

Characteristics and Development of Matured Hard Cheese from the Dolomites Mountain Region in Northern Italy

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Abstract

Long-matured hard cheese called mountain cheese is processed in the cold Alps, and it has been made at least before 2,000 BC. It is extremely important to analyze the relationship between fresh cheese and matured hard cheese to recreate the history of cheese processing in Europe. From case studies in the Dolomite Mountains in Northern Italy, this paper aimed to examine how fresh cheese developed into long-matured hard cheese from a dairy science and anthropogeography standpoint. Fresh cheese is processed by rennet addition, cutting, draining and salting. The fresh cheese was then matured in brine for several weeks to improve the taste. When the matured fresh cheese was taken out of the brine and air-dried, it became the matured hard cheeses such as *Dolomiti* cheese processed in the Dolomite Mountains. Leaving it out in air dries out the surface, forming a rind to protect the cheese on the inside. In the mountain regions, the processing of matured hard cheese developed further to make long aging process possible. Skim milk was used for more favorable maturation. The curds were heated to 42°C to remove more whey. These steps allowed the cheese to be preserved for about a year. This gave rise to long-matured hard cheese such as the mountain cheese processed in the Dolomite Mountains. The cold and semi-humid climate appears to be the biggest factor that channeled such development, and this change in cheese development could only have taken place in such environments as European mountains.

Key words: The Dolomites, Northern Italy, cold and semi-humid climate, hard cheese, fresh cheese, development

Introduction

The Celtic pastoralists had been developing hard cheese dating back to at least 2000 BC in the European Alps^{1,2)}. The cheese is characterized by its large, flat, wheel shape. Because the livestock is taken out to graze in the mountain pastures in the summer to produce milk that was processed and preserved as cheese, it is assumed that the large

wheel shape came about for the convenience of transporting the cheese down to the lowlands in the winter. Since then, the mountain cheese was developed into the cheeses from the European lowlands today, such as *Gruyere* and *Emmentaler* from Switzerland, *Conté* from France, etc. This mountain cheese is also found in the mountains of Northern Italy as *Latteria* or *Nostrano*. The mountain cheese forms the foundation of European matured hard cheeses. Hence, understanding the mountain cheese is absolutely essential to discussing the development of matured hard cheese in Europe.

In the surrounding European regions and in some neighboring countries, the fresh cheese is preserved and matured by curdling raw milk with rennet and then soaked in brine. We call this cheese as matured fresh cheese in this paper. The

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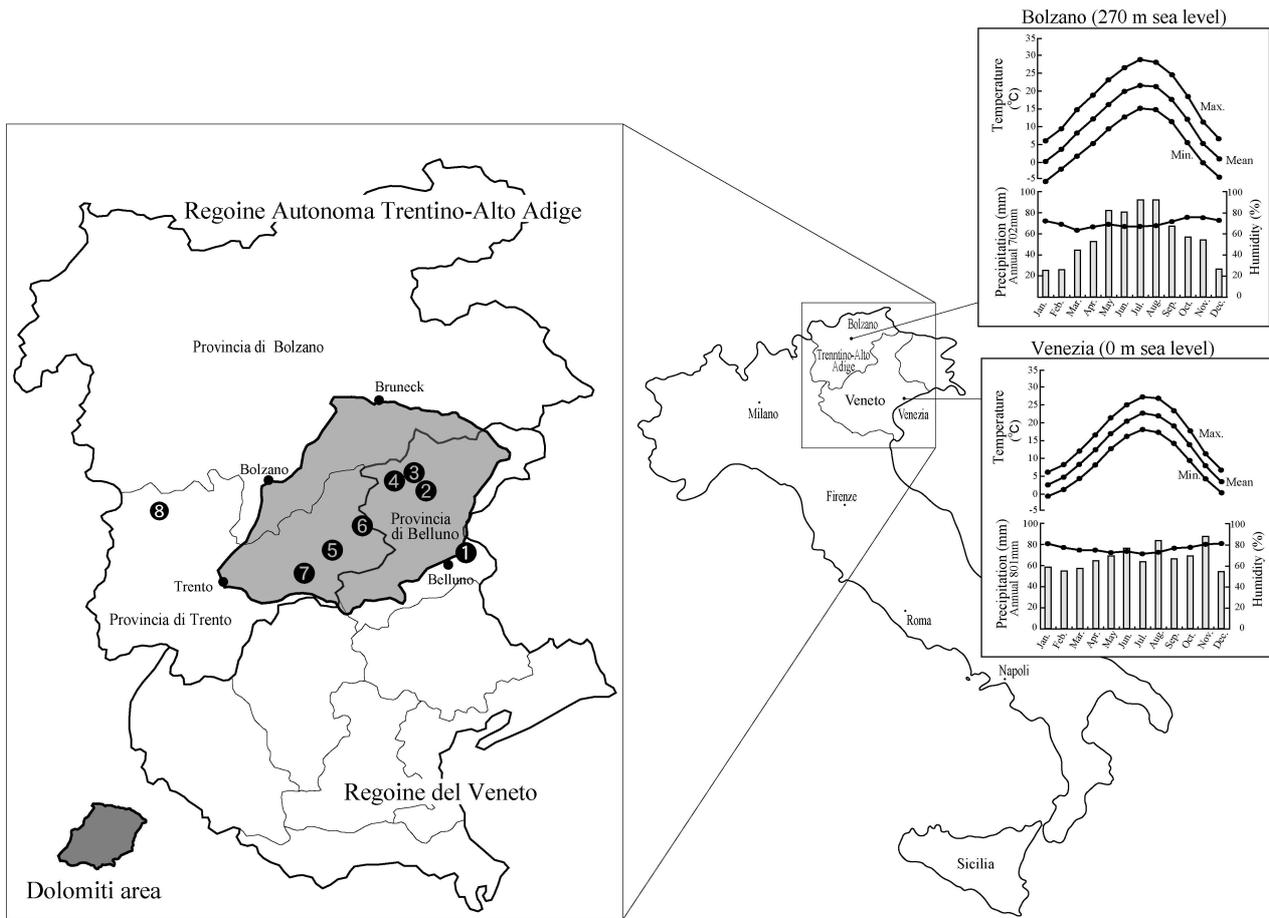


Fig. 1 Research sites (cases ①–⑧) in the Dolomiti Mountains in Northern Italy and weather conditions⁷⁾ in Bolzano and Venezia.

use of this technique has been confirmed with *Sirene* from Bulgaria^{3,4)}, *Feta* from Greece⁵⁾, *Jibun hadra*^{a)} from Syria⁶⁾, and other cheeses found along the coast of the Mediterranean Sea. These regions lack the technique to process matured hard cheese. The relationship between brined fresh cheese and hard cheese is also a very fascinating topic when recreating the history of how the matured hard cheese developed in Europe.

