

Traditional Dairy Products by Lactic Acid Bacteria in Mongolia

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몽골에 있어서의 전통적 유산균 발효유제품

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Abstract

The Mongolian milk processing technology has a specific characteristic as a result of the living habits of Central Asian nomads. There are many kinds of milk products in Mongolia due to their processing activity used milk from various dairy animal species. Mongolia has over 30 kinds of dairy products and fermented milk products which are occupied more than 36% of the Mongolian dairy products. Herdsmen who engaged extensive livestock production have specific methods to conserve and prepare the starter culture of fermented milk products in nomadic condition. Specifically, Mongolian lactic starter cultures were prepared from keeping milk products and specific wild plants. Nowadays, over 5 kinds of wild plants such as *Rheum undulatum* L, *Rheum ribes* L, *Rumex acetosa* L, *Artemisa sibirsenia* L, *Artemisa vulgare* are used for lactic starter preparing. Traditional processing methods of the Mongolian fermented milk products are based on the scientific basis and there are easy to learn and operate.

Key words: Mongolia, lactic acid bacteria, nomads, wild plants.

INTRODUCTION

Historically, Mongolian had the greatest respect for the importance of milk because the raw milk was the only Mongolian food resource in nomadic agricultural conditions. The traditional processing methods for milk and milk products have own its peculiarity which deeply related to consumption habits, geographical location, ecological conditions, climate, and rearing methods of livestock. The utilization technique of dairy products has been continuously improved from generation to generation (Ministry of Agriculture of Mongolia,

2000). Many Mongolian scientists have studied the physical and chemical characteristics of milk and milk composition of Mongolian livestock species. They studied on the traditional techniques for Mongolian milk products. They also reported the microbiological quality of milk and milk processing technique (Baldorji and Namsrai, 1980; Baldorji, 1988; Batsukh, 1995; Gombo, 1992; Indra, et al., 1988; Indra, 2000; Indra, et al. 1976; Nyamaa, 1980; Nansalma and Damdinsuren, 1998; Tsevel, 1936; Tsendsuren, 1989, 1998). Japanese scientist has studied on the chemical and biological properties of milk and milk products from different Mongolian dairy animals (Nakae, 1987, 1988). Through history, Mongolian have consumed milk and milk products from five kinds of livestock: cow, mare, camel, ewe and goat. Generally, Mongolian livestock are mostly native breeds and their productivity is relatively low compared with exotic breeds.

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But milk from native breeds has a high content of fat, protein and lactose. They have also more variability in their uses to make dairy products. For example, ewe milk is suitable for making cheese, skim milk (*urum*), dried curd (*aaruul*) and yoghurt. Camel milk has a high content of protein and lactose, so it is mostly used for fermented milk products and drinks (*undaa*). Mare milk has an abundant amount of lactose, but it is low in protein and fat content, it is used as a raw material for making koumiss, and while yak milk is rich in fat, it is suitable for making skim milk (*urum*), ghee and butter (Lhagbajav, 1998).

The aim of this research is to determine the Mongolian traditional technology for processing of dairy products in their natural conditions and the effects of external environmental factors on the basis scientific results.

TECHNOLOGICAL FEATURES OF MONGOLIAN DAIRY PRODUCTS

There are several specific characteristics in Mongolia dairy products.

In Mongolia, the utilization technology of milk is based on the cautiousness recycling of the raw milk and dairy products that doesn't have any possible economic value. The utilization techniques of milk were focused on the all of milk components were completely utilized through various steps of recycling process and there were no any other wastes (Nansalma and Damdinsuren, 1998). For example, skim milk (*urum*) that is final product from boiled fresh milk. It is a way of separating fat from milk (Fig. 1). Fermentation of remaining milk for making yoghurt, *clabber* (fermented camel and cow milk) and koumiss (fermented mare milk) causes



Fig. 1. Folding the *Urums* membrane.

conversion of lactose into lactic acid and alcohol. Final product of lactose utilization becomes an alcoholic drink (milk vodka). The boiled curd residues are filtrated and what is produced is "*aarz*" or dried curd "*aaruul*" (Nyamaa, 1980; "Milk" Joint Stock Company, 2000).

A vast territory of the Mongolia derived that various ecological regions, for example; the western and southern parts of the country, there are dry and warm climate and it is desert zone (Gobi). The northern and central part, there are humidity, fresh and moderate climate and it is forest region (Hangai). There are the eastern parts are dry and hot that is relatively low compared to other region and steppe region (Tal-heer).

