THE IMPROVEMENT OF QUALITY OF SLOVAK EWE MILK BASED ON THE CONTENT OF HEALTH AFFECTING FATTY ACID COMPOUNDS

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Abstract

Objective of this study was to determine the content of 70 C4-C24 fatty acids (FA) in bulk milk samples of Slovak grazed ewes at 4 farms during pasture and winter seasons. The effect of individuality, breed, lactation stage and parity of grazed ewes was investigated in 328 Tsigai, Valachian and Lacaune ewes, milk samples were taken on the same day. The content of individual FA in milk samples and pasture plants during entire pasture season was determined by GC. Unseparated isomers of conjugated linoleic acid (CLA) were resoluted by chemometric deconvolution. The FA content in milk fat of grazed ewes was higher up to 4-fold for CLA, 3-fold for trans-vaccenic acid (TVA), and 2-fold for α-linolenic acid (ALA) compared to that during winter diet. The content of CLA (3.2%) and TVA (7.2%) in milk fat of grazed ewes was higher than that in milk of pasture grazed ewes or cows published previously. Both CLA and TVA contents in milk fat decreased from May to mid-summer and then increased until mid-September to the content as that in May. The variations in CLA content in milk fat during pasture season are primarily related to the ALA content in pasture. The FA milk profile of cows grazing on Alpine pastures is rather similar to that of Slovak grazed ewes despite different forage and altitude. The second most abundant CLA *trans*-11,cis-13 isomer in cows' milk proposed as an indicator of milk products of Alpine origin was found also in milk of Slovak ewes grazing the pastures in altitude of 250-800 m. Further improvement in quality of ewe milk can be achieved by selecting individual ewes with higher CLA milk fat content (up to 5-fold inter-individual variation) and milk yields (up to 12-fold) and by oversowing pastures.

1. Introduction

The fatty acid (FA) profile of raw milk influences the nutritional and health characteristics of milk products. Milk FA have various effects on human health. The quality of dietary lipids could be an important modulator of the morbidity and mortality associated with obesity, arteriosclerosis, diabetes, hypertension, hyperlipidemia and cancer [Nagao and Yanagita, 2005]. Conjugated FA have attracted considerable attention because of their potentially beneficial biological effects of attenuating these diseases. An increasing interest in enhancing the conjugated linoleic acid (CLA) content in food products arises from its potential anti-carcinogenic, anti-atherogenic, anti-diabetic, anti-obesity, and immunomodulatory functions observed in animal models. Polyunsatured fatty acids (PUFA), such as linoleic acid (LA, 18:2, n-6), α-linolenic acid (ALA, 18:3, n-3) and arachidonic acid (AA, 20:4, n-6) being essential FA are very important for maintaining biological functions in mammalians. The intake of n-3 highly unsaturated FA, such as eicosapentaenoic acid (EPA, 20:5, n-3) and docosahexaenoic acid (DHA, 22:6, n-3), correlates with a reduced risk of cancer and cardiovascular disease. On the other hand, some saturated FA, such as myristic acid (MA, 14:0) and palmitic acid (PA, 16:0) and some unsaturated *trans*-FA show adverse effects on health maintenance and disease prevention.

There are several endogenous and exogenous factors affecting the ewes' milk FA profile, such as diet, season, climate, and physiological factors, e.g. individuality of animals, breed, lactation stage and parity. Previous studies were focused mainly on most significant dietary sources of FA variation, whereas the effect of physiological and genetic factors, particularly the effect of individuality of ewes on milk FA profile was investigated to a lesser degree.

The most important product of ewe farming in Slovakia is a bryndza cheese with yearly production about 5 x 10^6 kg. The EC regulation No. 676/2008 of July 16, 2008 registered the name Slovenská bryndza in the Register of protected designations of origin and protected geographical indications. Nevertheless, the detailed composition of individual FA of bryndza cheese has not been established. The FA profile of bryndza cheese corresponds to those in the milk fat this product is being produced from. Therefore, the content of individual 70 C4-C24 FA in milk fat of ewes fed with total mixed ration (TMR) during winter as well as that of ewes grazing on natural pasture (experimental flock of 330 ewes) was measured as bulk milk samples. Effect of individuality ewes as well as breed, parity and milk yield on the milk FA profile was investigated on the similar experimental flock belonging to three breeds- Tsigai, Improved Valachian, and Lacaune. In this case, the milk of grazed individual ewes was sampled on the same day due to the effects of differences in pasture management, pasture botanical composition and plants vegetative stage. The aim of this study was to determine the quality of Slovak ewe milk based on individual FA composition and to investigate options for improvement of ewe milk FA profile of ewes grazing on natural pasture as well as fed with winter diet.

