

Original Paper

The Characteristics and Historical Development of the Milk Processing System in Kyrgyz Republic

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Abstract

The objectives of this paper are to elucidate the milk processing system of Kyrgyz pastoralists and to speculate its historical development. The milk processing system of the Kyrgyz pastoralists involves the milk processing techniques called the fermentation processes to produce sour milk, cheese, and kumis, as well as the cream separation processes to produce cream, butter, butter oil, sour milk, naturally fermented milk, and cheese. As a result of comparing and analyzing the milk processing techniques of other surrounding regions, we found the following characteristics in the milk processing system of the Kyrgyz pastoralists: 1) Development of milk processing techniques suited for the cold environment of the northern Eurasian continent, such as the cream separation processes and production of kumis, and 2) a lack of use of the milk processing technique of the additive coagulation processes, in which they have not gone as far in the process as to use coagulants to make cheese. We conclude that the historical development of Kyrgyz pastoral nomad's milk processing system experienced the following transformations: With the West Asia type milk processing technique of the fermentation processes as the foundation, the pastoralists developed the cream separation processes and the kumis production techniques because of the cold climate, and eventually became dependent on the cream separation processes to separate milk fat with the use of the modern day cream separator.

Key words: milk processing system, pastoralist, historical development, Kyrgyz, comparative analysis

Introduction

There is a hypothesis, which claims that the subsistence of pastoralism was established with the invention of the milking and castration techniques^{1,2)}. In other words, the milking technology was a huge factor in establishing a pastoral lifestyle suited for the dry land, and their use of milk allowed the pastoralists to depend much of their lifestyles on their livestock. Hence, the milking of livestock and milk usage created a subsis-

tence called pastoralism. The authors conducted a research on the milk processing and usage in the dry lands of Eurasia to understand the very important milk culture within pastoralism. The research regions covered Syria in West Asia³⁾, Iran⁴⁾, India in South Asia⁵⁾, Tibetan Plateau^{6,7,8)}, and Mongolia in North Asia^{9,10)}. However, our research in Kazakhstan¹¹⁾ might be the only research related to the milk processing system in the central part of Eurasia, and there is almost no report or discussion on this topic in Kyrgyz republic. Like West Asia, South Asia, and North Asia, a discussion on Central Asia is crucial when studying the diffusion and transformation of pastoralism and milk culture in Eurasia.

Therefore, this paper aims 1) to elucidate the milk processing system of the Kyrgyz pastoralists in Central Asia, 2) to compare and analyze the characteristics of the milk processing system of the

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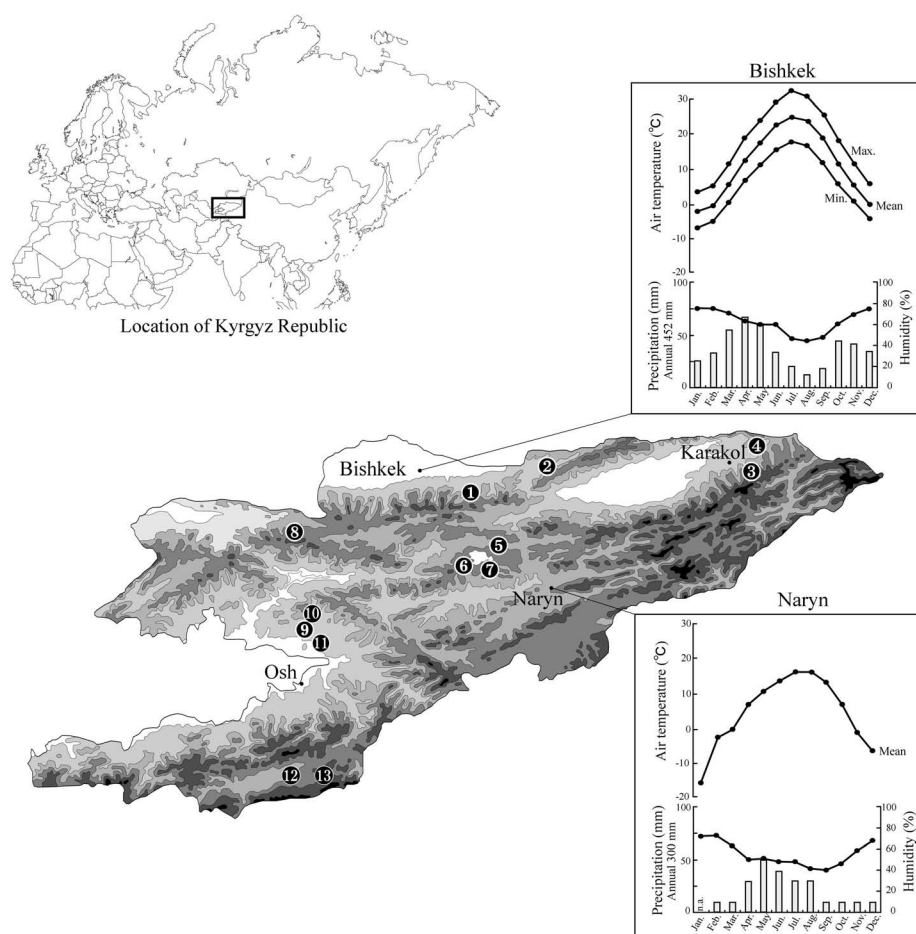


Fig. 1 Air temperature ($^{\circ}\text{C}$), precipitation (mm), humidity (%)²⁹⁾, contour line and survey sites (①–⑬) in Kyrgyz Republic.
 □ 500~1,000 m ■ 1,000~2,000 m ■ 2,000~3,000 m ■ 3,000~4,000 m ■ 4,000~5,000 m ■ 5,000 m~

Kyrgyz pastoralists with those in the surrounding areas, and 3) to speculate the historical development of the milk processing system of the Kyrgyz pastoralists living in the northern parts of the Eurasian continent.

