Study of Fatty Acids Content of Lipids in Mare's and Camel's Milk

Tamara Tultabayeva, Urishbay Chomanov, Bakhtiyar Tultabayev, and Aruzhan Shoman

Abstract--- The composition of saturated and unsaturated fatty acids included in the milk fat triglycerides using gas chromatographic analysis. Previously examined no more than 15-20 of saturated and unsaturated fatty acids contained in camel and horse milk fat. Analysis of fatty acid composition during the lactation period, showed a significantly greater amount of saturated and unsaturated fatty acids in fats investigated camel and horse milk.

Key words **---** mare's milk, camel's milk, ω3,6,9

I. Introduction

IN the East have long known about the therapeutic properties of camel, mare, goat and human milk is very similar in chemical composition, content of the albumin protein and vitamins, minerals and other biologically active substances.

Milk fat - one of the best dietary fat composition and taste. Fat milk has a low melting point and therefore is easily and quickly absorbed by the body. Milk fat is a source of vitamins C and D, fatty acids, many of which are not in vegetable and animal fats of other origin. Polyunsaturated fatty acids are particularly valuable because they cannot be synthesized in humans.

Fat of mare and camel milk on its physical and chemical properties differ significantly from the fat of cow's milk. Fat globules in camel milk of mares and smaller than a cow, so shoot them in the oil much more difficult.

II. Materials And Methods

Gas chromatographic analysis of fatty acid composition of milk fat is one of the principal methods of determining the lipids therein.

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Gas chromatographic analysis was performed on a gas chromatograph "Shimadzu GC 2010" with a flame ionization detector, after translation into the methyl esters by the method interstate standard (GOST 30418-96) transesterification of fat using sodium methoxide in methanol. Separation of the methyl esters were carried out on a capillary column 30 m in length and an internal diameter of 0.25 mm, carrier gas of hydrogen was passed at 40 ml / m. Separation was performed on a polar stationary phase SUPELCOWAX 10 with increasing temperature from 60C to 180C to 200C at a rate per minute, maximum temperature in the column 2300S.

Polar stationary phase enables the separation of the methyl esters of fatty acids of carbon number and unsaturation degree. Calculation of the components of milk fat of all samples was performed by the internal normalization. As the standard was specified mixture of methyl esters of individual fatty acids - saturated from $C_{4:0}$ (oleic) and $C_{22:0}$ (behenic), branched (iso - and ante-iso) of $C_{13:0}$ (iso- tridecyl) to $C_{18:0}$ (iso-stearic) from the monounsaturated $C_{10:1}$ (caproleic) to $C_{20:1}$ ω9 (gondoinic) and polyunsaturated $C_{18:2}$ ω6 (linoleic), $C_{18:3}$ ω6 (γ- linolenic), $C_{18:3}$ ω3 (α - linolenic) and $C_{20:4}$ ω6 (arachidonic).

III. Results And Discussion

As a result of studies, the following data. The chromatogram of fatty acid composition of mare's milk and camel fat are shown in Fig. 1 and 2, and to quantify the fatty acid content of fats in Tabl. 1 and 2. (present in appendix)

The chromatogram of fatty acid methyl esters of lipids of camel milk is presented in Fig. 1.(present in appendix)

The chromatogram of fatty acid methyl esters of lipids mare's milk is presented in Fig. 2. (present in appendix)

From Fig. 1 and 2 show that we have identified 27 fatty acids of camel's milk, only 12 acids of them are in an amount greater than 1%, and mare's milk fat identified 24 fatty acid, including 12acids in an amount greater than 1 %.

As can be seen from Tabl. 1, samples lipid camel milk fat, unlike similar samples mare milk fat, contain small amounts of saturated fatty acids from $C_{4:0}$ (oleic) to $C_{10:0}$ (capric) from 0.1 to 1.2% and the maximum number observed in summer time, and in the lipids of mare's milk from 0.2 to 4.2% with a maximum of their content in the spring.

