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FATTY ACID COMPOSITION OF MILK FROM TETEVEN NATIV SHEEP IN MOUNTAIN REGION

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Communication

Abstract: The study was performed on individual milk samples obtained on the monthly basis during the lactation period from 5 Teteven sheep reared in the Sredna Stara Planina mountain region. The fat extraction of milk samples was done by the Rose-Gottlieb method. Fatty acid composition was determined on a gas chromatograph with flame ionization detector and capillary column. The trends in fatty acid concentrations in sheep milk during the lactation were variable. The proportion of saturated fatty acids in Teteven sheep milk during the lactation was relatively high and varied from 70.34 to 72.19%. Variations in myristic acid concentrations by months were not significant (11.49–11.83%). The total amount of polyunsaturated fatty acids in the studied milk was relatively low and with similar values for the 4 months spent on pastures (3.78-4.11%). For this period, monounsaturated fatty acids, represented mainly by oleic acid (C18:1) decreased from 25.76 to 24.20%. The short-chain fatty acid concentrations were the highest in milk samples obtained in April and May, of medium-chain ones – in June and July, whereas long-chain fatty acids concentrations were similar over the grazing period.

Key words: sheep milk, milk fat, fatty acids

Introduction

Sheep husbandry is oriented to production of milk with high protein and milk fat content. Taking into consideration the effect of unsaturated fatty acid on human organism *(Parodi, 1999; Ryali et al., 1999; Jarheis, 2000)* the research was further focused on milk fat profile. *Signorelli et al. (2008)* did not observe any differences in the polyunsaturated fatty acid content in milk fat of native Italian breeds, including conjugated linoleic acid (CLA) concentrations. Having studied milk fat composition in Spanish Churra sheep, *Sanchez et al. (2010)* established a low inheritance with regard to saturated and monounsaturated fatty acid content and a potential for genetic variation in polyunsaturated fatty acid content.

Feeding appropriate rations could alter the fat content of sheep milk *(Addis et al., 2005)*. Changes in sward composition also influence the seasonal fatty acid content of milk fat *(Nudda et al., 2005)*. Apart fresh grass feed, sunlight exposure was reported to result in high short-chain fatty acid levels, higher lauric, myristic and stearic acid concentrations and to reduction in oleic, linoleic and linolenic acids *(Agustino et al. 2002)*.

The purpose of this investigation was to monitor the changes in milk fatty acid content during the lactation period of native Teteven sheep reared in Sredna Stara Planina region, with regard to milk fat quality evaluation.

Materials and Methods

The milk fatty acid profile in the local Teteven breed of sheep during the grazing period was studied. Five ewes at similar age and at their third month of lactation were grazed on natural pasture without concentrate. Sampling began immediately after weaning and was performed four times in a monthly interval. Samples were taken from the morning milk only and were stored at – 20 ºC. Milk fat extraction was done in the laboratory of the Dairy Science Unit at the Faculty of Agriculture, Trakia University, Stara Zagora by the method of Rose-Gottlieb. Methyl esters of fatty acids were separated on a gas chromatograph "Pay-Unicam 304" equipped with flame ionization detector and capillary column EC^{TM}-WAX, 30 m, ID 0.25 mm, Film: 0.25 μm.

Data were statistically processed by Statistica for Windows (Release, 4.3, Stat. Soft. Inc., 1994), and means were compared by Student's t-test.

Results and Discussion

Table 1 presents the results for saturated fatty acid content in the milk of Teteven sheep. Butyric acid (C4:0) concentrations decreased from April to July), while C6:0 levels increased from April to June and decreased in July. Caprilyc acid (C8:0) was high during the first two months (April and May) and decreased until July. Variations in C10:0 concentrations were not significant. Milk fat C4:0, C6:0 and C8:0 concentrations were higher than those reported for Karakachan sheep *(Mihaylova et al., 2008)* and sheep of the Srednostaroplaninska breed reared in the Sredna Stara Planina mountain *(Gerchev et al., 2011)*, but the tendency of change over the lactation was similar, probably due to the different pasture sward.