The authors conducted an on-site research to observe and interview 13 Kyrgyz pastoral households in November 2000 and August 2014. Then based on the authors' on-site research of the surrounding regions and materials from literature study, they compared and contrasted Kyrgyz with the surrounding regions and other central Asian regions in order to discuss the characteristics of the milk processing system of the Kyrgyz pastoralists. Any Kyrgyz or Russian word was written out in Roman alphabets according to Bekturova and Bedturov¹²⁾.

Research Site

1. Natural Environment

Forty % of Kyrgyz republic is located in the mountain regions over 3,000 m above sea level. The grassland in the mountains are used as grazing pastures for livestock in the summer between the time of snowmelt and snowfall. The flatlands along the Chuy River in the north, Ferghana basin in the southwest, and the valleys in the mountain regions are used for irrigated agriculture, which utilizes water from springs and melted snow.

In Bishkek, located at 800 m above sea level, the temperature rises above 30°C in the summer, but it could get down 7°C below freezing in the winter (Fig. 1). The temperature drops as the altitude rises, and in Naryn, at 2,000 m above sea level, the average temperature doesn't reach 20°C basically



Fig. 2 Landscape of grassland in 3000 m above sea level and animal grazing managed by Kyrgyz pastoralists.

and the temperature drops about 20°C below freezing in the winter. It is too cold to cultivate crops at over 2,800 to 3,500 m above sea level¹³⁾, and the natural grassland can only be used as pastures for the livestock (Fig. 2). The annual rainfall is only 452 mm in Bishkek and 300 mm in Naryn, not enough rain to grow wheat, vegetables, or corn. The climate in the research site of Kyrgyz republic is characterized by its aridity, and while the temperature in the flatlands below 1,000 m above sea level is high in the summer, most of the mountain regions experience a cold climate throughout the year. These characteristics of the natural environment formed the subsistence of pastoralism, which makes use of the difference of elevation, allowing the pastoralists to release livestock in the mountains for grazing, agricultural farm and hay production in the valleys, and perform seasonal transhumance of the livestock up and down the mountains.

2. Research Households

We researched a total of 13 households living throughout Kyrgyz republic by the observation and interview to understand the milk processing system in Kyrgyz republic (Fig. 1). All 13 research households raise cows and mares. In addition to cows and mares, households 3, 4, 6, 7, 8, and 12 raise sheep-goats and household 5 raises yaks. The size of the livestock herds is about 2 to 210 cows, 1 to 27 mares, 30 to 800 sheep-goats, and 450 yaks.

Households 2 and 11 live permanently in the winter village where the farmlands are located and entrust other households to take care of their livestock at the mountain pastures during the summer. The other households perform transhumance of their own livestock. They also take care of other households' livestock herds along with their own and release them in the mountain pastures in the summer time. Households 2 and 13 operate a lodging business at the same time to raise profit. All households cultivate crops, such as potatoes, vegetables, and grass in their winter village.

3. Milking

The cows are milked throughout the year. The lactating period of a cow is only about 6 to 7 months, but since there is no mating season, the pastoralists can obtain milk throughout the year. They milk the cows twice a day, once in the morning and once at night. Currently, most of the milk is sold to traders who come around to collect the milk for about 15 som^{a)}/L of milk. The cows provide about 20 L of milk each day.

The mares are mainly milked from May to June, but some mares are milked until the end of September in some area. The mares are milked 5 to 8 times per day, for about 2 min every 2 to 3 h. Each time, a mare can produce about 0.5 L/t, with a total of about 3 L/d. The mare is milked from the right flank as the person milking kneels on their right knee and places a bucket on top of the left knee so that they can use both hands to milk into the bucket. They position a foal next to the mare to elicit a lactogenic action, although they do not actually let the foal suckle first. Kumis made from a mare's milk can clean out the stomach when consumed and is thought to be healthy. It is said to be particularly good for the kidneys and the liver. For these reasons, many Kyrgyz people buy kumis from the pastoralists, supplying them with a valuable cash income.

They are currently not milking sheep even though they apparently milked sheep during the time of the Soviet Republic. Since they can obtain enough milk from the cows, they no longer bother milking sheep that yields very little milk. Lastly, there is no tradition of milking goats in Kyrgyz republic.

