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Production and properties of mongolian kumiss

This article presents data of kumys study in the Mongolian People's Republic, where this milk product is a traditional national drink. It describes the various options of kumys manufacturing technology, provides data on the chemical composition of kumys and source of mare's milk, view of sour milk microflora and subtleties in manufacture and storage of sourdough of kumys. Considered separately norms of kumys for the use depending on the age of people etc. and impact of kumys to human health.
Key words: mare's milk, kumys, proteins and lipids of kumys, biological and therapeutic properties of kumys, kumys manufacturing technology, sourdough of kumys, Mongolia.

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Моңғол қымызын алу тәсілдері және оның қасиеттері

Бұл мақалада Моңғол Халық Республикасының ұлттық дәсүрлі шырын болып саналынатын сусын – қымыз туралы мәліметтер келтірілген. Қымызды дайындау әр түрлі технологиясы сипатталына отырып, қымыздың және жылқы сүтінің химиялық құрамы және микрофлорасы, сонымен қатар қымызды қолдану және оның ұйытқысын сақтау тәсілдері сипатталынған. Қымыз сусынын жасқа орай пайдалану және денсаулыққа әсері бөліп карастырылған.
Түйін сөздер: жылқы сүті, қымыз, қымыз ақуызы және майлар, қымыздың биологиялық және шипалы қасиеті, қымызды дайындау технологиясы, қымыз ұйытқысы, Монғолия.

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Получение и свойства монгольского кумыса

Приводятся данные изучения кумыса в Монгольской народной республике, где этот кисломолочный продукт является традиционным национальным напитком. Описываются различные варианты технологии изготовления кумыса, приводятся данные по химическому составу кумыса и исходного кобыльего молока, пейзаж кисломолочной микрофлоры и тонкости в изготовлении, использовании и хранении кумысной закваски. Отдельно рассматриваются нормы использования кумыса монголами в зависимости от возраста и т.д. и влияния кумыса на здоровье.
Ключевые слова: кобылье молоко, кумыс, белки и липиды кумыса, биологические и лечебные свойства кумыса, технология изготовления кумыса, кумысная закваска, Монголия.

Lactic acid bacteria and yeast are used to produce various type of fermented dairy products such as kefir, Kumiss. Nomads in Eurasia area use bacteria to ferment nonpreservable milk from livestock. Mare's milk, which cannot be used for making products such as cheese, is raw horse milkused to make a liquor drink called "kumiss", "kumys" in Russia, Kazakhstan, Kirghiz and Sakha, "airag" in Mongolia, and "chegee" or "chigo" in Inner Mongolia China.

The oldest record of the kumiss was written down as drink of the nomads in the "History" of Herodotus. The kumiss was drink of only of Eurasia area for a long time.

Russian doctor announced kumiss 18 in the end of the century that it was drinking sake of the kumiss that "Kirghiz, the soldier of the Cossack had little tuberculosis", and it attracted attention of the Europe society that there was an effect of the medicine to kumiss. A wide variety of symbiotic

relationships are considered to exist among these microorganisms in kumiss. It has been reported that is consumed in large quantities in Mongolia. Consumption of kumiss by nomads in Mongolia is thought to contribute greatly to their health. And, There is a custom the Mongolia nomad keeps the last kumiss, and to drink in the lunar New Year. This paper introduce Mongolian nomads kumiss.

Kumiss experimental methods in Mongolia

Interviews were carried out at 49 homes of Mongolian nomads who produced kumiss. Milking was carried out for three months from June. The number of foals per household ranged from 6 to 10 per year. The foals in the herd were tied up each morning and left tied up until evening. The mares stayed near their foals, make milking easy. Each mare was milked 8 or 9 times a day, and about 2 liters of milk was obtained from each mare in one day. For making kumiss, the milk is cooled and then poured into a container for fermentation and stirred about 3,000 times with a special stick, though about 60 liters of milk is poured into a container at night and stirred about 10,000 times.

