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Original scientific paper

VARIABILITY OF SOME PRODUCTION TRAITS OF KARAKACHANIAN SHEEP IN NORTH MACEDONIA

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A b s t r a c t: Karakachanian (Karakachan) sheep, an indigenous strain of the Pramenka breed in North Macedonia, is in bigger danger of disappearance than the other two indigenous strains (Ovchepolian and Šarplaninian). Beside in North Macedonia, Karakachanian sheep is also present in the other countries of the Balkan Peninsula, namely: Serbia, Bulgaria, Greece, Albania and Turkey, its populations being at minimum level. This breed was created by many-century selection of the sheep, bred by the Karakachans, who were mostly nomads. These sheep are of small body weight and size, low productivity and triple production line (milk, meat, wool). They are quite vital animals, energetic, resistant to illnesses, and well adapted to adverse environmental conditions. Karakachanian sheep are either of dark or white colour of the hair. By the investigations conducted, these facts have been established: total production of lactation milk: 27.00 lit; average daily milk production: 0.17 lit; average percentage of milk fat: 8.38%; average percentage of protein: 4.54%; average percentage of lactose: 4.41%; average percentage of fat-free dry matter: 9.10%; average percentage of total dry matters: 16.74%; length of the lactation period: 156 days. The low production results clearly indicate the main reason for which this sheep breed has been supplanted by other, more productive sheep breeds.

Key words: Karakachanian sheep; milk production; lactation; chemical composition; variabilty

ВАРИЈАБИЛНОСТ НА НЕКОИ ПРОИЗВОДНИ СВОЈСТВА НА КАРАКАЧАНСКАТА ОВЦА ВО СЕВЕРНА МАКЕДОНИЈА

А п с т р а к т: Каракачанската овца како автохтон сој на расата праменка во Северна Македонија, во споредба со другите два соја (овчеполски и шарпланински), се наоѓа во најголема опасност од исчезнување. Освен во Македонија, ја има и во другите земји од Балканскиот Полуостров: Србија, Бугарија, Грција, Албанија и Турција, каде реалните бројки исто така се на минимално ниво. Расата настанала со повеќевековна селекција на овците кои ги чувале и одгледувале Каракачаните, кои во најголем дел биле номади. Овците се со мала телесна тежина и формат, мала продуктивност и со троен производен правец (млеко, месо, волна). Тие се доста витални, енергични, отпорни на болести и добро адаптирани на неповолни надворешни влијанија. Во рамките на популацијата постојат единки со темна и бела боја на волната. Согласно реализираните истражувања е утврдено следното: вкупно производство на лактациско млеко од 27,00 лит., просечно производство на дневно млеко од 0,17 лит., просечен процент на млечна маст од 8,38%, просечен процент на протеини од 4,54%, просечен процент на лактоза од 4,41%, просечен процент на безмаслена сува материја од 9,10%, просечен процент на вкупна сува материја од 16,74% и должина на лактација од 156 дена. Ниските производни резултати укажуваат на основната причина поради која оваа овца била истисната од другите попродуктивни раси овци.

Клучни зборови: каракачанска овца; млекопродукција; лактација; хемиски состав; варијабилност ж

INTRODUCTION

Karakachanian sheep is one of the three indigenous strains of the Pramenka breed in North Macedonia, beside Ovchepolian and Sharplaninian. It is the most primitive and the least productive sheep not only in Macedonia, but on the whole Balkan Peninsula as well, for which reason Hinkovski (qout. by Staikova, 2015) consider the strain as a Balkan endemite.

