Original scientific paper
UDC 637.12'632/'637.054(497.774/.775)

MILK CHEMICAL COMPOSITION OF PELAGONIAN PRAMENKA SHEEP BREED

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Abstract

Pelagonia is one of the most important breeding regions for Macedonian sheep, with an extensive diversity of various breeds. In the Pelagonia region, the Ovcepolian Pramenka breed is considered to be among the most prevalent native breeds. The breed's ability to withstand harsh conditions and graze on rough terrain is extremely valuable. Although Pramenka sheep are not particularly productive, their milk is valued for its high fat and protein content, which makes it ideal for manufacturing cheese and yogurt. This study set out to investigate the chemical composition of mid-term lactating Pelagonian Pramenka sheep, located in different parts of the Pelagonia region.

The research involved milk samples meticulously collected from 140 clinically healthy sheep, free of clinical or subclinical mastitis, in seven locations in the Pelagonian region. Milk analysis was performed using the analyzer for chemical analysis in raw milk - MilkoScan Mars 4 Foss, calibrated for sheep milk. The analysis included the determination of milk fat (%), milk protein (%), lactose (%), and milk total solids (%). Every sample underwent two analyses, with measurement repeatability (Sr) according to the device technical specification, for fat and protein: 0.015 % and total solids and lactose: 0.05 %. Basic descriptive statistical analysis was used for the evaluation of the obtained results, including mean values, standard deviation, coefficient of variation (%), and maximum and minimum values for better interpretation of the results. The statistical differences between groups were determined by one-way ANOVA and the Gomes-Howell test as a *post hoc* test. Statistical analysis was performed by the SPSS Statistics 19.0 software package.

The obtained values were comparable to the results provided by the previous author and other strains of Pramenka. Significant differences in milk composition were determined between the different selected locations. The highest content of fat was recorded in the sheep breed in Dunje (10.63 ± 1.34), and the lowest was recorded in Vitolishte (7.19 ± 1.29). In sheep milk sampled in the Germijan location, the lowest content of protein (5.31 ± 0.52) and total solids (18.09 ± 1.70) were measured, but these samples were rich in lactose (4.45 ± 0.23). The highest values for proteins were recorded in sheep located in Bach (7.19 ± 0.98), and the highest values for total solids were recorded in Grumazi (21.99 ± 3.64).

In summary, the most significant characteristic of the chemical composition of milk originating from the Pramenka sheep breed, bred in the Pelagonia region, is its considerable fat and protein content. Further investigation should be conducted to determine the differences in milk content in different seasons and lactating stages, and the correlation between variations in milk chemical composition and the content of pasture diversity.

***Key words**: Pelagonia region, Pramenka sheep breed, Milk, Chemical composition.*

1. Introduction

The indigenous sheep breed Pramenka is considered a valuable source of animal genetic diversity marked with various beneficial traits. Three indigenous genotypes of Pramenka are documented as traditional breeds in Macedonia, including the Sharplaninian, Karakachanian, and Ovchepolian breeds [1]. Pelagonia is a significant region in Macedonian sheep breeding, encompassing various breeds. The most prevalent indigenous breed in the Pelagonia region is the Ovcepolian Pramenka breed. Unique phenotypic traits distinguish the Pelagonian Pramenka and are closest to the Ovcepolian type of Pramenka breed [2]. Value-adding characteristics of this native breed, such

as hematology and biochemistry analysis, have also been assessed [3]. The Pramenka sheep breeds are known for their hardiness and adaptability to various environments [4]. Farming Pelagonian Pramenka sheep on natural pasture grazing is a traditional and sustainable practice. This breed is valued for its ability to graze on rough terrain and withstand harsh environmental conditions, which contributes to its overall productivity in certain regions. Rotational grazing is a common practice among farmers in the Pelagonia region. This involves moving sheep between pasture areas to promote regrowth and prevent overgrazing. This keeps the ecosystem of the pasture healthy and guarantees the sheep will always have food [5]. Grazing on diverse natural pastures provides Pelagonian Pramenka sheep with a varied diet rich in nutrients. This can improve the sheep's general well-being and energy levels as well as the quality of the milk they produce. While they are primarily raised for meat, they also produce milk, although not as much as other dairy sheep breeds [6]. Pramenka sheep typically yield around 80 to 120 liters of milk per lactation period, which lasts for about 150 to 180 [7] up to 190 days [8]. The milk produced by Pramenka sheep is known for its richness in fat and protein, making it suitable for cheese and yogurt production. Various factors, such as genetic factors (the breed and genotype of Pramenka sheep), their diet, and the surrounding environment, can affect the composition of Pramenka milk [8, 9]. The stage of lactation, the health of the sheep, the flock, and the particular management techniques are also examples of the variables that may affect milk composition values [10 - 12]. The diversity of the floral pasture composition can also have a substantial effect on sheep milk yield and its chemical composition by influencing forage quality, nutrient intake, palatability, and potentially providing herbal benefits to the animals [13]. Therefore, for the sheep to remain healthy and produce the most milk, the pasture vegetation must be managed properly.

