Differences on Biochemical Composition of GoatMilk at Carpathian Breed and Half Breed Saanen X Carpathian and French Alpine X Carpathian

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The aim of our study was to evaluate the gradient of milk yield, of milk biochemical composition and fatty acids profile according to breed, for primipara goats from Carpathian breed and Saanen x Carpathian and French Alpine x Carpathian half breed that were grown in semi-intensive system (Dobrogea, South Romania).
The studies were performed on goats raised at ANCC CAPRIROM farm, located in Constanta, Romania. The biochemical parameters (fat, proteins, lactose) were studied by electrochemical method with a Lactostar analyzer Funke Gerber type specialized for goat milk. Milk fatty acids profile, as fatty acids methyl esters (FAME), was determined by chromatographically gas method. The considerable high protein content found in half breeds, might be explained by the fact that bucks from specialized breeds such us Saanen and French Alpine which were used for half breeding, come from imported animals from France, which were locus genotyped for alpha S1 casein gene and were selected dominant genotypes that lead to a higher protein concentration in milk.The statistical analysis shows that the milk coming from Carpathian does and their half breeds is not significantly different regarding the levels of various fatty acids, saving omega 3 acids, which are considerable higher at Carpathian does, proving that food has the decisive role regarding composition.

Keywords: goat, milk, fatty acids

In Europe, the raising of milk goats is mostly encountered in the Mediterranean basin (Spain, France, Italy and Greece), where yields obtained from raising goats represent an important economic, social and environmental mean of progress. A higher interest from farmers' side for raising goats was recorded, which was materialized by increasing of the herds in the last years in Romania. In 2017 at EU level, Romania was ranked third place, after Greece (3768000) and Spain (3061430), with a total head of 2057309 goats [1].

The structure of the goat livestock in our country is composed of lower milk and meat specialized breeds, their output being smaller than that of the specialized breeds. The Carpathian and Banat White are the main breeds raised in Romania. Breeding measures can be initiated by crossbreeding with semen from specialized breeds, in order to eliminate these flaws and with the aim of obtaining half-breeds and varieties with superior productive potential adjusted to market demands and able to meet the conditions imposed by EU. In order to achieve a genetic stable population, several breeding must be made, which in the end will lead to a higher milk production and will preserve their rusticity. Researches done in Romania and in some East European countries, established that breeds and local populations, from lowland and hills areas, can be bred by crossbreeding with best individuals from Saanen and French Alpine breed.

The aim of our research was to evaluate the gradient of yield milk, biochemical composition and milk fatty acids structure based on breed for primipara goats of Carpathian breed and half-breed Saanen x Carpathian and French Alpine x Carpathian, raised in semi-intensive system (Dobrogea, South Romania).

Experrimental part

Materials and methods

The studies were performed on primipara goats of Carpathian breed, half breed F1 Saanen x Carpathian and half breed F1 French Alpine x Carpathian, kept at ANCC CAPRIROM farm located in Constanta, Romania. Three groups of 40 primipara Carpathian goats, half breed F1 Saanen x Carpathian and half breed F1 French Alpine x Carpatian were organized after ending the calving period in February 2017. The kids were weaned after 45 days from calving. The goats were milked

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twice a day for 6 months after weaning (at the beginning of April). The milk yield control was done every 30 days by weighing individually the milk quantity milked in the morning and in the evening. There were also individually milk samples taken for qualitative analysis.

The biochemical parameters (fat, protein, lactose) were analyzed by electrochemical method with a Lactostar analyzer Funke Gerber type specialized for goat milk. The fatty acids profile of goat milk, as fatty acids methyl esters form (FAME), were conditioned by chromatographic gas method [2].

The fodder rations for does groups under observation were determined according to nutritive values of food components and basis on weight and lactation level.

The statistical analysis

Significant differences between the least square means for milk production characteristics and genotypes were performed using IBM SPSS Statistics version 19. Differences of means were tested using t-Student test. A p-values of <0.05 was considered as statistically significant.

Results and discusions

The research had as main objective the analysis of the influence of breed in the expression of the lactogen potential of local goats and half breed with specialized breeds for milk yield (Saanen and French Alpine) which are bred and exploited in the specific conditions in the South-East of Romania. Necessity of conducting such research activities have as technical support continued development of the sector represented by breeding goat and the interest of breeders towards the Carpathian breed which compares to other breeds of import supports very well the conditions of the area where the research was held.

Changes observed in the yield and chemical composition of milk throughout the different breed are shown in Table 1.

