Scientific Papers. Series D. Animal Science. Vol. LXIII, No. 1, 2020
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

RESEARCH ON PERFORMANCES IN THE PRODUCTION OF MILK CARRIED OUT BY THE BĂLĂ ECOTYPE OF THE TSURCANA BREED

Andrei PUIE, Ion RĂDUCUȚĂ, Alexandra POLIOPOL, Andrei MARMANDIU, Ion CĂLIN

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: raducion@yahoo.com

Abstract

The present paper aims to analyze the quantitative performances and aptitudes in the direction of milk production achieved by the Bălă ecotype of the Tsurcana breed. The quantitative analysis was performed on a sample of female sheep from the Bălă ecotype, selected from farms in the northwest region of Romania, respectively the Maramureș and Bistrița-Năsăud areas. In order to carry out the analysis, statistical data were extracted from the genealogical register, following indicators such as total milked milk production, lactation period, suckling period duration, milking period duration. The results of this study highlight that the average milk production calculated for the period 2016-2019 and for the selected sheep herd is 82 kg milk, according to the standard of the Tsurcana breed, using the t-statistic test for the selected sample. Thus, the data show a difference of approximately 12 kg of milk between the average milk production of the selected sheep from the Bălă ecotype and the average milk production of the Tsurcana breed, a difference which is statistically insignificant. Finally, we can see that the Bălă ecotype has a good performance in milk production within the breed standard.

Key words*: evolution, lactation, milk production, Romania, Tsurcana breed.*

INTRODUCTION

Sheep breeding enjoys a great attention, as it is the main occupation among many farmers. The sheep breeds are exploited for the purpose of valuing their production, the small and medium-sized farms being the basic production units (Taftă, 2003). The sheep exploitation directions at national level mainly concern the milk, meat, wool and sheep pelts production, being appreciated for their diversity and special biological value (Pascal, 2007).

In the context of the diversification of sheep production, milk production is a major interest for consumers, who are mainly interested in the consumption of healthy foods with numerous nutritional benefits. Sheep milk is more popular among consumers in the form of dairy products, such as cheese and yogurt, while fresh sheep milk being rarely consumed due to its fat composition (Mohapatra, 2019). Normally, any sheep breed has milk production, but some breeds are specialized in this direction, while others are used for other productions such as meat or wool. (Stanciu, 2014). Worldwide, the total sheep population is 1209 million sheep, of which 21% are dairy sheep, respectively 254 million sheep, with a total milk production of 10.63 million tons. The most popular dairy sheep breeds (with a production higher than 200 liters/lactation) are Awassi, Assaf, East Friesian, Lacaune, Sarda, Chios, Manchega (Buzu, 2017). According to the latest statistical data worldwide, between the countries producing sheep milk, Turkey is the country with the most significant production of sheep milk (1.4 million tons), followed by China (1.2 million tons) and Greece (753 thousand tons). In the top 10 countries on sheep milk production, Romania is ranked 5th, with an amount of 626,145 tons in 2019, followed by Spain, Italy, Sudan, Mali and Somalia (FAO, 2019).

In accordance with the NIS (National Institute of Statistics) statistical data regarding the evolution of the sheep population in Romania, between 2013 and 2019, the total number of sheep increased steadily, from 9.1 million heads in 2013 to 12.9 million heads in 2019, an increase of 41.6% (NIS, 2019).

The evolution of sheep milk production in Romania has seen an upward trend in recent years, from 2013 to 2015, reaching a peak production of 4520 thousand hl in 2015,

following by a decrease to 3744 thousand hl in 2017. NIS data for 2019 show a significant increase in milk production, 3.7% more than the production recorded in 2017. What is more, in 2019 was registered a production of 5924 thousand hl of sheep milk, increasing by more than 53% compared to 3885 thousand hl registered in 2018 (NIS, 2019).

The most important sheep breeds in Romania, with their characteristic productions, are: Tsurcana - mixed production, Merinos - wool, Țigaie - wool and milk, Karakul - sheep pelts. Being a mixed race, the Tsurcana breed is the most widespread on the territory of Romania. According to NAAB (National Agency for Animal Breeding), the most recent statistical data find that the Tsurcana breed occupies a significant proportion in the breeds raised in our country (NAAB, 2019).

Out of the total number of sheep registered in the Official Production Control (OPC), the Tsurcana breed holds over 73% of the sheep livestock (1.7 million heads), followed at distance by the Țigaie breed with 13% of the livestock (323 thousand heads), respectively Merinos 6% (150 thousand heads) and Karakul 2% (21 thousand heads), out of a total of 2.4 million heads in COP (NAAB, 2019).

In the last 40 years, the following ecotypes have been differentiated from the Tsurcana breed: Tsurcana Bălă, Tsurcana Bucălaie, Tsurcana Brează, Tsurcana Oacheșă of Caransebeș and Tsurcana of Brastavățu. Of the six ecotypes, the Tsurcana Bălă ecotype is part of the white variety of the Tsurcana breed, which occupies the widest range, being the most numerous. At the same time, the white variety is appreciated for its greater milk production.

Therefore, in the exposed context, the present paper aims to carry out an analysis regarding the quantitative performances and aptitudes in the direction of milk production achieved by the Bălă ecotype of the Tsurcana breed, in the northwest region of Romania, highlighting the evolution of milk production in 2016-2019 and the lactation periods of the sheep population analyzed.

