regard.

Wooden boards leave the factory with a covering of fine dust and must be washed before use. As new boards are highly absorbent, the use of cleaning products and disinfectants is not recommended (see *Bankrot* chapter). Heat treatment with steam or hot water is recommended to prevent mould formation and reduce the amount of undesirable germs.

3.1 Why use steam cells?

Figure 11: Example of steam cell operated with a steam weeder

A steam cell is used to sanitise cheese boards and other utensils to make them aseptic or at least low-germ. Heat is by far the most reliable means of preventing and controlling listeria. The pre-cleaned boards are exposed to steam and reach temperatures of 75–85 °C both at the surface and in the core. Since wood is a porous material, it cannot be effectively sanitised using conventional methods such as scrubbing, washing, brief immersion in hot water or chemical disinfection. The most effective means of sanitisation is to apply heat for a sufficiently long period of time. For example, all pathogenic bacteria can be killed by pasteurisation. The standard conditions for pasteurisation are exposure to 72 °C for 15 seconds.

During sanitisation in a steam cell, cheese boards are exposed to temperatures of 70–85 °C for at least 20 minutes: the saturated water vapour permeates the pores right through to the core, transferring the thermal energy needed to kill living microorganisms. Unglued boards have high heat resistance of up to 100 °C, while glued boards should not be heated to temperatures above 90 °C.

A paper written by R. Imhof and P. Riva published by Agroscope in 2015 describes how to construct a simple steam cell for sanitising cheese boards.

3.2 Drying the wooden boards

One possible option is to dry washed boards in the fresh air on a sunny day. The boards must be placed in a clean, covered place to prevent airborne contamination (salmonella, listeria) through bird droppings or other sources. If the boards are dried inside, it is essential to ensure adequate circulation of dry air. Too rapid drying can cause the wooden boards to crack or warp. The ideal wood moisture content after drying is 15–20 %. Devices used to measure electrical resistance are commonly used to check the wood moisture content; they provide reliable results. Humidity levels in a wooden board are very heterogeneous. A board dries from outside in. The drying process varies depending on how the boards are stored – upright or flat. Furthermore, the density of the wood and the presence of knots can also lead to significant measurement fluctuations.

3.3 Using new wooden boards

Careful attention must be paid to new boards before use. To avoid undesirable mould formation, it is important to actively promote the formation of the biofilm. Acclimatisation facilitates biofilm growth through the absorption of water (>30%). Furthermore, it is advisable to repeatedly spray new boards or boards that have not been used for several months with surface cultures or high-quality smear water. It is also possible to store smear-ripened cheeses on new boards for a few weeks before using them for young cheese. This also helps to produce a ‘cellar climate’. Boards become more microbially robust with increasing use, making it easier for desirable flora to colonise the surface. There are various methods of increasing the moisture content of wooden boards:

• natural acclimatisation by pre-storage in the cheese cellar

• spraying the boards with water (with or without cultures)

• moderate drying of the boards after cleaning and sterilisation

Figure 12: Selection of surface cultures from Liebefeld Kulturen AG

Figure 13: Sprayer

4 Role of board humidity in rind formation

Figure 14: New boards with 37% humidity, contaminated with black mould

Wooden boards play an important role in cheese aging by regulating humidity at the cheese surface. A study (20-22-85) was conducted in Leibefeld to determine the ideal moisture content of the boards. This involved drying the same batch of boards to six different humidity levels in a sawmill: 10%, 14%, 17%, 20%, 24% and 37%. The board with 37% humidity, which was not dried in the kiln, presented with black mould.

The 12 cheeses used in the study came from the same batch. They were produced in the Kandersteg alpine dairy and tended for ten days in the dairy's cellar before being transported to the aging room in Liebesfeld (14 °C, 92% RH). Two cheeses were placed on each board. The cheeses pictured at the top of the board (see Figure 16) were brushed twice as often as the ones below. In the first month of aging, the top cheeses were brushed twice a week and the ones below four times a week. Between the second and seventh month of aging, the cheeses at the top were brushed just once a week and those at the bottom twice. Cheeses on the same board were brushed with the same brush and the same solution (six brushes, six buckets). The water was changed once a week. After four months, the boards were replaced.

After ten days of aging in the Liebefeld cellar, only slight differences between the rind smears were observed. The rind smear of the cheese stored on the board with 10% humidity and brushed twice a week was more yellowish in colour. After six weeks of aging however, differences gradually began to appear. White patches of mould formed on the surface of the cheeses stored on the boards with 10%, 14% and 17% humidity. This discolouration was more pronounced in the cheeses brushed twice a week. After 14 weeks the white patches turned black. The cheeses stored on the dry boards (≤ 20%) and brushed only twice a week were blotchy, while the cheeses aged on moist boards (24% and 37%) had a beautiful reddish-orange smear. Once the mould has become established, it is difficult to 'restore strength' to the surface bacteria. As aging progresses, the defect becomes more noticeable. The study also showed that mould forming on new boards with a moisture content of 37% is not automatically transferred to the cheese.

