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CHEMICAL COMPOSITION AND BIOLOGICAL PROTEIN VALUE OF MILK OF TSIGAI SHEEP AND THEIR F2 CROSS-BREEDS OF CHIOS

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Abstract: The composition of milk was studied from purebred Tsigai sheep and F2 cross-breeds with Chios breed from 4th to 6th month of lactation, raised on a mountain pasture. The chemical analysis samples were taken from each sheep in the period of April-June. The content of fat, protein and amino acids was determined in individual samples and total sample formed by the milk yield from all animals, proportional to the daily milk yield from each individual. There is a tendency for higher milk yield and content of total protein and casein in milk of F2 cross-breeds of Chios in comparison with Tsigai sheep. Milk sheep from F2 cross-breeds of Chios had higher content of Lysine, as well as glutamic acid, methionine and leucine, in comparison to that form Tsigai sheep, respectively: 0.458±0.011. 1.389±0.040. 0.084±0.005 and 0.572±0.013. The milk chemical index in both groups of sheep was comparatively low and it constituted respectively 38.3% in Tsigai sheep and 35.4% in F2 cross-breeds, as a result of low concentrations of methionine and cysteine in milk. Biological value of milk obtained from Tsigai breed sheep and F2 milk cross-breeds of Chios had close values - respectively 92.01 and 91.87%. Results showed that the sward composition and the vegetation stage had an influence over the essential amino acids content in purebred Tsigai sheep and their cross-breeds with Chios breed.

Key words: sheep, milk, chemical composition, amino acids

Introduction

The amount of milk proteins and their amino acid content have been studied profoundly in different animal species. Milk is the only source of food for the new-born and depending on the specific nutritional needs it has a certain composition. The differences among species in the amount of protein in the chemical composition are influenced by the nutritional requirements of the new-

born, the difference in postnatal growth rate, stage of maturity, body composition at birth, the influence of environment etc.

The interest for milk proteins is related to their biological and nutritional full value or degree of retention of nitrogen in body (*Gachev, 1995*). Amino acid composition of proteins in sheep milk has been studied in dairy sheep breeds by a number of authors (*Velev, 1986; Tanev et al., 1986; Stancheva, 2002*). Comparing amino acid composition of milk from Karakachanska and Tsigai sheep. *Mihaylova et al. (2006)* found higher content of proline, valine and isoleucine, as well as higher biological value in the first breed.

The objective of this study was to determine the chemical composition and protein biological value of milk from Tsigai sheep and their F2 cross-breeds with Chios breed raised in the region of the Central Balkan Mountain.

Materials and methods

The study was conducted with Tsigai sheep – I group and their F2 cross-breeds – II group, at the time of grazing period in April, May and June, raised on a mountain pasture.

The milk samples for the analysis were taken during the controls for each animal once a month from April till June including. As a total, sample was taken from each group. The basic chemical composition was determined on Milko-skan 133B. The principle of ion exchange column chromatography was used to determine amino acids of total milk protein. For that purpose the sample was treated by acidic hydrolysis with 6 n solution of hydrochloric acid at 110º C for 24 hours. Dissolution of the residue was performed in buffer of pH = 2.2. Sulphur-containing amino acids (methionine and cystine) were determined after sample oxidation with a mixture of carbon peroxide and performic acid. The different amino acids (except for tryptophane) were separated on an Amino analyzer (Amino Acid Analyzer T 339 M. Mikrotehchna – Praha) and their quantity was calculated from their elution volume and standard mixture.

The obtained data was processed by variance statistical methods of Statistica for Windows *(Release. 4.3. stat. soft. Inc. 1994)*.

Results and discussion

The results of the study on milk yield and the basic chemical composition of milk during the period are given in Table 1. From the reported data could be seen that the total milk quantity in the course of the experimental period was higher in sheep cross-breeds 13 l ($P<0.001$), but the dry matter content was by 0.24% lower in comparison with that in Tsigai sheep irrespective of higher values of the standard

deviation. Our results are close to those of *Unal et al. (2002)* and *Esen and Ay (2003)* in F1 cross-breeds of Chios. Inversely proportional to the milk, which had already been milked, was the content of dry matter, with a lower percentage (0.24%) was that from cross-breeds without the difference to be reliable. In F1 cross-breeds of Chios, *Pacinowski et al. (1999)* found a tendency for higher content of dry matter in milk, while in our results the values were lower. The low content of dry matter is determined by the low percentage of milk fat as was recorded a lowering by 0.55% in its concentration. Contrary to fats, a tendency for higher content of proteins in milk was recorded in the cross-breeds. The increase is due rather to high percentage of caseine in milk from the cross-breeds ($P<0.05$) than to non-caseine protein (NCP), where the differences between groups were minimal. The higher values of proteins in milk of F2 cross-breeds also determined the higher dry fat-free residue (DFR). At similar breeding conditions *Odzhakova et al. (2002)* found lower content of dry fat-free residue (11.57%) in cross-breeds of Rhodope Tsigai with rams of Bulgarian White Milk breed.