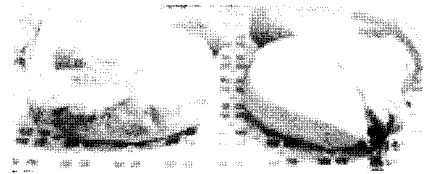
Every region has the own specifications to process their dairy products (Ongoodoi, 1991). For example, making yoghurt and *urum* there are difficult in "Gobi" desert zone and western regions of the country due to the climatic features happened and instead of that the "milk vodka" is made from *clabber* after separate of its fat. That is very popular in this region, for the steppe region and some provinces of western part of the country can not produce vodka from milk. Instead of such products, they preferred to make and consume wet or dried curds from their milk. The forest region, there is more suitable for making all dairy products using by their milk. Utilization of milk from some livestock is also different depending on specificity of livestock species and rearing methods. In some provinces of the northern parts have a few numbers of camel. Therefore, there is no milking camels and their milk is not used for making dairy products. Also, mares are not used for milking in the steppe region and the ewe is not used for dairy food consumption in some provinces of the northern region but in some provinces of the region are used ewe for milking. For the seasonal influence, lactation period and management system are varied on the Mongolia milk processing after calving. During the early spring, the colostrums from seasonal calving animal are used for making the various dairy products. So, the colostrum contains high contents of protein and minerals, it would be used for making white butter, cottage cheese and yoghurt. In the end of lactation period, the milk from various breeds become more concentrated and those are very suitable for making ghee, *urum*, dried curds and cheese. Lactation period of the native dairy breeds is very short because they need a long time of rearing period for they raise their offsprings on the pastoral

system.

Various kinds of curds, fresh cheeses are good protein sources for the dry climatic condition of Central Asia including Mongolia. Because these products are capable to being stored for long period, those are said as the specific food resources that well suited in the nomadic life style.

Mongolian dairy product processing techniques are originated and developed from the condition of nomadic husbandry. So, Mongolian herdsmen do not use the large scale of milk processing equipments. The simple equipments such as Mongolian style cauldrons, scoops and other tools are used for milk processing. These cauldrons are very important in their nomadic life. Mongolia herdsmen are used them not only to boil tea, preparing the daily meal but also processing their dairy products. Mongolian used also cauldrons for the processing of surplus milk during summer as well as store it to use during the winter and spring.

The Mongolian traditional technologies of producing dairy products are very simple and easy to learn. But the technology for processing the milk products, especially fermented milk products are based on the physical, chemical and biological phenomena. For processing the most of traditional dairy products of Mongolia, it is required to use the lactic starter in the first step of the processing procedure. The next steps of processing is unnecessary to use lactic acid bacteria



A. Butter products with paunch of animal



B. Butter with large intestine

Fig. 3. Appearance of traditional Mongolian butter like milk products.

because there are no need microbiological processes continuously. Because followed products processing is used high temperature that is kill all lactic acid bacteria (Damdinsuren, 1978). So, the Mongolian cheese, cheese like products (*aarz*, *eezgii*, *aaruul*, *byaslag* etc. Fig. 2) and other products (milk vodka) are not contained lactic acid bacteria.

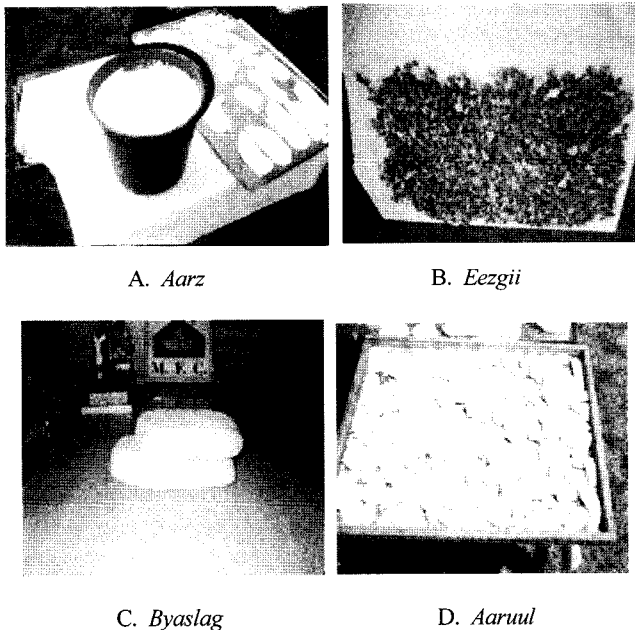
In Mongolia, the manufacture of dairy products have traditional technology of storage for a long time some their dairy products, such as butter, *urum* and cheese like products in the paunch and large intestine of animal (Fig. 3).