Table 1

QUANTITY VARIATION OF MILKED MILK (Kg / goat / day) AND MILK COMPOSITION (%) BASIS BREED (mean+_ sem)

Breed	**Milked milk quantity/head/day (Kg)**	**Fat (g%)**	**Protein (g%)**	**Lactose (g%)**
Carpathian	1.14^{ab}±0.0910	3.85±0.0436	3.17^{ab}±0.0128	4.59±0.0024
Alpine x Carpathian half breed	2.03^{a}±0.0649	3.77±0.0135	3.22^{a}±0.0273	4.61±0.0034
Saanen x Carpathian half breed	2.03^{b}±0.0790	3.82±0.0186	3.21^{b}±0.0086	4.64±0.0048

Various letters superscript (a, b, ab) from the columns indicate major differences (p<0.05)

The statistical analysis of average yield milk /day/goat of the three groups of primipara does indicates a considerable growth (p<0,05) of this index for half breed F1 Alpine x Carpathian and Saanen x Carpathian compared to primipara does of Carpathian breed.

Regarding the protein's content, the static analysis of the differences shows that there is considerable growth (p>0,05) of the protein average concentration in milk from half breed Alpine x Carpathian and Saanen x Carpathian goats compared with the one from Carpathian goats (table 1). There are no significant differences between the 2 groups of half breeds concerning the protein concentration.

There is no significant difference between the three groups of does regarding the average concentration of fat and lactose.

Table **2** gives an overview of the content of milk regarding the most important groups of fatty acids (FA). No significant differences were observed between the 3 breeds.

Table 2

THE MILK'S FATTY ACIDS PROFILE BASIS ON BREED (gFAME/100gTotal FAME) (mean± sem)

Fatty acids		Carpathian breed		F1 Alpine x Carpathian		F1 Saanen x Carpathian	
		mean	sem	mean	sem	mean	sem
C 4:0	Butyric	0.10	0.0310	0.10	0.0323	0.14	0.0293
C 6:0	Caproic	1.71	0.0721	1.63	0.1196	1.80	0.0850
C 8:0	Caprylic	3.53	0.0377	3.47	0.1349	3.41	0.1816
C 10:0	Capric	11.77	0.3984	11.80	0.6640	11.04	0.6406
C 11:0	Undecanoic	0.24	0.0109	0.27	0.0161	0.23	0.0114
C 12:0	Lauric	4.61	0.3564	4.79	0.4498	4.39	0.3614

C 13:0	Tridecanoic	0.08	0.0044	0.09	0.0061	0.08	0.0040
C 14:0	Myristic	9.73	0.3007	9.91	0.4649	9.42	0.3976
C 14:1	Miristoleic	0.31	0.0081	0.33	0.0166	0.32	0.0184
C 15:0	Pentadecanoic	0.42	0.0152	0.42	0.0195	0.43	0.0373
C 15:1	Pentadecenoic	1.22	0.0471	1.27	0.0324	1.18	0.0645
C 16:0	Palmitic	25.55	0.3788	26.83	0.4505	26.25	0.2843
C 16:1	Palmitoleic	1.11	0.0768	1.12	0.0587	1.12	0.1041
C 17:0	Heptadecanoic	0.51	0.0219	0.56	0.0304	0.54	0.0197
C 17:1	Heptadecenoic	0.70	0.0353	0.70	0.0361	0.76	0.0366
C 18:0	Stearic	10.63	0.4258	9.25	0.5854	9.82	0.2903
C18:1n9c	Oleic cis	20.61	0.4498	20.29	0.8153	21.87	1.0455
C18:2n6t	Linoleic trans	0.78	0.0906	0.75	0.1013	0.71	0.0867
C18:2n6c	Linoleic cis	2.57	0.1305	2.67	0.0998	2.82	0.2038
C20:0	Arachidic	0.10	0.0150	0.10	0.0145	0.09	0.0168
C 18:3n6	Linolenic gamma	0.04	0.0123	0.06	0.0139	0.06	0.0138
C 18:3n3	Linolenic alfa	0.99	0.1770	0.88	0.1329	0.82	0.1074
C18:2 cis-9, trans-11	Conjugated Linoleic	0.59	0.0847	0.62	0.0735	0.60	0.0692
C 20:2n6	Eicosadienoic	0.14	0.0387	0.15	0.0360	0.16	0.0346
C 20:3n6	Eicosatrienoic	0.08	0.0247	0.10	0.0252	0.11	0.0509
C 20:3n3	Eicosatrienoic	0.08	0.0288	0.05	0.0152	0.04	0.0166
Other FA		1.81	0.1513	1.77	0.1292	1.79	0.1761

After having synthetized the obtained results, can be observed that there are no significant differences between the three groups regarding the total percentage of saturates fatty acids (SFA), monounsaturated fatty acids (MUFA), unsaturated fatty acids (UFA) or polyunsaturated fatty acids (PUFA) (table 3).