Table 1. Chemical indicators of milk

Indicators	Tsigai sheep	cross-breeds F2 sheep (Ts x Chios)
	x±Sx	x±Sx
Milk-yield during milking period. l	41.22±0.90	54.18±1.80***
Dry matter. %	17.08±0.28	16.86±0.69
Milk fat. %	5.51±0.26	4.96±0.36
DFR. %	11.58±0.12	11.90±0.12
Proteins. %	5.65±0.11	6.02±0.28
Casein. %	4.08±0.08	4.54±0.18*
NCP. %	1.48±0.03	152±0.03
Ca. mg %	0.200±0.005	0.204±0.007
Curdling. s	250±36	270±44

DFR – Dry fat rescue
NCP – Non caseine proteins
* $p<0.05$
*** $p<0.001$

The average values of milk amino acids content are represented in Table 2. The proteins of both groups have almost equal content of the amino acids, such as aspartic and serine, slightly higher values have threonine, proline and alanine and milk of Tsigai sheep, while the difference in glutamatic acid is in favour of F2 cross-breeds sheep ($P>0.05$). It is known that both amino acids - aspartic and glutamic, improve the brain function. In the sulphur-containing amino acid glycine, the percentage in milk has close values, while in methyonine it is higher in sheep from the second group without reliable difference. The latter participates in the synthesis of complex lipids and choline. Our results of the amino acids reported above are higher than those announced by *Mihaylova et al. (2006)* for Tsigai and Karakachan

sheep with the exception of glutamic acid. The same author reported considerably higher values for sulphur-containing amino acids in milk of Tsigai and Karakachan sheep respectively (methionine 0.184 and 0.170mg% and glycine - 0.118 and 0.113 mg %). According to us, that's due to the sward composition on which the animals are bred.

The amino acids leucine, izoleucine and valine are included into the composition of proteins and they have an important biological significance for the animal organism. The differences between groups are minimal, but the advantage is for the milk cross-breeds. Our data are higher than those found by *Sabahelkheir et al. (2012)* in the sheep milk respectively 108.1, 72.4 and 71.9 mg/g from the total content of amino acids. The cyclic group of amino acids phenylalanine, tyrosine and histidine have a functional role for the organism, as the tyrosine participates in the synthesis of the hormone of the thyroid. Their content in the milk of both groups is of close values.

Table 2. Amino acids in milk during the milking period

Amino acids %	Tsigai sheep x±Sx	Sheep cross-breeds F2 (Ts x Chios x±Sx
Aspartic acid	0.482±0.025	0.481±0.008
Threonine	0.236±0.013	0.229±0.006
Serine	0.222±0.011	0.224±0.006
Glutamic acid	1.346±0.061	1.389±0.040
Proline	0.559±0.028	0.547±0.023
Cysteine	0.059±0.004	0.060±0.003
Glycine	0.099±0.005	0.099±0.025
Alanine	0.216±0.010	0.209±0.006
Valine	0.395±0.018	0.399±0.011
Methionine	0.075±0.012	0.084±0.005
Izoleucine	0.277±0.013	0.281±0.007
Leucine	0.556±0.023	0.572±0.013
Tyrosine	0.215±0.013	0.221±0.004
Phnylalanine	0.263±0.013	0.268±0.006
Histidine	0.175±0.008	0.172±0.004
Lysine	0.411±0.014	0.458±0.011*****
Arginine	0.195±0.009	0.191±0.006
Total	5.78±0.241	5.88±0.184

* $p<0.05$

The lysine and arginine are basic amino acids, as they contain two amino groups and one carboxylic, they serve the cell nucleus of the animal organism and especially are favourable for the proper growth and bone formation. The lysine can be found in greater quantity in the milk of diary cross-breeds at a low reliability of the difference ($P<0.05$), while as for arginine the values are close. Our results in relation to lysine are close to those of *Tanev et al. (1986)* for diary sheep breeds

(8.30 and 7.77 g/100g), but they are a little lower than the general values of *Alexieva et al. (1986)* for the amino acids lysine (571 mg/100g milk) and arginine (260 mg/100 g milk).

The values, which we obtained, for the different amino acids in sheep milk from both studied groups are higher than results found by *Stancheva (2002)* in high milk yield population of sheep.

The difference among groups of amino acids in milk from Tsigai sheep and their F2 cross-breeds are insignificant (Table 3). The amount of nonessential amino acids in milk is by 24.5% and 22.4% respectively for I and II groups, more in comparison with that of the essential amino acids (EAA). For both groups the amount of monoaminomonocarbonic acids is the highest, then follows the monoaminodicarbonic and cyclic amino acids, and the lowest is the amount of diaminomonocarbonic.

The content of essential amino acids that we found in both groups is higher than the average data of *Stancheva (2002)* for the high milk yield sheep population (19.03 g/l).