CHARACTERISTICS OF MONGOLIAN TRADITIONAL FERMENTED MILK PRODUCTS

Mongolian Traditional Fermented Milk Products

The fermented milk products take a major position among the Mongolian dairy products. Generally, in fermented products include such as a yoghurt (from cow's, yak's, ewe's and goat's milk), koumiss (fermented mare's milk), *clabber* from camel and cow milk cheese, and cow milk drink etc. (Gombodash, 1996). Souring milk makes those of all and these products are daily food for herdsmen also; serve as a intermediate raw materials and ingredients for processing of several other food products (Ministry of Agriculture of Mongolia, 1995 to 1999).

The majorities of the fermented milk products are widely used on diets of Mongolian consumers because they have therapeutic and nutritional effects on digestive organ and their functional enhancement. From the immemorial era, Mongolian



A. *Aarz*

B. *Eezgii*

C. *Byaslag*

D. *Aaruul*

Fig. 2. Appearance of traditional Mongolian cheese-like milk products.

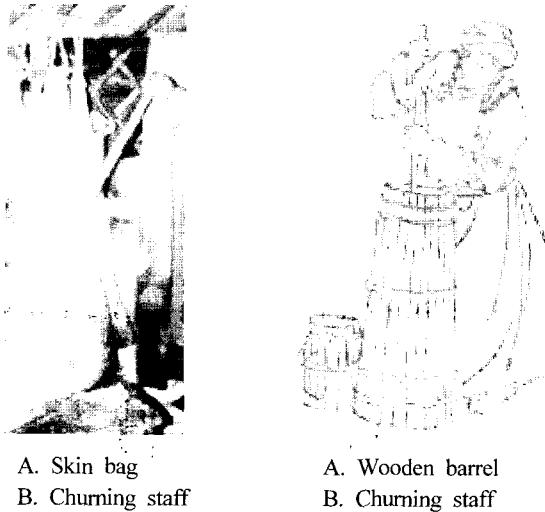


Fig. 4. Specific instruments of Mongolian style for making the fermented milk products.

have been consuming fermented food products and had obtained from some sources of starter. Central Asian nomadic inhabitants domesticated some wild animals and also they could "domesticate" some microorganisms from plants, grass and fruits that are caused the milk fermentation (Ministry of Agriculture of Mongolia, 1999). The herdsmen of rural area make various kinds of fermented milk products by themselves using the milk from various dairy breeds. They used several specific instruments of Mongolian style for making fermented milk products. For example, skin bag, different size of wooden barrel, churning staff, cauldrons, scoops and other tools (Fig. 4).

Mongolian Yoghurt

One of the most distributed and consumable traditional dairy products for Mongolian households is yoghurt. Yoghurt is made by milk from native cow, yak, sheep and goat. Mostly, boiled milk is used to make yoghurt. Tsoodol and

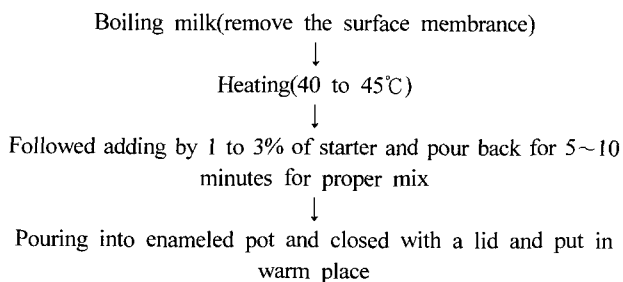


Fig. 5. The technique of manufacturing of traditional Mongolian yoghurt.

Munkhtuya (1974) determined the composition and properties of microorganisms of Mongolian yoghurt. They found those thermophile lactic acid bacilli of Bulgarian bacilli type and local strains of thermophile lactic streptococci in the yoghurt. Those bacteria had been played major role in the starter system and isolated from the local strains. During the last several years, researchers were informed the evidences that the lactobacilli are included in the composition of micro flora of Mongolian yoghurt, especially, local strains which produce antibiotics against causative agents of dysentery, salmonellosis, colibacteriosis, and putrefactive bacteria were not few (Tsoodol and Munkhtuya, 1974). Fig. 5 shows the traditional technology of Mongolian yoghurt making procedures in farmstead condition.