This breed was created by many-century selection of the sheep kept by the Karakachans (ethnic group, mentioned in the historical sources under several names: Karakachani, Sarakachani, Vlasi, etc.), who were mostly nomads (livestock breeders without permanent place of living), i.e. they were in constant movement with their flocks. In the times of the Ottoman Empire, when there were no borders between Balkan countries (Macedonia, Bulgaria, Greece, Serbia, Turkey, Albania), the flocks of Karakachanian sheep used to spend the summer season on the mountain pastures in Macedonia (Kožuv, Maleševo, Osogovo, Baba, Galičica, etc.), Bulgaria (Rhodopes, Rila, Stara Planina and a part of Sredna Gora), and Serbia (Stara Planina). During the winter season, Karakachanian sheep were kept in the lowland pastures by the seaside of the Aegean Sea in Greece, as well as in Thessaloniki Field, where the climate was considerably milder. These nomadic movements weakened in 1912 and stopped in 1928, (Mitié, 1984). There are data indicating that in winter the sheep were also kept in open space confined with a fence called koshara.

Karakachanian sheep is an indigenous breed of small body weight and size, low productivity and triple production line (milk, meat, wool), which belongs in the group of mountain and primitive sheep breeds, the s.c. Zackel type of sheep, and is quite vital, energetic and well adapted to the crude environmental conditions. During the intensification of sheep breeding, Karakachanian sheep lost its importance in modern production (Stevanovié et al., 2015).

Karakachanian sheep are of dark or white colour of the hair. The dark colour, depending on the stadium of the melanogenesis (synthesis of the pigment melanin), can be light brown, reddish, dark brown, or black (Boikovski et al., 2005).

This breed has high resistance to illnesses and no special demands regarding its nutrition (Stojilkovic et al., 2015; Dervisis et al., 2007).

According to Dervisis et al. (2007), Karakachanian sheep is in fact a part of the cultural heritage of the whole Balkan region, since it has been bred for quite a long time and is present in almost all the Balkan states: Greece (1,000 heads), Bulgaria (200), Serbia (30), Macedonia (only relics) and Turkey (relics), and according to Porchu (2021), this sheep is also present in Albania. Karakachanian sheep is one of the oldest sheep breeds in Europe, created and kept in conditions which simply cannot be repeated (Dervisis et al., 2007).

The technology of the Karakachan people used for breeding this sheep was very primitive and exceptionally conservative, and exactly for this reason the breed has retained its original phenotypical characteristics.

In the total number of all the three varieties mentioned above, which have been bred on the territory of North Macedonia (from 1950 onwards), the percentage share of Karakachanian strain has been variable, but always considerably less than the shares of the other two breeds.

In the period up to 1950, the number of Karakachanian sheep in Macedonia was around 220,000 head, or 10% of the total number of sheep head (2,200,000), but later the number began to decrease so in 1980 it was around 3%. In this time, the percentage share of the other two varieties of Pramenka (Ovchepolian and Sharplaninian) in the total sheep population was 60% and 30%, respectively (Mitić, 1984). The remainder of 7% consisted of cross-breeds with imported pure-blood breeds (mostly Merino breeds from France, Russia and Spain), (Pacinovski et al., 2006). Because of the absence of individual marking of the sheep, the precise number of each of these three indigenous breeds in North Macedonia has never been known until 2007, when the process of complete sheep's identification and marking began.

The low productivity is the main reason for continuos suppression over the time on Karakachanian sheep by the other more productive local and imported breeds, so nowadays only one flock has remained in North Macedonia, with around 40 heads (in the vicinity of Kumanovo).

The aim of this study is to present certain production traits of Karakachanian sheep, and their variations, something that hasn't been done for more than 4 decades, due to the lack of interest in its breeding.

MATERIAL AND METHODS

The examination was carried out in 2021, on the only remaining Karakachanian sheep flock, a property of the Institute of Animal Science at St. Cyril and Methodius University in Skopje. The flock is kept *ex situ*, and is located near Kumanovo (the village of Četirce). Of the total number of 46 heads, the examination covered 22 heads (milking ewes). The remaining 24 heads belonged in other categories (barren ewes, dry ewes, and some young heads which haven't reached the reproductive and productive stage yet). It is important to be mentioned that the sheep from this flock usually not milked; instead, the lambs are let to suckle from the beginning to the end of the lactation, and for this reason additional efforts had to be made to organize the milk production control.