Composition of kumiss

In the Mongolian nomads made kumiss samples (Uburhangai, Arhangai, and Bulgan provinces in Summer of 2012) used in experiments, total numbers of lactic acid bacteria and yeast cells were 10^7/ml- 10^8/ml and 10^6/ml, respectively, pH was 3.7-4.0, acidity was 1.0 -1.5 % and amount of alcohol was 1.5 - 2.5 %. By the carbon dioxide which yeast participating in fermentation of the kumiss forms. Analyses of major and minor components of kumiss samples collected at each site are shown in (tables 1 and 2), respectively.

The amounts of fatty acids in mare's milk are smaller than those in cow's milk. Major and minor components of kumiss samples collected in February (Mongolian nomad called lunar New Year) were also analyzed for the first time, and it was found that the composition of kumiss that had been stored over winter until February (lunar New Year) was not greatly different from that previously reported by the author for kumiss samples collected in summer. The amounts of minerals in the kumiss samples were small. However, large amounts of minerals would be ingested by drinking kumiss because kumiss is drunk by nomads in large quantities. And amino acid analysis were shown in (table 3). The amounts of other amino acids in the samples varied, probably due to bacterial metabolism.

Isolation of microbial flora

As for the report of the separation of bacteria from conventional kumiss, a report of Rubinnsky B of 1910 is the oldest. In late years change is big, and the classification of the yeast advances, and genus *Saccharomyces* becomes genus *Kluyveromyces*. Considering the possibility of the existence of a commensal relationship between lactic acid bacteria and yeast which are involved in the fermentation of kumiss, Isolated and identified strains of bacteria and yeasts from kumiss. I isolated of many Mongolian nomads homemade kumiss samples (Tvo, Aehangai, Bulgan, Uburhangai, and Dontgobi provinces) microbial flora are shown in (table 4). Several species of lactic acid bacteria belonging to the genera *Lactobacillus* and *Lactococcus* and many yeast species belonging to the genus *Kluyveromyces* were isolated from the Mongolian kumiss samples. The flavor of kumiss is thought to be affected by the amounts of amino acids produced, which depend on the type and amount of bacteria.

Bacteria growth and starters

The isolated some bacteria were inoculated into 10% reconstituted skim milk medium and cultured for 5 days at 32℃,28℃ and 25℃. In most cases, proliferation rate in the first 2 days was lower for bacteria cultured at 25℃ than for bacteria cultured at 32℃, but the bacterial count in the 25℃ culture medium had increased to the same level as that in the 32℃ culture medium on the fifth day. There was no difference between numbers of yeast cells in the 25℃ culture medium and 32℃ culture medium. These results indicate that there are large ranges of growth temperatures for lactic acid bacteria and yeast species involved in fermentation of kumiss and that the bacteria and yeast can grow at temperatures lower than those usually used for fermentation. This is probably due to adaptation to the cool climate in Mongolia. The temperatures in fermentation containers used in Mongolia were in the range of 23 to 27℃, and it is expected that various interactions occur between the bacteria involved in fermentation. Surveys on starters used by Mongolian nomads in the fermentation were carried out. A survey carried out in the 90s revealed that homemade starters were mainly used. A survey conducted in the summer of 2008, however, revealed that 29 of 30 households surveyed used 5-10 liters of kumiss obtained from other households to start the fermentation process. Fermentation would be successful in most cases if such a large quantity of the starter is used. A

homemade starter, made by fermenting goat's milk, was used by only one household.

