몽골의 전통식과 비만

Oyundari Nyamsuren

Mongolian University of Science and Technology

Mongolian Traditional Diet and Obesity

Oyundari Nyamsuren

Senior lecturer of Department of Nutrition Food and Biotechnology School
Mongolian University of Science and Technology Ulaanbaatar, MONGOLIA

Overview

Mongolia is located in the Central Asia and bordered on the north by Russia and on the east, south, and west by China. Total land area is 1,565,000 sq km (604.247 sq miles). Population of Mongolia is 2,533,100 (2004 population census). Economic activity in Mongolia has traditionally been based on agriculture and breeding of livestock. Mongolia also has extensive mineral deposits; copper, coal, molybdenum, tin, and gold accounting for a large part of industrial production. By the official estimates, per capita income is around $450 a year. Rural areas comprise half of Mongolia's population. Agriculture employs almost half of Mongolia's working force and accounts for 30(%) of GDP. The sector is dominated by herding, which, together with cropping play key role in the country's economic development. The size of the national livestock herd reached 28.027 million (excluding reindeers), for example, by the end of 2004 (The National Statistical Office). The Mongolians have bred five major groups of livestock including sheep, goats, horses, cattle and camels (Table 1). Yaks also have been raised in the mountains and reindeer herded in the high forests of the north by a different ethnic. Most herders own between 50 and 500 heads of livestock. In addition to food, their cows, horses, sheep, goats and camels provide transport, heat and clothing.

Nomadic Lifestyle and Traditional Food

Table 1. Modern proportions of livestock types in mongolia (thous. heads)

	Livestock	2002	2004
1	Camels	253	256
2	Horses	1988.9	2005.3
3	Cattles	1884.3	1841.6
4	Sheep	10636.6	11686.4
5	Goats	9134.8	12238
6	Reindeers	652	634
	Total	26551.6	30665.3

Mongolian herdsmen follow a nomadic way of life, moving three or more times a year and have high physical activities. Mongolian traditional nomadic herders have for centuries been dependent on mostly animal products for their dietary staples. Food is taken from their herds and stored to fit this wandering life style. There are three broad ecological zones in the country, namely forest steppe and high mountains in the north and northwest, grassland in the central and eastern region, the Great Govi desert in the south. The Mongolian diet varies with those ecological zones mentioned above. In the south, foods from camel, sheep and goat are the norm. However, in the Mountains and steppe, cattle, sheep, horse products are more common. Traditionally, Mongolian food is classified into 5 main groups recognized as white food (foods from milk), red food (foods from meat), yellow food (fatty foods), green food (foods from plant) and black food (alcohol/ natural water) (2).

There was obvious seasonal difference in the diet of nomads. The Mongolian climate necessitates a calorific intake that is higher in the winter months than in the summer. Dairy products were more popular in warmer weather when the livestock would foal and nurse, and meats (red food) more common in winter. Milk from cattle, goats or sheep is used for preparing many kinds of products and those are very popular in Mongolia. First of all, the milk is boiled and stirred many times, and after cooling, the "urum" (the cream that forms on the top of boiled milk) is taken off. Further, the boiled milk is fermented and used to make yogurt, aarts (sour cottage cheese), milk alcohol (shimiin arkhi) and aaruul (a dry curd) (Fig. 1). A small quantity of yogurt is poured into hot milk and fermented, and from this byaslag (cheese), eezgii (dry curds)