Tabel 3
CONCENTRATION OF TYPES OF TOTAL FATTY ACID IN GOAT MILK (MEDIE gFAME/100g Total FAME) FROM DIFFERENT BREED

No	**Breed**		**SFA**	**MUFA**	**PUFA**	**UFA**	**SFA/UFA**	**PUFA/ MUFA**
	Carpathian	mean	69.27	24.20	5.36	29.56	2.40	0.22
		sem	0.51881	0.3497	0.1401	0.4262	0.0512	0.0053
	Alpine X Carpathian half breed	mean	69.33	23.85	5.38	29.23	2.42	0.23
		sem	0.5627	0.4237	0.1682	0.5414	0.06	0.0057
	Saanen X Carpathian half breed	mean	67.60	25.47	5.37	30.84	2.25	0.21
		sem	0.8939	0.7583	0.2327	0.9026	0.0855	0.0079

significant differences were observed between groups regarding the ratio of omega 6/omega 3 fatty acids, but the percentage of omega 3 fatty acids is significantly higher ($p<0.05$) in the milk coming from Carpathian breed does compared to half breeds F1 Alpine x Carpathian and half breeds F1 Saanen x Carpathian (Table 4).

Tabel 4
CONCENTRATION OF OMEGA 3 AND OMEGA 6 FATTY ACID IN GOAT MILK (MEAN FAME/100gTotal FAME) FROM DIFFERENT BREED

Breed		**Omega 3**	**Omega 6**	**Ratio Ω6/Ω3**
Carpathian	mean	1.067^{ab}	4.31	5.24
	sem	0.10221	0.0956	0.5694
Alpine x Carpathian	mean	0.93^{a}	4.49	5.32
	sem	0.06579	0.1295	0.3557
Saanen x Carpathian	mean	0.90^{b}	4.46	5.49
	sem	0.06882	0.1960	0.3879

Various letters superscript (a, b, ab) from the columns indicate major differences ($p<0,05$)

Quality of milk and its composition varies according to breed, diet and feeding practices, management system, lactation stage, parity, and animal health [3]. The study by Mayer and Fiechter [4] however showed that there was no significant difference in milk composition among the six dairy breeds in Austria. This indicates that, although similar breeds were reared in several countries, the content of milk composition could vary according to the places.

The fat content of the goat milk is one of the most important nutritional and dietetically parameters of goat milk. No significant differences were registered, regarding lipids' concentration between the three breeds, even though the concentration is a little bit higher for the pure breed Carpathian does. The studies conducted on other goat breeds have highlighted the existence of differences regarding the fat percentage of milk. Zeng et al. [5] analyzed a data set of dairy goats in the US and registered a more than double level of fat (6.4%) in milk of Nigerian Dwarf goats, compared to the milk belonged to Sable breed (3.0%).

Regarding the gradient of protein concentration, our studies registered values between 3, 17% at Carpathian does and 3,21% at half breed. These results fit between average values of protein concentration (3,2%) for Carpathian breed [6]. The protein concentration is significantly higher ($p<0, 05$) for half breed from does and specialized dairy breeds bucks. The French Alpine and Saanen breed bucks are imported from France. Starting from 1990, in France, all bucks were genotyped for Alpha S1 casein gene. For reproduction purposes, there are selected genotypes AA and BB, called also dominants, which exceed FF genotypes called also recessive, regarding quantity and level of milk protein (+16% for protein quantity; [7]) and the efficiency of cheese processing (+18%, [8]).

The lipids from goat's milk contain several hundred fatty acids of whose percentage from the total of fatty acids varies considerably [9]. Medium-chain triglycerides normally reach a percentage of 36% in milk goat in comparison with 21% in cow milk, thereby reducing the synthesis of endogenous cholesterol [10].

The goat milk is rich in fatty acids with short catena (C6:0, C8:0, C10:0), which are synthetized by de novo in the mammary gland. Their ratio from the whole fatty acids of goat milk is twice as big compared to cow milk (abt 18% vs 8%) [11]. Our research analysis indicates an average level of these acids of 17.01% in the milk milked from Carpathian does, 16,89% from half breed French Alpine x Carpathian and 16,25% from half breed Saanen x Carpathian. Similar results were obtained also in the experiments reported by Soryal et al [12]. The concentration of fatty acids with short catena is an important factor because it influences the gustative and sensorial qualities of goat milk and derived dairy products [13].

The monounsaturated fatty acids (MUFA) do not lead to cholesterol accumulation, such as saturated fatty acids, nor do they suffer the roasting process as fast as the polyunsaturated fat. In addition, they have a positive effect on high density lipoproteins (HDL) concentration, those that transport cholesterol from the bloodstream to the liver where it is degraded by bile acids and subsequently excreted. The ratio of monounsaturated fatty acids in goat milk varies between 20 and 35% of the total fatty acids [14]. Without significant differences noted, our values vary from 23.85% to 25.47% of total fatty acids.