Koumiss

The traditional method of koumiss from mare's milk was inherited from antiquity to modern generation of Mongolian. The koumiss is an important product used for daily consumption during the summer, at the same time mares milk is broadly employed for therapeutic and dietetic purposes in Mongolia. Fermented mare's milk is a product of combined fermentation by lactic acid, alcohol and CO₂.

The chemical composition of Mongolian koumiss is presented in the Table 1.

Fig. 6 shows the procedure to make the traditional Mongolian koumiss.

If it affected by thermal treatment there is no possibility to finish the koumiss. The natural characteristics of mare milk are remained in untouched area. It is abundant in free amino acids, high concentration of lactic acids, ethanol and CO₂. Due to the above characterizations, the koumiss which are produced during fermentation will be changed to more digestible, higher nutrient quality and taste compared with other fermented dairy products in Mongolia.

Contents of essential amino acids of mare milk protein are almost equal to amino acids from meat. The lysine content of

Table 1. Chemical composition of mongolian koumiss

Classification of koumiss	Titratable acidity(%)	Chemical substance(%)		
		Proein	Fat	Alcohol
Underdone ferment	0.70~0.80	2.0~1.8	2.2~2.0	0.8~1.2
Fermented	0.90~1.0	1.8~1.7	2.0~1.8	1.2~1.8
Stiffed	1.1 ~1.2	1.7~1.2	1.3~1.4	1.8~2.0

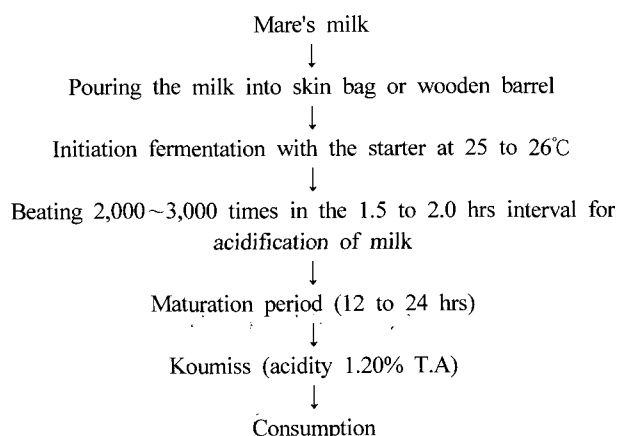


Fig. 6. Processing procedure of Mongolian koumiss.

mare milk is higher than that of cow and ewe milk and human milk. Lactobacilli, lactococci and yeast are added to the koumiss fermentation process. The streptococci have a lower resistance to extreme amount of acidity therefore, the number of streptococci could be increased in initial stages of fermentation, and their number could be reduced in middle and final stage. However, yeast grows well in acidic environment and produce the biological substances that have positive effect on the bacterial growth. The bacterium and the yeast are mutually symbiosis organisms capable of growing in beneficial combination. During the koumiss making, the beating treatment by wooden stick provides air supply into the mass and activates the alcoholic fermentation.

Cows Milk Drink (*undaa*)

The milk drink (*undaa*) is one of the common beverages for peoples who live in southern Mongolia (Gobi region). The *undaa* is produced by following procedures; in the first step, boiled milk cooling to 30~35°C or fresh whole milk is poured into skin bag and second step, as a starter the matured *undaa* is added into the skin bag and finally the skin bag is beaten for further processing. The agent is used for initial fermentation, but after maturing some part is remained and the other fresh milk added in the skin bag to adjust fermentation level. Fully matured *undaa* has gross granules of protein, 2.0% to 2.4% titratable acidity, below 2.5% of alcoholic content and produces a little amount of CO₂. Before the drinking, it has to diluted with milk or can be boiled to make mild the strong acidity. During fermentation of *undaa*, the beating activity may separates the milk fat. Then the separated remain liquid is utilized for distillation of vodka and the other part, the curd