2. Material and Methods

Milk samples collected from ewes bred at Trenčianska Teplá farm were analyzed. This experimental farm kept 330 dairy ewes belonging to three breeds Tsigai, Improved Valachian, and Lacaune with parity 1-8. In winter season from mid-February to mid-April, the ewe basic diet consisted of corn silage (2.5 kg), meadow and Lucerne hay (0.7 kg and 0.3 kg), commercial concentrate feed mixture (0.8 kg), and mineral supplement (0.02 kg). In the grazing season from mid-April to mid-September, the ewes grazed natural pasture and also received a concentrated feed at a dose of 0.2 kg/day during machine milking. The FA composition of bulk ewe milk from the daily milkings was analyzed at least once in a month, and more frequently in milk of ewes fed TMR and at the beginning of the pasture season (April-June). On days of milk sampling during pasture season, also botanical families and main plant species of pasture samples on the content of individual FA were analyzed [Meľuchová et al., 2008]. For evaluation of the effect of ewe individuality on FA profile, individual milk samples from 328 ewes, 1148 Tsigai, 124 Improved Valachian, and 56 Lacaune, grazing pasture were collected on the same day on morning milking. For completion of data evaluation, the bulk milk products of ewes grazed on pasture from Ružomberok, Liptovská Anna, and Tajov farms were studied too.

The lipids from milk samples and dried pasture plant samples were extracted using chloroform-methanol mixture (2:1). The extracts were derivatized by sodium methanolate in methanol and analyzed as methyl esters of fatty acids (FAME). For analysis of FAME capillary gas chromatography with flame ionization detector in capillary column 100 m x 0.25 mm i.d. x 0.25 μm film thickness of CP-Sil 88 as stationary phase was used. Gas chromatographically unseparated CLA isomers, mainly triplet *trans*-7,*cis*-9, *cis*-9,*trans*-11, and *trans*-8,*cis*-10 isomers of CLA, were resoluted by chemometric deconvolution [Blaško et al., 2009]. For quick analysis of milk FA of individual ewes the capillary column 60 m x 0.25 mm i.d. x 0.25 μm film thickness of DB-23 as stationary phase was used.

The contents of individual FA samples in bulk milk were analyzed using a one-way ANOVA statistical package. The data for individual animals were statistically evaluated using a general linear model procedure with nominal variables of breed and parity and continuous variable of milk yield.

3. Results and discussion

The results of GC analysis of individual FA content in bulk milk samples of ewes fed with winter diet (TMR) and those grazed on natural pasture as well as that of pasture plant sample are presented in Table 1. The variations in CLA milk fat content during continuous transition from a period of TMR diet, a period of gradually increased content ratio of pasture /TMR, and a final period of pasture feeding are presented in Fig. 1.

Cis-9,*trans*-11 CLA isomer and *trans*-vaccenic acid (TVA) show most significant more than 5-fold changes in the individual FA milk fat content among ewes fed winter diet and pasture. Ewe feeding with TMR during the first 60 days after lambing, except for colostrum period, resulted almost in consistent individual milk FA content, e.g., CLA 0.65 g 100 g^{-1} in agreement with a quasi-standardized TMR diet. Nevertheless, the ALA content of meadow hay as a part of TMR diet from various cuts of 32 Slovak producers was in broad content range from 14.6 to 53.5% (g 100 g^{-1} FAME). Replacement of meadow hay as a part of TMR diet by that having a higher ALA content (50 g 100 g^{-1} versus 25 g 100 g^{-1}) led to a two-fold increase of CLA (0.65 to 1.22 g 100 g^{-1} FAME) and TVA (1.44 to 2.58 g 100 g^{-1} FAME) content in milk of TMR-fed ewes. Luna et al. (2008) reported a two-fold increase in CLA and TVA contents upon feeding ewes with a TMR diet enriched with flax seed and sunflower oil (CLA 0.47 vs. 0.85 g 100 g^{-1}, and TVA 0.87 vs. 1.72 g 100 g^{-1} FAME). Generally, when compared with previously published data, the estimated CLA milk fat content in our ewes fed with a winter diet (0.65 g 100 g^{-1} FAME) was moderately higher due to more appropriate TMR composition.

Table 1 and Fig. 1 suggest a rise in CLA, TVA and ALA content in milk samples upon transition from a TMR diet to a pasture diet. CLA, TVA and ALA values have been increasing from a TMR period throughout a transition period to the beginning of pasture season (May). The CLA and TVA contents declined later (June-July), however, they rose again to the end of the pasture season from August to mid-September. The composition of FA in the milk of pasture-grazed ewes in September was similar to that at the beginning of pasture season in May. The content of CLA and TVA in milk of ewes grazing fresh pasture at the beginning or at the end of pasture season was up to 4-fold higher and that of ALA was doubled compared with those fed with standard TMR diet. This finding was consistent with a higher ALA content in pasture (60 g 100 g^{-1} FAME) (Fig. 2). Lower CLA (up to 2-fold) and TVA contents in milk fat noted during warm and dry summer (June-July) were associated with the corresponding decrease in ALA content (60 vs. 40 g 100 g^{-1} FAME) in grazed pasture. The about 2-fold increase in CLA and TVA contents in ewes' milk fat noted between the end of July and mid-September was consistent with higher ALA content of pasture grass (60 vs. 40 g 100 g^{-1} FAME).