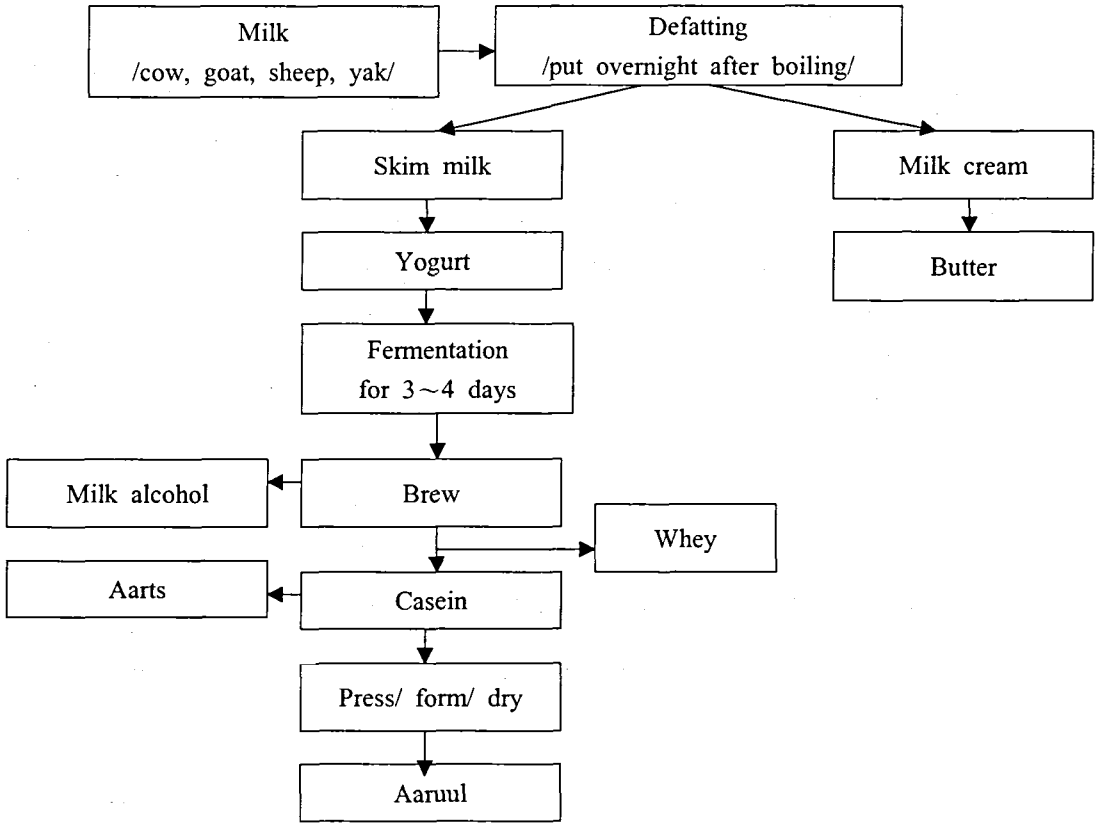

Fig. 1. Flow diagram for preparing butter and fermented milk products.