Analysis of the Milk Processing System

Umesao¹⁴⁾ proposed that the knowledge and analysis relating to complicated milk processing should be understood in terms of “milk processes” based on the characteristics of how a product is made, and to understand the whole process systematically. This paper acknowledges the importance of understanding complicated milk processing as the milk processes and will develop a discussion using the milk processing system and systematic analysis formulated by Dr. Sasuke Nakao, who had developed Umesao’s proposal in detail¹⁵⁾. Nakao focused on the first process applied to milk and presented the following 4 milk processes: 1) fermentation processes, 2) cream separation processes, 3) additive coagulation processes, and 4) heat condensation processes. To explain, 1) in the fermentation processes, fermentation is the first stage of processing milk and the fermented milk is further processed to make other milk products. The process of lactic acid fermentation in which sour milk is made is included in this processes. Then, milk fat and protein are extracted from the fermented milk. The process of making kumis with alcohol fermentation utilizing the churning technique is also included in this processes. 2) In the cream separation processes, the cream is first separated, followed by the processing of cream and skim milk to make other milk products. The technique of the heating/cream separation process separates the cream by first heating the milk and letting it stand to let the fat float to the surface. The technique of the no heating/cream separation process separates the cream by letting the milk stand without heating or by using a cream separator. 3) The technique of the additive coagulation processes adds coagulant to milk first to make cheese. The coagulants include rennet (enzyme synthesized in the abomasum or fourth stomach of ruminants), sour milk, plant-based organic acid, and plant enzyme. Cheeses commonly found in Europe, such as Gouda and Cheddar are made from the coagulated solids created when casein protein is partially broken down with rennet. 4) The technique of the heat condensation processes entails boiling and reducing milk. *Kheer* and *khoa* from

India, made by boiling down milk, and condensed milk made in developed countries belong in this processes. This paper will continue the discussion using Nakao’s milk processing system and systematic analysis.

Milk Processing System in Kyrgyz

As the cow’s milk and mare’s milk markedly differ in composition, the processed milk products differ as well. The cow’s milk is used to make cheese and butter oil and the mare’s milk is exclusively used to make *kymyz*. This paper will go on to report the milk processing techniques of the fermentation processes and the cream separation processes (Fig. 3).

1. Fermentation processes

1.1 Processing *kūrūt* (Cheese) from Milk

The cow’s milk is called *süt*. The dust and dirt mixed into *süt* at the time of milking must be removed with a cloth or a gauze. After boiling to pasteurize *süt*, it is left out to cool. When it is about body temperature, the sour milk set aside from the previous production is added. One cup or approximately 200 mL of sour milk is added to 5 L of *süt*. The container with the *süt* should be covered with a cloth and left out in a warm place for about 6 h to make sour milk called *ajran*. Alternatively, the *süt* can be left out overnight for *ajran* to be ready by the following morning. While letting *süt* stand, it is never touched or shaken. *Ajran* is eaten frequently both as a meal or a snack at any hour, making it an important ingredient for the Kyrgyz diet. It also tastes delicious with sugar.

Ajran can be further processed to make cheese. First, *ajran* is dehydrated in a cloth for about two days. The cheese left in the bag is called *süzmö* and the whey produced from this process is called *sary süüü*^{b)}. Some households add salt when dehydrating *ajran* in a pouch (Household 1). Most of the *sary süüü* is discarded, but it is sometimes fed to the livestock or given to someone whose internal organs are not feeling well. *Süzmö* is eaten with bread or mixed well with water and salt to make a drink called *čalap*. *Süzmö* can also be preserved until the winter by adding salt. The cold climate in the mountain region in Kyrgyz can