Similar data on milk FA composition of ewes grazing pasture at Trenčianska Teplá in May and September were also found in other ewe farms in Ružomberok, Liptovská Anna and Tajov (Table 1). Seasonal variations of CLA milk fat content in Ružomberok and Trenčianska Teplá farms shown on Fig. 3 suggest that the effect of summer pasture period on CLA content from Ružomberok farm was not significant because of superior climate conditions associated with higher altitude of pastures (altitude: 800 m vs. 250 m a.s.l.). Ewes grazing pastures with higher altitudes (altitude: 800 m a.s.l.) in North Slovakia showed a more consistent composition of milk FA in the same pasture season. Bearing in mind global warming, the above findings suggest that further development of ewes' milk production should be situated in a northern part of the country at higher altitudes thus providing more good-quality pasture and meadow hay for a dry winter diet as well as more consistent FA composition of ewe milk products with a higher content of health affecting FA compounds (Ostrovský et al., 2009).

The observed CLA-ALA relationships suggest that the variation of CLA milk fat content during pasture season are primarily related to seasonal changes of ALA content in pasture plants. Preliminary pasture reseeding in Trenčianska Teplá farm was accomplished using a common oversowing mixture of seven plant species (32 kg ha^{-1}) (Fig. 4). Pasture reseeding resulted in rel. 8% increase in pasture ALA content in June-July, however, it decreased to a control level throughout pasture season (Meľuchová et al., 2009). In the next season we will investigate optimized oversowing the pasture with *Lolium perenne* and *Trifolium repens* showing quick connection to pasture, high cover and durability growth aimed at increasing the ALA content in pasture.

The FA composition of ewe milk samples collected at 4 Slovak ewe farms (Trenčianska Teplá, Ružomberok, Liptovská Anna and Tajov) (altitude: 250 – 800 m a.s.l.) were compared with published data for cow milk collected at 4 Swiss alpine locations (altitude: 1275 – 2120 m a.s.l.). The milk and cheese contents of CLA, TVA and ALA were found to be rather similar despite significant altitude and botanical differences between these pastures. Consequently, altitude or botanical composition does not serve as a crucial factor for increasing the content of health promoting milk FA. A similar content of ALA in Slovak and Swiss pastures (about 60%) provides comparably high CLA, TVA, and ALA contents in milk products of ewes and cows grazing on pasture. *Trans*-11,*cis*-13 CLA was the second most abundant CLA isomer in milk fat from cows grazing high-altitude Alpine pastures. Therefore, this isomer has been implicated as a useful indicator of milk products of Alpine origin. Nevertheless, we noted identical data for milk of ewes grazing on natural pastures with an altitude range of 250-800 m a.s.l. Partial GC-MS chromatograms of milk FA separation with deconvoluted resolution of CLA isomers of ewes grazing on pasture (CLA content 2.5%) and TMR-fed ewes' milk sample (0.5% CLA) are shown in Fig. 5 (Blaško et al., 2009). The content of *trans*-11,*cis*-13 CLA isomer in milk fat of ewes grazing on pasture is about 3-fold higher than that of *trans*-7,*cis*-9 CLA isomer being normally the second-most abundant CLA isomer in ruminant milk fat as shown on chromatogram for milk of ewes fed with TMR in Fig. 5.

Table 2 (Soják et al., 2009) compares the FA profile of Slovak ewe milk (Tajov) and Swiss cow milk (l'Etivaz 2) (Kraft et al., 2003) both with the highest CLA milk fat content. Importantly, the contents of CLA (3.50%) and TVA (7.85%) in milk fat of ewes grazed on Tajov pasture are higher than those of cows and ewes grazing on pasture published so far (Collomb et al., 2006).

Further improvement in FA milk fat profile can be achieved by selecting individuals from ewes' flock with higher CLA milk fat content and higher milk yield. The current selection of dairy ewes does not consider the content of individual FA in milk fat. The study of the effects of inter-individual variation, breed, parity on milk FA profile and milk yield of individual ewes grazed on pasture of 328 ewes belonging to Tsigai, Improved Valachian, and Lacaune breeds shows how these parameters might affect the composition of individual milk fat FA (Soják et al., 2012). To eliminate confounding dietary and seasonal effects on milk FA profile, the milk of ewes grazed on pasture was sampled on the same day May 16, 2009. On the same day, the highest CLA milk fat content was found in years 2007-2008 (Fig. 6). In addition to diet, ewe individuality is another most important factor significantly affecting the milk FA profile. The CLA milk fat content varied up to 5-fold among individual ewes feeding pasture on the same day (Fig. 7). Of note, the systematic differences in CLA milk fat content between ewe pairs of examined breeds were prevailingly maintained over 16-wk pasture season as well as in previous year (Fig. 8). A profound impact of ewe individuality inhibits a less significant effect of breed and parity on milk FA composition.