Fermentation containers

The traditional fermentation vessel in Mongolia is a vessel called fuful that is made from cow hide with a capacity of 70-100 liters. Of 49 households surveyed, 39 households were using polystyrene containers, 8 households were using fufuls and 2 households were using tin containers. Use of polystyrene containers has increased because making a fuful is a time-consuming task and because polystyrene containers have become readily available. When asked whether the type of fermentation container has an effect on the taste of kumiss, the nomads who were interviewed replied that kumiss made in a fuful is tastier and cooler. An unglazed earthenware vessel is used in India for making fermented milk called dahi. It has been reported that the surface of the earthenware vessel induces vaporization of the water in milk, and the product obtained is enriched and cool. Another advantage of an unglazed earthenware vessel is that the vessel contains bacteria involved in fermentation and fermentation can be started by simply adding milk to the vessel. The same is probably the case for the cow hide vessel used to make kumiss. According to the nomads in Mongolia, kumiss can be made by simply adding mare's milk to the fuful and stirring. It is therefore likely that bacteria involved in fermentation also reside in the hide used for making fuful. However, this is not the case for polystyrene or tin containers and the absence of bacteria in these containers probably has an effect on the properties of kumiss.

Amounts of kumiss consumed

Written it with surprise about the Mongolia nomad whom Ruburck W took a trip to Mongolia in the thirteenth century swallowed up only the kumiss, and did not take the meal. In a survey conducted in the summer of 2008, 35 of the 40 men interviewed and 36 of the 42 women interviewed said that they drank kumiss every day. The mean amounts of kumiss consumed per day by men and women living in Arhangai province were 4 liters and 2 liters, respectively. The mean amounts consumed per day by men and women living in Bulgan province were 9.7 liters and 3 liters, respectively. As shown in (table 5), some men in Bulgan province drank as much as 20 liters a day. Large quantities can be drunk because kumiss is a relatively low-calorie drink, with only about 400 Kcal in one liter. The amounts of fatty acids in mare's milk are smaller than those in cow's milk. Men who drink large quantities of kumiss say they don't need to take meals.

The last kumiss made in September before the snow starts to fall is left outside to freeze for use as a white food in festivities during the lunar New Year in Mongolia. For the New Year celebration, the kumiss is thawed and drunk by everyone in the household. All of the kumiss is drunk during the lunar New Year.

Effects of kumiss

Interviews regarding the effects of kumiss were also carried out. Replies regarding the beneficial effects of kumiss included "It's good for the body.", "It cleans the intestine.", "It cleanses the body.", "It eliminates bad things from the body.", "It makes the stomach work better.", "It improves liver function.", "It improves lung performance.", It prevents tuberculosis.", "It improves blood pressure.", "Its good for people with low blood pressure.", "It strengthens bones.", "It has many minerals."

And "It prevents colds in winter". Kumiss contains 8-9 mg of vitamin C per 100 ml and is an important source of vitamin C for nomads, who do not eat many fruits and vegetables. In the interviews, the reply to the question "What people should not drink kumiss ? " was people with a bone fracture, because kumiss can cause bone displacement. On the other hand, people with a compound fracture drink kumiss for bone displacement. Although it has been reported that kumiss is effective for reducing high blood pressure, it was also pointed out in the interviews that people with high blood pressure should not drink kumiss, and some people with high blood pressure said they had stopped drinking kumiss. Fermented milk has been shown to have a blood pressure-lowering effect, and it has been reported that ACE-inhibitory peptides produced in fermented milk are involved in this effect, and that lactic acid bacteria and yeast cells also play a role. However, the mechanism by which blood pressure is not increased and the mechanism by which high blood pressure is reduced are different. Causes of high blood pressure have still not been fully elucidated, and the effect of the alcohol content of kumiss (about 1.5-2.5 %) must also be taken into account when considering the effect of kumiss on blood pressure.

In the Physical Therapy Department of Ulaanbaatar National Hospital, relatively

Table 1 - Chemical composition analysis of Mongolian kumiss

Kumiss sample	Water	Solid	Protein	Fat	Ash	Insolubled nitrogen
	(%)	(%)	(%)	(%)	(%)	(%)
Uburhangai province 2012 NO1	95,0	5,0	2,0	1,6	0,3	1,1
Aruhangai province 2012 NO1	94,0	6,0	2,3	1,9	0,3	1,5
Aruhangai province 2012 NO2	95,2	4,8	2,0	1,9	0,3	0,6
Bulgan province 2012 NO1	94,9	5,1	2,1	2,1	0,3	0,6
Bulgan province 2012 NO2	94,8	5,2	2,3	1,7	0,3	0,9