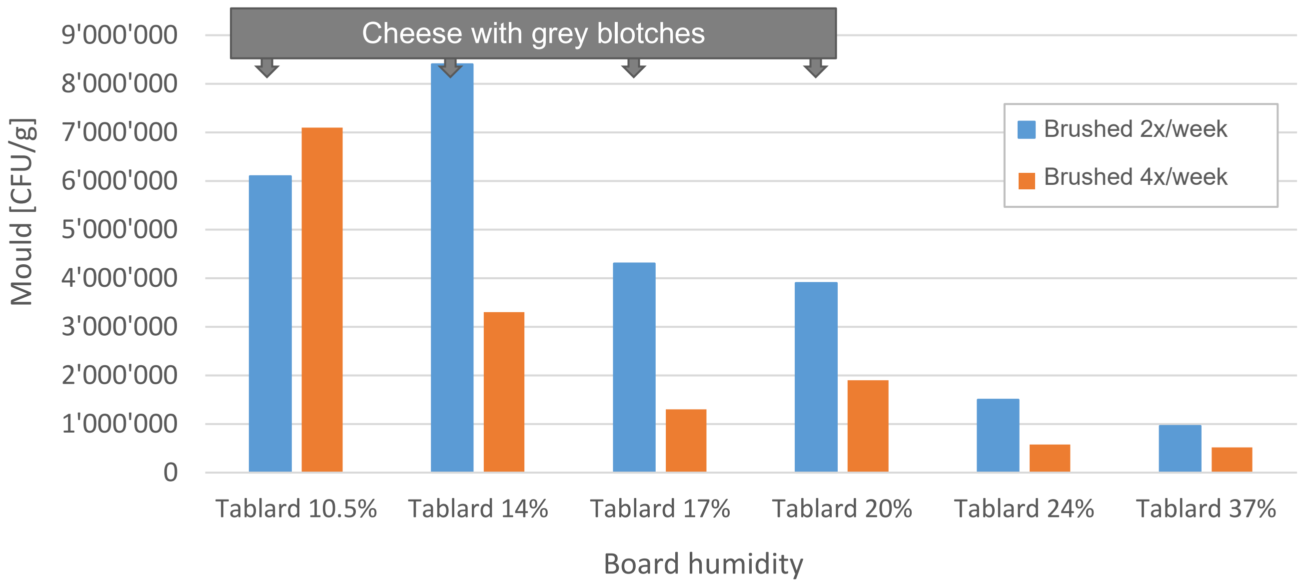


Figure 15: Mould formation on the surface of 7-month-old cheeses as a function of board humidity