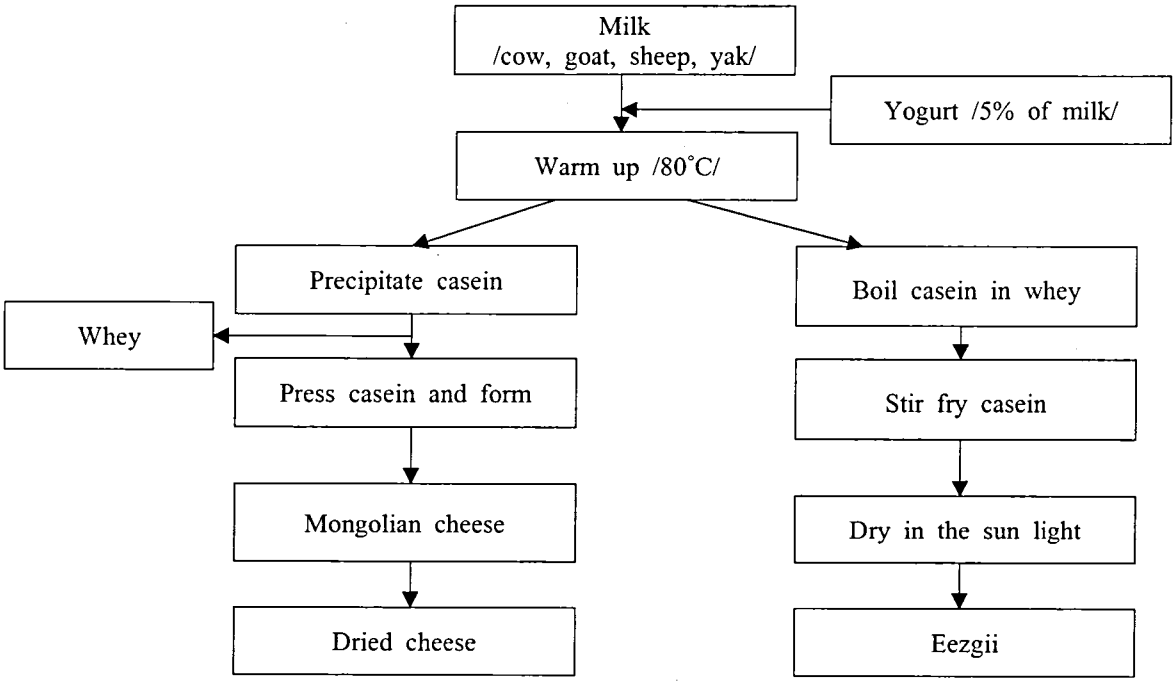

Fig. 2. Flow diagram for preparing Mongolian cheese and eezgii.

and eedem (similar to cheese) are made (Fig. 2). Milk from camel is also used for preparing various dairy products. These dairy products can be called "the white food". The white food along with wheat and dried meats (borts) provide their main source of food all year round. Tea with milk, drunk at breakfast, lunch and dinner, is an essential part of the daily diet.

Among traditional dairy products, mare's milk is very important to the Mongolian diet. Unlike other sources of milk, mare's milk is extremely low in fat and casein. Therefore mare's milk is not used to make butter, yogurt, cheese, dried curds or other above mentioned dairy products and only used to make traditional fermented mare's milk named "airag". Mongolians drink *airag* as a main food and drink sources, and at the same time horse milk has been used in the raw state for centuries as a traditional therapeutic diet. Because the people have few vegetables in their diet, *airag* is an important dietary staple. *Airag* is available for at least 6 months out of the year, starting in May when the foals are born. Both men and women milk the mares and it must be done about 5~6 times a day. The fermentation is done in large horse or cow's skin bags called "huhuur". Following quotes are from John of Plano Carpini, a Papal envoy to the Mongols in the mid 1240s. "The land of the Tatars [Mongols] has abundant water and grass and is suitable for sheep and horses. Their way of life is only a matter of drinking mare's milk to assuage hunger and thirst. As a rule, the milk of one mare is enough to satisfy three persons. When they are on campaigns or at home they drink only mare's milk." From this quote, we can get a perspective of how mare's milk was valuable for nomadic diet.

Traditionally, meat and fat consumption of nomadic people was quite low compared with the modern Mongolian diet in urban. Mongolians prefer beef and mutton, and horse meat is getting popular recently. During the last a few years, camel meat has been added to the menu. Fish and chicken are rarely eaten except by urbanites. The nomadic life and the country's climatic conditions have given rise to specific methods of preserving meat. The most common one is naturally freeze drying. Beef, mutton or camel meat

is cut into long strips that are hung for freeze as well as for dry in winter and preserved for a long period and it is called "Borts".

One of the most important energy sources in the traditional diet was cereals, mostly barley and wheat flour. Traditional Mongolian diet also included wild herbs and plant roots as well as several kinds of wild berries along with animal products mostly in summer and autumn.

Traditionally, drinking alcohol was strongly discouraged, and only matured elders over 36 were allowed to drink according to their will, and even in that case, only a mild, 13～15 % proof beverage made of distilled milk was available.

Certainly, traditional Mongolian diet has advantages and disadvantages. There are several advantages for those dietary patterns including high intake of milk products, low intake of processed food and seasonal differences on energy intake. On the other hand, there are some disadvantages including high intake of animal products and saturated fat, and low intake of vegetables, fruits as well as dietary fibers. Today, the traditional dietary pattern and consumption idea still dominate the most rural people.

