Study of ω-3,6,9 Fatty Acids Content in Horse Fat

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

***Abstract*---**Traditional animal fats do not meet the requirements of biologically valuable fat, balanced fatty acid composition. In the body fat food fulfills two functions: nonspecific - as a source of energy, and specific - as a source of essential fatty acids, fat soluble vitamins, the material and construction for the biosynthesis of fatty body tissues. Such a balanced diet is implemented with the inclusion in the diet of plant 1/3 and 2/3 of animal fats. Horse fat on the content of essential fatty acids surpasses other farm animals. Thus, the mass fraction reaches linolenic acid relative to the total fatty acids 22%, whereas beef fat, this figure does not exceed 5%. Furthermore, equine fat little cholesterol (13-32 mg%), which is one of the factors antisclerotic action, whereas cholesterol in beef and pork fats is 75% and 125 mg. Horse oil has a high digestibility, which reaches 97%, while the figure for beef, lamb and pork fat does not exceed 90%. Therefore, we studied the qualitative and quantitative composition of the fatty acids in the fat equine.

***Keywords*--** PUFA, MUFA, horse fat**.**

I. Introduction

THE food industry development in Kazakhstan is now especially relevant in the changing conditions of the environment - with the entry into the Customs Union and the planned entry into the WTO, as well as due to changes in the internal environment - in terms of population growth, intense increase in food consumption and changes in consumption patterns toward higher quality and more diverse products.

The main challenge facing the food industry is to meet the physiological needs of the population with high-quality, biologically valuable and environmentally friendly products having certain functional properties. Food should not only meet the needs of the human body in nutrients and energy, but also to perform preventive and curative tasks /1/.

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Satisfies these requirements is virtually impossible using traditional foods, and the solution of the problem cannot be based only on the known technological solutions, so you need to search for new theoretical and practical approaches to the development of new advanced technologies, based on a combination of raw materials of animal and plant origin /2/.

II. Materials And Methods

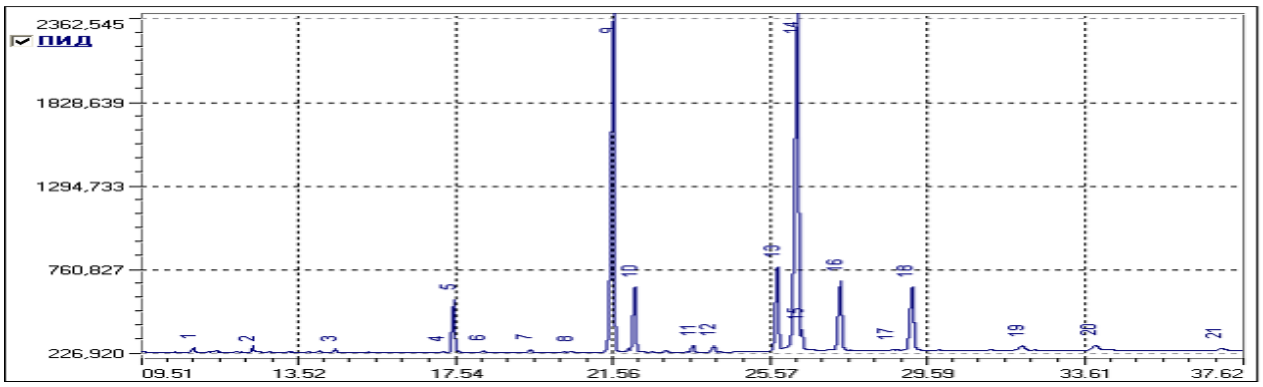
Sample preparation and determination of fatty acid composition was performed in accordance with GOST 51483-99 "Vegetable oils and animal fats. Determination by gas chromatography mass of methyl esters of individual fatty acids to their sum, "based on the conversion of fatty acid triglycerides into their methyl esters, and gas chromatographic analysis of the past /3/. The methyl esters have a lower boiling point compared with the parent acid, which greatly facilitates the chromatography.

The flask was placed a sample of the test sample of 1 g of fat mass and added sm31 10% solution of sodium methylate in methanol. Attached to the flask, a reflux condenser and heated to boiling on a steam bath for 15 minutes and then added to the flask 13 sm31 M solution of sulfuric acid in methanol and heated for another 15 min. After cooling with running water added 25 cm^3 of distilled water and the contents of the flask were transferred to a separator funnel, extracted with 10 cm^3 of hexane two times. The combined extracts were washed with distilled water 7 cm^3 portions until complete removal of acid (methyl orange was monitored). The extract was dried by filtration through a pad without an aqueous sodium sulphate and used for the test. As standard was used a mixture of methyl esters of the individual fatty acids.