Table 2 - Mineral composition of Mongolian kumiss

Kumiss sample	Na	Ca	P	Fe	K	Mg	Zn	Cu	Mn
	(mg/ 100g)	(mg/ 100g)	(mg/ 100g)	(mg/ 100g)	(mg/ 100g)	(mg/ 100g)	(μg/ 100g)	(μg/ 100g)	(μg/ 100g)
Uburhangai province 2012 NO1	12	60	43	0,1	47	6	200	0	0
Aruhangai province 2012 NO1	10	57	37	0,1	37	4	200	0	0
Aruhangai province 2012 NO2	11	66	54	0,1	59	5	200	0	0
Bulgan province 2012 NO1	13	59	39	0,1	42	6	200	0	0
Bulgan province 2012 NO2	13	58	49	0,1	64	7	300	0	0

Table 3 - Amino acid analysis of Mongolian kumiss

Kumiss sample	Asp	Thr	Ser	Glu	Gly	Ala	Cys	Val	Met
	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml
Uburhangai province 2012 NO1	2	2	12	18	5	16	0	3	1
Aruhangai province 2012 NO1	4	4	3	28	4	16	0	4	2
Aruhangai province 2012 NO2	1	1	2	5	3	9	0	2	1
Bulgan province 2012 NO1	2	1	2	13	2	7	0	2	2
Bulgan province 2012 NO2	4	4	6	16	4	15	0	5	2
Kumiss sample	Leu	Tyr	His	Phe	Lys	Trp	Arg	Pro	Ile
	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml	mg/ 100ml
Uburhangai province 2012 NO1	9	4	3	4	3	0	6	29	3
Aruhangai province 2012 NO1	11	0	0	5	3	0	0	10	0
Aruhangai province 2012 NO2	5	0	0	3	2	0	0	22	0
Bulgan province 2012 NO1	9	4	0	3	3	0	4	12	0
Bulgan province 2012 NO2	15	5	3	5	8	0	0	11	5

Table 4 - Isolated of microbial flora for Mongolian kumiss

Lactic acid bacteria		yeast	
Lactobacillus	*acidphilus*	*Kluyveromyces*	*marxianus var.marxianus*
Lactobacillus	*delbrueckii* subsp.*bulgaricus*	*Kluyveromyces*	*marxianus* var.*lactis*
Lactobacillus	*delbrueckii* subsp.*lactis*	*Kluyveromyces*	*mesenteroides*
Lactobacillus	*paracasei* subsp. *paracasei*	*Saccharomyces*	*cerevisiae*
Lactobacillus	*paracasei* subsp.*tolerans*	*Saccharomyces*	*florentinus*
Lactobacillus	*plantarum*	*Saccharomyces*	*fragilis*
Lactobacillus	*rhamnosus*	*Debaryomyces polymorphus*	
Lactobacillus	*lactis* subsp.*cremoris*	*Debaryomyces hansenii*	
Lactobacillus	*brevis*	*Candida kefyr*	
Lactobacillus	*helveticus*	*Candida tropicalis*	
Lactococcus	*lactis* subsp.*lactis*	*Torula delbrueckii*	
Streptococcus	*salivarius* subsp.*thermophilus*		
Pediococcus	*acidilactis*		
Leuconostoc	*oenos*		

Table 5 - Kumiss drink a day in Bulgan province

Man			Women		
NO	Age	Drink a day	NO	Age	Drink a day
1	58	10L/day	1	69	1L/day
2	56	5L/day	2	60	1L/day
3	55	10L/day	3	50	4 ~ 5L/day
4	54	5L/day	4	50	1 ~ 2L/day
5	53	10L/day	5	50	1 ~ 2L/day
6	51	10 ~ 12L/day	6	46	5L/day
7	51	10L/day	7	40	5L/day
8	51	5L/day	8	38	1 ~ 2L/day
9	47	10L/day	9	30	5 ~ 6L/day
10	42	20L/day	10	30	3L/day

unfermented kumiss has been used with good results in recent years for hot compress therapy for patients with severe shoulder stiffness and lumbar pain. Kumiss is able to penetrate through the skin, and there is a traditional custom in Mongolia of rubbing kumiss on children's skin to prevent them from catching a cold.