The purpose of the current study was to examine the chemical composition of the Pelagonian Pramenka sheep located in different parts of the Pelagonia region during the mid-term lactation phase.

2. Materials and Methods

The research was conducted on total 140 Pramenka sheep breed raised on private farms on seven different locations in Pelagonia region [Germian (N21.5297°, E40.9196°; Gneotino (N21.484600°, E40.984033°), Grumazi (N21.583757°, E41.043793°), Orehovo (N21.560185°, E41.065093°), Bach (N21.557644°, E40.929873°), Dunje (N21.691352°, E41.257381°), and Vitolishte (N21.827254°, E41.179923°)]. According to location, all animals were divided into seven groups. The diet for all animals was free grazing with the addition of hay and a barley-based concentrate ration. Water was available *ad libitum*. The study was conducted during the spring season (May to June). Only clinically healthy animals with no signs of clinical or subclinical mastitis were included. Sheep were in mid-phase lactation (2nd to 3rd month of lactation). Animals were hand-milked at 7 a.m. on the day of sampling following the standard hygienic procedure. After the asepsis was finished, the sample was taken and the first milk jet was thrown away. The individual milk samples were refrigerated at +4 ^{0}C and transferred to the laboratory of the Veterinary Faculty in Bitola for further assessment.

A total of 15 mL of milk samples was used in the analysis. Before analysis, every sample was heated to 40 ^{0}C in a water bath. Milk analysis was performed using the analyzer for chemical analysis in raw milk - MilkoScan Mars 4 FOSS (Hilleroed, Denmark), calibrated for sheep milk. The analysis included the determination of milk fat (%), milk protein (%), lactose (%), and milk total solids (%). Every sample underwent two analyses, with measurement repeatability (Sr) according to the device technical specification, for fat and protein: 0.015 % and total solids and lactose: 0.05 %.

Basic descriptive statistical analysis was used for the evaluation of the obtained results, including mean values, standard deviation, coefficient of variation (%), and maximum and minimum values for better interpretation of the results. The statistical differences between groups were determined by one-way ANOVA and the Gomes-Howell test as a post-hock test. Statistical analysis was performed by the SPSS Statistics 19.0 software package.

3. Results and Discussion

The current study provided data about the basic chemical composition of milk from the indigenous Pramenka sheep breed reared in the Pelagonia region. For this study, seven different Pelagonian locations have been selected for evaluating the milk composition. Results revealed significant differences between different locations in some of the analyzed parameters (Table 1).

Most of the parameters analyzed in milk from Pelagonian Pramenka were congruent with values reported by other authors in different strains of Pramenka, with some exceptions. Namely, Matutinovic and coworkers [12] reported up to 8.25% fat, 6.57% proteins, 4.03% lactose, and 19.79% total solids in Dalmatian Pramenka. For Istrian sheep, as an indigenous Croatian sheep breed, Drzaic and coworkers reported 7.16% fat, 5.93% proteins, and 4.30% lactose [14]. It can be noticed that

Table 1. Descriptive statistics showing the milk components of the Pramenka breed in different Pelagonia regions

Parameter		Region						
		Germian[a]	Gneotino[b]	Grumazi[c]	Orehovo[d]	Bach[e]	Dunje[f]	Vitolishte[g]
Fat %	Mean SD	**7.33±1.51[cf]**	**7.93±1.6[f]**	**9.89±2.75[ag]**	**7.94±1.18[f]**	**9.36±1.97**	**9.63±1.34[abdg]**	**7.19±1.29[cf]**
	max-min	9.63-4.67	9.94-5.24	13.77-3.19	10.41-6.02	13.21-7.21	10.79-7.5	9.99-5.36
	CV	0.21	0.19	0.27	0.15	0.21	0.13	0.18
	SE	0.38	0.49	0.56	0.28	0.63	0.27	0.26
Protein %	Mean SD	**5.31±0.52[cdefg]**	**5.9±0.9**	**6.73±1.17[ag]**	**6.54±0.64[af]**	**7.19±0.98[af]**	**5.93±0.44[ad]**	**6.30±0.73[ace]**
	max-min	6.57-4.46	7.69-5.01	9.03-4.88	7.94-5.62	8.86-5.22	6.97-5.08	7.52-4.56
	CV	0.09	0.15	0.17	0.10	0.14	0.07	0.11
	SE	0.13	0.29	0.23	0.15	0.31	0.09	0.15
Lacose %	Mean SD	**4.45±0.23[ef]**	**4.19±0.49**	**4.11±0.50**	**4.36±0.26**	**4.13±0.20[ag]**	**4.23±0.15[ag]**	**4.43±0.19[ef]**
	max-min	4.92-4.05	4.85-3.62	4.72-2.45	4.92-3.93	4.4-3.75	4.52-3.95	4.83-4.05
	CV	0.05	0.10	0.12	0.062	0.05	0.03	0.04
	SE	0.06	0.14	0.10	0.063	0.06	0.03	0.03
Total solids %	Mean SD	**18.09±1.70[cdef]**	**18.61±2.18[cf]**	**21.99±3.64[abg]**	**20.08±1.42[af]**	**21.82±2.83[a]**	**21.90±1.57[abdg]**	**18.96±1.76[cf]**
	max-min	21.57-15.69	21.94-15.42	27.4-13.87	22.98-17.48	27.06-17.47	24.7-18.36	23.17-15.43
	CV	0.09	0.12	0.16	0.07	0.13	0.07	0.09
	SE	0.42	0.69	0.74	0.33	0.89	0.32	0.36