Shifts in Dietary Pattern of Mongolians

Under the socialist regulation between 1921 and 1991, Mongolian population was classified into herders, farmers and urbanities. The dietary pattern of urbanities was shifted steadily towards consuming a larger quantity of meat products and a higher intake of cereal especially wheat as well as imported refined foods. During that time, consumption of dairy products was declined among urbanities. There were major increase in vegetable consumption among farmers and urbanities but the variety of vegetables was very limited to potatoes, cabbages, carrots and onions. In the same time, the traditional diet consumption pattern was still dominated the most rural people, particularly herders.

Mongolia began its transition from a centrally planned economy to a market oriented economy in 1990. Since the transition, the dietary pattern of Mongolians as well as the lifestyle has been changed obviously. Mongolia is facing nutritional problems associated with both under nutrition and over nutrition. Lack of access to food due to economical shortages is one of the major causes of malnutrition in the country. Sedentary lifestyle with subsequent reduction in physical activity along with changing dietary patterns are major contributing factors to the problem of overweight and obesity in the population.

The population is increasing annually in Ulaanbaatar because of the migration stream to the capital city. Over half the population now lives in cities and they have low physical activity but prefer to eat diet rich in simple carbohydrates and highly processed imported foods. Mongolia relies heavily on imported foods, which account for more than half of the national dietary energy supply. There has been huge increase in fatty meat and alcohol consumption in contrast to declined milk consumption, especially among urbanities. In addition, vegetable and fruit consumption is still low in the population. Unlike the Mongolian traditional diet, there are not seasonal and lifestyle differences in the modern diet.

These unhealthy changes of dietary pattern, coupled with rural-to-urban rapid migration as well as lack of nutrition education may have contributed to the emergence of diet-related chronic diseases such as obesity and cardiovascular diseases. It has been shown that in Mongolia, mortality due to heart disease and cerebro-vascular diseases is rising (Health Indicators, 2004). The prevalence of overweight and obesity in adults is

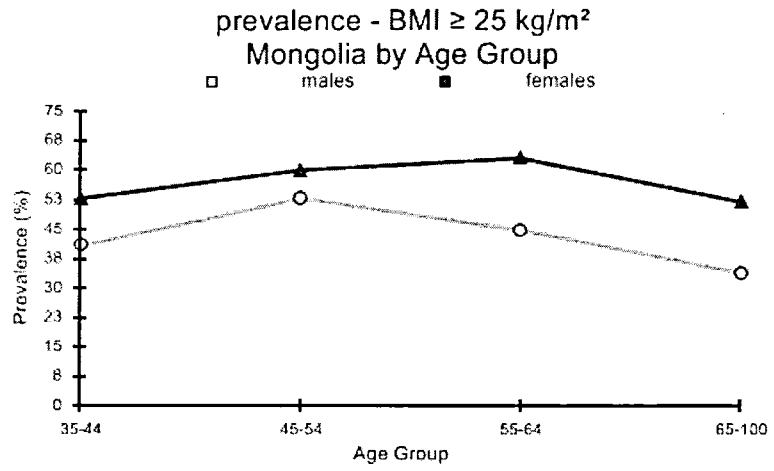

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Fig. 3. Prevalence BMI≥25 kg/m² in Mongolia by age group.

increasing in Mongolia. In the national survey on "Glucose intolerance and associated factors in Mongolia" (1999), prevalence- BMI ≥ 25.0 kg/m² was 44 % for men and 57 % for women among 2449 adults (age> 35 years old) in Mongolia. Highest prevalence of overweight was in the group of 45～54 years old for men; 55～64 for women (WHO Global InfoBase Online) (Fig. 3).

As epidemiological studies have shown, weight gain is an important factor in elevating blood pressure. From the survey result, one-half of men and almost one-half of women were hypertensive (Fig. 4). One-third of all subjects were centrally obese. Considering the conditions of principal interest-glucose intolerance, hypertension and obesity, one-half of all subjects demonstrated one or more of these conditions. Central obesity was the most common condition, followed by hypertension and then glucose intolerance. Central obesity and hypertension was the most common combination (17% of all subjects) (2).