Lauric acid (C12:0) levels persisted high during the entire period and tended to decrease in July (Table 1). In May and June, only traces of C13:0 could be found. Myristic acid (C14:0) in Teteven sheep milk was almost equal during the entire period of the study. The amount was significantly higher than values reported for Karakachan and Tsigay sheep breeds *(Mihaylova et al., 2008; Gerchev*

and Mihaylova, 2009) and similar with the Srednostaroplaninska sheep breed *(Gerchev et al., 2011)*. Palmitic acid (C16:0) concentrations decreased in May and then increased until July. Among saturated fatty acids with odd number of carbon atoms, C15:0 variations were inconsistent whereas C17:0 tended to increased from April until July. Stearic acid (C18:0) levels showed the same trend of change as margaric acid (C17:0) – increase from April to July. The concentrations of C16:0, C17:0 and C18:0 in Teteven sheep milk were considerably higher than those reported in Karakachan and Tsigay sheep *(Mihaylova et al., 2008; Gerchev and Mihaylova, 2009)* and similar with the Srednostaroplaninska sheep breed *(Gerchev et al., 2011)*.

Table 1. Saturated fatty acids content

Fatty acids	April		May		June		July	
	x	Sx	x	Sx	x	Sx	x	Sx
C4:0	4.335**	0.362	3.953	0.213	3.383	0.493	2.690**	0.070
C6:0	2.476*	0.087	3.185	0.199	3.496*	0.399	2.692	0.242
C8:0	3.104	0.500	3.359	0.246	2.643	0.298	2.566	0.299
C10:0	5.994	0.408	6.160	0.600	5.302	1.241	6.090	0.247
C12:0	4.054	0.296	4.184	0.181	3.542	0.361	3.405	0.192
C13:0	-		0.186	0.087	-		0.022	0.012
C14:0	11.491	0.323	11.699	0.275	11.833	0.371	11.816	0.530
C15:0	0.562	0.104	0.846	0.196	0.545	0.057	0.751	0.081
C16:0	25.678	0.532	23.815	0.444	25.863	1.385	27.871	0.484
C17:0	0.700	0.270	1.072	0.500	1.345	0.113	1.261	0.086
C18:0	12.037	0.456	12.612	0.396	12.388	0.608	13.030	0.387

*p<0.05
**p<0.001

The content of unsaturated fatty acids – C10:1 and C12:1 in milk fat was low and changed inconsistently during the lactation months, whereas C14:1 was determined at low amounts by the beginning of lactation and in June (Table 2). The change in palmitoleic acid (C16:1) in studied samples tended to decrease slightly in May, April and then increased until the end of lactation. Milk fat oleic acid (C18:1) concentrations were gradually decreasing and reached the lowest value by lactation end. The percentage of C18:1 was the highest at the beginning of the grazing period. In many studies performed during grazing period, a positive correlation was found between C18:1 and conjugated linoleic acid (CLA) concentrations, with C18:1, particularly some isomers, are substrate for CLA synthesis.

Table 2. Unsaturated fatty acids content

Fatty acids	April		May		June		July	
	x	Sx	x	Sx	x	Sx	x	Sx
C10:1	0.273*	0.027	0.220	0.023	0.058	0.055	0.191*	0.016
C12:1	0.048	0.006	0.023	0.016	0.022	0.015	0.051	0.016
C14:1	0.018*	0.014	-	-	0.398*	0.090	-	-
C16:1	0.448	0.147	0.414	0.130	0.543	0.187	0.646	0.131
C18:1	24.973*	0.381	24.402	0.426	23.996	0.254	23.315*	0.557
C18:2	2.414	0.168	2.593	0.141	2.589	0.081	2.798	0.380
C18:3	1.369	0.112	1.408	0.090	1.257	0.108	1.312	0.108

* $p<0.05$

Polyunsaturated linoleic fatty acid (C18:2) increased during the lactation but the alterations in linolenic acid (C18:3) were various. The levels of these two acids in the milk of Karakachan, Tsigay and Srednostaroplaninska sheep breeds reared in Rhodopes and Stara planina mountains, were higher than those in Teteven sheep *(Mihaylova et al., 2006; Mihaylova et al., 2008; Gerchev et al., 2011)*.

The content of main fatty acid groups is shown n Table 3. The total amount of saturated fatty acids (SFA) during lactation was high and ranged from 70.07% in May to 72.19% in July. Monounsaturated fatty acid levels (MUFA) were higher at the beginning of lactation (April-June) and decreased in July. Polyunsaturated fatty acids (PUFA) remained with similar values over the entire lactation period. A similar ratio of the fatty acid groups in the milk of Pleven Blackhead sheep was observed by *Alexiev (2010)*. MUFA are beneficial for people with coronary and cardiovascular diseases, the effect of PUFA is similar but they are more prone to oxidation due to the higher degree of unsaturation.