A total of 5 milk controls have been made. The examined ewes' age ranged from the second to the twelfth lactation, with most in the second and the third lactation (Table 1).

During the examination, 110 individual lactation tests have been made in total, distributed according to the age as follows: 25 tests in the second lactation period, 30 in the third, 5 in the fourth, 15 in the fifth, 10 in the seventh and ninth, 5 in eleventh and 10 tests in the twelfth lactation (Table 1).

Table 1

The age range and lactation tests of the tested sheep in 2021

Parameter	Age of sheep								Total
	II	III	IV	V	VII	IX	XI	XII	
	Lactation number								
Number of sheep	5	6	1	3	2	2	1	2	22
	Lactation tests								
Number of lact. tests	25	30	5	15	10	10	5	10	110

Because of the specific way of breeding (ex situ), during the whole year the sheep are kept in barn, which necessitates their continuous feeding with meadow and lucerne hay (150 kg per head/ year), grain (barley, maize), (120 kg per head/year) and a certain amount of concentrate (50 kg 0per head year) during the year. At the same time, the sheep are allowed to use some space (yard) around the premises, whose area is approximately 1–2 ha.

In the entire course of the experiment, the lambs were with their mothers, and that's why in the days of milk control they had to be separated in a special space.

Milk production of the sheep was followed by a standard A4 method (ICAR, 2009) which involves measuring the daily production of milk per head at intervals of 28 to 34 days.

The recording of the milk yield started 10 days after lambing and lasted until the moment of drying (middle of June).

During the milk control period, with reference to the moment, the milk recording was made in such a way that the lambs were separated from their moms for the morning milk control, 12 hours before the control. After that, the lambs were returned to their mothers for 24 hours, and then separated again for the evening milk control, 12 hours before the control. A total of 5 milk measurements were made, and from each of them a collective individual milk sample of 50 ml (at least 25 ml from each milking) was taken for analysis of the milk (fat, protein, lactose, fat-free dry matter, total dry matters). Based on this milk yield measurements, the following data were calculated:

– Total milk production from one lactation, lit.
– Average production of morning milk, lit.
– Average production of evening milk, lit.
– Average production of total daily milk, lit.
– Average percentage of milk fat, %.
– Total amount of milk fat, kg.
– Average percentage of protein, %.
– Total amount of protein, kg.
– Average percentage of lactose, %.
– Total amount of lactose, kg.
– Average percentage of fat-free dry matter, %.
– Total amount of fat-free dry matter, kg.
– Average percentage of total dry matter, %.
– Total amount of total dry matter, kg.
– Length of lactation, in days.

In statistical terms, the data were processed with the use of an SPSS statistical package (2004), Version 13, while the influence of individual factors was determined using the F-test. For each milk production trait the mean, minimum (min) and maximum (max) values were determined, as well as the standard deviation (S.d.) and the coefficient of variation (Cv).

Table 2

Descriptive statistical data on the investigated Karakachanian sheep milk traits, LS – mean ± SE

Parameter	N	Mean ± SE	Min	Max	S. d.	Cv
Lactation milk (litres)	22	27.00 ± 0.221	16.80	30.00	6.35	23.52
Length of lactation (days)	22	156 ± 0.32	122	171	10.98	7.04
Morning milk yield (litres)	22	0.08 ± 0.001	0.07	0.10	0.02	25.00
Evening milk yield (litres)	22	0.09 ± 0.001	0.08	0.11	0.01	11.11
Total daily milk yield (litres)	22	0.17 ± 0.02	0.15	0.21	0.05	29.41

N – examined sheep, SE – standard error, S.d. – standard deviation, Cv – coefficient of variation

RESULTS AND DISCUSSION

Lactation milk yield: According to the data in Table 2, the average lactation milk yield of Karakachanian sheep for the entire control year (2021) was 27 litres, with variations ranging from 16.80 to 30.00 litres.