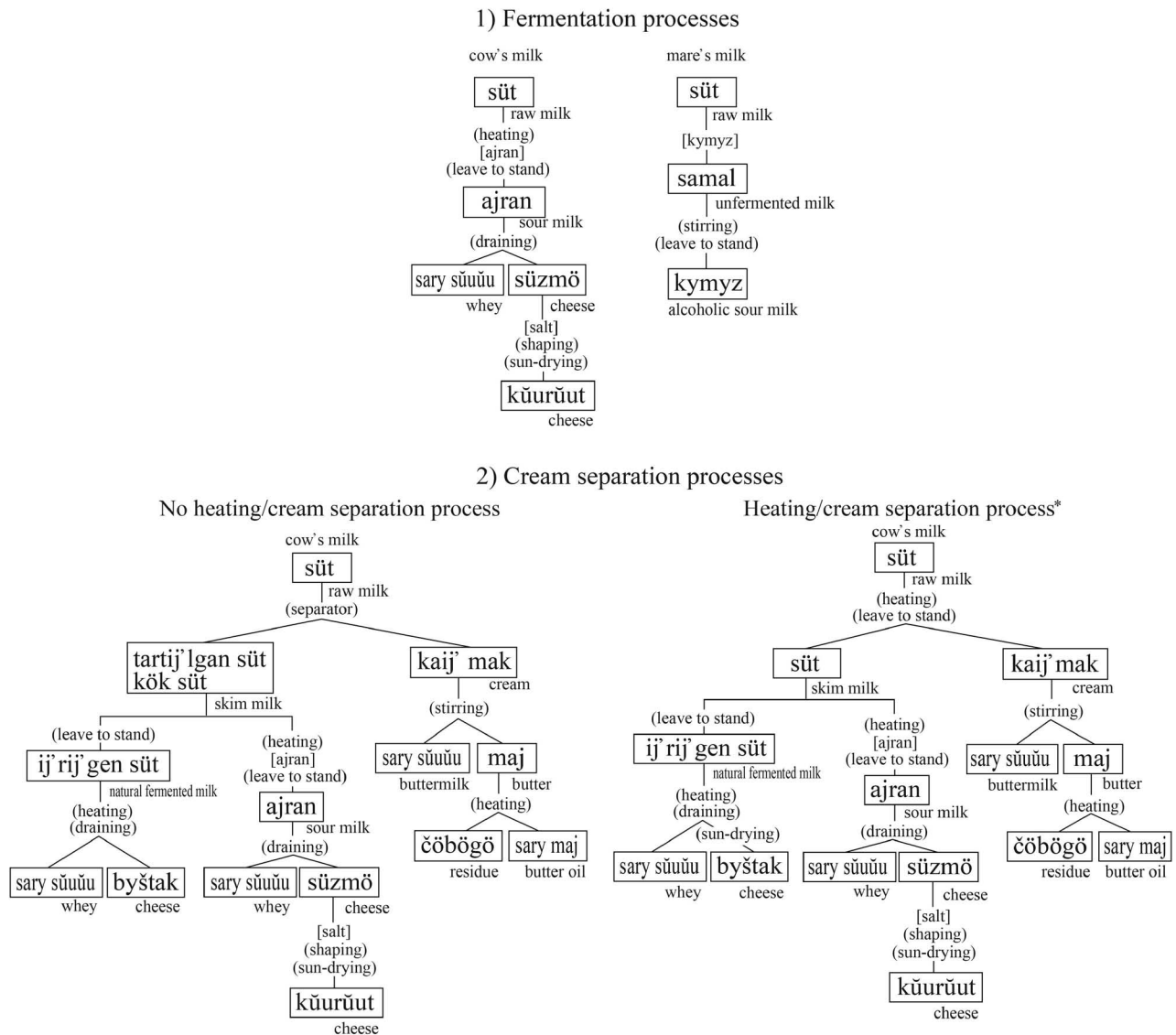


Fig. 3 Milk processing system in the current Kyrgyz Republic.

□ Product [] Additive () Processing

*It was Kyrgyz pastoralists' main milk processing technique for cream separation before the prevalence of cream separators in the Soviet Republic era.

give it a long shelf life even though it has a relatively high water content. It can be processed into unripened dry cheese called *küürüt* by kneading *süzmo* smoothly by hand, adding salt, and forming small 2 cm balls before aerating and drying them out in the sun for about one week. *Küürüt* can be preserved for several years. Some households said that they sometimes added roasted ground wheat called *talkan* when forming *küürüt*. They eat *Küürüt* any time on its own or cooked with bouillon to make a soup called *akcjerke* in the winter, but it is not often used as meals.

1.2 Processing *Kymyz* (alcoholic sour from mare's milk) from Milk

Mare's milk is also called *süt*. To specifically differentiate it from the cow's milk, it can be called *beenij'n sütü*, which literally means mare's milk. The dust and dirt are removed from *süt* with a cloth or a gauze and *süt* is poured into a goatskin pouch called *saba*. These days, the pastoralists use *čjeljek*, a wooden barrel or a polyethylene container instead of *saba*. The container is fumigated with smoke from burning wood, because the wood smoke apparently gives *kymyz* a better flavor. A



Fig. 4 Hospitality of Kyrgyz pastoralists. Butter oil or *sary maj* (left), cream or *kaij'mak* (middle), and alcoholic sour milk from a mare or *kymyz* (right), served with bread and jam.

small amount of *kymyz* from previous production is placed inside *saba* as a starter. The mixture of *kymyz* and *süt* poured inside *saba*, which has not started fermentation is known as *samal*. *Samal* is stirred inside *saba* repeatedly with an stirring stick called *bij'skje*. After about 2 to 3 h, *samal* turns into alcoholic sour milk *kymyz*.

Kymyz is not preserved, and all of it is consumed during the period when the mares are milked. The pastoralists drink as much *samal* or *kymyz* as they like when they want while they milk the mares. They also serve *samal* or *kymyz* when they have visitors (Fig. 4). Households 9 and 10 living in southern Kyrgyz do not raise mares and therefore do not make *kymyz*.

2. Cream separation processes

2.1 No heating/cream separation process

After straining dust and dirt from cow's milk with a cloth or a gauze, the milk is poured into a cream separator while it is still warm from milking to separate cream and skim milk. The cream is called *kaij'mak* and the skim milk is called *tartij'lgan süt*^{c)} or *kök süt*^{d)}. *Kaij'mak* is an important ingredient in Kyrgyz meals and eaten with bread or other dairy products.

The cream is kept in a cold place and after accumulating about 5 L, it is churned for about 30 min with a spoon or by hand to make butter. Butter is rinsed. Butter is called *maj* or *žuuūugan maj*, which means rinsed butter. Buttermilk is called

sary šuuūu or simply *šuuūu*, which means water. Buttermilk is rarely used by the pastoralists. *Maj* is heated in a pot under low heat for about 1 h to make butter oil called *sary maj*^{e)}. *Sary maj* can be stored for a long time. It is eaten with fried bread or used in place of cooking oil mainly in the winter. *Čöböğö* is a brown dairy residue left on the bottom of the pot after heating *maj*, and when flour or sugar is added, the local households eat *čöböğö* with bread or given as a snack for the children. Households 9 and 10 do not add flour or sugar, but add milk instead to make *čöböğö*.

Skim milk called *tartij'lgan süt* or *kök süt* can be processed under either one of two processes to produce *kūurūut*, which is unripened dry cheese or *byštak*, which is fresh cheese. *kūurūut* is made with the same technique as the fermentation processes. In other words, *kūurūut* is first made by the lactic acid fermentation of *tartij'lgan süt* or *kök süt*, which creates sour milk or *ajran*, which is then drained, salted, and dried in the sun. *Byštak* is made by leaving out *tartij'lgan süt* or *kök süt* for about a day to let natural fermentation occur. This naturally fermented milk is called *ij'rij'gen süt*. It is never consumed as is. It curdles when heated for about 10 min and turns into *byštak* when this curdled milk is drained through a cloth for about 1 h. *Byštak* is not stored for long time, but is eaten immediately. When sugar is added to *byštak*, it is very delicious with a sweet and sour taste. It is eaten often for breakfast with bread and tea. *Byštak* is not produced near the Song-Kul Lake region in central Kyrgyz (households 6 and 7).

