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М. Е. Елубаева, А.А. Ахмедов, М. Х. Нармуратова, Г. Нармуратова, Ж. М. Сулейменова, Б. А. Буралхиев, А. Д. Серикбаева

Состав жирных кислот в липидах верблюжьего молока в зависимости от сезонов года

Аннотация. *В работе были проанализированы изменения состава жирных кислот в верблюжьем молоке, в зависимости от сезона года. В течение года содержание насыщенных жирных кислот, в значительной степени варьировалось. Были проанализированы колебания концентрации масляной кислоты в течение года, весной и осенью, отмечено увеличение содержания на 0,2% и 0,3%, соответственно. Так же были измерены колебания концентрации гексановой кислоты (0,1%). Содержание каприловой кислоты (С8) в весенний период увеличивается в 2 раза, по сравнению с зимой и осенью. Содержание каприновой кислоты (С10) составляет зимой и весной 23,2% и 25,6%, соответственно, и снижается до 4,8% летом и осенью повышается до 7,8% (P ≤ 0,05). Наблюдался повышенный уровень пальмитиновой кислоты (С16) 29,0% в летний период. Образцы молока в осенний период характеризовались высокой концентрацией насыщенных жирных кислот, в связи с наличием миристиновой (16,6%) и стеариновой кислот (23,5%) (p ≤ 0,05).*

Весенние, летние и зимние образцы верблюжьего молочного жира содержат "полезные" сочетание жирных кислот.

По результатам исследования состава жирных кислот молочного жира верблюжьего молока можно объяснить давно известные и используемые в народной медицине некоторые диетические свойства верблюжьего молока, но не имеющие на сегодняшний день научно обоснованного объяснения.

Ключевые слова: верблюд, молоко, жирные кислоты, липиды, мононенасыщенные жирные кислоты, полиненасыщенные жирные кислоты.

Авторы:

Елубаева М. Е. — Специалист Отдела магистратуры «Казахского национального аграрного университета», 050013, Казахстан, г. Алматы, пр. Абая, 8; e-mail: phd.01@mail.ru;

Ахмедов А. А. — Докторант кафедры «Технология и безопасность Казахского национального аграрного университета», 050013, Казахстан, г. Алматы, пр. Абая, 8;

Нармуратова М. Х. — кафедра биологии и биотехнологии, «Казахский национальный университет им. аль-Фараби», пр. аль-Фараби, 71, 050040, Алма-Ата, Республика Казахстан; e-mail: m.narmuratova@gmail.com;

Нармуратова Г. — «Казахский государственный женский педагогический университет», старший преподаватель, Казахстан, г. Алматы, ул. Айтеке би, 99; e-mail: n.g.k84@mail.ru;

Сулейменова Ж. М. — Руководитель Инновационного научно-образовательного центра технологии и качества продовольственных продуктов «Казахского национального аграрного университета», 050013, Казахстан, г. Алматы, пр. Абая,8; e-mail: zhulduznur@gmail.kz;

Буралхиев Б. А. — Декан факультета Технологии и биоресурсов «Казахского национального аграрного университета», 050013, Казахстан, г. Алматы, пр. Абая, 28; e-mail: buralkhiev@bk.kz;

Серикбаева А. Д. — Профессор кафедры Технология и безопасность «Казахского национального аграрного университета», 050013, Казахстан, г. Алматы, пр. Абая, 28; e-mail: serikbayeva@yandex.kz.

Nutritional value of food and especially milk estimated amount and composition of lipids milkfat content of unsaturated fatty acids, which play an important role in metabolism. It mainly palmitic, oleic fatty acids having one double bond, linoleic having two double bonds, three-linolenic, arachidonic with four double bonds.

Of most natural lipid complex chemical composition is a dairy fat, which is the energy source for the biochemical processes in the body. Milk fat is biologically complete and contains all the known fatty acids. It is characterized by several features that distinguish it from other fats, both animal and vegetable origin: a low melting point 27–35^{0}C. Since

this temperature is below the temperature of the human body, fat enters the human intestine in a liquid state and is easier to digest. Better digestion of milk fat contributes tiny fat globules with a diameter of 2–3 microns. Physiological value of milk fat due to the content of fat-soluble vitamins (A, E, D) and essential fatty acids (PUFA) (linoleic, linolenic, arachidonic). In a large number found in milk and other anti-sclerotic substances — phosphatides affecting fat absorption intensity. Contained in fosfastidah phosphorus necessary for our nervous system. In fat milk also contains sterols, including ergosterol particularly important constituting vitamin B. pleasant taste milkfat refines the taste of dairy products, moreover, causes the homogeneity and the plasticity and consistency of their structure [1].

Materials and Methods.

Milk samples.

In order to have a high variability in fatty acid composition, th healthy animals were randomly selected of South Kazakhstan during 4 different season where the whole 23 of milk samples were collected.