Using the Dolomite Mountains of Northern Italy as a case study, this paper attempts to 1) understand the process of long-matured hard cheese known as the mountain cheese and fresh cheese also produced in the mountains, 2) extract the characteristics of these cheese processing, and 3) examine how the fresh cheese developed into long-matured hard cheese.

Materials and Methods

1. Ecological Environment of the Research Site

The field survey of observations and interviews was conducted in Veneto and Trentino-Alto Adige regions in Northern Italy in July 16 to July 27 of 2015 and July 14 to July 19 of 2016 (Fig. 1). The northern part of Veneto to Trentino-Alto Adige consists of a mountain region that extends into the Alps. The eastern part of the Alps, specifically from Belluno, Veneto to Bolzano-Trento, Trentino-Alto Adige shares the same geographical and topographical features and is called the Dolomites. The Dolomites is made up of cascading vertical mountain peaks and forest-covered valleys with a river cutting through them (Fig. 2). The cluster of mountains include the Marmolada (3,344 m), Mount Pelmo (3,169 m), and other mountains that are over 3,000 m high. Geologically, there is an



Fig. 2 Landscape of the Dolomites.

abundance of dolomite in this region.

While the temperature in Venice at around 1 m above sea level drops below freezing in the winter, it is relatively hot in the summer with a highest average monthly temperature of about 30°C (Fig. 1)⁷⁾. At the hottest time of the summer, the highest temperature during the day could get close to 40°C. Bolzano, Trentino-Alto Adige, located in the north at 270 m above sea level, also experiences similar heat in the summer, because it is located in the valley. However, the monthly average falls to about 15°C at night, even at the hottest time of the year. The temperature falls comparatively as the elevation rises and as one heads north. In the summer, it is cool with the highest temperature of only about 20°C at 2,000 m above sea level. The relatively cool summers work well for maturing cheese. The average humidity is about 70% in the winter and about 60% in the summer in these mountains. The humidity falls to about mid-40% to mid-50% during the day. The lower humidity during the day is also a large factor in the processing of matured hard cheese. The natural environment of the mountain region in Northern Italy can be summarized as being cold and semi-humid in the mountains and hot and semi-humid in the valleys.

2. Transhumance in the Dolomites

The geological feature of the Dolomites is the continuous sequence of mountains that are over 3,000 m high and valleys rich in vegetation. The valley floors are found at about 200 to 800 m above sea level. Wheat, corn, and fruits, such as apples

and grapes, are cultivated in the lowlands located below 600 m above sea level. Grass becomes the main crop at about 800 m above sea level. Forests appear at over 1,000 m above sea level, except where expansive grasslands are found where trees had been cleared. The timberline is found at about 2,300 m above sea level, and bald patches of earth make their appearance as vegetation becomes sparse above this point⁸⁾. The pastoralists have been making use of this elevation difference for the transhumance of sheep, goats, and cows^{9~13)}. This kind of seasonal transhumance might have had its origin in prehistoric periods¹⁴⁾. Today, they primarily raise cows and rarely raise sheep anymore.

In the summer between June and September, the cows and goats are released into a high mountain pasture called *malga* where they feed on lush grass and produce milk. The pastoralists continue to make hard and fresh cheeses on the mountain pastures in the summer when the milk production is at its highest after early spring when calves are born. They eat the matured cheese they make as they care for the herd, but they take the leftover matured hard cheese down to the lowland farming village as provisions for the winter. Since the snow accumulates in the winter, the pastoralists raise the cows in a barn called *stell*. The hay fed to the cows is grown in a field called *maso*, which is located at a half way point between the summer pastures and the winter village. The hay is harvested and stockpiled in the summer and fed to the cows during the winter. The winter farming village allows the pastoralists to cultivate agricultural products in the summer and raise cows in the winter. The cheese is mainly processed by the men in the Dolomites pastoralist society, but men often leave the village in the winter to make money. Therefore, instead of processing the raw milk obtained in the winter by themselves, they ship it to a cheesemaking facility in the village called *caseificio*. If they run out of the matured hard cheese they made in the summer at *malga*, they could purchase it at *caseificio*. The pastoralists make use of the elevation difference in their seasonal production activities – grazing of livestock on the mountains in the summer in search of cooler climate and better pastures, and rearing of livestock in a barn in the warmer lowlands in

the winter; production of cheese in a cold natural environment on the mountains in the summer, and production of cheese in a well-equipped cheesemaking facility in the winter; production of cheese by the pastoralists on the mountains in the summer, and production of cheese by professional cheesemakers in the lowlands in the winter. These activities shape the subsistence configuration that is extremely well-suited to the Italian mountain region made up of mountains and valleys. Moving the cheesemaking activities from the mountains in the summer to the lowlands in the winter works extremely well in a complementary way, such that the subsistence of transhumance in Italy could be carried out throughout the year^{15~17}).

Today, many households remain in the lowland year round and do not head up to the mountains during the summer. *Caseificio* currently processes cheese throughout the year. It could get up to 30°C during the day in the summer in the lowlands, and the temporary heat spike greatly affects the processing of matured cheese. Even under such circumstance, the cheesemakers manage to process cheese throughout the year with the use of electric coolers or by making creative adjustments to the cheese caves.

3. Cheesemakers in the Research

The following cheesemakers and types of cheese were studied in this research: mountain cheese, *Latteria di Malga* from the cheesemaker, *Malga Sant' Anna* (1,070 m above sea level) in Tambre, Belluno, Veneto (Case 1); mountain cheeses, *Nostrano di malga* and *Nostrano di Capra*^{b)} and fresh cheese, *Ricotta* from the cheesemaker, *Malga Fontanafreda* (1,768 m above sea level) in Selva di Cadore, Belluno (Case 2); mountain cheese, *Malga Laste* and fresh cheeses, *Ricotta* and *Tosèla* from the cheesemaker, *Malga Laste* (1,868 m above sea level) in Rocca Pietore, Belluno (Case 3); mountain cheese, *Ombretta* and fresh cheese, *Ricotta* from the cheesemaker, *Malga Ombretta* (1,904 m above sea level) in Rocca Pietore, Belluno (Case 4); mountain cheese, *Nostrano Primiero* and fresh cheeses, *Tosèla* and *Dolomiti* from the cheesemaker, *Caseificio di Primiero* (637 m above sea level) in Mezzano, Trentino (Case 5); mountain cheeses, *Formaggio Nostrano Fresco*, *Formaggio Nostrano*

Stagionato and *Formaggio Misto Capra*^{c)} and fresh cheeses, *Ricotta* and *Tosèla* from the cheesemaker, *Malga Valfontane* (1,750 m above sea level) in Valfontane, Trentino (Case 6); mountain cheese, *Formaggio del Lagorai* and fresh cheeses, *Ricotta* and *Tosèla* from the cheesemaker, *Malga Cagnon di Sopra* (1,885 m above sea level) in Calamento, Trentino (Case 7); mountain cheeses, *Casolet*, *Formagel/Taviela*, *Pegaes*, and *Capra Stagionato*^{d)} from the cheesemaker, *Caseificio Turnario di Pejo* (1,554 m above sea level) in Pejo, Trentino (Case 8)¹⁸⁾ (Fig. 1). The matured mountain cheeses are collectively called *Latteria* or *Nostrano* in Northern Italy. Most of the cheesemakers also process fresh cheeses such as *Tosèla* and *Dolomiti* as well as *Ricotta* cheese made out of whey.