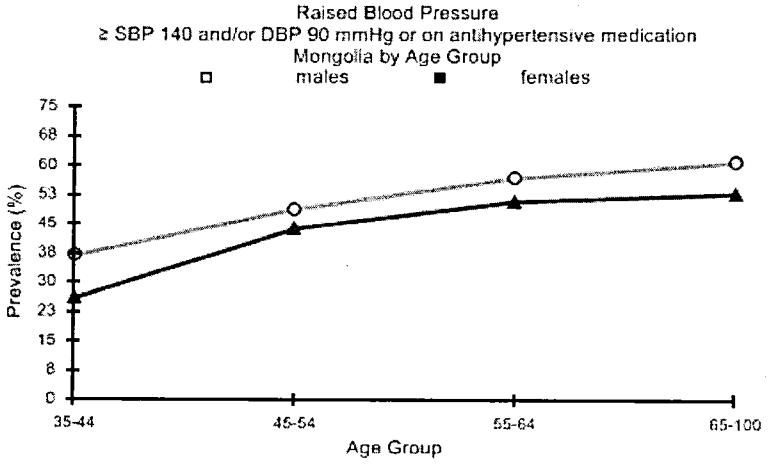

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Fig. 4. Prevalence of raised blood pressure in Mongolia by age group.

Importance of a Mare's Milk for Health

For staying healthy and keeping normal weight, nowadays many Mongolians prefer to use traditional dairy products particularly mare's milk products as a functional food. The nutritional values of mare's milk have been proved as high. From mid to late lactation period, the Mongolian mare's milk containing on average 10~20% total solids, 1.6~2.0% fat, 2.0~2.1% true protein, 6.5~7.0%lactose, 0.4~0.5% ash and calculated energy content of 2.0~2.4kJ/g (R. Indra, 1983). Protein fraction of mare's milk is particularly rich in whey protein, and the lipid fraction is rich in polyunsaturated fatty acids. Mare's milk is four times higher in vitamin C contents than cows' milk but also yields vitamins A, B_1, B_2, B_{12}, D, and E (Emanuele.M. 1998). This explains how Mongolians could survive on a diet with minimal vegetables and fruit. Some studies demonstrate that mare's milk and *airag* is not only a high quality source of nutrients, but also many important and effective roles for health.

- Immunity enhancing effect of Mare's milk aids to quick recovery of health condition after severe medical treatment as well as to overcome physical retardation in children.
- Minerals and acetylcholine abundant in mare's milk stimulate function of peripheral nerves, prevents from osteoporosis, bone calcification and heart dysfunction.
- Low molecular active compounds improve function and condition of liver, stomach, duodenum, colon and kidney.
- Regenerating effect on skin disorders and ulcers, arose from stress.

When an individual is taking whole mare's milk or fermented mare's milk (airag) daily, it also gives a sense of satiety (fullness). Therefore mare's milk product is very helpful for an individual who wants to keep normal weight and achieve weight loss.

A recent study in *Obesity Research* indicates that increasing calcium, and particularly calcium-rich dairy foods, may help reduce the nation's obesity epidemic. In a population-based study showed that the three to four servings of dairy foods helped people lose more fat from the abdominal region, when compared to those who just cut calories or took calcium supplements. Key nutrients in dairy foods including the calcium and protein appear to improve the body's ability to burn fat. (By Dr. Lynda Johnson, University of Missouri, USA)

Research on Horse Products

Since horse meat and mare's milk is getting popular in Mongolia, my recent researches are focused on horse fat and protein which are major components of milk and meat. First we investigated the fatty acid composition of horse meat and milk using the standard procedure (ISO-5508). Fatty acid determination was performed by gas chromatography with an Agilent GC equipped with a flame ionization detector. The unsaturated fatty acids found in the horse body fat study were oleic (C18:1), linoleic (C18:2), linolenic (C18:3) and palmitoleic (C16:1) acids. From this study, the mean saturated fatty acid contents of milk and meat were 38.0 % and 48.46%, respectively, in contrast to the mean unsaturated fatty acid contents were 61.0 % and 51.06%, respectively. The result shows that horse products are the excellent source of unsaturated fatty acids which usually depresse the blood cholesterol concentration.