Ewe individuality markedly affected milk yield with variations up to 12-fold (Fig. 9). Just like in the previous year, the rank of individual ewes during pasture season based on milk yield was maintained particularly for those with more different milk yield. We found a non-significant inverse relationship between the CLA milk fat content and milk yield (Fig. 10). There seems to be only a trend of decreasing CLA milk fat content with increasing milk yield. Therefore, the ewes with a higher CLA milk fat content and correspondingly higher milk yield should be considered in ewe selection. The annual replacement rate in an experimental ewe flock is 20-25%. Upon eliminating the data for 25% ewes with a lower CLA milk fat content and a lower milk yield, the average CLA milk fat content increased approximately by 10% while keeping the milk yield. In the case of higher starting CLA milk fat content this increase should be even higher. On the other hand, the average milk yield increased approximately by 15% while keeping the average CLA milk fat content.

4. Conclusions

The contents of CLA and TVA in milk fat of pasture-grazed ewes belong to the highest ever published for ruminant animals. They decreased in lowland pastures during summer months, and increased again at the end of pasture season up to the levels noted at the beginning of the season. The seasonal variations in milk FA contents were related to those of ALA content in pasture. The strategies aimed at increasing CLA milk fat content in ewes fed with a winter diet through replacing the meadow hay as a part of a winter diet with that having a higher ALA content, and in those grazing on pasture through reseeding pasture with plant species with a higher ALA content were investigated. In addition to diet, ewe individuality is another important factor significantly affecting the CLA milk fat content. Ewe individuality significantly affected milk yield too. Upon consideration of statistically not significant relationship between the CLA milk fat content and milk yield, the animals with a higher CLA milk fat content and a correspondingly higher milk yield should be considered in ewe selection for improving milk quality in experimental ewe flock. The ewe selection based on a single milk sample for each ewe on the same day from the experimental grazed flock was substantiated by prevailing maintenance of the systematic differences in CLA milk fat content as well as milk yield of individual ewes during pasture season as well between pasture seasons.

Acknowledgement

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Figures and Tables

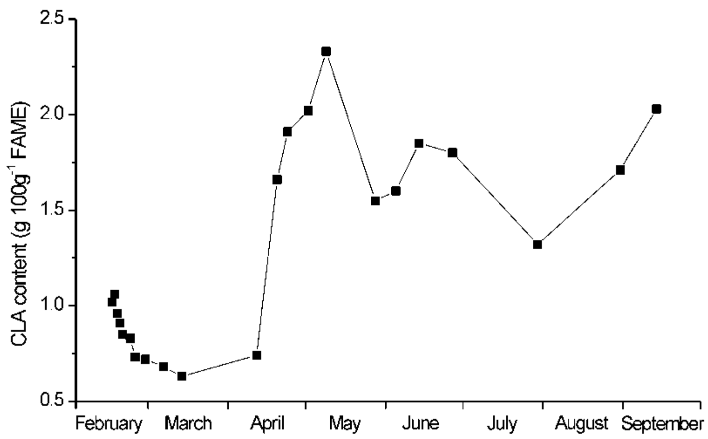

Fig. 1. Temporal variations in CLA milk fat content of ewes during a period of TMR diet, a period of gradually increased content ratio of pasture / TMR diet, and a period of pasture feeding in Trenčianska Teplá farm.

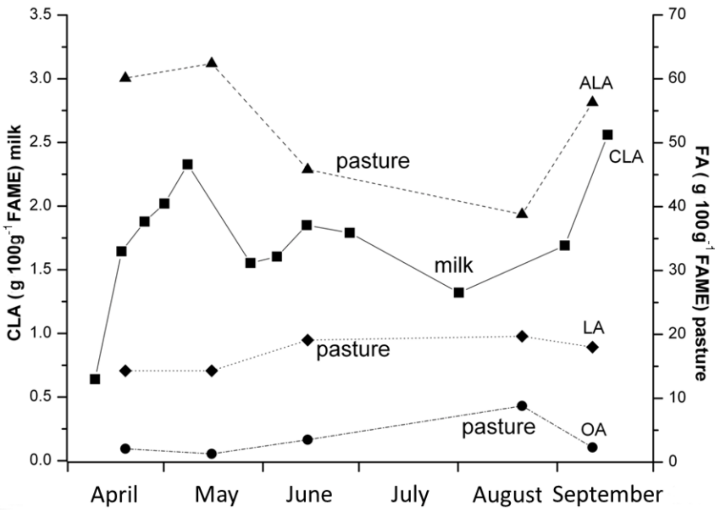

Fig. 2. Temporal variations in the content of CLA in ewe milk fat and content of α-linolenic (ALA), linoleic (LA) and oleic (OA) acids in pasture samples during pasture season in Trenčianska Teplá.