The cheesemakers from cases 2, 3, 4, 6 and 7 make their cheese seasonally at *malga* in the mountains during the summer, while the cheesemakers from cases 5 and 8 make their cheese at *caseificio* located in a lower highland city throughout the year. The cheesemaker from case 1 is called *malga*, but they live and make cheese in the lower highland, relatively close to where cheese is consumed, and are actively involved in agri-tourism. The cheesemakers from cases 2, 3, 4, 6, and 7 process cheese seasonally in the mountains in the summer and descend to the lowlands with their livestock herd in the winter. They do not process cheese during the winter, but ship raw milk to *caseificio* for processing. The mountain cheeses made at *malga* in the mountains and at *caseificio* in the lowland have a very similar cheesemaking process. The cheesemakers from cases 2, 3, 4, 6, and 7 do not use a cooler or any other machines to process and mature cheese. The cheese is ripened inside a cave where the environment matches the cold natural environment of the surrounding mountain region. Raw milk is heated with firewood and gas. The cheesemaker from case 1 uses electricity to heat milk, but they constructed their cave with thick walls behind their cheesemaking facility to keep the environment as natural and as cold as possible. The cheesemaker from case 5 is located in a lower highland city and uses an electric cooler to control the temperature year round. While the cheesemaker from case 8 is also located in a city, they are able to utilize the natural environment to

control the temperature inside the cave, because their facility is located at a relatively high elevation.

All the cheesemakers use cow's milk to process cheese. The cheesemakers from cases 1, 2, 3, 4, 6, and 7 raise their own cows and use the milk they obtained to process cheese in the summer. At *caseificio* (Case 5), they collect milk and process all the cheese for the union members. The cheesemaker from case 8 takes their milk to *caseificio* and has the in-house cheesemaker process cheese for their own family. The cheesemaker from case 2 raises goats and also makes cheese out of goat's milk. The cheesemaker from case 6 does not raise goats, but purchases goat's milk to process goat cheese. This paper will not be discussing cheese made from a goat's milk or a mixture of goat's and cow's milk, but the process is basically the same as the cheese processed from a cow's milk.

Results

We describe the cheese processing of long-matured hard cheese called mountain cheese and fresh cheeses, *Ricotta* and *Tosèla* at *Malga Laste* (Cheesemaker 3) located in Rocca Pietore, Belluno. The process of making *Dolomiti* cheese will be based on *Caseificio di Primiero* (Cheesemaker 5) from Mezzano, Trentino. It will be noted each time when other cheesemakers use a different method.

1. Long-Matured Hard Cheese called Mountain Cheese

Raw milk is called *latte*. The raw milk obtained in the evening is poured into a container called *vasche di affioramento* and chilled with cold water overnight (Fig. 3). *Vasche di affioramento*s are traditionally made of copper, but these days, there are some made of stainless-steel. Next morning, the cheesemaker removes the cream called *panna* that had floated to the top (Fig. 4-1). Skim milk called *latte scremato* is mixed together with the whole milk obtained that morning in a large copper vat called *caldera* (Fig. 5). This milk will become the raw ingredient for cheese. About 420 L of raw milk - equal parts of skim milk (210 L) and whole milk (210 L) - is poured into the vat. The skim milk is combined with the whole milk to reduce the



Fig. 3 Cream separation from whole raw milk by the left standing in the container called *Vasche di affioramento*.

milk fat content for cheese processing, because 1) reduced milk fat is more favorable for maturing cheese, and 2) the separated cream can be used to process butter. The cream is stirred in a churn called *zangola* and washed with water to remove milk protein to purify butter. It is never salted. This process yields about 2.1 kg of butter from the cream skimmed out of the 210 L of whole milk. The butter has been a valuable source of edible oil, because other oil crops like sunflowers and olives do not grow in the Alps.

The skim and whole milk mixture is kept warm by heating at about 36°C, but is not pasteurized. The cheesemakers do not add starter culture to this milk, but only make use of the lactic acid bacteria naturally occurring in the raw milk. The milk is heated primarily with firewood from a fir or spruce tree. The rennet is added to the mixed milk, which was warmed to about 36°C, to form curds. The rennet used is a store-bought, powdered, coagulating enzyme extracted from the abomasum of a ruminant. About 4 teaspoons of rennet are added to 420 L of raw milk. The powdered rennet is dissolved in cold water and then added to the raw milk. In the past, every household used to extract their own rennet directly from the abomasum. The rennet is called *caglio* and the curd is called *cagliata*. The timing of cutting the rennet-coagulated milk is determined about 20 min after the rennet was added. The curd is lifted with a finger to check for a clean break. When ready, the curds are cut in