With the significant rise in obesity in this last decade comes a corresponding increase in the prevalence of hypertension (having a blood pressure (BP) greater than 140/90 mmHg). The important issue is biological effect of digested horse meat and milk protein on blood pressure. Angiotensing I-converting enzyme (ACE) inhibitory peptides have attracted particular attention for their ability to prevent hypertension (8, 10, 11). The purpose of the experiment described here was to investigate the antihypertensive effect of digested horse muscle protein and to isolate ACE inhibitory peptides from hydrolysed muscle protein. Horse meat was hydrolyzed by pepsin (1/2,000 g) and ACE inhibitory activity and production of peptides were increased with time (Fig. 1). ACE inhibitory activity of the 4hr hydrolysates showed the strongest activity (65.8%) and then activity was slightly decreased from 4hr hydrolysis. The result indicated that most of ACE inhibitory peptides were generated at the early stage of hydrolysis and further cleaved a little resulting in the small decrease in the inhibition.

Table 2 Fatty acid content of horse milk and meat

Fatty acids	Mare's milk, %	Horse meat, %	Dalan, %	Horse subcutaneous fat, %
C4:0~C6:0	-	8.95	12.79	19.25
C8:0	0.7	-	0.02	-
C10:0	2.58	0.04	0.05	0.04
C12:0	3.57	0.09	0.14	0.15
C14:0	5.66	1.03	2.55	2.78
C14:1	0.55	0.04	0.11	0.16
C16:0	24.73	15.52	20.2	19.6
C16:1	7.5	1.02	1.51	4.1
C17:0	0.24	0.56	1.12	0.33
C17:1	0.8	0.2	0.04	0.47
C18:0	0.52	20.52	19.46	3.52
C18:1	23.5	11.68	22.1	22.34
C18:2	6.2	29.15	9.9	6.62
C18:3	22.2	3.64	5.27	19.45
C20:0	0.04	0.2	0.45	0.07
C20:1	0.03	0.26	0.34	0.43
C20:2	0.12	0.42	0.24	-
C20:3	-	4.6	2.0	-
C22:0	0.05	1.6	0.81	-
Total	99.0	99.52	99.1	99.31

Peptic hydrolysis of horse meat showed strong ACE inhibition activity and its IC50 was 43μg/ml (28.8 μM). To isolate the ACE inhibitory peptide, the pepsin hydrolysates were purified by various chromatographs. First, it was fractionated by gel filtration chromatography using Sephadex G-25 column (Fig. 2). The fractions from Sephadex G-25 were divided into 6 groups (1~6) according to their absorbance at 210 and 280nm, and the ACE inhibitory activities of these 6 fractions were measured and are shown as inhibition ratios (%) in Fig. 6. Active fractions were lyophilized and then the fraction 4 was re-applied into an ion exchange chromatography using CM Sephadex C-25 column. ACE inhibitory activity of each chromatographic peptide peak from CM Sephadex was tested to determine the most active peptides. The result showed that the most potent fractions, which were eluted at NaCl concentration of 0.05~0.6M, have angiotensin

I-converting enzyme inhibition activity. Next, the fractions with the strongest specific activity were re-separated by RP-HPLC using 5C18-AR-II (4.6×250mm) column.

Fractions from each HPLC run were collected manually according to peaks and then lyophilized. ACE inhibitory activity was found in fractions 33-1,2,3; 34-1,2; 35-1, 36-1,2,4; 37-1; 38-1; 45-3 from ACE assay (Data not shown). Among them, fraction 33-3 showed relatively strong ACE inhibitory activity (36.6%)