In comparison of similar examinations of Karakachanian sheep performed in our neighboring countries (Bulgaria, Serbia, Greece) a big variability in results can be noticed. This variations are probably a result of the influence of different paragenetic factors under which these sheep are bred, and also the poor selection which has been done for years.

Significantly higher values for the lactation milk yield of Karakachanian sheep are quoted by Nedelchev et al. (2002), according to which they range in a considerably wider scope (35 to 149 litres), whereas the dairy milk yield is 40 litres.

According to Boikovski et al. (2005), the milk yield of Karakachanian sheep, controlled in a period of two consecutive years (2001 and 2002), is 33.10 and 41.80 litres, respectively. Also the authors concluded that sheep's milk yield in 200 days of lactation is 55.60 litres, and for the entire lactation period 67.87 litres. These results confirm the fact that this sheep has the predisposition for a significantly higher milk yield, but only in a considerably longer period than the one covered in our examinations.

In other examinations of Boikovski et al. (2005) have been reported a higher lactation milk yield (58.56 litres) for Karakachanian sheep, of which 20.92 litres go to the suckling milk yield and 37.64 litres to the dairy milk yield.

Similar results to ours are reported by Porchu and Markovich (2006), according to which the milk yield for one lactation in this sheep is quite low, 24 – 26 kg.

A dairy milk yield of 40 litres in Karakchanian sheep was found by Hinkovski et al. (1984), which again indicates a significant milk production capacity.

In the examinations done in the first half of the 20th century, Hlebarov (1940) reported an average lactation milk yield of 74.78 litres in Karakachanian sheep for a period of 198 days, the average milk yield being 0.378 kg of milk. The maximum milk yield registered in these examinations was 149 litres. The dairy milk yield registered by this author was 29,94 litres in a 98 days' milking period (mean daily milk yield of 0.31 litres), with a maximum daily milk yield of 1.52 litres.

Slightly lower results compared to ours for the lactation milk yield of Karakachanian sheep (25 litres) were reported by Andonov (2005).

Ivanov et al. (1960) found that the mean milking milk yield of Karakachanian sheep was 25 – 30 litres, while for the entire lactation period it was 40–45 litres.

Following the milk yield in sheep of Karakachanian strain of different age, Tanev et al. (1963) found that these sheep retained their capacity of giving milk up to the 8th lactation (85.40 litres), which means a sheep's age of nine years, but, in general, after the 5th lactation it is in a continuous decrease. This way, in example, these authors registered a milk-giving capacity of 78 litres in the third lactation, continuously growing till the 5th lactation where it was equal to 91.40 litres, and then dropping down to 85.40 litres in the 8th lactation.

According to Aleksieva (1977), the average lactation milk-giving capacity of sheep of Karakachanian breed is 61.82 litres, with the variance ranging from 25.33 to 140.40 litres, and a quite high coefficient of variation (26.4%).

Tsochev et al. (1999), registered a lactation milk yield at Karakachanian sheep equal to 61.13

litres, with mean daily milk yield of 0.366 litres, while Genkovski (2002) registered a slightly lower annual milk yield of 58.56 litres (20.92 litres in the suckling period and 37.64 litres in the milking period).

Dervisis et al. (2007) claim that the average lactation milk yield of Karakachanian sheep in Greece ranges between 45 and 50 litres, with the average content of milk fat equal to 6.5 – 7%.

Following the influence of a sheep's age on the lactation milk-giving capacity, Boikovski et al. (2005) found an unequal dynamics in the milk yield from this sheep breed. At first, a continuous increase of the milk yield from the first to the third lactation (55.00, 60.52 and 62.52 litres, respectively), then a drop in the fourth lactation (49.61 litres), an increase in the fifth and sixth lactation (61.99 and 88.73 litres), again a drop in the seventh (48.23 litres), and once more an increase in the eighth lactation (62.05 litres). This is another proof of the resistibility of this indigenous sheep breed and the maintenance of a quality production (persistence) in a long period of time.