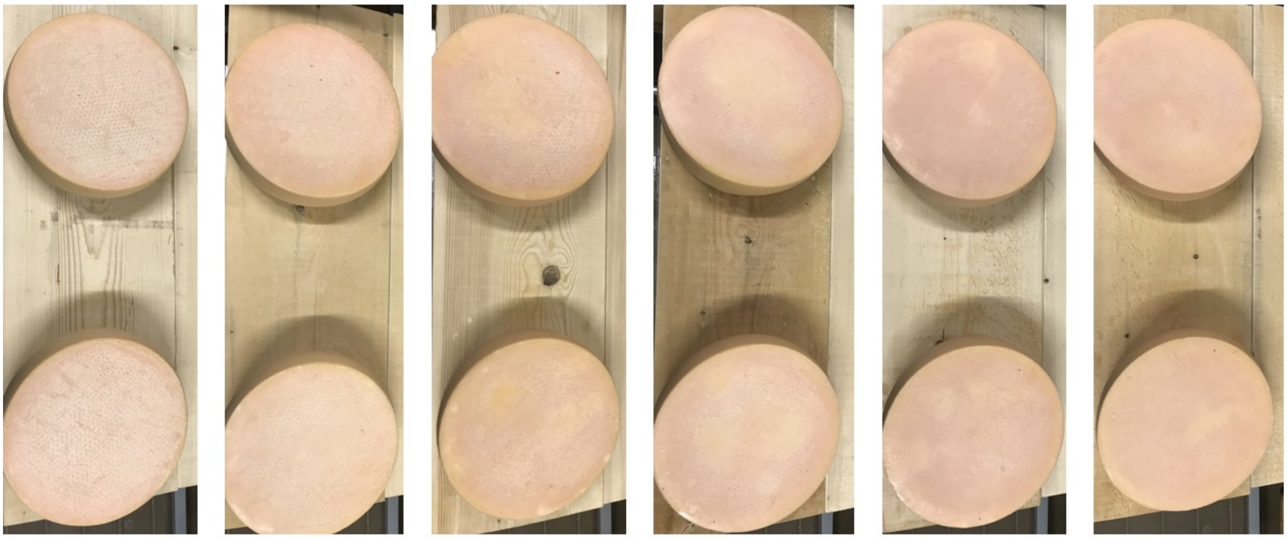
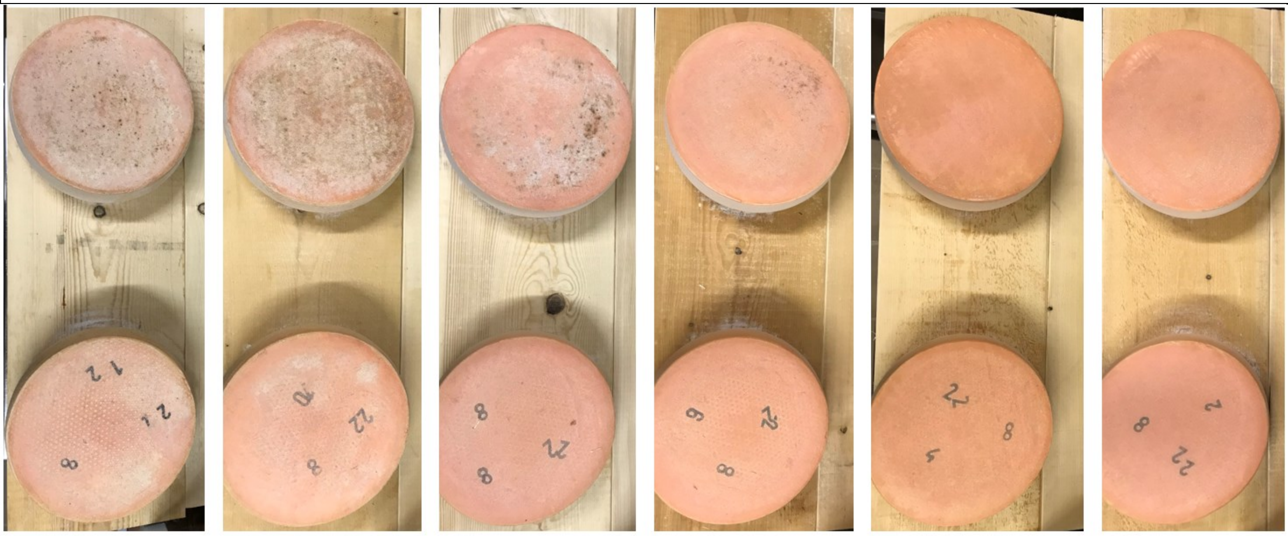
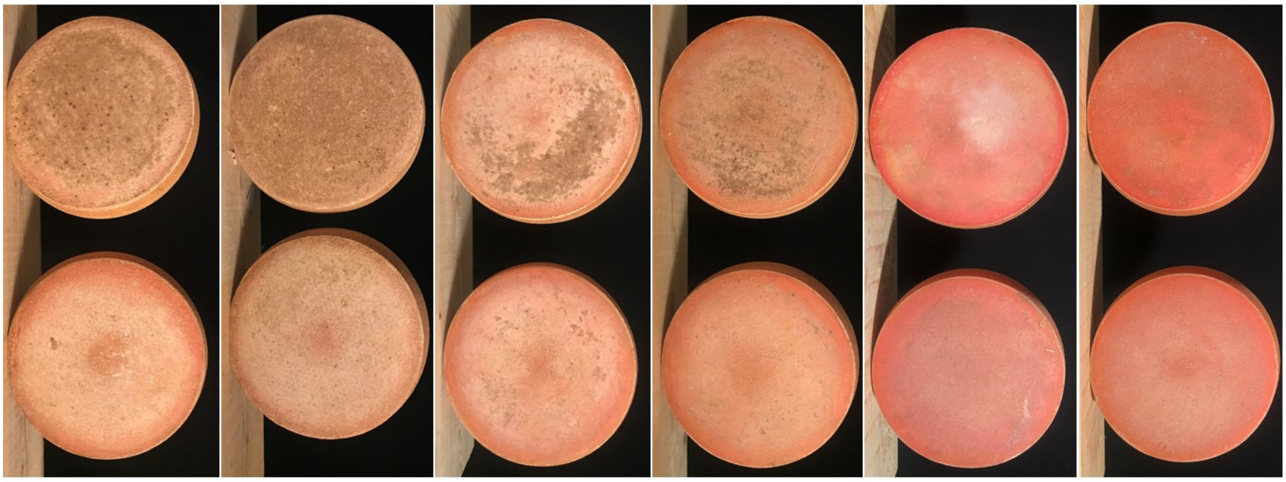
<table>
<tr><th></th><th colspan="6">Board humidity level</th></tr>
<tr><th></th><th>10.5%</th><th>14%</th><th>17%</th><th>20%</th><th>24%</th><th>37%</th></tr>
<tr><td>6 weeks</td><td colspan="6"></td></tr>
<tr><td>14 weeks</td><td colspan="6"></td></tr>
<tr><td>7 months</td><td colspan="6"></td></tr>
</table>