2.2 Heating/cream separation process

Currently, the pastoralists mostly use a cream separator to separate cream from milk. However, before the cream separators became available in the Soviet Republic era, the pastoralists left the milk out to naturally separate the cream.

The cow's milk is heated and allowed to stand overnight in a cool place. In the morning, the cream has floated to the surface. The cream is separated when it is skimmed from the surface. This cream is called *kaij'mak*. The pastoralists use the terms, *byšyrgan kaij'mak*^{f)} and *kyrgyz kaij'mak*^{g)} to differentiate this cream from the cream made with a cream separator. The cream made naturally

is a little like sour cream that has been through light lactic acid fermentation. The skim milk left after the cream has been skimmed off is called *süt*, just like milk. The process of turning *kaij'mak* into *sary maj*, *süt* or skim milk into *küürüt* or *byštak* takes the same process as the no heating/cream separation process. The milk processing technique of the heating/cream separation process is rarely used today, because it has become far more efficient and productive to separate milk fat from milk using a cream separator.

Characteristics of the Milk Processing System in Kyrgyz

In order to discuss the characteristics of the milk processing system in Kyrgyz by comparing the milk processing techniques of Kyrgyz and the surrounding regions. We summarized the milk processing techniques of the surrounding regions in Fig. 5. The case studies of the milk processing system were taken from documents from Hirata³⁾, Hirata and Hara⁴⁾, Shahrani¹⁶⁾, Nejima¹⁷⁾, Matsui¹⁸⁾, Matsubara¹⁹⁾ for West Asian regions, Hirata⁵⁾ for South Asia, Hirata^{6,7,9)}, Kurita²⁰⁾ for the Tibetan highlands, Hirata^{11,21)}, Hirata *et al.*^{22,23)} for Central Asia, and Hirata⁹⁾, Hirata *et al.*²²⁾, Konagaya²⁴⁾, Umesao¹⁴⁾, Miaki²⁵⁾ for North Asia.

1. Characteristics of Milk Culture in the Surrounding Regions

In the West Asia Persian type, especially around the Persian region, milk is turned into sour milk, sour milk is churned into butter, and butter is heated to make butter oil. The authors call this particular milk processing technique, the West Asian fermentation processes. The sour milk is also drained, salted, and dried in the sun to make cheese. It is also characteristic of this region to add rennet to milk to make cheese, utilizing the milk processing technique of the additive coagulation processes.

The South Asia Lowland type has inherited the West Asian fermentation processes from the West Asia Persian type to make butter oil by churning sour milk and heating butter. One of the characteristics is that the production of cheese from sour milk and buttermilk is missing from the South Asia

Lowland type. In their milk processing technique in the additive coagulation processes, the cheese is made using a plant-based organic acid. They also use the technique of the heat condensation processes by boiling and condensing milk. Only the South Asia Lowland type uses the techniques of using plant-based organic acid as a coagulant and making condensed milk from raw milk in the Eurasian continent.

In the Central Asia Lowland type, which spans from Turkmenistan, north of Kyrgyz to southern Kazakhstan, the milk is turned into sour milk, and made into cheese by draining, salting, and drying sour milk in the sun. At the same time, the sour milk is churned into butter and then is heated to make butter oil. This Central Asia lowland technique of the fermentation processes is similar to that of the West Asia Persian technique of the fermentation processes in that they are exactly the same. In the Central Asia Lowland type, kumis is made not just from the mare's milk, but also from cows and camels. Since Central Asia is located in the northern part of Eurasia and is in a much colder climate, the cream separation processes has developed. The milk is left out to separate the cream and the cream is churned into butter. The butter is heated to make butter oil, which is then stored. In the Uyghur region, the cream is sometimes directly heated to make butter oil. The skim milk goes through lactic acid fermentation or natural fermentation to be made into cheese. Also, rennet is sometimes used as a coagulant to make cheese. They use both rennet and sour milk as coagulants in the Uyghur region. The Central Asia Lowland type uses the cream separation processes along with the West Asian fermentation processes.

North Asia type centers on the milk processing technique of the cream separation processes. The cream is not churned, but is directly heated to make butter oil. Their fermentation processes is limited to the production of alcoholic sour milk. It is also characteristic of this type to use sour milk as a coagulant when making cheese.

Central Tibetan Plateau type is a mix of the West Asia Persian type and the North Asia type. Their fermentation processes does not include production of butter oil, because the cold climate allows the pastoralists to preserve butter. Butter is