III.Results And Discussion

Horse fat as an intermediate between plant and animal, is able to quickly melt and maintain the desired consistency. It used medicine and cosmetology. Horse fat is absorbed into the body and displays excess cholesterol.

The chromatogram of the methyl esters of fatty acids of horse fat is presented in Figure 1.



1.$C_{10:0}$, 2.$C_{11:0}$, 3.$C_{12:0}$, 4.$C_{14:0}$ iso, 5.$C_{14:0}$, 6.$C_{14:1}$ ω5, 7.$C_{15:0}$, 8.$C_{16:0}$ iso, 9.$C_{16:0}$, 10.$C_{16:1}$ ω7, 11.$C_{17:0}$, 12.$C_{17:1}$ω 7, 13.$C_{18:0}$, 14.$C_{18:1}$ ω9, 15.$C_{18:1}$ ω7, 16.$C_{18:2}$ ω6, 17.$C_{18:3}$ω 6, 18.$C_{18:3}$ω 3, 19.$C_{20:1}$ω 9, 20.$C_{21:0}$, 21.$C_{20:4}$ω 6.

Fig. 1 Chromatogram of fatty acid methyl esters of horse fat

Results of fatty acid composition of horse fat during the year (spring, summer, autumn and winter) are shown in Table. 1.

TABLE I
FATTY ACIDS CONTENT OF HORSE FAT BY SEASONS

№	acid name	acid code	Content,%			
			winter	spring	summer	autumn
Saturated fatty acid n-structure						
1	Capric	$C_{10:0}$	0,14±0,01	0,30±0,01	0,08±0,01	-
2	undecynic	$C_{11:0}$	-	0,21±0,01	-	-
3	lauric	$C_{12:0}$	0,12±0,01	0,14±0,01	0,11±0,01	0,12±0,01
4	tridecylene acid	$C_{13:0}$	0,25±0,01	-	-	0,23±0,01
5	myristic acid	$C_{14:0}$	5,00±0,01	3,76±0,01	2,78±0,01	3,46±0,01
6	pentadecenic acid	$C_{15:0}$	0,34±0,01	0,27±0,01	0,34±0,01	0,27±0,01
7	palmic acid	$C_{16:0}$	34,30±0,01	29,70±0,01	26,15±0,01	31,15±0,01
8	margaric acid	$C_{17:0}$	0,43±0,01	0,45±0,01	0,60±0,01	0,23±0,01
9	stearic acid	$C_{18:0}$	3,59±0,01	6,11±0,01	5,52±0,01	5,17±0,01
10	arachidonic acid	$C_{20:0}$	-	-	-	-
11	heneicosanoic acid	$C_{21:0}$	0,16±0,01	1,20±0,01	0,35±0,01	0,20±0,01
Branched fatty acids						
1	Iso-myristic acid	$C_{14:0}$	-	0,13±0,01	-	0,25±0,01
2	Iso-palmic acid	$C_{16:0}$	-	0,11±0,01	-	-
3	Iso-margaric acid	$C_{17:0}$	-	-	0,25±0,01	0,15±0,01
4	Iso-stearic acid	$C_{18:0}$	-	-	0,10±0,01	0,17±0,01
Monounsaturated fatty acids						
1	myristoleic acid	$C_{14:1}$ω 5	0,26±0,01	0,31±0,01	0,10±0,01	0,18±0,01
2	10- pentadecenic	$C_{15:1}$ω 5	-	-	0,13±0,01	0,07±0,01
3	7-hexadecenoic acid	$C_{16:1}$ω 9	0,26±0,01	-	0,46±0,01	0,32±0,01
4	palmitoleic acid	$C_{16:1}$ω 7	5,87±0,01	4,89±0,01	4,96±0,01	5,25±0,01
5	10-heptadecenoic acid	$C_{17:1}$ω 7	0,52±0,01	0,46±0,01	0,59±0,01	0,42±0,01
6	oleic acid	$C_{18:1}$ω 9	35,18±0,01	36,28±0,01	33,81±0,01	34,20±0,01
7	vaccenic acid	$C_{18:1}$ω 7	4,0±0,01	1,55±0,01	1,85±0,01	2,30±0,01
8	gondoinic acid	$C_{20:1}$ω 9	0,19±0,01	0,51±0,01	0,53±0,01	0,15±0,01
Polyunsaturated fatty acids						
1	linoleic acid	$C_{18:2}$ω 6	5,72±0,01	6,60±0,01	16,96±0,01	12,24±0,01
2	γ - linolenic	$C_{18:3}$ω 6	0,02±0,01	0,1±0,01	0,08±0,01	0,27±0,01
3	α- linolenic	$C_{18:3}$ω 3	3,33±0,01	6,72±0,01	4,1±0,01	3,25±0,01
4	arachidonic acid	$C_{20:4}$ω 6	0,32±0,01	0,20±0,01	0,11±0,01	0,12±0,01

As can be seen from Table.1, horse fat samples content of saturated fatty acids (from myristic to capric) $C_{10:0}$ - $C_{14:0}$, $C_{18:0}$ (stearic) are in a small amount, also observed a small amount of branched fatty acids (0.1 -0.25%). Only palmitic acid $C_{16:0}$ is present in the fats of the test samples in significant quantities in the autumn-winter period 31.15 and 34.30%; decreases in summer - 26.15%.