Figure 16: Cheese aging at 6 weeks, 14 weeks and 7 months as a function of board humidity. At each stage of aging, the cheeses pictured at the top were brushed only half as frequently as those at the bottom.

A second Liebefeld study investigated how board humidity at the start of aging influences the area beneath the rind. Basically, if boards are too dry, they absorb water from the cheese. This dries out the rind and the paste immediately beneath it – changing the colour, texture and flavour of the cheese in this area.

Figure 17: Thickness of paste beneath the rind of the three cheese samples

The photo opposite shows samples of hard cheese aged for seven months. Ten days after production, the cheeses were transferred to boards with different humidity levels. Three different board preparation processes were compared:

Process 1: left-hand sample – board wetted twice with water

Process 2: middle sample – board sprayed once with water

Process 3: right-hand sample – dry, untreated board

5 Board-related defects

5.1 Red discoloration (*Bankrot, rouge du tablard*)

According to Dr. H. Hänni (Schweizerische Milchzeitung Nr. 51, 1953), *Bankrot* describes the phenomenon of a pinkish red discolouration, later turning brownish red, which appears in the paste immediately beneath the rind and gradually spreads inwards as the cheese matures. Cracks form overtime where the discolouration initiated, often culminating in putrid decomposition from this point. In mild cases the red discolouration appears only in the middle of the paste while the rest appears healthy. The Danish researcher S. Knudsen discovered that the red discolouration is caused by the salts of nitrous acid, called nitrites. When these nitrites permeate the rind and come into contact with the paste, they produce a progressive red discolouration. S. Knudsen explained the origins of nitrates by the fact that the boards harden over time. Nitrate forms on the surface of the board in the presence of airborne ammonia. Nitrate is the salt of nitric acid and as such is closely related to nitrite. According to his theory, several bacteria in the cheese rind are capable of reducing nitrate to nitrite. The nitrite entering the cheese can cause the red discolouration under favourable pH conditions. Dr. H. Hänni cited studies which clearly showed that moist, slimy deposits on the cheese boards are the primary sources of nitrite. If moisture levels in the cellar are so high that droplets form on the ceiling and stacks, water containing nitrites or nitrates can easily be deposited on the cheese. Then the salts can permeate the cheese. Nitrates were also detected in defect-free cheeses, but never nitrites. To avoid the defect *Bankrot*, we recommend preventing condensation droplets falling directly onto the cheese and ensuring that the cellar is not too damp.

In the publication ALP forum 2007, No. 51 d, the authors stated that *Bankrot* cheese often has a strong red discolouration immediately beneath the rind which gradually fades as it extends into the cheese. The *Bankrot* defect is the result of the ‘slumping’ of damp cheeses whose rinds shows signs of patchy decomposition. Nitrite and nitrate produced from ammonia by nitrifying bacteria are typically detected in connection with *Bankrot*. Nitrite can react with aromatic amino acids and their degradation products to form diazo dyes [Kammerlehner 2003]. Too damp boards, high humidity and high concentrations of ammonia in the cellar air favour the occurrence of *Bankrot*.

5.1.1 Practical examples

The results of nitrite and nitrate analysis of the brown zone confirmed the defect *Bankrot*.

Figure 18: Semi-hard cheese (left) and hard cheese (right) with Bankrot

Table 2. Nitrate and nitrite concentrations in cheese with the *Bankrot* defect

Cheese type	***Guidelines***	**Semi-hard (4 months)**	**Hard**
Nitrate [mg/kg]	*< 2.0*	160	67
Nitrite [mg/kg]	*< 0.2*	76	13
Causes		*Water droplets on the air intake pipe concealed behind the stacks of cheese caused the defect in the semi-hard cheese shown above.*	*Water droplets from the lime walls (containing potassium nitrate) dripped onto the cheese and diffused into the paste.*

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