In significant quantities, regardless of the season of the year, contains a high-molecular acid $C_{14:0}$ (myristic) and $C_{16:0}$ (palmitic): most of their content is noted in camel milk - 11.9 and 29.4% in winter, and in mares 10.4 and 28.6% in the spring. The lowest number is 8.5, and 27.5% in autumn, and 6.0 and 18.2% - winter periods, respectively, and $C_{18:0}$ (stearic) increased from 16.1 in the summer to 18.2% in autumn in camel milk, and in mares with 1.0% in the autumn-winter period to 1.4% in the spring. Unsaturated fatty acids in

the lipids of camel's milk is detected arachidonic acid 0.4-05%, and mare's milk lipids - heneicosanoic acid (C 21: 0) 0.1-0.2%.

In lipids of all samples, found 4 saturated iso-acids (two out of these first palmitic (14-methyl-hexadecanoic) and iso-stearic (16-methyl-heptadecanoic) in an amount of from 0.1 to 0.7%) small quantities of 0.1 -0.8% in the lipids of camel milk and 0.2-0.7% in the mare's milk.

Of the monounsaturated fatty acids contained the maximum number of $C_{16:1}$ ω-7 (palmitoleic) - 6,7 and 7.3% in winter, minimum 5.4% in autumn in camel and 6.1% in the summer of mare's milk, $C_{18:1}$ ω-9 (oleic), on the contrary contained in the autumn maximum -21.3 and 25.0% in winter and decreases to 18.0% in camel milk and mare's milk in the summer to 17.0%, respectively.

In animals, linoleic acid automatically organisms referred to α-linolenic acid (ω3), by analogy with vegetable oils (such as linseed oil, wherein the linolenic acid is α-isomer and present in significant amounts (up to 60%).

As seen from Tabl. 1, the lipid mare milk fat are present as indispensable $C_{18:2}$ω 6 (linoleic or 9,12-octadecadienoic acid) in an amount (8,2-14,5%) and small amounts (0,4- 0,5%), arachidonic ($C_{20:4}$, 5,8,11,14-eicosatetraenoic acid), which also relates to ω-6 essential fatty acids.

Unlike mare's milk fat, as seen from Table 2, polyunsaturated ω 6 fatty acid ($C_{18:2}$ and linolenic acid $C_{18:3}$ γ-linolenic acid) contained in small amounts in camel milk compared with mare milk. The total content of them in the winter and spring is 4.1 and 4.6%, in the summer-autumn period of lactation is 4,2-5,9% and 27,8-27,5% respectively. The acid content of ω 3 ($C_{18:3}$ α-linolenic) there is a high content in camel milk quantities (0.6-0.9%) in comparison with the mare milk.

For example, in the milk fat of mares, first discovered the following fatty acids: $C_{10:1}$ (or kaprinolenovaya decene), $C_{16:1}$ ω 9 (7-hexadecenoic), $C_{18:1}$ ω 7 (11-octadecenoic or vaccenic), $C_{18:3}$ ω 6 (6,9,12-octadecatrienoic or gamma-linolenic acid), $C_{18:3}$ ω3 (9,12,15-octadecatrienoic and α-linolenic), $C_{21:0}$ (heneicosanoic acid) and two branched saturated acid - $C_{16:0}$ (14- methyl or iso-pentadecanoic, palmitic) and $C_{18:0}$ (16-methyl-heptadecanoic or iso-palmitic).

In the camel milk fat, are also present above acids except $C_{21:0}$, and also revealed the presence of two branched acids $C_{14:0}$ iso- (12-methyl-tridecanoic or iso- myristic) and $C_{17:0}$ iso- (15-methyl-hexadecanoic or iso-margaric)

We first found that a mare milk fat linolenic acid is present in substantial quantities mainly in the form of 6 ω (γ-linolenic or 6,9,12-octadecatrienoic acid) in amounts 17,3-22,8% and only a minor amount of ω 3 is α-linolenic acid (9,12,15-octadecatrienoic), only 0.2%. In the camel milk fat γ - and α-linolenic acid are present in small amounts: γ-linolenic 1,5-1,7%, α-linolenic half 0.6-0.8%.

IV. Conclusion

On fatty acid composition of milk fat of different animals (mares camel) for a long period of study, there are a few publications [2-4]. These fats are mainly represented by no more than 15-20 saturated or unsaturated fatty acids, mainly with an even number of carbon atoms. The most studied bovine milk fat, which found a significantly greater amount of saturated and unsaturated fatty acids.