Table 3. Amino acid groups in the milk

Amino acid group %	Tsigai sheep x±Sx	Sheep cross-breeds F2 (Ts x Chios) x±Sx
Σ Essential	2.487±0.113	2.572±0.066
Σ Non-essential	3.294±0.129	3.312±0.118
Σ MAMC	2.135±0.109	2.157±0.082
Σ MADC	1.828±0.066	1.979±0.048
Σ DAMC	0.606±0.023	0.649±0.017
Σ CAA	1.212±0.060	1.208±0.037

MAMC – monoaminomonocarbonic amino acids
MADC – monoaminodicarbonic
DAMC – diaminomonocarbonic
CAA – cyclic amino acids

The biological value of a particular product could be measured as the results of the determined amino acids composition are compared to the so called 'ideal amino acid profile', which correspond to completely balanced amino acid protein. The method of amino acid indicator was based on that comparison *(Ganchev, 1995; Makova, 1988)*. In table 4 are compared the obtained values for the different essential amino acids in sheep milk for the studied groups with referent values for the 'ideal' and the whole egg protein.

Table 4. Biological value of sheep s protein

Essential amino acids g/100 g Total protein	Reference pattern (FAO/ WHO)	Whole egg Protein	Tsigai sheep	Index %	cross-breeds F2 sheep (Ts x Chios)	Index %
Threonine	4.0	4.8	4.10	102.5	3.89	97.3
Leucine	7.0	8.8	9.62	137.4	9.73	139.0
Isoleucine	4.0	6.7	4.79	119.8	4.78	119.5
Valine	5.0	7.2	6.83	136.6	6.79	135.8
Methionine +	3.5	5.2	1.34	66.3	1.24	70.0
Cysteine						
Lysine	5.5	6.2	7.11	129.3	7.79	141.6
Phenylalanine +	6.0	5.7	8.27	137.8	8.32	138.7
Tyrosine						
Tryptophane	1.0	1.6				
Eessential amino acids	36.0	46.3	42.06		42.54	
Chemical index	100%		38.29		35.42	
Biological value		97%	92.01		91.87	

The milk of both groups surpassed the egg protein in relation to its content of almost all EAA, total phenylalanine + tyrosine with the exception of methionine + cysteine. The chemical index in sulphur-containing methionine + cysteine was lower in milk from F2 cross-breeds - 35.42 than that of Tsigai sheep - 38.29.

Biological value of sheep milk obtained from Tsigai sheep and their F2 cross-breeds of Chios, compared to that of egg protein, which is accepted for 97 % was respectively 92.01 and 91.87%, respectively in Tsigai sheep and the cross-breeds and the chemical index is respectively 38.29 and 35.42.

Conclusions

A tendency was found for higher milk yield and content of total protein and casein in milk from F2 cross-breeds of Chios in comparison with Tsigai sheep.

Milk from sheep F2 cross-breeds of Chios had higher content of Lysine, as well as glutamic acid, methionine, leucine, in comparison with that from Tsigai breed.

The milk sheep chemical index in both groups of sheep was comparatively low and it constituted respectively 38.3% in Tsigai sheep and 35.4% in F2 cross-breeds, as a result of low concentrations of methionine and cysteine in milk. Biological value of milk, obtained from Tsigai breed sheep and F2 milk cross-breeds of Chios had close values - respectively 92.01 and 91.87%.

Hemijski sastav i biološka vrednost proteina u mleku ovaca rase cigaja i njihovih F2 meleza sa rasom hios

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Rezime

Sastav mleka je ispitivan kod čistokrvnih cigaja ovaca i F2 meleza sa rasom Hios, odgajanih na planinskom pašnjaku, od 4. do 6. meseca laktacije. Uzorci za hemijsku analizu su uzeti od svake ovce u periodu april-jun. Sadržaj masti, proteina i amino kiselina određivan je u pojedinim uzorcima i ukupnom uzorku formiranom od mleka od svih životinja, srazmerno dnevnom prinosu mleka od svake pojedinačne životinje.

Postoji tendencija za veći prinos mleka i sadržaj ukupnih proteina i kazeina u mleku kod F2 meleza sa rasom hios u poređenju sa cigaja ovcama. Mlečna grla F2 melezi sa rasom hios su imala veći sadržaj lizina, kao i glutaminske kiseline, metionina i leucina, u odnosu na cigaja ovce, odnosno: 0,458 ± 0,011, 1,389 ± 0,040, 0,084 ± 0,005 i 0,572 ± 0,013.

Hemijski indeks mleka u obe grupe ovaca bio je relativno nizak i respektivno predstavlja 38,3 % kod cigaja ovaca i 35,4 % kod F2 meleza, kao rezultat niskih koncentracija metionina i cisteina u mleku. Biološka vrednost mleka dobijenog od cigaja rase ovaca i mleka F2 meleza sa rasom hios imaju bliske vrednosti - odnosno 92,01 i 91,87 %.

Rezultati su pokazali da su sastav travnjaka i faza vegetacije imali uticaj na sadržaj esencijalnih aminokiselina kod čistokrvnih cigaja ovaca i njihovih meleza sa rasom hios.

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