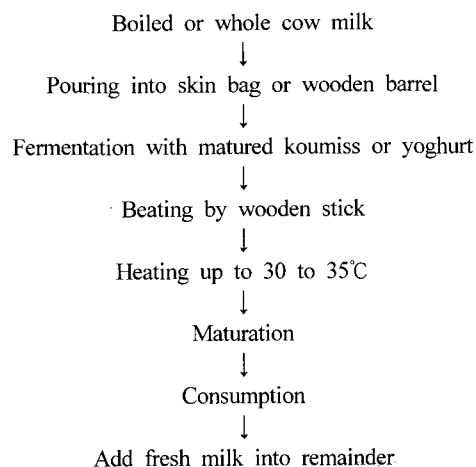


Fig. 7. Processing procedure of cow milk drink(*undaa*).

is filtrated for making "*aaruul*" (dried curd).

Fig. 7 shows the processing procedure of cow milk drink.

Camel Clabber (*Hoormog*)

Indra et al. (1976) studied composition of camel milk and observed some differences between total solids, lactose and fat contents in camel milk. The microbial agent that granulated and ungranulated lactobacilli, lactococci and yeast were studied in the related with fermentation process as a result of camel clabber. The processing procedure of Mongolian camel clabber is presented in Fig. 8.

Camel milk is soured by lactic acid bacteria and yeasts. The fermentation procedure of camel clabber making is principally similar with mare's koumiss and cow milk drink.

Butter and Sheep's Butter from Clabber

Butter and sheep's butter from *clabber* are the traditional Mongolia fermented dairy products, very delicious and everyone takes pleasure in eating them.

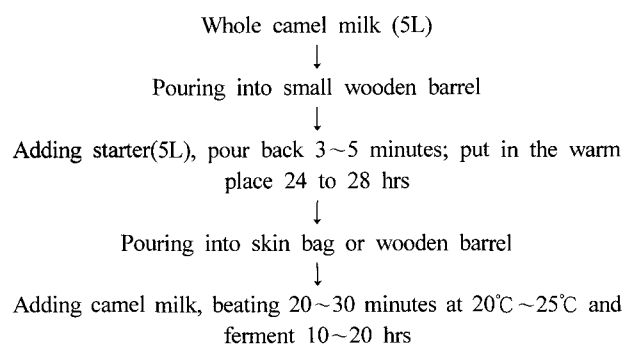


Fig. 8. Processing procedure of Mongolian Camel clabber.

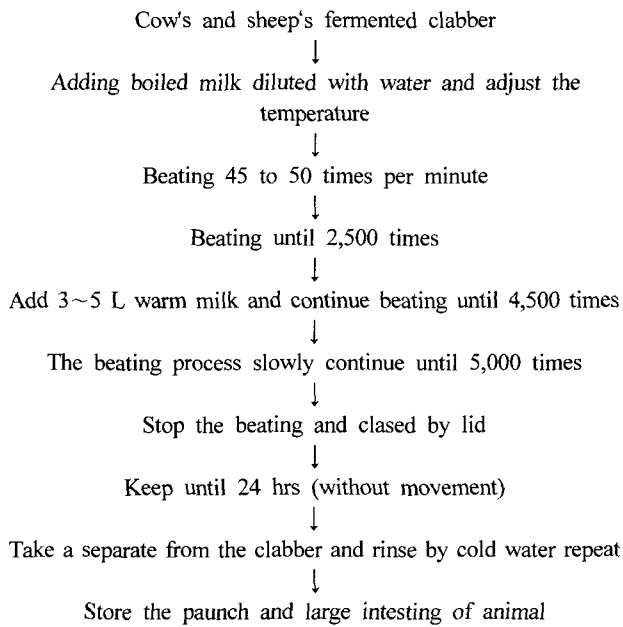


Fig. 9. Processing procedure of butter of cow and sheep's clabber.

They also have a high content of nutrients and suitable for preservation for a long time. Butter of clabber is produced from cow and sheep fermented milk by beating work (Lhagbajav, 1998). During the fermentation, a little amount of "hiram" (mixture of boiled milk and water) is added. The ratio of hiram and fermented clabber is 0.5 : 10.0 for sheep and 1.0 : 10.0 for cow milk. Also, the beating temperature is different for both products (Fig. 9).