According to our data the fat mare's milk is a special fat milk fats among other animals (camel, goat and cow), as it contains large amounts of essential ω-6 essential fatty acids: $C_{18:2}$ ω 6 (linoleic), $C_{18:3}$ ω 6 γ-linolenic and $C_{20:4}$ ω 6 (arachidonic). The total content thereof is 25,8-31,5%, the total content of unsaturated acids was 57,7-62,2%, respectively, and saturated acids 37,8-42,3%. In this regard, the mare milk fat, is also as mare milk great interest in terms of nutritional and biological value.

Thus a mare milk fat in all periods of lactation contains 5-6 times more essential polyunsaturated ω-6 fatty acids in comparison with camel milk fat.

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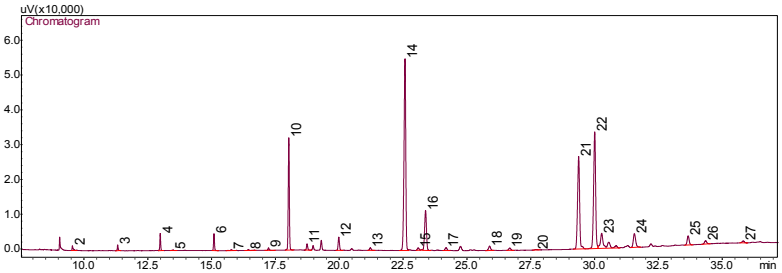
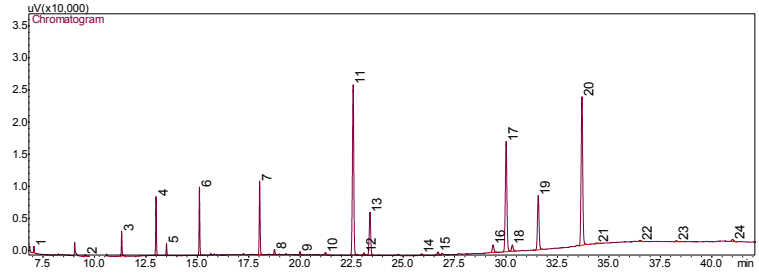
She has more than 110 scientific publications in national and international publications, the author of two analytical reports on national and combined dairy products. Total work experience is 27 years, researcher experience – about 18 years. In leading position is about 10 years.

APPENDIX



1.$C_{4:0}$, 2.$C_{6:0}$, 3.$C_{8:0}$, 4.$C_{10:0}$, 5.$C_{10:1}$, 6.$C_{12:0}$, 7.$C_{12:1}$ ω 3, 8.$C_{13:0}$, 9.$C_{14:0}$ iso, 10.$C_{14:0}$, 11.$C_{14:1}$ ω 5, 12.$C_{15:0}$, 13.$C_{16:0}$, iso, 14.$C_{16:0}$, 15.$C_{16:1}$ ω 9, 16.$C_{16:1}$ ω 7, 17.$C_{17:0}$ iso, 18.$C_{17:0}$, 19.$C_{17:1}$ ω 7, 20.$C_{18:0}$ iso, 21.$C_{18:0}$, 22.$C_{18:1}$ ω 9, 23.$C_{18:1}$ ω 7, 24.$C_{18:2}$ ω 6, 25.$C_{18:3}$ ω 6, 26.$C_{18:3}$ ω 3, 27.$C_{20:0}$

Fig. 1 The camel milk fatty acids chromatogram



1.$C_{4:0}$, 2.$C_{6:0}$, 3.$C_{8:0}$, 4.$C_{10:0}$, 5.$C_{10:1}$, 6.$C_{12:0}$, 7.$C_{14:0}$, 8.$C_{14:1}$ω5, 9.$C_{15:0}$, 10.$C_{16:0}$, iso, 11.$C_{16:0}$, 12.$C_{16:1}$ω 9, 13.$C_{16:1}$ω 7, 14.$C_{17:0}$, 15.$C_{18:0}$ iso, 16.$C_{18:0}$, 17.$C_{18:1}$ω 9, 18.$C_{18:1}$ω 7, 19.$C_{18:2}$ω 6, 20.$C_{18:3}$ω 6, 21.$C_{18:3}$ω 3, 22.$C_{20:1}$ω 9, 23.$C_{21:0}$, 24.$C_{20:4}$ω 6.