All the above-mentioned examinations indicate the fact that Karakachanian sheep, an indigenous sheep breed in the Balkans, has a significantly higher milk production capacity compared to the results from our examinations. This is probably a result of the way of breeding of these sheep in our country (ex situ in vivo), the specific breeding technology which includes complete usage of the milk for feeding the lambs, practiced for more than 20 years, as well as the poor selection done in a long period of time.

According to the results it can be concluded that the sheep have lost their instinct for milking, since in this control they have been milked manually for the first time after a long period of time. Another reason for such a low milk production capacity is the possibility of the appearance of incest, i.e. the in-breeding depression regarding the production of milk, having in mind the fact that for a long time in the flock are used same rams, i.e. rams of own production, without introducing some fresh blood.

Daily milk production: Analyzing the daily milk yield, in the morning and the evening milking 0.08 and 0.09 litres have been obtained on the average, or that is an average daily milk yield equal to 0.17 litres for the whole lactation period (Table 2).

The minimum and maximum amounts of morning milk ranged from 0.07 to 0.10 litres, and of evening milk from 0.08 to 0.11 litres.

Tsochev et al. (1999) and Genkovski (2002) found a daily milk yield of 0.366 litres and 0.310 litres for Karakachanian sheep, which is a significantly higher amount compared in our examinations. Higher daily milk yield, indicates good genetic predisposition for giving milk for this sheep breeds.

According to Petrova et al. (1998), the average daily milk yield at Karakachanian sheep is 269.9 ml, while Aleksieva (1979) found a significantly higher daily milk yield of 515 ml. This is another proof of the good milk-giving ability of this indigenous sheep breed.

Lactation length: The average lactation length at the examined sheep head was 156 days, with minimal and maximal length of 122 and 171 days, respectively (Table 2).

A significantly longer lactation period of 198 days was found by Hlebarov (1940) and by Genkovski (2002) – 188.77 days.

Lactation length between 165 and 194 days is reported by Boikovski et al. (2005) too, which once again confirms the ability of this breed for achieving a long lactation period and thus rendering a higher production of milk.

Presenting the length of lactation in two periods of time, Andonov (2005) reports that the length of the suckling period at Karakachanian sheep is 90 days, whereas the length of the milking period is around 100 days, or the total lactation length is 190 days.

The lactation length found in our research was significantly shorter compared to the similar examinations on Karakachanian sheep, once again indicates the reason of absence of milking for quite a long time; instead, they have been left to discharge the milk only through the act of suckling by the lambs. Since the stimulation for milk secretion during suckling is comparatively lesser than during milking, we think that this is the main reason for which the length of the lactation period is quite smaller than the one which actually should be and which has been established for the ewes from the same breed in other researches.

Chemical composition of the milk: The results obtained on the milk's chemical composition have shown values usual for this breed. The average contents of milk fat, proteins and lactose were: 8.38%, 4.54% and 4.41%, respectively, whereas the annual production of these three parameters was 2.26 kg, 1.23 kg and 1.19 kg (Table 3). The average

contents of fat-free and total dry matters for the whole lactation period was 9.10% and 16.74%, respectively, or, based on the total amount of milk obtained in a year, the annual production of these two parameters was 2.46 kg and 4.52 kg, respectively.

As expected, the greatest variation was found in the total dry matters where the coefficient of variation was 31.78, while the least variation was found in the fat-free dry matter where the coefficient of variation was 23.17. This is because of the small number of variants examined in the experiment.