Mongolian Traditional Lactic Starter Preparing Systems

Starter of Mongolian yoghurt, koumiss and clabber were found many centuries ago and kept them pure state from generation to generation (Burenjargal, 2001). That was not easy to keep pure state in conditions of nomadic life style. But Central Asian nomads resolved the problem of starter rationally for their dairy products, because lactococci, lactobacilli



A. *Rheum undulatum* L.



B. *Rheum ribes* L.



C. *Rumex acetosa*



D. *Artemisa vulgare* L.



E. *Artemisa sibirsenae*

Fig. 10. Specific wild plants for Mongolian lactic starter culture.

and yeast as starter are able to grow well together and the desired products are made by activating each other and some microorganisms. While some other microorganisms are inactivated in compliance with certain technological regimen from the processing of fermented dairy products. For example, to activate lactic acid bacteria for making yoghurt, the milk is warmed at 45°C and put in anaerobic condition. When temperature reaches 30°C after gradual reduction below 40°C, lactococci is grow and aromatic substances are produced. It is not suitable to use yeast in yoghurt as a starter culture, because yeast is not capable of growing at high temperature and anaerobic condition, they can be inactivated during yoghurt fermentation. The yeast for koumiss starter is activated from 20°C to 25°C in aerobic condition. It is peculiar that although a lot of fermented milk products such as mares milk, *clabber* from camel's milk and yoghurt of cow's, ewe's, goat's, cow's and yak's milk and the cheeses, and butter have different tastes each other but they are fermented by the same starter. There are many kinds of lactic acid bacteria and yeasts on the surface of specific wild plants of Mongolia (Biliner, 1974). Nowadays there are still custom of using some plants (Ligaa, 1987), such as *Rheum undulatum* L. (rhubard, geshuune), *Rheum ribes* L. (rhubarb, gishuune), *Rumex acetosa* L. (rumex acetosa, isgelen hurgan chih), *Artemisa sibirsenana* (wormwood, sharilj) and *Artemisa vulgare* (mug

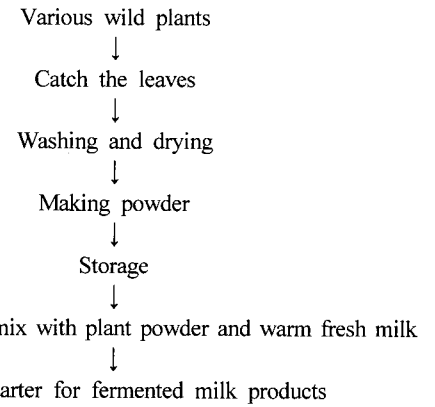


Fig. 12. Lactic starter preparing procedure from specific wild plants.

wort, agi) shown in Fig. 10. Those wild plants were used to make some dairy products, but nowadays, such products are disappeared gradually.

So, in Mongolia, there are two systems for starter preparing. The first preparing system is keeping from fermented milk products, shown as Fig. 11, and the second preparing system is obtained from the specific wild plants, shown as Fig. 12.

By the first preparing system, the starters are obtained from yoghurt aged for 1 to 2 days after or yoghurt filtrated and dried. The yoghurt starter which obtained by filtrated through clean white cotton cloth and that is capable to be stored for 6 to 10 months without loss of their activity. Before using as starter, the filtrate and dried yoghurt have to scale up the activity in warm milk by mixed with thoroughly. Also during the making fermented dairy products, Mongolian used extract from prepared starter powder of dried curds specially, and the remainder of clabber and koumiss is put in the skin bag for the next product's starter. In condition of nomadic livestock husbandry, various starters are not easy to be preserved in pure state. In the case of starter activation from filtered or dried yoghurt residue can be used for further fermentation of the same product. For the normal fermentation of the koumiss, it is added only fresh mare milk in the skin bag and stirred or beat by wooden stick for aeration. By the another preparing system, the starter is obtained from the various wild plants. The specific plants leaves are caught and cleaned by wash in fresh water and dried for several days. The fermented milk product starter is obtained by making powder and mix with fresh milk through to be stored 1 or 2 days.