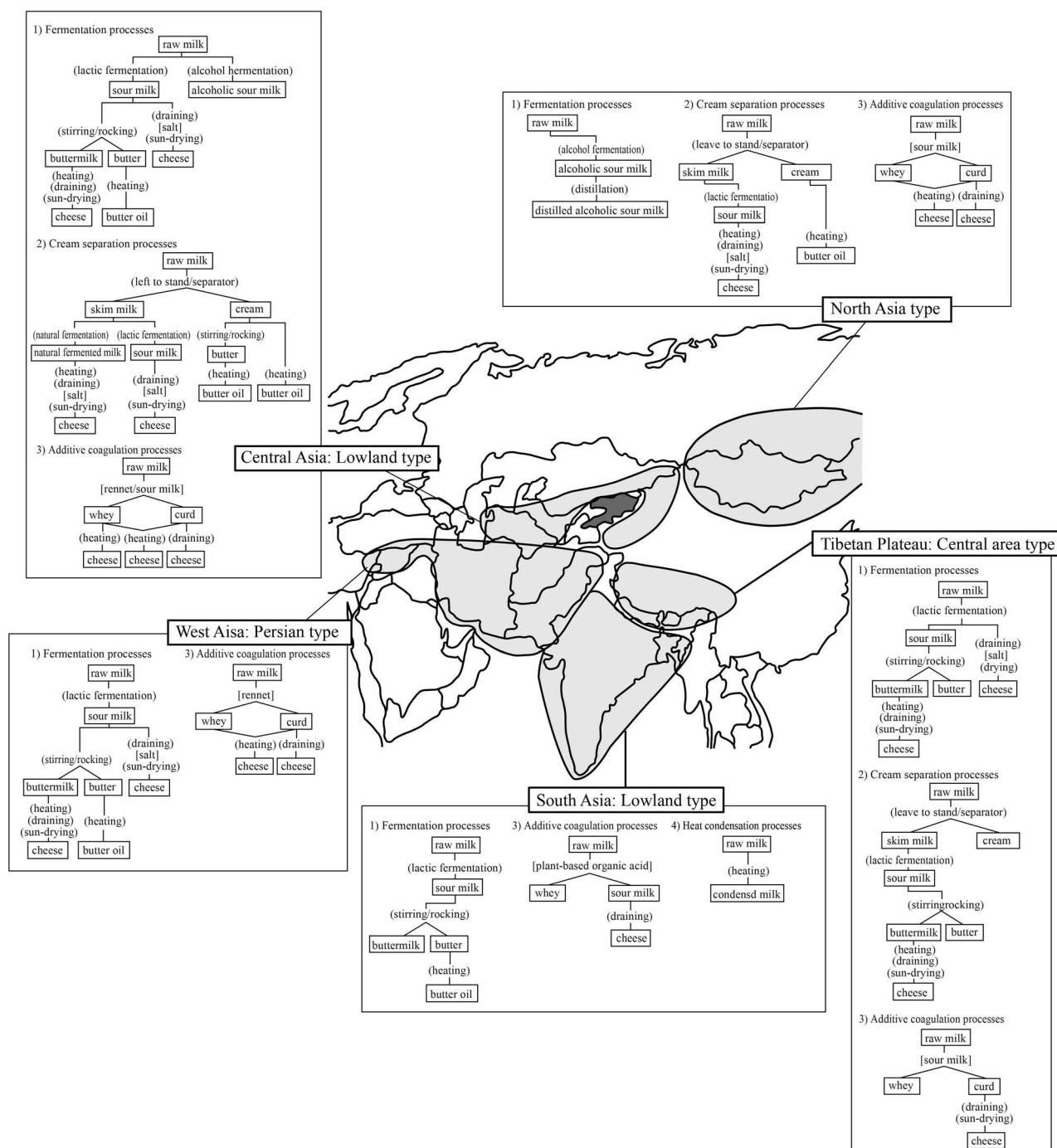


Fig. 5 Classification of milk culture types around Kyrgyz Republic and their geographical distribution.

□ Product [] Additive () Processing

the final product in the milk fat separation process. While the cream is separated in the cream separation processes, they have not developed further technique to process the cream into other milk products. Sour milk is used as the coagulant in the additive coagulation processes.

2. Characteristics of the Milk Processing System of the Kyrgyz Pastoralists

The milk processing system of the Kyrgyz pastoralists utilizes the milk processing technique of the cream separation processes to make butter oil and cheese just like the Central Asia Lowland type and the North Asia type. The technique of the cream separation processes developed only in the

cold northern regions of the Eurasian continent. Kumis is also made with the Central Asia Lowland type and North Asia type, and it is another technique only developed in the northern region of Eurasia, including Kyrgyz. This is because if the temperature can be maintained between 14°C and 16°C during the summer, the yeast can work actively to cause alcohol fermentation²⁶⁾. This kind of temperature condition can only be fulfilled in the cold environment of the northern regions of Eurasia. The Kyrgyz pastoralists use milk processing techniques suited for cold regions, such as the cream separation processes and production of kumis.

The regions around Kyrgyz all use the milk processing technique of the additive coagulation processes. The Central Asia Lowland type and the West Asia Persian type use rennet, the North Asia type and the Central Tibet Plateau type, and part of the Central Asia Lowland type (Northern Uyghur) use sour milk, and the South Asia Lowland type uses plant-based organic acid as the coagulant. Kyrgyz does not use this milk processing technique of the additive coagulation processes. Therefore, the lack of coagulant use in the cheese making process is the characteristic of the Kyrgyz pastoralists' milk processing system. The Kyrgyz pastoralists have not gone as far in the process as to use coagulant to make cheese.

As a result of comparing and analyzing the milk processing techniques with other surrounding regions, we have determined that the characteristics of the Kyrgyz pastoralists' milk processing systems can be summarized as follows: 1) development of milk processing techniques suited for the cold ecology of the northern Eurasia, such as the cream separation processes and the production of kumis, and 2) lack of development in the use of coagulants to make cheese in their milk processing technique.