(1) Long-matured hard cheese

(2) Matured hard cheese

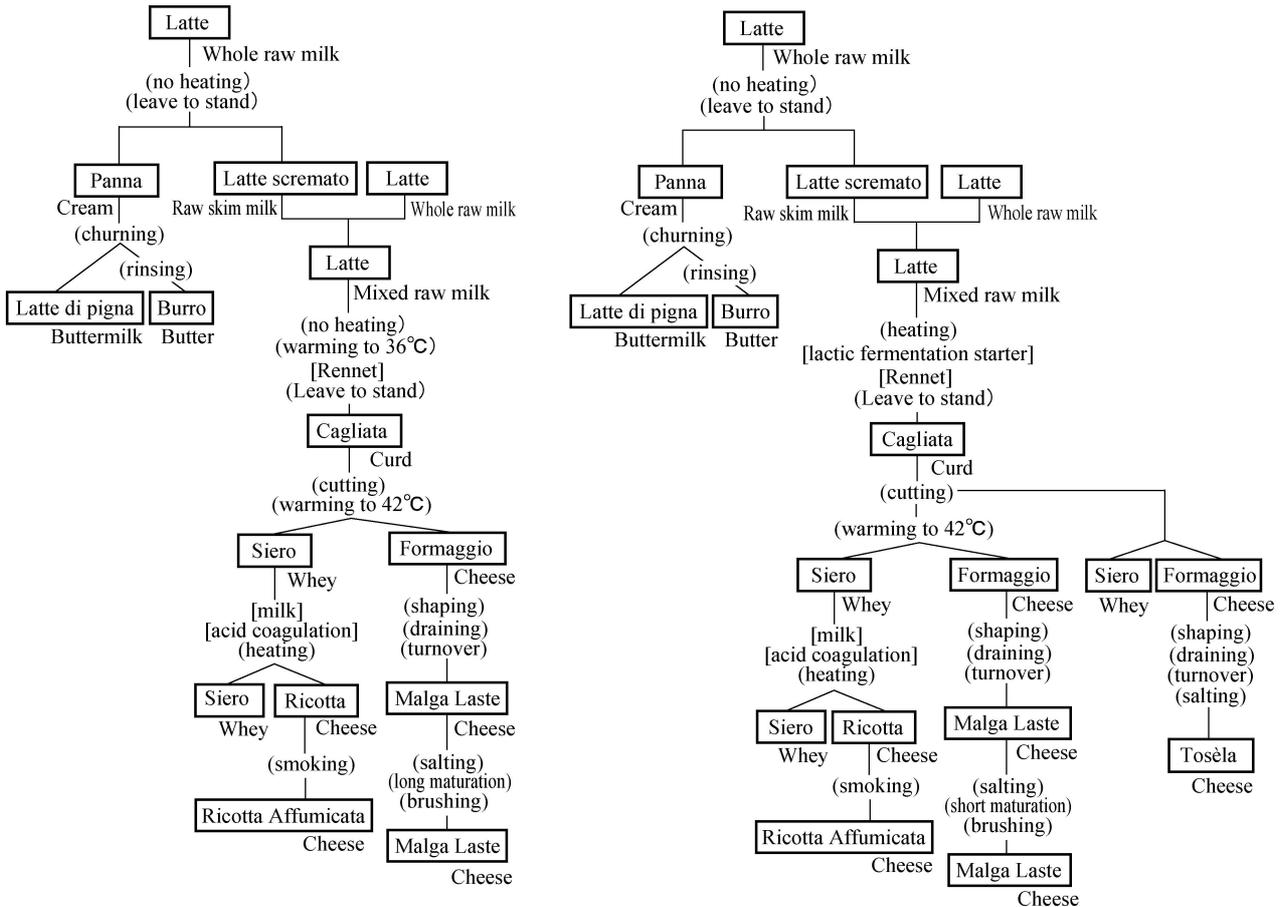


Fig. 4 Short and long aging techniques of matured hard mountain cheese, *Malga Laste* and fresh cheese, *Tosèla* at *Malga Laste* (case ③) in Laste di Rocca Pietore, Provincia di Belluno, Regione del Veneto, Italy.
 □ Product [] Additive () Processing



Fig. 5 Large vat called *caldera* for warming milk which is used in the Dolomites.

a repetitive, slow, and gentle stirring motion. It is continuously stirred and cut for about 30 min to

drain whey from the curds. The whey is called *siero*.

As the whey is released from the curds, the curds become elastic. The curds are cut until they become the size of a rice grain. Once the cutting is done, the curds are heated to about 42°C in about 10 min in order to drain more whey from the curds. After it has been heated to about 42°C, it is left for about 30 min to let the curds sink to the bottom of the vat. When the curds have settled at the bottom of the vat, they are called *formaggio*, which means cheese.

These *formaggio* are scooped out, wrapped in fine cloth, and packed in a mold designed for draining whey. It is turned over 20 min later and a large stone is placed on top to press more whey out. After it had been pressed for 15 min, it is taken out of the cloth and any cheese that had squeezed

outside the mold is trimmed with a knife. It is then packed tightly back into the mold. The cheese is turned over occasionally while it is left until the evening. Its surface is sprinkled with coarse salt in the next morning, at which point it is placed in a cheese cave. The cheese is called by its proper name once it is placed in a cave. At *Malga Laste*, for example, they call the cheese *Malga Laste* when they put it in the cave. The next following morning, the cheese is turned over again and salted on the other side. Some cheesemakers salt the cheese by soaking it in saturated salt water for about 2 d. After that, the cheese is turned over every day for three months and after three months, the cheese is turned over once every 10 d. If a blue mold grows on the surface, it is scraped off with a knife. Other cheesemakers may wash it or brush the mold off the surface with water. The cheese is matured and aged in this manner from six months to a year. *Malga Laste* processed mountain cheeses that are about 35 cm in diameter and 8 to 10 cm thick (Fig. 6). Some cheesemakers make smaller cheeses that are 13 or 20 cm in diameter, but they are always about 8 to 10 cm thick.

Malga Laste does not have a cooler or a humidifier in the cheese cave. The caves at *malga*, located about 1,500 to 2,000 m above sea level, are naturally maintained at a temperature of 13°C to 20°C with a humidity of about 50% to 80%. The walls of the cave are assembled with thick stones. Some have windows, but not at *Malga Laste*. The humidity may seem low, but they say that the cheese will lose just the right amount of moisture during the maturing process. When it gets too dry in the cave, it has certainly led to cracks in the long-matured cheeses. The cheesemakers may adjust the humidity by storing vegetables in the cave or hanging prosciutto or salami from the ceiling. They say that there are no problems, even though it seems too hot when the temperature inside the cave reaches 20°C.

The cheesemakers sell *Malga Laste* when it had been matured for about 20 d to tourists who visit *malga*. When the maturation period is short, the skim milk and whole milk mixture is pasteurized at 65°C for 15 min and then a store-bought lactic acid bacteria is added to the milk (Fig. 4-2). The bacteria is added to ensure that the milk is fermented

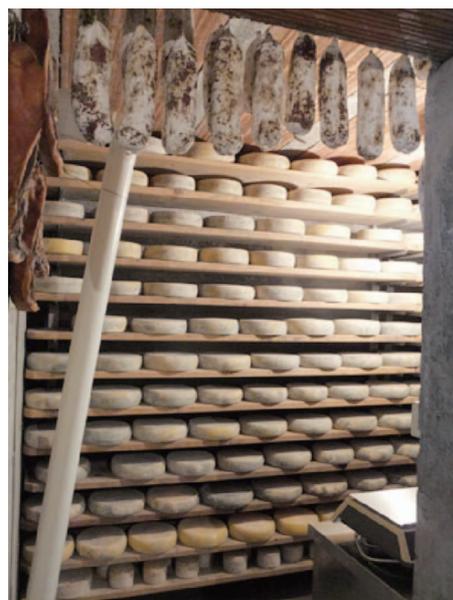


Fig. 6 *Malga Laste*, long-matured hard mountain cheese in the *Malga Laste*.

in the short time. Aside from this step, it is processed in exactly the same way as the longer aged *Malga Laste* cheese. Considering that cheese was made in the summer and brought down to the lowlands in the winter, this shortened maturing period was most likely due to the influence of recent tourism.