The number of milk samples was balanced between winter (n = 6), spring (n = 4), summer (n = 7) and autumn (n = 6).

Milk was collected at milking time at the end of milking. It was stored in ice-box up to the laboratory then frozen at -20^{0}C up to the analysis.

Lipid analysis.

Milk fat extraction.

For the analyze the extracted using hexane milkfat.

50–60 ml of milk was heated to 40^{0}C 10 minutes is homogenized using ultrasound disintegration, and 10 minutes on an automatic shaker. From the resultant homogeneous milk lipids isolated via extraction. To extract to 10 ml of milk was added 1 ml of 30% ammonia and 10 ml of 80% ethanol. The mixture was transferred to a separatory funnel, 20 ml of hexane and 20 ml of petroleum ether, stirred, and the organic phase was decanted, the aqueous phase was re-extracted 3 times with hexane. The isolated lipids were stored at -40^{0}C in hexane.

To 1 ml of the fat in hexane was added 5 ml of hexane. From the resulting solution was sampled and 75 microliters via nitrogen pump hexane was removed to concentrate the sample. Then, 1 ml of hexane-isopropanol (3:2). To a solution of 1 ml of isopropanol with concentrated sulfuric acid (mixture consisted of 200 l acid and 1 ml of isopropanol).

The resulting solution was heated in an oil bath at 1000C for one hour, after which 1 ml of distilled water and incubated for 10 minutes in an ice bath. As a result, the resulting organic and aqueous phases. To analyze the fatty acid composition of milk fat by gas chromatography using the organic phase was diluted with 2 ml of hexane [2, 3].

The study fatty acid composition of lipids of camel milk.

Gas chromatography and lipids of camel milk was carried out on the device shubat Carlo Erba instrument, model GC 8000 Top (Erba Science). In this paper we used capillary column SUPELCOWAX length of 30 mm and a width of 0.32 mm and a flame ionizing detector (manufacturer: SUPELCO, Bellafonte, USA). As the carrier gas, helium was used. Was chosen the optimal transmission rate for chromatography of lipids of camel milk and shubat — 2 ml / min. Gas chromatograph pre etalonirovali samples following fatty acids:

- Saturated volatile, water-soluble fatty acids: butyric (C4), caproic acid (C6);
- Saturated volatile, insoluble in water: caprylic acid (C8), capric acid (C10);
- Saturated nonvolatile, insoluble in water: lauric acid (C12), myristic acid (C14), palmitic acid (C16), stearic acid (C18), arachidic acid (C20);
- Unsaturated fatty acids: palmitoleic acid (C16: 1), oleic acid, omega 9 (C18: 1 (ω-9)), vaccenic acid omega 7 (C18: 1 (ω-7)), omega-6 linoleic acid (C18: 2 (ω-6)), linolenic acid (C18: 3), eicosenoic acid (C20: 1) [4].

Results and Discussion

The composition of fatty acids in the lipids of precast camel milk, depending on the season. Observed fluctuations containing certain fatty acids, depending on the season (Table 1).

During the year the content of saturated fatty acids varies greatly. Observed fluctuations in the concentration of butyric acid in a year, in spring and autumn, its content increased 0.2% and 0.3%, respectively. The same concentration of hexanoic acid (0.1%) contain winter, spring and summer collecting samples of milk. Spring content with caprylic acid (C8) is increased by 2 times than in winter and spring. Content of capric acid (C10) in winter and spring up 23.2% and 25.6%, respectively, decreasing to 4.8% in summer and autumn rising to 7.8% ($P \leq 0,05$). Summer milk samples rich in palmitic acid (C16) 29.0%. Autumn milk samples are characterized by high concentration of saturated fatty acids, due to the presence of myristic (16.6%) and stearic acid (23.5%) ($p \leq 0,05$).

Table 1. **Fatty acid composition of lipids precast camel milk, depending on the season (%) [4, 5]**