Of the monounsaturated fatty acid content of horse fat acids $C_{14:1}$ ω 5, $C_{16:1}$ ω 9, $C_{17:1}$ ω7 and $C_{20:1}$ ω9 varies by season slightly from 0.1 to 0.59%, it should be noted, the higher the content of palmitoleic $C_{16:1}$ ω7 acid (4,89-5,87%) and high levels in all seasons oleic $C_{18:1}$ ω9 acid (33.81 - 36.28%).

It was established that the main part of the polyunsaturated fatty acids in equine fat is linoleic acid (ω6), which varies slightly in the winter-spring period (5,72-6,60%) and reaches a maximum in the autumn and summer (12,24 and 16 , 96%), respectively. There is also a large number (9,11-0,32), arachidonic ($C_{20:4}$, 5,8,11,14- eicosatetraenoic acid), which also refers to the ω6 essential fatty acids.

Polyunsaturated fatty acids from fat horse, we managed to divide the capillary column linolenic acid $C_{18:3}$ on the two

isomers: α-isomer (6,9,12 octadecatrienoic) ω6 acid and (α isomer octadecatrienoic 9,12,15) ω3.

As seen from Table 1, the essential polyunsaturated γ-linolenic acid (ω3) present in all samples by seasons in a significant amount (3,25-6,72%) and γ-linolenic acid in quantities (0,02-0, 27%).

Table 2 is a summary of the quantitative content of acids, divided into groups (unsaturated, monounsaturated and polyunsaturated) acids in equine fat.

TABLE II
THE FATTY ACIDS CONTENT IN HORSE FAT

№	Fatty acids groups	Contents seasonal year,%			
		winter	spring	Summer	autumn
1	Saturated, incl .:	44,33	42,37	36,28	41,23
	n- acid	44,33	42,13	35,53	40,83
	branched - iso, anteiso	-	0,24	0,35	0,40
2	Unsaturated, incl .:	55,67	57,63	63,70	58,77
	monounsaturated	46,28	44,00	42,42	42,89
	monounsaturated ω9 incl .:	35,63	36,79	34,80	34,67
	polyunsaturated, incl .:	9,39	13,63	21,28	15,88
	diene	5,72	6,60	16,96	12,24
	trienoic acid	3,35	6,83	4,21	3,52
	tetraene	0,32	0,20	0,11	0,12
3	essential polyunsaturated				
	ω 6, incl .:	6,06	6,91	17,15	12,63
	linoleic	5,79	6,60	16,96	12,24
	γ- linoleic	0,02	0,11	0,08	0,27
	arachidonic acid	0,32	0,20	0,11	0,12
	ω 3, incl .:	3,33	6,72	4,13	3,25
	α- linoleic	3,33	6,72	4,13	3,25

As seen from Table. 2, the variation of the total content of unsaturated and saturated fatty acids are significant: reduced saturated fatty acid content in the summer, at 6.09% (from 42.37% to 36.28% spring to summer) and correspondingly increased content of unsaturated acids and 6.07% (from 57.63% to 63.70% until spring to summer). Unsaturated acids small changes in the group of monounsaturated acids - increases in the winter, at 3.86% (from 42.42% to 46.28% in summer in winter). The total content of essential polyunsaturated fatty acids (PUFAs) in summer significantly increased by 11.89% (from 9.39% to 21.28% in winter in summer).

IV. Conclusion

Thus, samples horse fat year period, the detected maximum content of essential polyunsaturated ω-6 fatty acids (17.15%), unlike the winter sample (6.06%), the amount of ω-3 fatty acids (α-linolenic acid) changes seasonal : increases in the spring to 3.32% in winter to 6.72% in the spring), there is a high content of ω 9 monounsaturated acid $C_{18:1}$ (oleic) from 33.81 to 36.28% in the summer in the spring.

Refferences

[1] Zabodalova L.A. Functional foods - way to health /Milk processing. 2006. №11

[2] Levitsky A.P. The ideal formula of fatty food / Odessa: "Odessa Biotechnology", 2002-61p.

3. GOST 51483-99 "Vegetable oils and animal fats. Determination by gas chromatography mass of methyl esters of individual fatty acids to their sum "

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