The cases 1 to 8 showed that the cheesemakers at *malga* and *caseificio* from the Dolomites used the same processing technique to make mountain cheeses, which are collectively known as *Latteria* and *Nostrano*.

2. Fresh Cheese - Ricotta

A large amount of whey is produced in the process of making *Malga Laste* (Fig. 4-2). *Ricotta* cheese is processed using this whey. About 10 L of skim milk is added after the whey is heated until it is hot. Then magnesium carbonate called *Solfato di magnesio* is added as it continues to be heated. Citric acid or lactic acid is sometimes added instead, but magnesium carbonate is more often used in the Dolomiti region. The foam formed on the surface is carefully removed while heating, but some cheesemakers do not remove the foam. Heating is completed when it starts to boil and *Ricotta* starts to float to the surface. The *Ricotta* is scooped up in a mold and left to release whey.

It could be eaten immediately, but it is also smoked to extend its shelf life. The cheese is smoked in a smoker for about 20 d using fir and spruce wood chips. Many cheesemakers will smoke *Ricotta* when they burn firewood to process mountain cheese as *Ricotta* is placed on top of a shelf that is built above the stove used to heat milk. Smoked *Ricotta* is called *Ricotta affumicata*. *Ricotta* is kept longer when it is smoked and becomes harder the longer it is ripened. The hardened smoked *Ricotta* is grated and sprinkled on dishes and adds a great smoky flavor to the meal.

3. Fresh Cheese - *Tosèla* and Dolomiti

The fresh cheese, *Tosèla*, is also born out of the process of mountain cheese (Fig. 4-2, Fig. 7). *Tosèla* is also called as *Schiz* in Veneto region. Curds are cut and poured into a mold without heating to 42°C. It is left at room temperature for about 15 min. *Tosèla* is produced after it is turned over and left for about two hours at a low temperature. Sometimes, it is soaked in brine for about one hour. *Malga Laste* processes *Tosèla* by first adding a starter culture to pasteurized milk and keeping the milk at a slightly higher temperature. They take much longer to cut the curds and their curds are the size of an almond.

Caseificio di Primiero in Mezzano processes the fresh cheese, *Dolomiti*, in addition to *Tosèla* (Fig. 8). The differences between their *Tosèla* and the one processed at *Malga Laste* are that: 1) it is processed with whole milk, 2) lactic acid bacteria is not added to the milk, and 3) salt is not added. Therefore, all rennet-coagulated fresh cheese, with or without fermentation or salt, is called *Tosèla* in the Dolomites. The *Dolomiti* cheese, on the other hand, is made using lactic fermentation starter, which is added after pasteurization. It is coagulated with rennet, then it is drained-off, shaped, turned, salted, and left for 15 d to let the saltiness blend into the cheese. The process of making *Dolomiti* differs from *Tosèla*, because it is matured for about 2 weeks after salting. *Dolomiti* can also be referred to as a type of matured fresh cheese.

The *Dolomiti* cheese is mainly in Belluno Province and Trent Province in the Dolomites. Some cheesemakers let *dolomiti* to stand up to 2 months for its maturation. *Dolomiti* in this condi-



Fig. 7 *Tosèla*, fresh cheese with sliced long-matured hard mountain cheese and salami.

tion becomes the matured semi-hard cheese.

4. Long-Matured Hard Cheese - Similarity in the Process and Diversity in the Flavor

The details in making the mountain cheese may differ slightly, as the temperature to which the raw milk is heated may be different by 1 to 2 degrees or the number of times the cheese is turned may vary, but the actual cheese processing steps are the same among all the cheesemakers. They all use the mixture of skim milk and whole milk; the mixed milk is unpasteurized; they traditionally utilize the naturally occurring bacteria; they maintain the mixed milk at about 36°C, to which they add rennet, and let it stand for a specified period; they gently stir and cut the curds for about 30 min; they heat the curds to about 42°C to drain whey from the curds; they add salt and turn the cheese while it is matured in the natural environment inside a cheese cave; they remove the mold growing on the surface of the cheese with a brush or by other methods.

Despite having the same process, the mountain cheese is called by multiple names. Even just with the mountain cheeses made with a cow's milk by the cheesemakers in this research, they are called *Latteria di Malga*, *Nostrano di malga*, *Ombretta*, *Nostrano Primiero*, *Formaggio Nostrano*, *Formaggio Nostrano*, *Formaggio del Lagorai*, *Casolet*, and *Formagel/Taviela*. While these cheeses are processed in the same way, the cheesemakers branded their own cheeses, which resulted in mountain cheeses with various names.

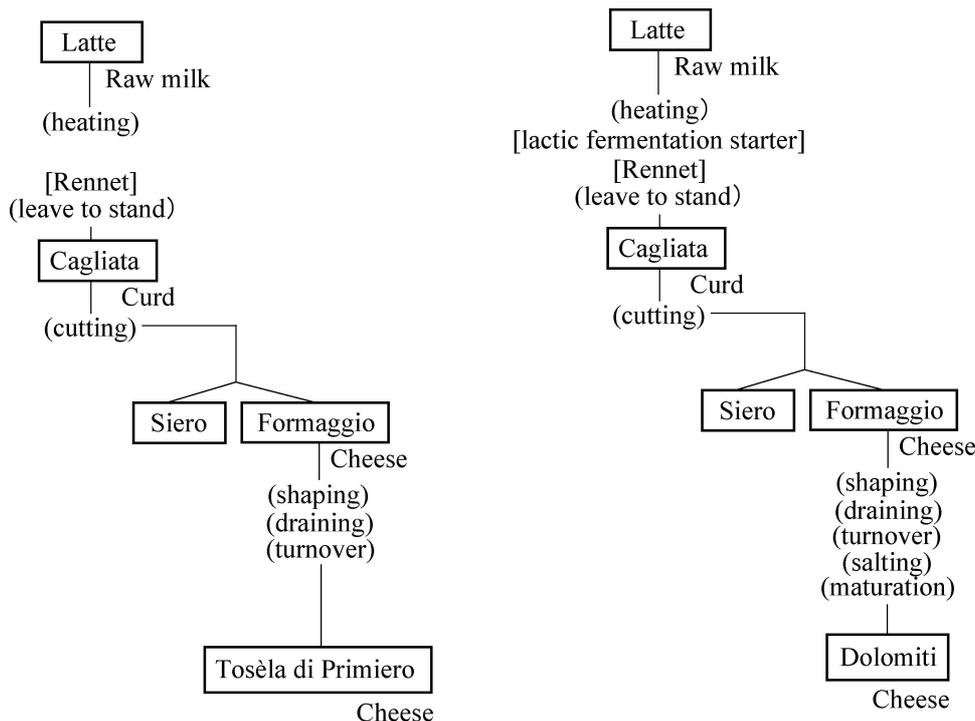


Fig. 8 Processing technique of fresh cheeses, *Tosela* and *Dolomiti* at *Caseificio di Primiero* in Provincia (case ⑤) di Bellono, Regione del Veneto, Italy
 □ Product [] Additive () Processing