Historical Development of the Milk Processing System in Kyrgyz

According to testimonies from households 4, 9, 12, and 13, until the 1970's, the Kyrgyz pastoralists made naturally fermented milk called *ij'rij'gen süit* by letting milk stand, and then churn-

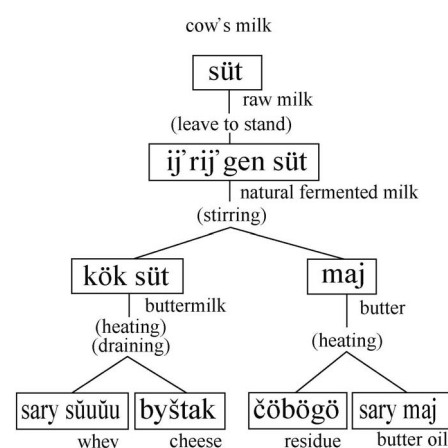


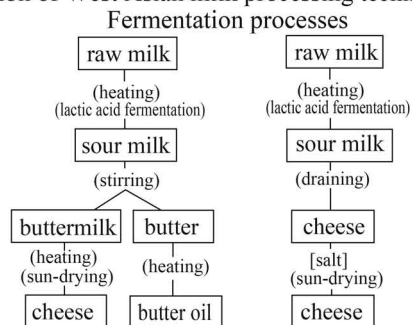
Fig. 6 Milk processing technique of the Kyrgyz pastoralists in Kyrgyz until the 1970's.

ing it to make butter or *maj* (Fig. 6). Household 13 used to churn milk to turn it directly into butter. *Maj* was heated to make butter oil or *sary maj*. Buttermilk or *kök süit* was heated and coagulated to make *byštak*. They said that it required quite a bit of labor to process sour milk into butter, because the churning took 2 to 3 h.

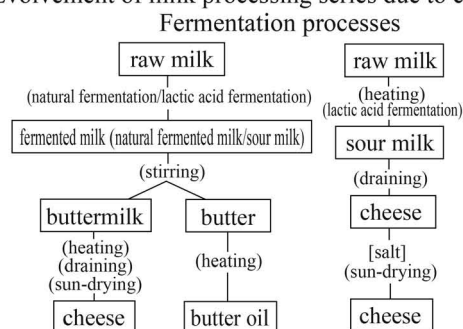
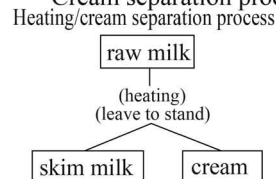
The milking and the milk processing technique, particularly the fermentation processes are thought to have originated from West Asia^{27,28)}, and diffused to rest of the Asian continent and then to Europe. The milk processing technique that Kyrgyz pastoralists used until the 1970's positively match the technique of the West Asia type fermentation processes (Fig. 5). In fact, it suggests that the West Asia type fermentation processes was also the milk processing technique transmitted diffused to and shared widely throughout Kyrgyz in Central Asia. Based on this assumption (Fig. 7-1), let us speculate on how it could have developed and changed into the current milk processing system in Kyrgyz.

The West Asia type fermentation processes allows the natural fermentation of milk to take place, because the cold ecology of Kyrgyz in northern Eurasia keeps the milk from spoiling when it is left out (Fig. 7-2). Like sour milk, the naturally fermented milk is churned into butter, and then heated to make butter oil. Buttermilk is heated, drained, and dried under the sunlight to make cheese. This process matches the milk processing technique that the Kyrgyz pastoralists used until

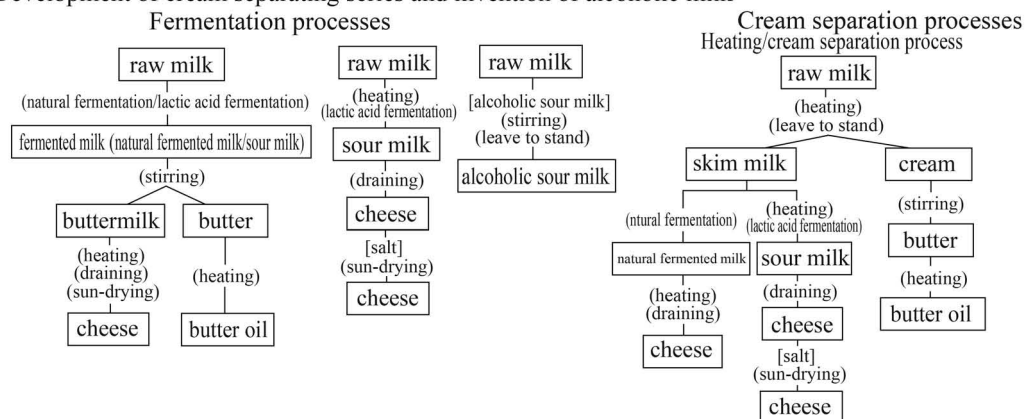
1) Diffusion of West Asian milk processing technique (fermentation processes) to the area of Kyrgyz Republic



2) Evolvment of milk processing series due to cool environment

**Cream separation processes**

3) Development of cream separating series and invention of alcoholic milk



4) Changes of milk processing technique caused by the adaptation of cream separator