Fatty acids	Wintern = 6	Springn = 4	Summern = 7	Autumnn = 6
Satureted fatty acids				
C_4	0,10 ± 0,01	0,20 ± 0,03	0,10 ± 0,01	0,30 ± 0,04
C_6	0,10 ± 0,01	0,10 ± 0,01	0,10 ± 0,01	0,04 ± 0,01
C_8	0,10 ± 0,01	0,20 ± 0,03	0,10 ± 0,01	0,08 ± 0,01
C_{10}	23,2 ± 3,0	25,6 ± 3,3	4,8 ± 0,6	7,8 ± 1,0
C_{12}	1,00 ± 0,01	0,8 ± 0,1	0,9 ± 0,1	1,4 ± 0,2
C_{14}	11,3 ± 1,5	8,6 ± 1,1	11,6 ± 1,5	16,6 ± 2,1
C_{16}	23,5 ± 3,1	20,9 ± 2,7	29,0 ± 3,8	22,6 ± 2,8
C_{18}	13,0 ± 1,6	10,6 ± 1,4	18,5 ± 2,4	23,5 ± 3,1
C_{20}	0,0 ± 0,0	1,3 ± 0,1	0,0 ± 0,0	0,0 ± 0,0
Total	72,3 ± 9,4	68,3 ± 8,8	65,0 ± 8,5	72,3 ± 9,4
Unsaturated fatty acids				
$C_{16:1}$	6,0 ± 0,8	5,6 ± 0,7	6,5 ± 0,8	8,5 ± 1,1
$C_{18:1\ (\omega-7)}$	2,5 ± 0,3	2,4 ± 0,3	4,4 ± 0,6	3,7 ± 0,5
$C_{18:1\ (\omega-9)}$	16,2 ± 2,1	19,2 ± 2,5	22,1 ± 2,8	7,8 ± 1,0
$C_{20:1}$	0,0 ± 0,0	1,3 ± 0,1	0,0 ± 0,0	0,0 ± 0,0
Total	24,7 ± 3,2	28,5 ± 3,7	33,0 ± 4,3	20,0 ± 2,6
Polyunsatureted fatty acids				
$C_{18:2\ (\omega-6)}$	2,2 ± 0,3	2,4 ± 0,3	1,9 ± 0,2	2,2 ± 0,3
$C_{18:3}$	0,0 ± 0,0	0,8 ± 0,1	0,0 ± 0,0	1,0 ± 0,1
Total	2,2 ± 0,3	3,2 ± 0,4	1,9 ± 0,2	3,2 ± 0,4
Residues	0,8 ± 0,1	0,0 ± 0,0	0,10 ± 0,01	4,5 ± 0,6

In summer there is a tendency to increase monounsaturated fatty acids — 33%. Thus, the maximum concentration of fatty acids occur in the following seasons: autumn — palmitoleic acid (8.5%); summer-vaccenic (4.4%) and oleic acid (22.1%); spring — eicosenoic acid (1.3%) ($p \leq 0,05$). Arachidic acid found in spring samples of lipids of camel milk (1.3%).

With regard to polyunsaturated fatty acids in camel milk, it should be noted the fundamental changes in milk composition, up to partial or complete cleavage of certain unsaturated and polyunsaturated fatty acids within a year.

Thus, linolenic acid is found only in the spring — fall 0.8% and — 1.0%. Proportion of linoleic acid during the year is relatively stable, except in the summer period, when it is slightly lowered.

There is a lack or very low content of impurities in the spring, summer and winter samples of camel milk fat.

The results obtained for fatty acid content of camel's milk lipids are shown in Table 2.

Fatty acids with a short carbon chain, giving the milk a specific odor and taste, increases in spring and autumn — 0.5% and 0.4% respectively. The presence of fatty acids C4—C8 may be associated with a variety of spring vegetation. The lowest amount of fatty acids with short chain summer observed (0.2%). Fatty acids having an average carbon chain dominates the winter and spring — 35.3%

Table 2. **The fatty acid lipid camel milk along the length of the carbon chain, depending on the season (in %)**

Fatty acids	Wintern = 6	Springn = 4	Summern = 7	Autumnn = 6
Short (C_4 — C_8)	0,30 ± 0,04	0,5 ± 0,1	0,20 ± 0,03	0,4 ± 0,1
Average (C_{10} — C_{14})	35,3 ± 4,6	35,0 ± 4,5	17,3 ± 2,3	25,8 ± 3,4
Long (C_{16} — C_{20})	63,4 ± 8,2	64,5 ± 8,4	82,4 ± 10,7	68,3 ± 8,9

and 35.0%, respectively ($p \leq 0,05$), as compared to other seasons of the year. Fatty acids with longer carbon chain does not change significantly during the year.

Proceeding of the fatty acid composition of milk fat camel milk can be attributed to some dietary properties of camel milk has long known and used in traditional medicine, but do not have to date scientifically sound explanation.

The metabolism of lipids, autacoids formed LDL cholesterol (low density lipoprotein) and HDL-cholesterol (high-density lipoprotein), which can form bile acids and sex hormones adrenal — testosterone, estradiol, and cortisone, etc. The presence of fatty acids derived from short chain (C4—C8), which are involved in the cycle of formation of HDL-cholesterol is harmful to the organism, since they provoke formation holesterolnyh plaques. In the formation of LDL cholesterol necessary for the proper functioning of organism involved derivatives of fatty acids with medium and long chain. At the same time, the presence of unsaturated bonds is of particular importance [6-8].