There certainly is a difference in flavor between the mountain cheeses from different cheesemakers and regions, even though the process of making them is the same. This paper aims to examine what causes this difference in flavor. For instance, the cheesemakers raise their own cows and goats and make their own milk at *malga*. Many of these cheesemakers claim that the flavor of their cheese is unique, because the animals feed on a variety of natural herbs on their summer pasture and then produce delicious tasting milk. In other words, the different grass growing on the pastures (Fig. 9) makes the milk itself different. By using different tasting milk in the cheesemaking process, it creates a distinct flavor in the cheese. Dorioz *et al.*¹⁹⁾ pointed out that it was grasslands that privileged the originality and diversity of local cheeses. Furthermore, the mountain cheese is processed using naturally occurring lactic acid bacteria. This bacteria also differs in type depending on the region, which affects the milk fermentation. Therefore, the distinct regional flavors of the mountain cheese seem to come from the use of native grass grown in each region, which changes the characteristics of



Fig. 9 Making of hay which contains various medicinal plants.

the milk, as well as the use of lactic acid bacteria growing in each region, which affects the maturation of the cheese. The raw milk microflora plays a determining role in the transformation of the components of the milk in the cheese, with sig-

nificant consequences for the sensory characteristics of the cheeses²⁰⁾.

In summary, the mountain cheeses undergo the same cheesemaking process, but they have different flavors from the difference in the native grass and the lactic acid bacteria. Pecile²¹⁾ also pointed out that local animal feeds and local microflora were critical in the formation of milk flavors and cheese diversity.

Discussion

1. Long-Matured Hard Cheese and Fresh Cheese

Both long-matured hard cheese and fresh cheese are found in the mountain regions of Northern Italy. The long-matured hard mountain cheeses are called *Latteria* or *Nostrano* and the fresh cheeses are called *Tosèla* and *Dolomiti*. The mountain cheese is cut and often served with wine. *Tosèla* and *Dolomiti* are cut and served fresh or cooked and served with a cornmeal porridge called *polenta*. Both long-matured hard cheese and fresh cheese enrich the meals in the mountains in the summer. However, there is usually only one cheesemaker stationed at *malga*. How can one person effectually process so many types of matured hard and fresh cheeses?

As Fig. 4 shows, the long-matured hard cheese and fresh cheese both undergo almost the same process of turning raw milk into curds. There is a slight difference in order to make fresh cheese, the curds are kept at a slightly higher temperature and the curds are cut into bigger size than if they were to process long-matured hard cheese. The variation happens next, and to process long-matured hard cheese, the curds are cut then heated to about 42°C to drain whey. Then it is shaped, drained, salted, and matured and aged for several months during which period the cheese is turned and brushed. To process fresh cheese, the curds are drained and salted immediately after the cutting, or sometimes left to sit for 15 d after the curds are drained and salted. As described above, the long-matured hard cheese and fresh cheese are derived from the same initial process and do not use completely separate processing techniques. A single cheesemaker at *malga* is able to make various cheeses by them-

selves, because the cheeses share the same processing sequence.

The cheese processing system of long-matured hard cheese and fresh cheese consists of having the same process instead of having completely separate processing techniques. While they share the same process in the beginning, the variation in the cheeses come from the fact that the process changes in the middle and they are finished using different processing techniques.

2. Development from Brined Fresh Cheese to Long-Matured Hard Cheese

The practice of processing fresh cheese by brining rennet – coagulated curd has developed in the surrounding European regions and the neighboring countries, particularly along the Balkan Peninsula and the Mediterranean coast in West Asia. In Syria, the raw milk is curdled with rennet and the curds are cut, drained, salted, and served immediately. This freshly made cheese is called *Jibun hadra*. On the other hand, *Sirene* from Bulgaria and *Feta* from Greece are served after the curds had been matured in brine for several weeks. Both cheeses are matured fresh cheese that is made by adding rennet to unheated raw milk and soaked in brine. Unlike West Asia, the cheese processing from the Balkan Peninsula has the extra step of maturing cheese in brine. In this paper, we attempt to analyze the relationship between these fresh cheeses and the cheeses from Northern Italy, and the authors may be so bold as to examine and presume how the brined fresh cheese developed into long-matured hard cheese. The history of its development is recreated with the assumption that the cheese was developed from simple to complex processes and from the form it took when the cheese was consumed immediately to when the cheese was intended to have a long shelf life. With that in mind, the next section will make some speculations based on dairy science and anthropogeography while looking at the relationships between each processing technique.

Jibun hadra from Syria and *Tosèla* from Northern Italy have the simplest process out of all the cheeses. The rennet is added to the raw milk while the milk is still warm. The cheese is done when the curds are cut, drained, and salted. In some parts of