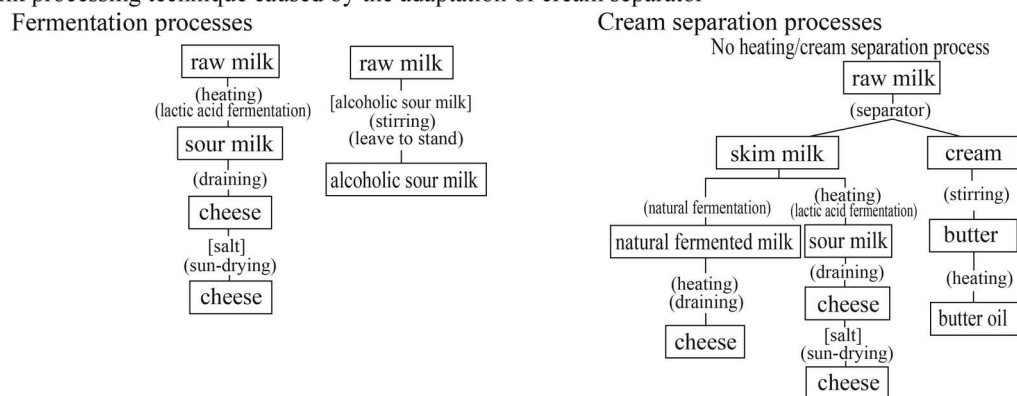


Fig. 7 Development of the milk processing system in Kyrgyz Republic, located on the northern region of the Eurasian Continent.

 Product
 [] Additive
 () Processing

around 1970 (Fig. 6). The West Asia type fermentation processes was diffused to Kyrgyz and because the cold climate kept the milk from spoiling even when it was left out, the technique of deliberately processing milk into sour milk changed to the technique of relying on natural fermentation. It is not hard to imagine that they also developed the technique of leaving the milk out to separate the cream when it floated to the surface (Fig. 7-2). The fact that Süzmö, with its relatively high water content, can be preserved for a long time reveals that Kyrgyz is located in a mountain region with a cold ecology.

Once the pastoralists began to separate cream from milk, they eventually started to churn cream to make butter, and then to heat butter to make butter oil (Fig. 7-3). Skim milk is made into cheese with sour milk or naturally fermented milk. This cream separation processes is a technique widely used by Kyrgyz pastoralists until the popularization of the cream separators (Fig. 3). In this cold climate, they also adapted the technique of making kumis from mare's milk (Fig. 7-3). This technique of turning milk into kumis has been succeeded from generations to generations of Kyrgyz pastoralists to the present day.

The cream separator finally became available to the Kyrgyz pastoralists in the Soviet Republic era, changing the technique of leaving the milk out to naturally separate cream from milk to one which artificially separates the cream from milk (Fig. 7-4). The separation of cream using a cream separator is the main technique of the cream separation processes used by most Kyrgyz pastoralists today (Fig. 3). Since the cream separation and the production of butter oil using a cream separator is much more efficient and requires less effort, butter oil is no longer processed with the fermentation processes. The reason why the pastoralists stopped using milk processing technique of the fermentation processes in the 1970's (Fig. 6) is due to the widespread use of the cream separators. The other techniques involving lactic acid fermentation of milk, draining, salting, and drying of sour milk for cheese production, and production of kumis continued, because they were important ingredients in the Kyrgyz diet. As such, we speculate that this is the milk processing system used by the Kyrgyz

pastoralists today.

We conclude that the West Asia type fermentation processes is the foundation for the milk processing system of the Kyrgyz pastoralists. We can also conclude that the cream separation processes and production of kumis developed as a result of the cold climate, and the pastoralists began relying on the cream separation processes by the recent use of the cream separators. The reason why Kyrgyz pastoralists did not adapt the additive coagulation processes remains an important future discussion topic.

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Notes

- a) 1 Kyrgyz COM was \$0.019 in July 2014. Kyrgyz bread called naan was about 20 Kyrgyz COM.
- b) The literal translation is 'yellow water'.
- c) The literal translation is 'processed raw milk by cream separator'.
- d) The literal translation is 'blue raw milk'.
- e) The literal translation is 'yellow oil'.
- f) The literal translation is 'heated *kaij'mak*'.
- g) The literal translation is 'Kyrgyz *kaij'mak*'.

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キルギス共和国の乳加工体系の特徴とその発達史

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本稿の目的は、1)中央アジアのキルギスにおける移牧民の乳加工体系を明らかにし、2)キルギス移牧民の乳加工体系の特徴を周辺地域と比較検討することにより分析し、更に、3)ユーフラテス大陸北方域に位置するキルギス移牧民の乳加工体系の発達史について推論することにある。現地調査は、キルギス移牧民13世帯を対象に、観察とインタビューを2000年11月、2014年8月におこなった。キルギス移牧民の乳加工体系は、発酵乳系列群とクリーム分離系列群の乳加工技術を採用していた。発酵乳系列群の乳加工技術では、酸乳、チーズ、乳酒を、クリーム分離系列群の乳加工技術では、クリーム、バター・バターオイル、酸乳、自然発酵乳、チーズを加工していた。周辺地域の乳加工技術と比較分析した結果、キルギス移牧民の乳加工体系の特徴として以下の2点を明らかにした。①クリーム分離系列群や乳酒の加工というユーラシア大陸北方域の冷涼な生態環境に適合した乳加工技術を発達させたこと、②凝固剤使用系列群の乳加工技術を採用せず、凝固剤を利用してまでチーズを加工するようには発達してこなかったことである。キルギス移牧民の乳加工体系の発達史は、西アジア型の発酵乳系列群の乳加工技術を土台とし、冷涼性ゆえにクリーム分離系列群と乳酒の乳加工技術が発達し、近年のクリームセパレーターの採用により乳脂肪分画はクリーム分離系列群に依存するように変遷していったと結論づけることができる。