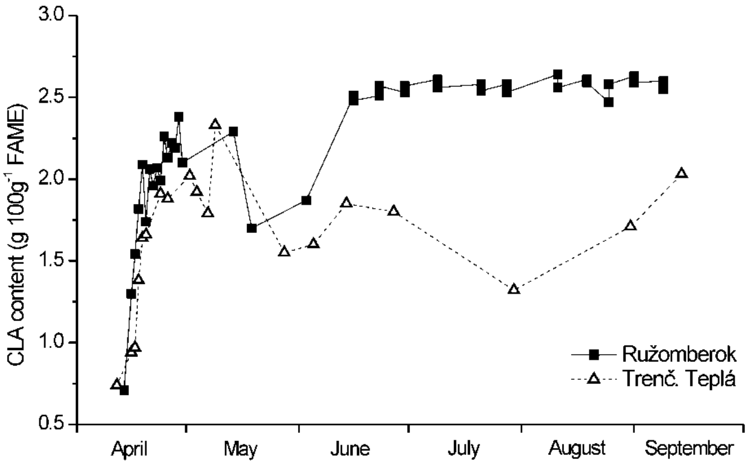

Fig. 3. Temporal variations in the content of CLA ewe milk fat during pasture season in ewe farm Trenčianska Teplá (250 m a.s.l.) and Ružomberok farm (800 m a.s.l.).

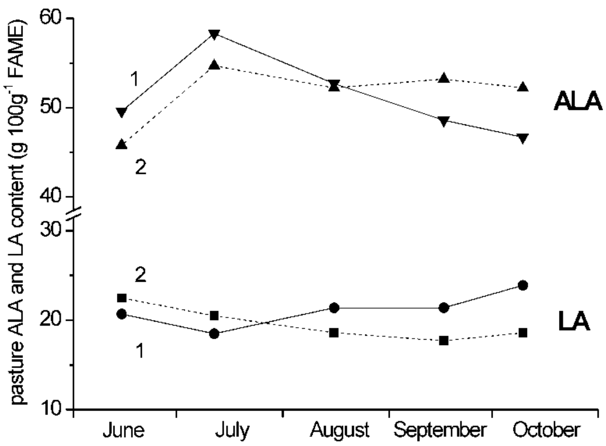

Fig. 4. Temporal variations in the content of ALA and LA of pasture after reseeding the plants mixture compared with the control pasture in Trenčianska Teplá in 2008, 1 – oversowing pasture, 2- control pasture.

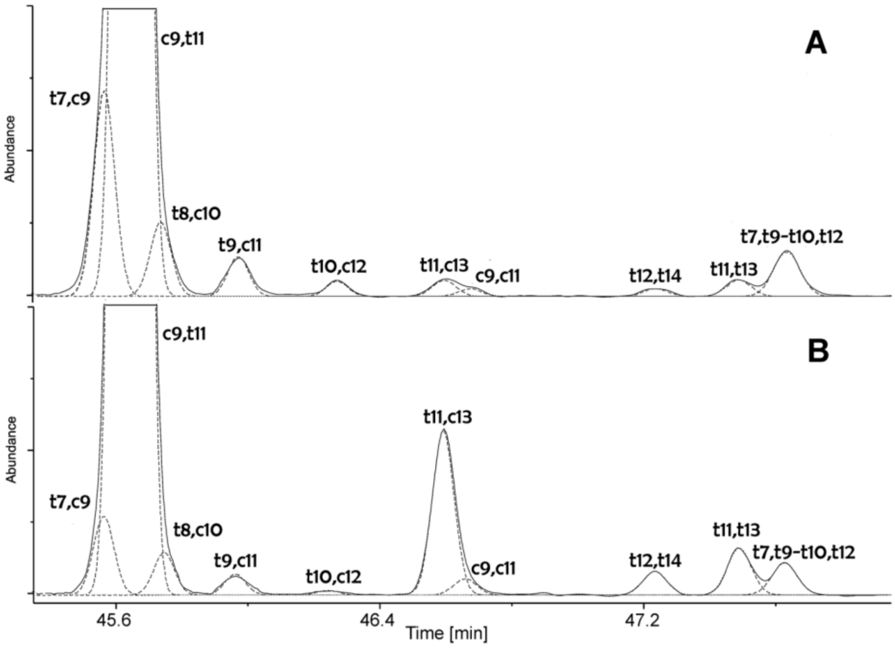

Fig. 5. Partial GC-MS chromatograms of FA separation with deconvoluted resolution of CLA isomers (doted lines) from Trenčianska Teplá farm. A – milk sample of ewes grazing on pasture (CLA content 2.5%), B – milk sample of ewes fed TMR (CLA content 0.5%).