Fig. 2 The mare's milk fatty acids chromatogram

TABLE I
QUANTIFICATION OF THE FATTY ACIDS IN THE MARE'S AND CAMEL'S MILK

№	acid code	Content,%							
		Winter		Spring		Summer		Fall	
		mare	camel	mare	camel	mare	camel	mare	camel
Saturated fatty acid n-structure									
1	$C_{4:0}$	0,3±0,01	0,1±0,01	0,3±0,01	0,2±0,01	0,3±0,01	0,2±0,01	0,3±0,01	0,1±0,01
2	$C_{6:0}$	0,2±0,01	0,1±0,01	0,3±0,01	0,1±0,01	0,1±0,01	0,5±0,01	0,2±0,01	trace
3	$C_{8:0}$	2,0±0,01	0,1±0,01	2,1±0,01	0,2±0,01	1,7±0,01	0,4±0,01	1,8±0,01	0,1±0,01
4	$C_{10:0}$	3,9±0,01	0,1±0,01	4,2±0,01	0,1±0,01	4,0±0,01	1,2±0,01	3,6±0,01	0,1±0,01
5	$C_{12:0}$	5,0±0,01	1,0±0,01	5,3±0,01	1,0±0,01	4,7±0,01	1,3±0,01	4,6±0,01	0,7±0,01
6	$C_{13:0}$	-	0,1±0,01	-	0,1±0,01	-	0,1±0,01	-	0,1±0,01
7	$C_{14:0}$	6,0±0,01	11,9±0,01	6,4±0,01	10,4±0,01	6,2±0,01	10,5±0,01	5,2±0,01	8,5±0,01
8	$C_{15:0}$	0,4±0,01	1,3±0,01	0,4±0,01	1,4±0,01	0,4±0,01	1,5±0,01	0,3±0,01	1,5±0,01
9	$C_{16:0}$	18,2±0,01	29,4±0,01	20,9±0,01	28,0±0,01	22,5±0,01	28,2±0,01	19,9±0,01	27,5±0,01
10	$C_{17:0}$	0,2±0,01	0,8±0,01	0,3±0,01	0,7±0,01	0,2±0,01	0,8±0,01	0,3±0,01	0,9±0,01
11	$C_{18:0}$	1,0±0,01	16,3±0,01	1,4±0,01	17,5±0,01	1,2±0,01	16,1±0,01	1,0±0,01	18,2±0,01
12	$C_{20:0}$	-	0,5±0,01	-	0,4±0,01	-	0,4±0,01	-	0,4±0,01
13	$C_{21:0}$	0,2±0,01	-	0,2±0,01	-	0,1±0,01	-	0,1±0,01	-
Branched fatty acids									
1	$C_{14:0}$	-	0,2±0,01	-	0,2±0,01	-	0,2±0,01	-	0,2±0,01
2	$C_{16:0}$	0,3±0,01	0,3±0,01	0,3±0,01	0,3±0,01	0,3±0,01	0,4±0,01	0,2±0,01	0,4±0,01
3	$C_{17:0}$	-	0,8±0,01	-	0,6±0,01	-	0,5±0,01	-	0,4±0,01
4	$C_{18:0}$	0,7±0,01	0,1±0,01	0,4±0,01	0,2±0,01	0,5±0,01	0,1±0,01	0,5±0,01	0,3±0,01
Monounsaturated fatty acids									
1	$C_{10:1}$	1,4±0,01	trace	1,1±0,01	0,1±0,01	0,8±0,01	0,1±0,01	1,2±0,01	trace
2	$C_{12:1}$ ω 3	-	0,1±0,01	-	0,6±0,01	-	0,1±0,01	-	0,1±0,01
3	$C_{14:1}$ ω 5	0,8±0,01	0,7±0,01	0,6±0,01	0,6±0,01	0,5±0,01	0,7±0,01	0,6±0,01	0,4±0,01
4	$C_{16:1}$ ω 9	0,5±0,01	0,4±0,01	0,4±0,01	0,5±0,01	0,3±0,01	0,4±0,01	0,3±0,01	0,5±0,01
5	$C_{16:1}$ ω 7	7,3±0,01	6,7±0,01	6,8±0,01	5,9±0,01	6,1±0,01	6,3±0,01	6,9±0,01	5,4±0,01
6	$C_{17:1}$ ω 7	-	0,5±0,01	-	0,3±0,01	-	0,4±0,01	-	0,5±0,01
7	$C_{18:1}$ ω 9	21,8±0,01	18,0±0,01	19,6±0,01	20,2±0,01	17,0±0,01	19,9±0,01	25,0±0,01	21,3±0,01
8	$C_{18:1}$ ω 7	1,1±0,01	5,9±0,01	1,2±0,01	5,3±0,01	1,1±0,01	5,2±0,01	1,4±0,01	5,7±0,01
Polyunsaturated fatty acids									
1	$C_{18:2}$ ω 6	13,0±0,01	2,9±0,01	14,5±0,01	3,2±0,01	8,3±0,01	2,7±0,01	8,2±0,01	4,2±0,01
2	$C_{18:3}$ ω 6	14,0±0,01	1,2±0,01	12,6±0,01	1,4±0,01	22,8±0,01	1,5±0,01	17,3±0,01	1,7±0,01
3	$C_{18:3}$ ω 3	0,3±0,01	0,9±0,01	0,3±0,01	0,7±0,01	0,2±0,01	0,6±0,01	0,2±0,01	0,8±0,01
4	$C_{20:4}$ ω 6	0,5±0,01	-	0,4±0,01	-	0,4±0,01	-	0,4±0,01	-