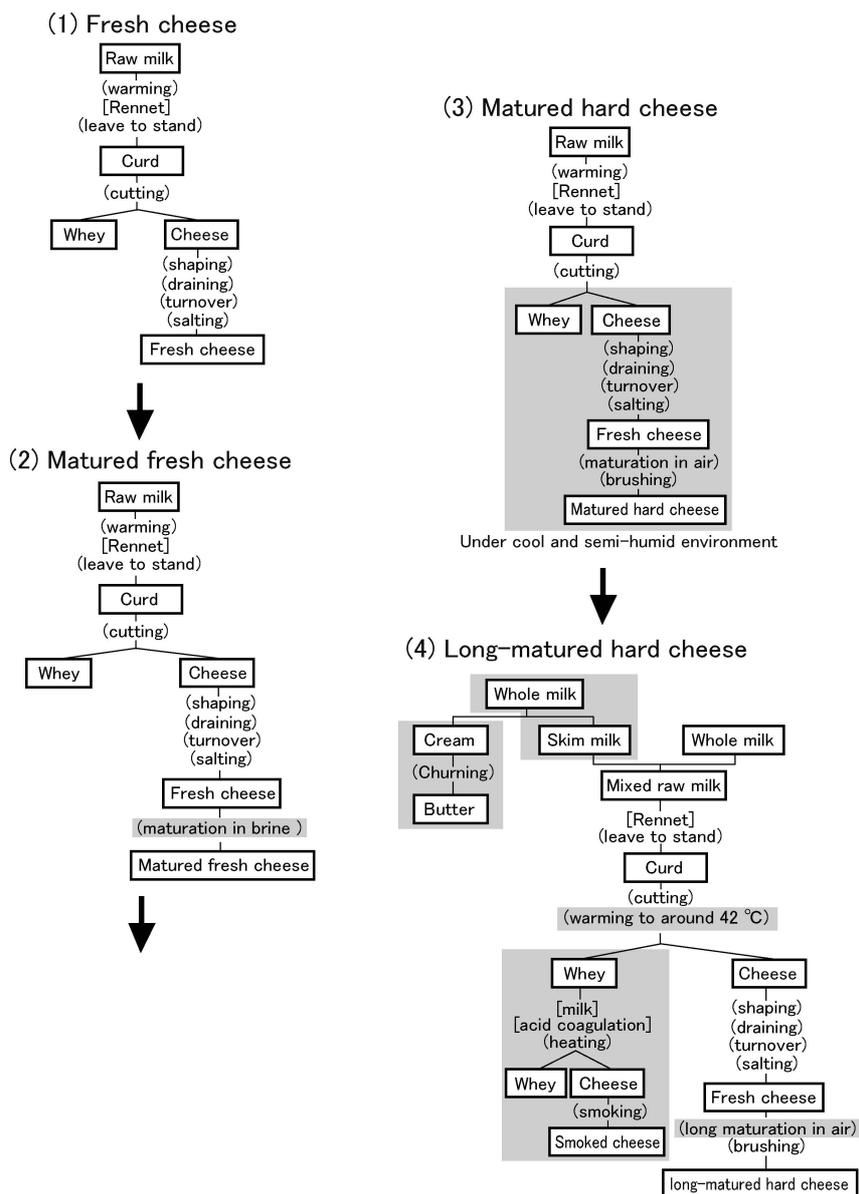


Fig. 10 Development of fresh cheese into long-matured hard mountain cheese in the European mountain region.

□ Product [] Additive () Processing
 ■ Development of milk processing technique

Syria and Italy, the cheese is served without being salted (Fig. 10-1). The Bulgarian *Sirene* and Greek *Feta*, are made when the cheese is matured in the brine for several weeks (Fig. 10-2). The brining makes the cheese milder and improves the flavor.

When the matured fresh cheese is taken out of the brine and air-dried, it becomes the matured hard cheeses found in Northern Italy such as Italian *Dolomiti* (Fig. 10-3). The process of the fresh *Dolomiti* and the semi-hard *Dolomiti* is the same only except for the period of maturation.

Artisans in the cheesemakers say that the *dolomiti* was the same cheese as the mountain cheese *Nostrano*²²). The *dolomiti* shows the continuity of processing fresh cheese and semi-hard cheese, and the possibility of development from a fresh cheese to a hard cheese in the cool environmental nature of mountains, the Dolomites. Leaving it out in air dries out the surface, forming a rind to protect the cheese on the inside. A mold grows on the surface, but it is removed with a brush each time, which also helps to promote the formation of the rind. Recently, the cheesemakers sometimes pasteur-

rized milk and added store-bought bacteria to promote maturation in a short period. The proper amount of moisture inside the cheese is gradually removed during the maturing process. This is made possible by the natural environment found at the mountainside of the Alps in Northern Italy. The natural environment of the cheese cave even during the summer is a cool 13–20°C with a 50–80% humidity. Such a cool and semi-humid environment allows for proper drain and smooth maturation of cheese. Klantschisch *et al.*²³⁾ reported that it should be less than 11°C for a suitable maturation of semi-hard cheese *Raclette* produced by using raw milk. The semi-hard and hard cheese need such a similar cool environment for the maturation. If it gets too dry, the humidity can be adjusted by placing vegetables, prosciutto, or wine inside the cave. The walls of the cave are also made thick with stones to stabilize the temperature and humidity. On the other hand, the cheese may be taken out of the cave temporarily and left outside, if it needed to be dried to remove more whey.

This gradual maturing was a difficult technique in the Italian lowland where it got above 40°C in the summer. Long-matured hard cheese, like *Parmigiano Reggiano*, processed in the lowland of the Po river basin, was not developed until the end of the thirteenth century²⁴⁾. The maturing of hard cheese was thought to be a difficult technique originally in regions that experienced hot summers, such as the Italian lowlands, Balkan Peninsula, and West Asia. The Celts appeared to have been processing matured hard cheese by 2,000 BC, but these were processed in a cold region in the Alps^{1,2)}. The manufacturing of hard cheese that was matured in air was most likely possible from an early stage in Northern Italy, because of the cold and semi-humid climate of the mountains.

In the mountain regions of Northern Italy, the processing of matured hard cheese developed further to make long aging process possible. Skim and whole milk mixture is used instead of whole milk to process the cheese (Fig. 10–4), because the lower fat content promoted more favorable maturation. The removed cream is used to make butter and serves as an essential source of oil. The curds are heated to 42°C to remove more whey and allowed the cheese to mature and be preserved for

about a year. This gave rise to long-matured hard cheese. Additionally, the whey protein remaining in whey is readily denatured by heat, so the whey can be heated and coagulated to process cheese. The sequence of development described above gave shape to all the cheeses made in the Dolomite Mountains in Northern Italy.

The cheese developed from fresh cheese to matured fresh cheese, and then to matured hard cheese, and finally to long-matured hard cheese under the natural environment of the Alps in Northern Italy. Only in this region could the cheese have undergone this transformation, as the major factor that caused such development was unmistakably the cold and semi-humid climate of the European mountains.

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Notes

- a) *Jibun hadra* means “young cheese”. *Hadra* means “green”, but it also means “young”.
- b) The mountain cheese made of cow's milk is called *Nostrano di malga* and the mountain cheese made of goat's milk is called *Nostrano di Capra* at *Malga Fontanafreda*. Besides the fact that the cow's milk may consist of a

mixture of skim milk and whole milk, the process of making cheese with a cow's milk or a goat's milk is almost the same.

- c) The mountain cheese made of cow's milk is called *Formaggio Nostrano* and the mountain cheese made of a mixture of cow's milk and goat's milk is called *Formaggio Misto Capra* at *Malga Valfontane*, but the cheese processing is almost the same. *Formaggio Nostrano* is further classified as *Formaggio Nostrano Fresco* ("fresh" *Formaggio Nostrano*) for cheese aged two months, and *Formaggio Nostrano Stagionato* ("matured" *Formaggio Nostrano*) for cheese aged one year. The names may vary, but the cheese processing is the same.
- d) At *caseificio Turnario di Pejo*, the mountain cheese made with a mixture of skim and whole cow's milk and matured for one month is called *Casolet* and the mountain cheese made with whole milk and matured for two to four months is called *Formagel/Taviela*. *Pegaes* is a mountain cheese made by heating curds to 45 °C (43°C if processing *Formagel/Taviela*) to drain whey and matured for six months. *Capra Stagionato* is a mountain cheese made with a goat's milk. The cheese processing is almost the same with the exception of the milk used, temperature at which the whey is drained, and the maturing time.