Short-chain fatty acid content (Table 3) was the highest in milk produced during April and May, of medium-chain fatty acids – in June and July, and long-chain fatty acids maintained stable concentrations during the entire lactation period. The time course of short- and medium-chain fatty acids corresponded to results reported for the milk of Karakachan and Tsigay sheep reared in Rhodopes and Sredna Stara Planina mountains *(Mihaylova et al., 2006; Mihaylova et al., 2008)*, whereas the concentrations of long-chain fatty acids was lower.

Table 3. Groups of fatty acids in milk from sheep

	April		May		June		July	
Fatty acid groups	x	Sx	x	Sx	x	Sx	x	Sx
Σ SFA	70.43	3.338	71.07	3.337	70.34	4.928	72.19	2.630
Σ MUFA	25.76	0.575	25.06	0.595	25.02	0.601	24.20	0.720
Σ PUFA	3.78	0.280	4.00	0.231	3.85	0.189	4.11	0.488
Σ C4:0-C11:0	15.91	1.357	16.30	1.258	14.83	2431	14.04	0.858
Σ C12:0-C16:1	41.30	1.422	41.17	1.299	42.89	2.466	44.56	1.436
Σ C17iso-C25:0	41.49	1.164	42.09	1.553	41.57	1.164	41.72	1.518

The milk of Teteven sheep was characterized with high concentrations of saturated fatty acids and respective lower levels of MUFA and PUFA. These results correspond to what was reported by *Alexiev (2010)* in Pleven Blackhead sheep milk and the results of *Gerchev et al. (2011)* for Staroplaninska sheep milk. The omega-6/omega3 ratio, which is important for healthy diets, is low and gradually increased over the lactation – from 1.76 in April to 2.13 in July. The milk fat atherogenic index changed from 2.38 in April to 2.55 in July. The biologically important PUFA/SFA ratio (also called P/S ratio) of sheep milk is low and changed insignificantly: from 0.054 in the beginning of grazing to 0.057, proving that the changes in milk fat content over the grazing period were small and in general, maintained a balanced level. The observed ratios of fatty acids in Teteven sheep milk were considerably lower than those reported in Karakachan and Tsigay sheep breeds reared in the same region *(Mihaylova et al., 2008; Gerchev and Mihaylova, 2009)*. This could be probably attributed to the higher content of SFA and could be interpreted as a specific feature of this sheep breed.

Conclusion

The proportion of saturated fatty acids in Teteven sheep milk during the lactation was relatively high and varied from 70.34 to 72.19%. Myristic acid concentrations ranged between 11.49% and 11.83%)

The total amount of polyunsaturated fatty acids in the studied milk was relatively low and with similar values for the months spent on pasture (3.78-4.11%). Monounsaturated fatty acids, represented mainly by oleic acid (C18:1) decreased from 25.76 to 24.20%.

The short-chain fatty acid concentrations were the highest in milk obtained in April and May, of medium-chain ones – in June and July, whereas long-chain fatty acids concentrations were similar over the grazing period.

Sadržaj masnih kiselina u mleku ovce tetevenske rase

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Rezime

Istraživanja su sprovedena na individualnim uzorcima mleka dobijenih mesečnim prikupljanjem u toku laktacije 5 ovaca rase Teteven u regionu Srednje Stare planine. Ekstrakcija masti iz uzoraka mleka radjena je Rose-Gottlieb metodom. Sadržaj masnih kiselina određen je gasnim hromatografom sa plamen jonizacionim detektorom i kapilarnim kolonama.

Nivo masnih kiselina u ovčijem mleku u periodu laktacije bio je veoma varijabilan. Udeo zasićenih masnih kiselina u mleku Teteven ovce u periodu laktacije bio je relativno visok i varirao je od 70.34 do 72.19%. Varijacije u koncentraciji miristinske kiseline po mesecima nisu bile značajne (11.49–11.83%).

Ukupna količina poli-nezasićenih masnih kiselina u ispitivanom mleku bila je relativno niska i ujednačena u ispitivanom pašnom periodu (3.78-4.11%). Za ovaj period, mono-nezasićene masne kiseline, koje su predstavljene uglavnom sa oleinskom kiselinom (C18:1) su se smanjile od 25.76 do 24.20%.

Koncentracija masnih kiselina kratkog lanca bila je najveća u uzorcima mleka uzetih u aprilu i maju, srednjeg lanca u junu i julu, dok je koncentracija masnih kiselina dugog lanca bila jednaka tokom čitavog pašnog perioda.

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