Month/year	Average daily temperature [°C]			Average daily rainfall [mm]			Average CLA content [g 100g^{-1}]		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
April	11.0	10.0	12.5	0.1	1.5	0.4	2.00	1.02	2.00
May	16.4	14.8	14.5	3.0	1.8	2.0	2.30	1.93	1.70
June	18.6	19.0	16.5	3.5	2.6	5.2	1.65	1.47	2.00
July	19.4	19.2	19.8	2.3	3.5	3.0	1.32	1.64	2.05
August	19.4	18.3	19.5	2.5	2.6	1.8	1.71	2.01	1.88

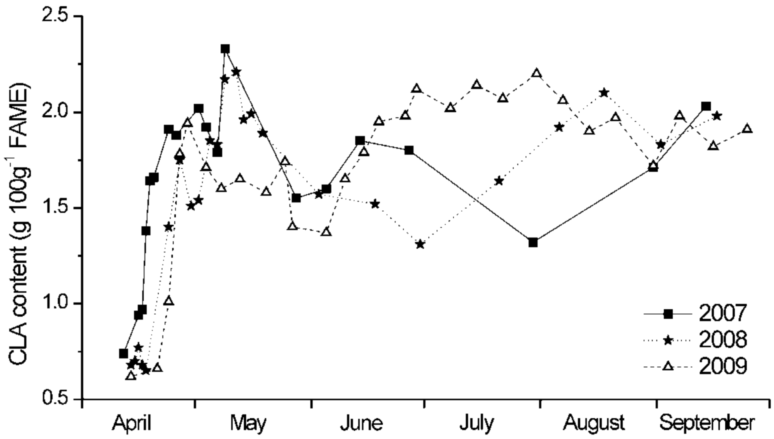

Fig. 6. Temporal variations of average daily temperature, average daily rainfall, and average CLA milk fat content during pasture season of years 2007, 2008 and 2009 in Trenčianska Teplá farm.

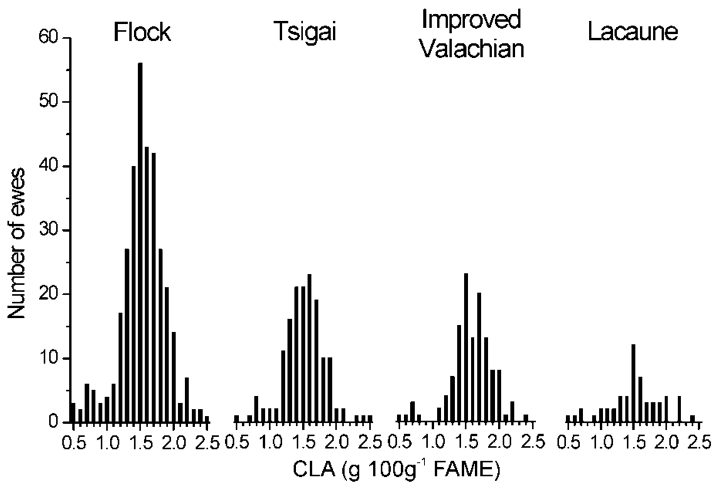

Fig. 7. Frequency distribution for CLA milk fat content of 328 individual ewes of flock and 148 Tsigai, 124 Improved Valachian, and 56 Lacaune breeds on May 16, 2009 in Trenčianska Teplá farm.

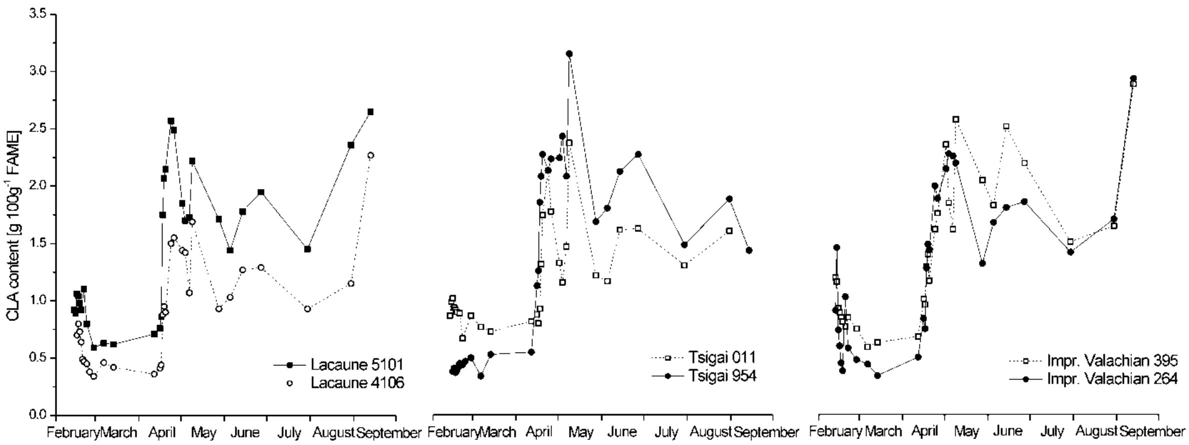

Fig. 8. Temporal variations in CLA milk fat content of pairs Lacaune, Tsigai and Improved Valachian ewes with most different CLA milk fat contents (from 15 investigated ewes) during continuous transition from dry winter to natural pasture diet.