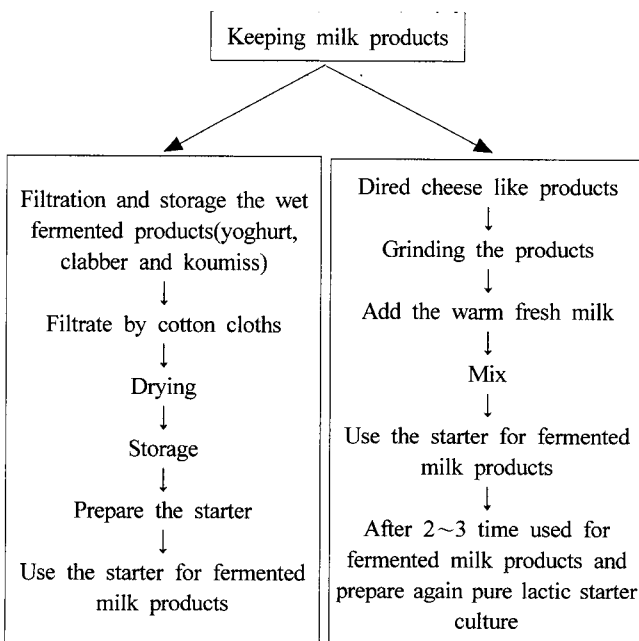


Fig. 11. Preparing system of starter culture for Mongolian fermented milk from other milk products.

CONCLUSIONS

Mongolian dairy products could provide the complete nutritional needs for the Mongolian. Traditional dairy products are concurred in condition of nomadic animal husbandry and instruments and technology for processing such are produced regularly. Processing ways of Mongolian dairy products are based on the wasteless technology.

It is well adapted technique in Central Asian nomadic environment and climate condition. Mongolia has over 30 kinds of dairy products; yoghurt, *urum*, *ghee*, *aaraul*, *eezgii*, cream, cheese, wet curd, dried curd, butter, ice cream made by various kind of animal's milk. Mongolian major unfermented milk products are *clabber* from cow and sheep milk, *huruuds* of cow and camel milk, milk drinks from cow and sheep milk, vodka from koumiss and *clabber*, cow and sheep milk butter from each *clabber*.

The fermented milk products occupied more than 36% of dairy products such as: yoghurt of cow's, yak's, sheep's, and goat's milk, koumiss of mare's milk, *clabber* of cow's milk and drink from *clabber* etc. It is specific characteristics that the Mongolian starter is composed of three microorganisms (lactobacilli, lactococci, and yeast) all together in the living state. Mongolia has a traditional specific method to obtain the starter from the specific wild plants and storage the starter using by cotton filtrate drying in the nomadic condition. Most of Mongolia dairy products can be used as final products and also, there is suitable use like raw materials for making another dairy products.

Traditional Mongolian milk processing scale is not large. The simple equipments that are used Mongolian style cauldrons, scoops and other tools for their nomadic life.

The Mongolian traditional technologies of dairy products processing are very simple and easy to learn but all those are based on the physical, chemical and biological phenomena.

요 약

몽골의 유가공 기술은 중앙아시아 지역의 유목민 생활방식의 독특한 전통에서 온 것으로 고유의 특성을 갖고 있다. 몽골의 전통적인 유가공 방식은 몽골의 토착종인 몽골우의 원유의 품질과 각 유성분 (단백질, 지방, 그리고 유당)의 허실 없는 완전이용 개념에 바탕을 두고 있다. 몽골에서는 다양한 종류의 유제품 생산 동물로부터 젖을 취하여 가공하는 것

이 발달했으므로 많은 종류의 유제품이 제조되고 있다.

몽골에서는 30종 이상의 유제품이 제조되고 있는데 그 중 36%는 발효유제품이 차지한다. 몽골의 전통적 발효유제품은 그 자체가 매우 특색이 있다. 왜냐하면 유산균, 유산간균 그리고 효모가 함께 발효 유제품의 스타터로 사용되고 또한 함께 생육하고 있기 때문이다. 몽골에서는 유목민 생활의 여건 하에서 발효유제품에 쓰이는 유산균 스타터의 제조와 보관 방법이 매우 독특하게 전해져 오고 있다. 기존의 발효유제품을 처리하여 스타터로 준비하거나 몇몇 특별한 야생식물로부터 유산균을 얻는 방식이 독특하다. 지금은 *Rheum undulatum* L., *Rheum ribes* L., *Rumex acetosa* L., *Artemisa sibirsenia* L., *Artemisa vulgare*와 같은 다섯 종류 이상의 야생식물이 유산균 스타터의 균원으로 사용되고 있다. 몽골에서는 젖을 가공할 때 소규모로서 매우 간단한 도구를 사용하는데 특히 발효유제품 가공기술은 배우기가 쉽고 나름대로의 과학적인 현상에 그 바탕을 두고 있다.

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