References

- 1) Barker G.: *Prehistoric Farming in Europe*. Cambridge University Press, Oxford (1985)
- 2) Kindstedt P. S.: *Cheese and Culture: A History of Cheese and Its Place in Western Civilization*. Chelsea Green Publishing Co., Vermont (2012)
- 3) Hirata, M., Yotova, M., Uchida, K. and Motoshima, H.: Milk processing system in the South-west of Bulgaria. *Milk Science*, **59**(3), 237–253 (2010) Written in Japanese
- 4) Hirata, M., Yotova, M. and Uchida, K.: Milk processing system in the Balkan Mountains, central Bulgaria—A hypothesis on the development history of mature cheese using mold—. *Milk Science*, **60**(2), 85–98 (2011) Written in Japanese
- 5) Cheese Professional Association: *The Manual for Cheese Professional*. Asuka publisher, Tokyo (2014) Written in Japanese
- 6) Hirata, M. and Miyazaki, A.: Milk products used in cities and villages of Syria. *Food Science*, **247**, 46–55 (1998) Written in Japanese
- 7) Canty and Associates LLC.: *Weatherbase*. Canty and Associates LLC, Virginia [cited 29 Jul. 2015]. Available from URL: <http://www.weatherbase.com/> Accessed 10 February 2016.
- 8) Erschbamer, B., Unterluggauer, P., Winkler, E. and Mallaun, M.: Changes in plant species diversity revealed by long-term monitoring on mountain summits in the Dolomites (northern Italy). *Preslia*, **83**, 387–401 (2011)
- 9) Evans, E. E.: Transhumance in Europe. *Geography*, **25**(4), 172–180 (1940)
- 10) Davies, E.: The patterns of transhumance in Europe. *Geography*, **26**(4), 155–168 (1941)
- 11) Ryder, M. L.: *Sheep & Man*. Gerald Duckworth & Co. Ltd., London (1983)
- 12) Shirasaka, S.: "Ordinary" and "extraordinary" on tourism through transhumance of sheep in the northern Part of Italy. *Rikkyo University Bulletin of Studies in Tourism*, **14**, 18–42 (2012) Written in Japanese
- 13) Fassio, G., Battaglini, L. M., Porcellana, V. and Viazao, P. P.: The role of the family in mountain pastoralism - Change and continuity. *Mountain Research and Development*, **34**(4), 336–343 (2014)
- 14) Oeggl, K., Schmidl, A. and Kofler, W.: Origin and seasonality of subfossil caprine dung from the discovery site of the Iceman (Eastern Alps). *Vegetation History and Archaeobotany*, **18**, 37–46 (2009)
- 15) Burns, R. K.: The Circum-Alpine Culture Area: A Preliminary View. *Anthropological Quarterly*, **36**(3), 130–155 (1963)
- 16) Uhlig, H. and Kreutzmann, H.: Persistence and Change in High Mountain Agricultural Systems. *Mountain Research and Development*, **15**(3), 199–212 (1995)
- 17) Tani, Y.: *Flock management of Transhumant Francesco*. Heibonsya publisher, Tokyo (1996) Written in Japanese
- 18) Caldera, B.: *Formaggi d'altura copertina flessibile*. Vivalda Editori Srl, Torino (2012)
- 19) Dorioz, J.-M., Fleury, P., Coulon, J.-B. and Martin, B.: The land, the environment and cheese production: the example of cheese produced in the Northern Alps. *The proceedings of INRA faed with sustainable development: Landmarks for the Johannesburg conference*, August

- 26th to September 4th 2002, Johannesburg, record 22 (2002)
- 20) Beuviel, E. and Duboz, G.: The microbiology of traditional hard and semihard cooked mountain cheeses. In *Cheese and Microbes*. (ed. by C. W. Donnelly). ASM Press, Washington, pp.133-150 (2014)
- 21) Pecile, A.: *Malghe de formaggio*. Dipartimento Agricoltura, Alimentazione, Foreste e Montagna Servizio Vigilanza e Promozione Dell'attività Agricola, Provincia Autonoma di Trento, Trento (2003) Written in Italian
- 22) Association "Road of Cheeses and Flavours of the Belluno Dolomites": *Dolomiti*, Association "Road of Cheeses and Flavours of the Belluno Dolomites", Belluno; [cited 14 Dec. 2011]. Available from URL: <http://www.formaggisaporidolomiti.it/EN/cheeses/traditional-cheeses/dolomiti> Accessed 10 August 2015.
- 23) Klantschitsch, T. K., Bachmann, H-P. and Puhan, Z.: Influence of milk treatment and ripening conditions on quality of Raclette cheese. *Lait*, **80**, 51-67 (2000)
- 24) Zannoni, M.: *The Soragna Museum of PARMIGIANO-REGGIANO cheese*. Silva Editore Parma, Parma (2004)

イタリア北部山岳地帯の熟成ハード系チーズの特徴とその発達史

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山のチーズと呼ばれる長期熟成ハードチーズが、紀元前2000年には冷涼なアルプス山岳地帯でつくられていた。フレッシュチーズと熟成ハードチーズの関連性の分析は、ヨーロッパにおけるチーズ発達史の再構築にとって極めて重要な論考となる。本稿では、イタリア北部山岳地帯のドロミテ地域を事例に、熟成ハードチーズとフレッシュチーズの加工工程を把握し、フレッシュチーズから熟成ハードチーズへの発達史過程について酪農科学・人文地理学的に考察することを目的とした。フレッシュチーズは、レンネット添加、カッティング、脱水、加塩することによって加工されている。フレッシュチーズは、風味の向上のため、塩水に漬けたまま数週間静置し、熟成されるようになっていった。この熟成フレッシュチーズを、塩水から取り出し、空気中で乾燥化を進めると、ドロミテ地域でつくられているドロミテと呼ばれるチーズのような熟成ハードチーズとなる。空気中で静置するため、表面は乾燥し、形成された外皮が内部のチーズを守るようになる。山岳地域では、熟成ハードチーズは長期熟成ハードチーズへと更に発展していった。より望ましい熟成を進展させるために、チーズづくりには乳脂肪含量を低くした脱脂乳が利用されるようになった。カードからよりホエイを除去するために、カードは42°Cまで加温されるようになった。ここに、ドロミテ地域でみられる山のチーズのような長期熟成チーズが誕生することになる。このような発達へと向かわせた大きな要因は山岳地帯の冷涼・半湿潤性であり、ヨーロッパ山岳地帯でなるべくして変遷したチーズの発達だったと考えられた。