Table 3

Chemical composition of milk at Karakachanian sheep, LS – mean ± SE

Parameter	N	Mean ± SE	Min	Max	S.d.	Cv
Fat, %	110	8.38 ± 0.18	7.38	9.84	2.37	28.28
Fat, kg	110	2.26 ± 0.14	1.24	2.95	0.54	23.89
Protein, %	110	4.54 ± 0.23	4.08	5.43	1.35	29.74
Protein, kg	110	1.23 ± 0.16	0.69	1.63	0.32	26.01
Lactose, %	110	4.41 ± 0.28	3.98	4.78	1.19	26.98
Lactose, kg	110	1.19 ± 0.21	0.67	1.43	0.29	24.35
BSM, % (NSM) – non solid matters	110	9.10 ± 0.16	7.82	9.57	2.54	27.91
BSM, kg (NSM)	110	2.46 ± 0.21	1.31	2.87	0.57	23.17
VSM, % (TSM) – total solid matters	110	16.74 ± 0.14	7.82	15.73	5.32	31.78
VSM, kg (TSM)	110	4.52 ± 0.11	2.35	2.64	1.15	25.44

N – lactation tests, SE– standard error, S.d. – standard deviation, Cv – coefficient of variation

Regarding the chemical composition of the Karakachanian sheep milk during the suckling period (from the 14th to the 42nd day), Odjakova. (2002) found these average values: 6.21% of milk fat, 5.82% of protein, 11.15% of fat-free dry matter, and 17.35% of total dry matters. During the milking period (from the 60th to the 150th day), the authors found the following values for the same parameters: milk fat – 7.45%, protein – 6.27%, fat-free dry matter – 11.73%, and total dry matters – 19.20%.

Analyzing the structure of the colostrum in this sheep breed (from the 1st to the 7th day after the partus), the authors in the seventh day found that the content of the milk fat is 7.01%, protein – 6.56%, fat-free dry matter – 11.74%, and total dry matters – 18.75%.

Comparing the chemical composition of the milk from two indigenous sheep breeds – Karakachanian sheep and Copper-red Shumen sheep, during the entire lactation period, Boikovski et al. (2005) found higher values for almost all the examined parameters (milk fat, protein, lactose, fat-free dry matter, and total dry matters) in Karakachanian sheep (6.081%, 6.343%, 4.368%, 11.308%, and 17.390%, respectively), than in Copper-red Shumen sheep (6.037%, 6.031%, 4.348%, 10.978%, and 17.022%). Only the values of minerals content were identical in both sheep breeds (0.598%).

Higher values of almost all chemical parameters in the milk from Karakachanian sheep were found by Petrova et al. (1998): protein: 5.90%; lactose: 4.52%; fat-freee dry matter: 11.13%; and total dry matters: 18.82%. The exception is the content of milk fat with value of 7.77%.

The values found for the percentage of milk fat in these examinations are higher than those for the same parameter found in the other indigenous sheep breeds in Macedonia – Ovčepolian, where it was 7.77% (Pacinovski et al., 2015), and Sharplaninian, where Tashkovski (quot. by Kozarovski, 1998) and Oglobin (quot. by Kozarovski, 1998), found a lower content of milk fat (5.51% and 5.61%).

Results of milk composition indicates that milk from Karakachanian sheep is much richer in dry matters compared to the milk from the other indigenous sheep breeds in Macedonia and the region.

CONCLUSIONS

The obtained results indicating low production of milk (both in the entire lactation period and daily) and the length of lactation in Karakachanian sheep clearly explain the reason of sheep breed suppression by other, more productive sheep breeds.

The milk chemical composition demonstrates that Karakachanian sheep milk is much richer in dry matters than the milk from the other indigenous sheep breeds. This results indicate the need of serious dedication to protect this indigenous sheep breed.

The future activities should be oriented to the physical protection of Karakachanian sheep, and also to the selection in order to improve the most of its production traits. The good selection activities can also improve the milk quality and composition. With the selection activities the genetic capacity of this breed can be improved that can provide a sustainable functioning of the sheep farms involved.

Further, much more specified and efficient financial support for maintaining this sheep breed is necessary, through the national programs drawn-up and executed by the state, in order to increase the interest in keeping Karakachanian sheep.

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