Polyunsaturated fatty acids (PUFA) consumed by ruminants suffer ruminal biohydrogenation process under the action of ruminant flora microorganisms and due to their favorable effects on consumer's health, it represents the group of most valuable fatty acids. As for the goat milk, the ratio of polyunsaturated fatty acids from the total milk fatty acids varies between 3% and 5% [15]. In our study, the ratio of polyunsaturated fatty acids from lipids are 5.36% for Carpathian goat milk, 5.38% for half breeds French Alpine and 5.37% for half breeds Saanen.

The most valuable of polyunsaturated fatty acids is the conjugated linoleic acid (CLA). The conjugated linoleic acids (CLA) are conjugated dienes of the linoleic acid. The name refers to position and geometric isomers of the linoleic acid, which are characterized by a double bond system separated by a simple single bond. There are 28 possible isomers, but the dominant isomer in the milk lipids is the rumenic acid (C18: 2 cis-9, trans-11). The main source of CLA of the human diet are the milk lipids and cover 75% of the human body's daily requirement of this compound. Since CLA consumption has properties of body fat decrease by inhibiting lipogenesis and stimulating lipolysis, therefore, raising goats on pasture is the best way to increase milk CLA content. No significant differences are recorded in our study regarding CLA concentration between the three breeds, the values being between 0.58% for Carpathian does and 0.62% for half breed French Alpine does.

The main component of lipids in the human diet are the saturated fatty acids (SFA). They are stable substances of predominantly animal origin. An excessively high ratio of saturated fatty acids in the diet can lead to chronical diseases such as atherosclerosis or obesity. The hypothesis that milk and cheese consumption leads to increased LDL lipoprotein synthesis and to risk of coronary artery disease was contradicted by the studies conducted since 2000. It is now believed that an increase of LDL concentration in blood can be assigned to lauric acids C12: 0, myristic C14: 0 and palmitic C16: 0, while the remaining saturated fatty acids present in milk neutralize their effect, as they lead to increased levels of HDL lipoproteins [16].

The saturated fatty acids are the dominant group, in the ruminant milk, with their total fatty acid content ranging from 67% to 75% of total fatty acids [17].In the present study it was observed that the level of saturated fatty acids varies between 67.6% and 69.33%, without significant differences recorded between breeds. The main saturated fatty acid in mammary milk is palmitic acid C16: 0. Its concentration was between 25.55% at Carpathian does and 26.83% at French Alpine half breeds.

The human diet rich in omega-6 fatty acids leads to an increased ratio of omega-6 / omega-3. The ratio ω-6 / ω-3 in the majority of population diet varies between 15: 1 and 16.7: 1 [18], but it is recommended to keep as low as possible the ratio of omega 6 fatty acids. The optimal ω -6 / ω -3 ratio is specific for different diseases: in diet of asthmatics it should be 5: 1, and in case of patients suffering from rheumatoid arthritis and colon cancer is recommended a ratio of 2.5: 1 [18]. The World Health Organization and FAO (Food and Agriculture Organization) recommend a ratio of fatty acids ω -6 / ω -3 below 4, a value that has been shown to significantly reduce (by 70%) the number of deaths due to cardiovascular disease.

Analyzes performed on milk come from all three breeds revealed a significant increase in omega 3 content at Carpathian breed does ($p < 0.05$) compared to their half breeds. Our data indicate that Carpathian does and their half breeds, which feed mainly comes from pasture, produce a milk with an omega-6 / omega-3 ratio between 5.24 and 5.49 in the summer, but there are no significant differences between the three does categories.

Conclusions

The unique feeding behavior and highly digestive efficiency is the main advantage of goats over the rest of ruminants species, regarding the production of milk rich in valuable nutritive components.

The biochemical analyzes performed to assess milk quality are in accordance with those in many other studies that showed that milk from goats which were fed to the pasture, besides having a higher content of medium chain fatty acids, is also naturally rich in unsaturated fatty acids and conjugated linoleic acid. The ssignificantly increased protein content can be explained by the fact that males from specialized Saanen and French Alpine breeds that were used for half breeding come from imported animals from France that have been genotyped at the locus for the S1alpha casein gene and the dominant genotypes were selected in order to lead to a high concentration of protein in milk. The statistical analysis shows that there is no significant difference between milk from the Carpathian does and their half breeds regarding the level of different fatty acids, except for omega 3 acids, thereby leading us to the conclusion that nutrition plays a decisive role in terms of composition.

In conclusion, taking into account the benefits that its lipid profile has, the milk from goats fed on pasture can be considered a true "treasure chest". However, further researches in different pastoral environments are necessary in order to maximize the potential of goat milk lipids and their beneficial health role.

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