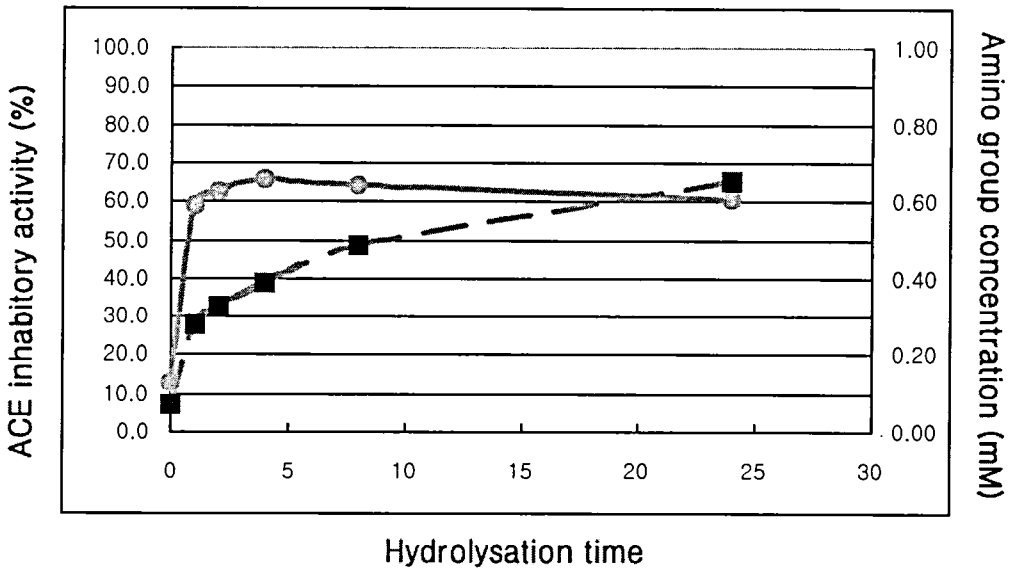

Fig. 5. ACE inhibitory activity of peptic hydrolysates of horse muscle protein after various times hydrolysis at 37°C.

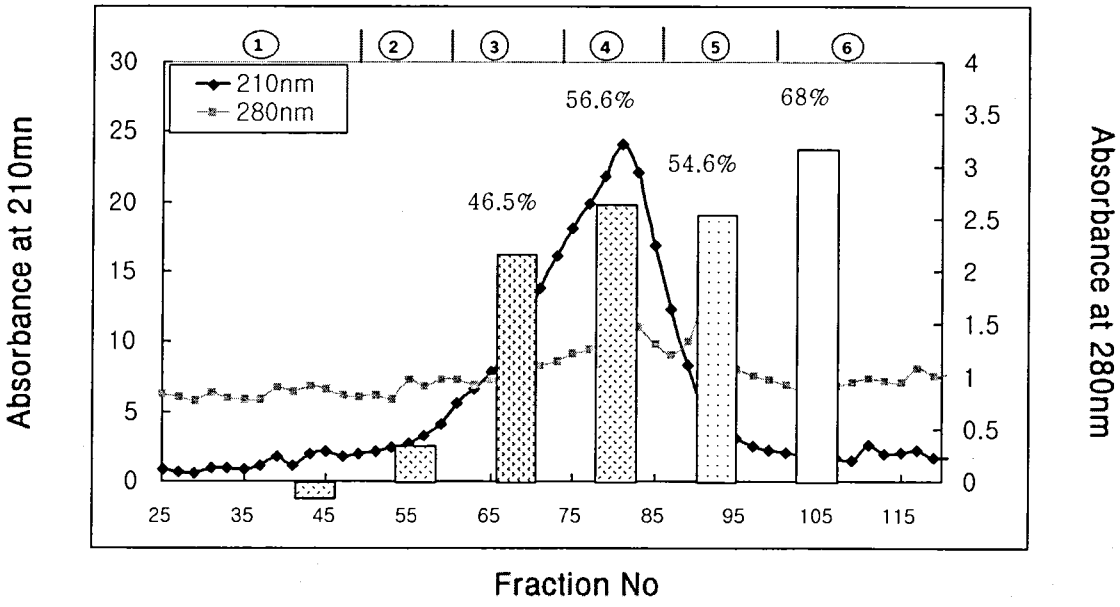

Fig. 6. Sephadex G-25 gel filtration chromatography.