So that the fatty acid composition of lipids of camel milk by animal species and breeding area has no significant difference. However, identified a period in which the fatty acid composition of milk has an optimal structure. Spring, summer and winter samples of camel milk fat contain «useful» a combination of fatty acids.

The content and the combination of unsaturated fatty acids in nutrition is an important positive property. Linoleic and linolenic fatty acid — a vitamin F; they do not yield to the biological value of proteins. In modern data play an important role of polyunsaturated fatty acid ω-3 and ω-6, which have special physiological activity in the body [9, 10].

It was established that camel milk contains 28.9% of unsaturated fatty acids, of which 25.8% and 3%, monounsaturated fatty acid 27.2% shubat and unsaturated fatty acids, of which 24% of monounsaturated and polyunsaturated fatty 3,2% acid. This implies that milk and camel shubat rich with essential polyunsaturated, i.e. essentially required for body fat acids, which are involved in sterol metabolism. Milk fat is only 1/3 provides the human body in polyunsaturated fatty acids, the rest must be replaced with vegetable oil with a high content of these acids.

Conclusion.

Camel milk fat has nutritional properties, a source of energy for the biochemical processes in the living organism, easily accessible and different valuable nutritional properties compared to other dairy fats. Low molecular weight volatile fatty acids (C4—C10) of fresh dairy fat determine its odor acid with a chain of 12 or more carbon atoms is practically odorless and tasteless.

Physiological value-fat milk and dairy products due to camels in saturated (C10—C14) and essential fatty acids (C18: 2 (ω-6), C18: 3 and C20: 1) [4, 5]. As known, the lack of polyunsaturated fatty acids in an organism provokes various diseases. Besides pleasant taste of camel milk fat milk and its derivatives ennobling, causes homogeneity and ductility of the structure and consistency of the fatty acids.

Spring, summer and winter samples of camel milk fat contain «useful» a combination of fatty acids.

From the fatty acid composition of milk fat camel milk can be explained by some dietary properties of camel milk has long known and used in traditional medicine, but do not have to date scientifically sound explanation.

Elubaeva M. E., Akhmedov A. A., Narmuratova M. H., Narmuratova G., Suleimenova Zh. M., Buralkhiev B. A., Serikbayeva A. D.

Effect of the season on the fatty acid composition of lipids camel milk

Abstract. *The composition of fatty acids in the lipids of camel milk, depending on the season. Observed fluctuations containing certain fatty acids, depending on the season.*

During the year the content of saturated fatty acids varies greatly. Observed fluctuations in the concentration of butyric acid in a year, in spring and autumn, its content increased 0.2% and 0.3%, respectively. The same

concentration of hexanoic acid (0.1%) contain winter, spring and summer collecting samples of milk. Spring content with caprylic acid (C8) is increased by 2 times than in winter and summer. Content of capric acid (C10) in winter and spring up 23.2% and 25.6 %, respectively, decreasing to 4.8% in the summer and autumn rising to 7.8% (P ≤ 0,05). Summer milk samples rich in palmitic acid (C16) 29.0%. Autumn milk samples are characterized by high concentration of saturated fatty acids, due to the presence of myristic (16.6 %) and stearic acid (23.5%) (p ≤ 0,05).

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Key words: camel, milk, fatty acids, lipids, season, monounsaturated fatty acids, polyunsaturated fatty acids.

Authors:

Elubaeva M. E. — Specialist of the Department of Magistracy of the Kazakh National Agrarian University, 050013, Kazakhstan, Almaty, Abai Ave.; 8; e-mail: phd.01@mail.ru;

Akhmedov A. A. — Doctoral student of the department Technology and safety of the Kazakh National Agrarian University, 050013, Kazakhstan, Almaty, Abai Ave., 8;

Narmuratova M. Kh. — Associate Professor of the Department of Biology and Biotechnology of the Kazakh National University named after Al-Farabi, 050040, Kazakhstan, Almaty, al-Farabi Avenue, 71; e-mail: m.narmuratova@gmail.com;

Narmuratova G. — Kazakh State Women's Pedagogical University, senior lecturer, Kazakhstan, Almaty, Aiteke bi str., 99; e-mail: n.g.k84@mail.ru;

Suleimenova Zh. M. — Head of the Innovative Scientific and Educational Center for Food Products Technology and Quality of the Kazakh National Agrarian University, 050013, Kazakhstan, Almaty, Abai Ave., 8; e-mail: zhulduznur@gmail.kz;

Buralkhiev B. A. — Dean of the Faculty of Technology and Bioresources of the Kazakh National Agrarian University, 050013, Kazakhstan, Almaty, 28, Abai Ave., e-mail: buralkhiev@bk.kg;

Serikbayeva A. D. — Professor of the Chair Technology and Security of the Kazakh National Agrarian University, 050013, Kazakhstan, Almaty, Abay Ave., 28; e-mail: serikbayeva@yandex.kz.

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