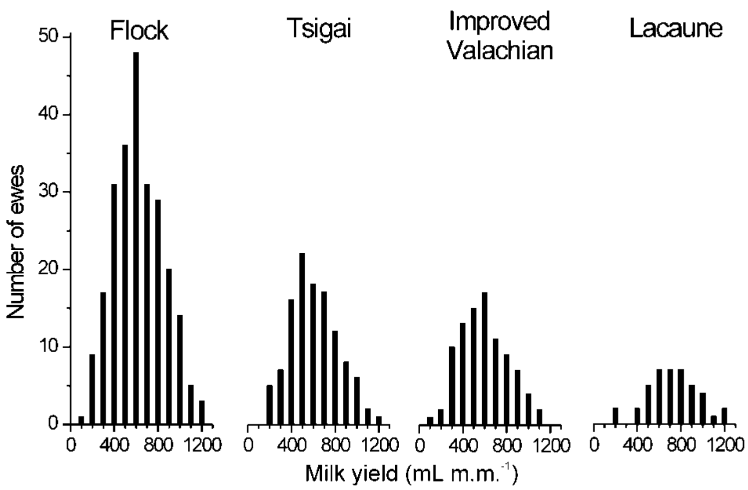

Fig. 9. Frequency distribution for milk yield (mL morning milking) of 328 individual ewes of flock and 148 Tsigai, 124 Improved Valachian, and 56 Lacaune breeds on May 16, 2009 in Trenčianska Teplá farm.

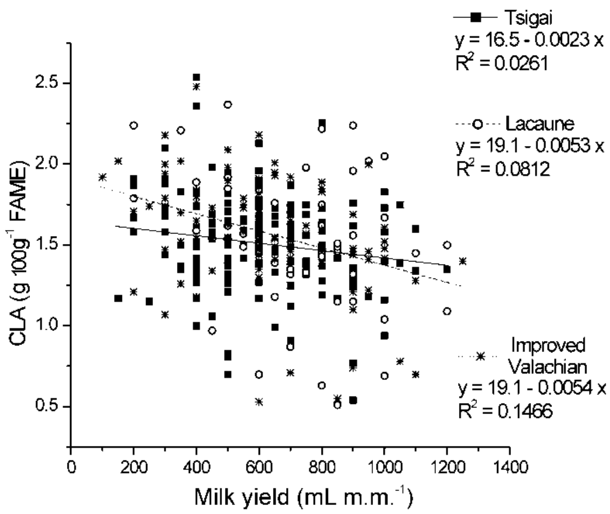

Fig. 10. Relationship between CLA milk fat content and yield of morning milk of 328 individual ewes 148 Tsigai, 124 Improved Valachian, and 56 Lacaune breeds on May 16, 2009 in Trenčianska Teplá farm.

Table 1. Milk fatty acid composition of ewes fed TMR, hay TMR aditived, grazing on pasture in Trenčianska Teplá, Ružomberok, Tajov, and in pasture plants

	TMR	TMR+hay	Trenč. Teplá		Ružomberok	Tajov	Pasture (T. Teplá)
			May	July	July	May	May
C4:0	3.31	2.58	4.05	2.25	2.83	2.42	-
C6:0	2.43	2.58	2.84	1.29	1.75	1.91	-
C9:0	0.04	2.69	0.04	0.04	1.46	1.78	-
C8:0	2.23	0.08	2.78	1.01	0.04	0.04	-
C10:0	6.82	8.50	8.45	3.32	4.53	5.93	0.04
C10:1	0.16	0.02	0.25	0.15	0.01	0.01	-
C11:0	0.08	0.10	0.11	0.03	0.05	0.06	-
C12:0	4.01	4.41	4.80	2.38	2.67	3.27	0.12
C12:1	0.02	0.04	0.03	0.09	0.02	0.03	-
iso-C13:0	0.06	0.10	0.07	0.05	0.07	0.09	-
C13:0	0.09	0.09	0.11	0.08	0.08	0.07	-
iso-C14:0	0.11	0.12	0.12	0.13	0.14	0.15	-
C14:0 (MA)	9.21	8.84	9.92	9.72	8.50	9.61	0.42
C14:1	0.10	0.17	0.16	0.20	0.13	0.16	0.01
iso-C15:0	0.27	0.34	0.39	0.43	0.36	0.36	-
anteiso-C15:0	0.37	0.36	0.67	0.57	0.65	0.70	-
C15:0	0.83	0.76	1.14	1.23	1.18	1.18	0.11
C15:1	0.05	0.03	0.12	0.14	0.15	0.13	-
iso-C16:0	0.27	0.24	0.29	0.27	0.31	0.30	-
C16:0 (PA)	22.85	21.65	18.05	24.82	22.15	21.73	15.16
6-8t-C16:1	0.08	0.18	0.61	0.27	0.53	0.69	-
9-11t-C16:1	0.34	0.42	0.39	0.40	0.55	0.40	-
c9-C16:1	0.71	1.19	0.72	1.11	0.74	0.79	2.01
c11-C16:1	0.05	0.06	0.01	0.02	0.02	0.02	0.03
iso-C17:0	0.52	0.54	0.61	0.60	0.55	0.56	-
anteiso-C17:0	0.47	0.49	0.55	0.48	0.45	0.49	-
C17:0	0.66	0.70	0.76	0.83	0.82	0.78	0.17
C17:1	0.26	0.46	0.22	0.38	0.23	0.26	0.05
iso-C18:0	0.09	0.12	0.04	0.07	0.06	0.06	-
C18:0	12.01	6.26	9.66	12.30	11.52	10.54	1.58
t6-t8-C18:1	0.10	0.18	0.08	0.07	0.18	0.19	-
t9-C8:1	0.14	0.26	0.12	0.10	0.21	0.24	-
t10-C18:1	0.35	0.63	0.21	0.14	0.36	0.18	0.15
t11 C18:1 (TVA)	1.44	2.58	4.68	1.70	5.87	7.85	-
t12/c6-8-C18:1	0.24	0.31	0.21	0.09	0.44	0.29	-
c9/c10-C18:1 (OA)	21.43	22.95	17.16	24.19	17.53	15.52	2.55
c11/t15-C18:1	0.66	0.65	0.51	0.57	0.70	0.55	0.29
c12-C18:1	0.36	0.36	0.27	0.26	0.26	0.16	-
c13-C18:1	0.09	0.12	0.13	0.08	0.15	0.14	-
c14-C18:1+9t12t-C18:2	0.36	0.28	0.61	0.52	0.81	0.63	-
C18:2	0.35	0.36	0.66	0.55	0.59	0.41	-
c9t12-C18:2	0.11	0.17	0.16	0.16	0.20	0.13	-
t9tc12 + t11c15-C18:2	0.08	0.12	0.13	0.08	0.08	0.09	-
C18:2 n-6 (LA)	2.77	3.15	2.43	2.75	3.05	2.12	16.48
t11c15-C18:2	0.14	0.09	0.11	0.11	0.10	0.07	-
c9c15-C18:2	0.04	0.04	0.09	0.08	0.13	0.09	-
C18:3 n-6	0.02	0.01	0.03	0.02	0.01	0.02	-
C19:0+C18:2	0.13	0.10	0.12	0.15	0.05	0.03	-
C18:3+cyclo C18	0.14	0.11	0.22	0.29	0.11	0.11	-
C18:3 n-3 (ALA)	0.52	0.56	1.08	1.57	1.72	1.01	58.96
t7c9-C18:2	0.020	0.04	0.03	0.04	0.04	0.06	-