▨ ACE-inhibitory activity of fractions (1~6)

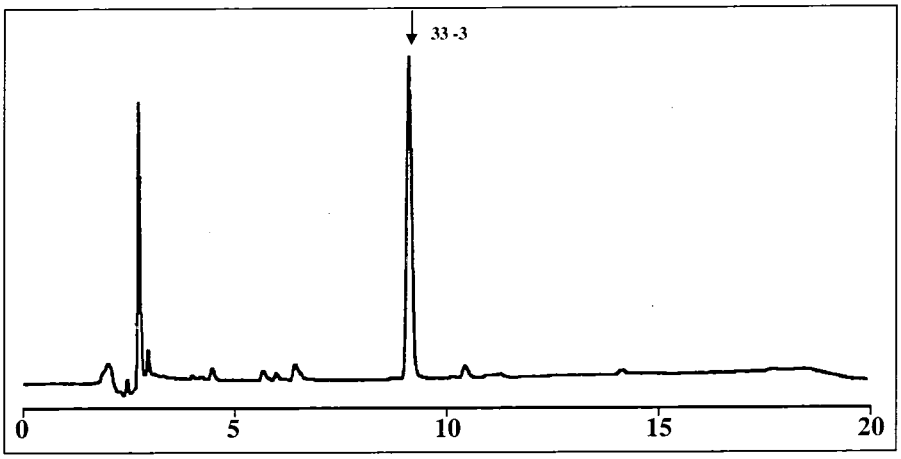

Fig. 7. RP-HPLC (re-chromatography of fraction 4~33 from CM Sephadex ion-exchange chromatography) The arrow indicated the active fraction.

(Fig. 7). In the future research, we will determine amino acid sequences of this active fraction.

These results showed that horsemeat protein hydrolysates could be used as a functional food ingredient having anti-hypertensive property. Our research will be focused on mare's milk proteins.

Summary

Traditional Mongolian diet is low in vegetables and fruits, high in animal products especially dairy products. Among the dairy products mare's milk and fermented mare's milk (airag) has a major role for the nomad's diet. Today, dairy product consumption is still high among the herders. Nowadays urban people also prefer to use traditional dairy products particularly mare's milk products as a functional food for not only staying healthy but also keeping normal weight. Therefore Mongolia has recently begun selling whole mare's milk and mare's milk powder products in the market.

Being overweight contributes to rising blood cholesterol levels which is a major risk factor for prevalence of heart disease and stroke. From the result of our recent research, both horse meat and milk are the excellent source of unsaturated fatty acids which usually depresse the blood cholesterol concentration.

Hypertension is twice as common in obese adults as compared to those who maintain a healthy weight (17). Angiotensin I-converting enzyme (ACE) inhibitory peptides have attracted particular attention for their ability to prevent hypertension. In the recent study, we investigated the ACE inhibitory activity derived from horse muscle proteins. The result indicated that peptic hydrolysis of horse meat has ACE inhibition activity and it could be used as a functional food ingredient having anti-hypertensive property. In conclusion mare's milk products can be selected as a good source of functional food to reduce the nation's obesity and hypertension epidemic.

Suggestions

1. Change current food policies and encourage consumption of dairy product as well as other healthier lower fat products

2. Develop a program to prevent and decrease overweight and obesity in Mongolia
3. Encourage the healthy lifestyle and build up a healthy eating habits
4. Encourage the health education specially nutrition education

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♣ 강연자 소개 ♣

<약력>

- Graduate study PhD candidate, JSPS-RONPUKU Fellow Department of Applied Life Science Graduate School of Agriculture Kinki University, JAPAN
- Research topic: "Study on the biological active peptides from Mongolian horse meat and milk"
- 2000 Protein Science Laboratory at National Food Research Institute (NFRI)
- 2005 Global Nutrition 2002 Advanced International Training Program
- 2004 Japan Society for the Promotion of Science (JSPS) approved me as a JSPS-RONPAKU

E-mail : oyunaa70@yahoo.com