Legend: a,b,c,d,e,f,g: level of statistical differences ($p < 0.05$) in milk components among regions.

reported values for fat content in Croatian indigenous sheep breeds were lower when compared to the values obtained in this research. However, Stancheva and coworkers reported 9.28 % of fat milk for the Karakachan and 9.21 % for the Copper-Red Shumen sheep [15]. Pacinovski and coworkers measured 8.38% fat, 4.54% proteins, 4.41% lactose, and 16.74% of total solids in the Macedonian Karakachanka sheep breed [9]. Ovcepolian Pramenka, to which Pelagonian Pramenka is the closest, was the subject of previous analysis by Pacinovski and coworkers who reported up to 7.90% of fat in Ovcepolian Pramenka milk [8].

Many factors, including breed, ewe age, litter size, nutrition, animal health, environment, lactation stage, and others, affect milk yield and its composition [16]. The most important in the evaluation of milk composition is the lactating phase. Throughout the lactating phase, sheep milk composition can fluctuate in terms of increasing the content of fats and protein [17]. Also, twice-a-day milking can increase the milk yield with a lower percentage of fat and protein than that of milked once daily [18]. Matutinovic and coworkers reported on the significant influence of flock, year, and season on the quality of milk in sheep [12]. Pacinovski and coworkers studied the influence of certain paragenetic factors on daily milk production and milk quality in the Ovcepolian Pramenka breed [8]. The environment has an impact on both extensive and semi-extensive Pramenka farming, and there is a noticeable difference in the milk's composition and quality. In the selected farms included in this study, an extensive farming system fully adapted to the local natural resources (mainly transhumance with a nomadic system of production) is a common practice, which is typical for sheep farming in our country [19], more than semi-intensive (barn-pasture system common during the winter period) or intensive sheep farming. In this research, significant variations in milk content have been recorded between most of the flocks in different selected regions. The most significant variations are found in the milk fat percentage, notably in the Dunje region, where it can vary by as much as 9.63%, as opposed to the 7.33% fat percentage found in milk samples taken from sheep in the Germian region. Talevski and coworkers (2009) did not find significant differences in fat percentage in sheep milk collected from three different locations, but milk fat was the most variable component with the biggest variation coefficient in comparison with the other measured milk components [20]. However, in our study, milk samples were collected individually from animals instead of pool sampling of collected milk from a certain region, as was the case in the Talevski and coworkers (2009) study [20]. Significant differences were also evident in the percentage of

milk protein, with the most abundant in milk samples obtained in Bach (7.19%) compared to Germijan, where the lowest content of milk protein (5.31%) was recorded. According to some authors, the significant variations of fat, proteins, and total solids in milk were positively related to the altitude of the terrain [21]. The altitude of all seven regions included in this study was between 577m for Gneotino and 1079m for Grumazi. Sheep milk sampled in the Grumazu region had 9.89% fat, 6.73% protein, and 21.99% total solids, compared to Gneotino milk samples with 7.93 % fat, 5.9% protein, and 18.61% total solids. No differences were recorded in lactose percentage between Orehovo, Gneotino, and Grumazi. Milk sampled from sheep in the Bach region had the lowest percentage of lactose (4.13%), and Germijan had the highest lactose content (4.45%). Grazing is considered to have the most impact on lactose content in milk. Namely, botanical composition and availability of sufficient and good nutrients from the pasture or the grassland have the most impact on the milk's chemical composition [22].

The poor control of diet based predominantly on grazing with only a small quantity of hay and grains added to their diets is typical in transhumance with a nomadic and semi-intensive system of dairy sheep production [23]. Adding concentrate to sheep's daily diet is a common practice in sheep dairy production as an additional supplement to most of the essential nutrients, which may not be sufficient with a grazing diet system. The feeding management is mostly based on the farming system used, which is mainly a breeder's decision. Therefore, the variations in milk composition in this study may also be influenced by the feeding management on individual farms.

4. Conclusions

- The study's findings indicate that the content of particular components in milk samples from Pramenka sheep, bred in specific locations within the Pelagonia region, resembled the values previously reported by other authors in various Pramenka strains. The results of this study revealed statistically significant differences in some components, especially fat and protein content, among milk samples obtained in different Pelagonian locations. These differences may be attributed to many factors affecting the milk compositions, which is also the case in this study. Nevertheless, this research also supports the idea that milk from Pelagonian Pramenka sheep is noteworthy for having a high protein and fat content, which makes it particularly helpful for specialty dairy products. By being aware of and taking advantage of these variations, dairy production methods can be improved, and the quality of goods made from this milk can rise.
- Therefore, we believe that the findings of this study will be followed by additional research to ascertain the variations in milk content in various seasons and lactating stages, as well as the relationship between the diversity of pasture content and variations in milk chemical composition.

5. References

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