TABLE II
TOTAL FATTY ACID CONTENT IN LIPIDS OF CAMEL'S MILK

№	Fatty acids groups	Contents seasonal year,%							
		winter		spring		summer		fall	
1		mare	camel	mare	camel	mare	camel	mare	camel
	Saturated, incl .:	38,5±0,1	62,6±0,1	42,5±0,1	61,5±0,1	42,3±0,1	62,2±0,1	37,8±0,1	59,4±0,1
	n- acid	37,5±0,1	61,7±0,1	41,8±0,1	60,2±0,1	41,5±0,1	61,0±0,1	37,1±0,1	58,1±0,1
	branched - iso, anteiso	1,0±0,1	0,9±0,1	0,7±0,1	1,3±0,1	0,8±0,1	1,2±0,1	0,7±0,1	1,3±0,1
2	Unsaturated, incl .:	61,2±0,1	37,3±0,1	57,5±0,1	38,5±0,1	57,7±0,1	37,7±0,1	62,2±0,1	40,6±0,1
	monounsaturated	33,4±0,1	32,3±0,1	29,7±0,1	33,2±0,1	26,0±0,1	32,9±0,1	36,1±0,1	33,9±0,1
	polyunsaturated, incl .:	28,1±0,1	5,0±0,1	27,8±0,1	5,3±0,1	31,7±0,1	4,8±0,1	26,1±0,1	6,7±0,1
	diene	13,0±0,1	2,9±0,1	14,5±0,1	3,3±0,1	8,3±0,1	2,7±0,1	8,2±0,1	4,2±0,1
	trienoic acid	14,3±0,1	2,1±0,1	12,9±0,1	2,1±0,1	23,0±0,1	2,1±0,1	17,5±0,1	2,5±0,1
	tetraene	0,8±0,1	-	0,4±0,1	-	0,4±0,1	-	0,4±0,1	-
3	essential polyunsaturated								
	ω 6, incl	27,8±0,1	4,1±0,1	27,5±0,1	4,6±0,1	31,5±0,1	4,2±0,1	25,9±0,1	5,9±0,1
	linoleic	13,0±0,1	2,9±0,1	14,5±0,1	3,2±0,1	8,3±0,1	2,7±0,1	8,2±0,1	4,2±0,1
	γ - linolenic	14,0±0,1	1,2±0,1	12,6±0,1	1,4±0,1	22,8±0,1	1,5±0,1	17,3±0,1	1,7±0,1
	arachidonic acid	0,8±0,1	-	0,4±0,1	-	0,4±0,1	-	0,4±0,1	-
	ω 3, incl	0,3±0,1	0,9±0,1	0,3±0,1	0,7±0,1	0,2±0,1	0,6±0,1	0,2±0,1	0,8±0,1
	α- linolenic	0,3±0,1	0,9±0,1	0,3±0,1	0,7±0,1	0,2±0,1	0,6±0,1	0,2±0,1	0,8±0,1