Large quantities of lactic acid bacteria and yeast pass through the intestinal tract when kumiss is consumed, but the bacteria and yeast are killed by gastric juice. It had been thought that dead bacteria have no useful role for the intestinal tract, but it has been reported that enterobacteria utilize intracellular and extracellular amino acids and dissolved peptidoglycan.

Moreover, the bacteria and yeast in kumiss contain undigestible polysaccharide. Kumiss may therefore be a source of dietary fiber for the nomads

in Mongolia, who do not eat large quantities of fruits and vegetables. It should also be noted that the alcohol in kumiss acts on blood vessels and has a relaxing effect on the body. Many factors are involved in the beneficial effects of kumiss on health. Studies are currently underway to determine the effects of the isolated strains of lactic acid bacteria on mouse lymphocytes and to identify substances that help to maintain health. The nomads in Mongolia have shown great wisdom in preserving the custom of drinking fermented milk containing substances that promote health.

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Reference

1 Berlin PJ (1962) Kumiss, Annual Bulletin, IDF: pp.3-6.

2 Herodotus (Carter H) (1962) Herodotus of halicamassus, pp.288-289.Oxford University Press. London : England.

3 Khirisanfoval.(1961) Antimicrobial properties of kumys from cow and mare milk, *Moloch.Prom*,30:16-19.

4 Koroleva NS(1975) Technology of kefir and kumys, Bulletin of IDF 227 : pp.96-100.

5 Lang ABS (1970.) A study koumiss manufacture as a potential new outlet for milk, *The milk industry.* 10: pp.22-24.

6 Lie J (1996) International academic conference on korea and Mongolia. The Korean association for Mongol Studies: pp.52-54.

7 Oberman H (1985) fermented milk, In:Microbiology of fermented food.vol.1. (Wood,B.J.B ed). Elsevier Applied Science Publishers. pp.167-196. New York :USA.

8 N Ishige (2008.) World fermentated milk, pp.79-83,pp. 224-240 ,harusyobou.Tokyo : Japan.

9 Rubinnsky B (1910) Studien uber den kumiss, *Zbt furbakt* :pp.161-177.

10 RuburckW(DawsonC)1251(1980).The MongolMisson, pp.224-258.Ams.Press:New York :USA

11 S Ishii, M Kikuchi and S Takao (1997)Isolation and Identification of Lactic acid bacteria and yeast from chigo in inner Mongolia China, *Anim Sci,J,*68 (3)pp.325-329.

12 S Ishii, M Kikuchi, K Muramatus and S Takao (1999) Identification of compounds causing symbiotic growth of *Lactobacillus paracasei* subsp. *tolerans* and *Kluyveromyces marxianus* var.*lactis* in chigo, Inner Mongolia,China, *Anim Sci,J,*70(2)pp.81-89.

13 S Ishii (2009) Microbiological examination and characteristic on the nomads traditional drink Airag, Past and Present of the Mongolic peoples. Research Institute for Languages and Cultures of Asia and Africa. pp.510-516. Tokyo : Japan.

14 S Ishii (2013) Properties of mare's milk liquor (Airag) in Mongolian Nomads,

16 The Nomadic Life of Mongolian Plateau Under the Global Climate Changes.

17 Diversification of the Mongolian World□, afro-eurasian inner dry land civilizations collection 7, Comparative Studies of Humanities and Social Sciences Graduate School of Letters, Nagoya University. pp45-57. Nagoya: Japan.

18 Zhilian M G and Trud C (1955) Antibiotic action of the microflora of koumiss on the tubercle .Int Abst.*Biol.Sci.*7:pp.112.