Table 1. continuous

	TMR	TMR+hay	Trenč. Teplá		Ružomberok	Tajov	Pasture (T. Teplá)
			May	July	July	May	May
c9t11-C18:2 (CLA)	0.65	1.22	2.49	1.21	2.62	3.50	-
t8c10-C18:2	0.01	0.02	0.01	0.02	0.01	0.02	-
t9c11-C18:2	0.005	0.011	0.006	0.006	0.011	0.001	-
t10c12-C18:2	0.001	0.002	0.002	0.001	0.003	0.008	-
t11c13-C18:2	0.006	0.003	0.04	0.020	0.07	0.12	-
c9c11-C18:2	0.005	0.006	0.003	0.003	0.006	0.005	-
t12t14-C18:2	0.002	0.001	0.01	0.01	0.02	0.01	-
t11t13-C18:2	0.006	0.01	0.02	0.0	0.05	0.02	-
t7t9-t10t12-C18:2	0.03	0.002	0.02	0.012	0.02	0.01	-
C20:0	0.22	0.13	0.21	0.32	0.28	0.25	0.47
C20:1	0.10	0.09	0.20	0.12	0.20	0.23	-
C20:2	0.03	0.03	0.02	0.03	0.02	0.01	-
C21:0	0.06	0.04	0.11	0.10	0.12	0.10	-
C20:3 n-6	0.03	0.06	0.08	0.03	0.03	0.02	-
C20:4 n-6 (AA)	0.24	0.33	0.21	0.20	0.15	0.08	-
C22:0	0.07	0.03	0.14	0.14	0.18	0.18	0.83
C20:5 n-3 (EPA)	0.05	0.06	0.07	0.10	0.09	0.08	-
C23:0	0.05	0.01	0.10	0.09	0.12	0.14	-
C24:0	0.05	0.01	0.17	0.06	0.11	0.13	0.57
C22:5 n-3 (DPA)	0.01	0.15	0.21	0.17	0.19	0.15	-
C22:6 n-3 (DHA	0.02	0.04	0.07	0.04	0.05	0.05	-

Table 2. Comparison of fatty acid profile of best Slovak ewes’ milk (Tajov) and best Alpine cows’ milk (l’Etivaz 2) based on the content of health affecting fatty acid

FA	Tajov ewes´ milk fat	l’Etivaz 2 Kraft (2003) cows´ milk fat
CLA	3.50	2.67
TVA	7.85	3.86
ALA	1.01	1.30
EPA	0.08	0.10
DHA	0.05	0.11
AA	0.08	0.07
LA	2.12	1.31
MA	9.61	8.28
PA	21.7	21.9
OA	15.5	17.5
MCFA	12.0	5.70
n-6 : n-3	2.06	1.01