MATERIALS AND METHODS

The objective of this study is to present the productive characteristics of the Bălă ecotype of the Tsurcana breed (quantitative results regarding total milk production, lactation period, suckling period duration, milking period duration). In this respect, the quantitative analysis was performed on a sample of 2422 females from the Bălă ecotype, selected from farms in the northwest region of Romania, respectively the Maramureș (MM) and Bistrița-Năsăud (BN) areas, farms growing this ecotype (Table 1). There were selected farms in each area, with variable sheep numbers, registered in the Genealogical Register (GR) of the Tsurcana breed administered by the Association of Shepherd Breeders "Păstorul Crișana" Arad (GR Tsurcana, 2020).

Table 1. Sheep sample selected for analysis (heads)

Year	Area	Lactation					Total/year
		I	II	III	IV	V	
2016	MM	80	80	80	80	80	**400**
	BN	80	80	80	80	80	**400**
2017	MM	80	80	80	80	80	**400**
	BN	80	80	80	80	80	**400**
2018	MM	80	80	80	80	80	**400**
	BN	80	80	80	80	80	**400**
2019	MM	80	80	80	80	80	**400**
	BN	80	80	80	80	80	**400**
Total/ lactation		**640**	**640**	**640**	**640**	**640**	**3200**

Area	**MM**	**BN**	**Total**
Total livestock	1600	1600	3200
Unique animals	1360	1062	2422

The principle of sample selection was based on a lactation period analysis. Thus, lots of 80 sheep heads were chosen for 5 lactation periods, during 2016-2019 (Table 1). There were analyzed 1600 animals in each area, of which a total of 1360 unique animals from Maramureș area and 1062 unique animals from Bistrița-Năsăud area.

Analysis of quantitative results regarding quantitative results regarding total milk production, lactation period, suckling period duration, milking period duration was performed in Microsoft Excel, using descriptive statistical methods.

Also, the paper aims to compare the average milk production for the sample selected from the Bălă ecotype, with the average milk production of the Tsurcana sheep population, specified in the breed standard.

In this respect, the *t-statistic* test was applied to the sample, with the help of the SPSS program, formulating the test hypothesis H_0: $\overline{x} = \mu$, which tests whether the difference between the average milk production of the sheep sample ($\overline{x}$) and the average production of Tsurcana breed (μ) is statistically significant.

RESULTS AND DISCUSSIONS

Tsurcana breed standard

In view of the zootechnical appreciation of the animals, the main characteristics of the Tsurcana sheep are included in the standard of the Tsurcana breed (SR 13502/2006), document approved at national level by the Association of Standardization in Romania. This standard refers to pure-bred breeding sheep, the Tsurcana breed, recorded in the Genealogical Register (ASRO, 2006).

The body weight is between 48-65 kg for males (lambs, rams), respectively 38-48 kg for females (lambs, sheep), but can be exceeded. The sheep of this breed have the average age at the first delivery of 24 months.

Mainly, sheep from this breed are exploited for mixed milk-meat-wool production. Average milk production at the Tsurcana breed on the whole lactation is 100-120 kg, and the milked milk production is 60-70 kg, the quantity of milk being determined by weighing, with an accuracy of ± 40 g.

According to the breed standard, the sheep from the Tsurcana breed are divided into three varieties: White, Black, Rațca (assimilated). The Bălă ecotype of the Tsurcana breed is part of the White variety.

It is a sheep population with very long coarse white wool, with an optimal structure between fibers. They are harmonious sheep with a medium body weight and mixed productions. The most typical herds are found in Alba county, in Valea Sebeşului (Săsciori, Sugag, Mărtinie), Valea Pianului (Loman, Purcareţ) and from this area they have spread in large numbers in the area of Bistrița and in the farms in Cluj County, Maramureș, Satu-Mare, Sălaj, Arad, Timiş and the area of Moldova.

Performances regarding the milk production of the Bălă ecotype during 2016-2019

The results of the research study followed the quantification of the productive aptitudes in the direction of milk production of the Bălă ecotype of the Tsurcana breed, being presented the main performance indicators for the analyzed sample.

In order to characterize the productive performances, the representation of the lactation sequence was performed: L I, L II, L III, L IV, L V for the studied herd. In this regard, for each lactation the number of sheep, the age at the delivery, the number of the lactation or age category, the duration of the lactation period, the total milk production, the duration of the milking period, the average daily production were taken into account.

Also, the method used for milk control, the unit of measure for the quantity of milk, the date of lactation, the date of weaning of the lambs, the number of milk tests on sheep (4 controls), for the calculation of milk production on lactation were analyzed.

Milking period duration

The duration of the milking period represents the time interval between weaning the lamb and ending the lactation.

The milking system used is system II - milking after a period of lactation, according to the *Norms of appreciation of sheep and goats of reproduction*, *Order no. 22 of January 20, 2006*.

The official control of milk production was carried out by the A.C.O.C. Bistrița-Năsăud and A.J.C.O.C. "PRO OVIS" Maramureș, accredited by NAAB to evaluate the performances regarding milk production.

Thus, according to ICAR regulations, milk production is evaluated using the official control methods of milk production in sheep (ICAR Guidelines, 2019).

In the analyzed farms, milk production control was achieved by using the control methods AT (one control per day at 30 days, first in the morning and next in the evening) and A4 (two controls, in the morning and the evening of the control day, at interval of 30 days).

The average duration of the milking period calculated for the livestock analyzed from the Maramureș and Bistrița-Năsăud regions is represented in Table 2.

For the 2016-2019 period, the milking period has an average duration of 109 days (L I), 111 days (L II), 109 days (L III), 108 days (L IV) and 110 days (L V), with a total average value of 109 days.

Table 2. Average milking period duration (days)

Year	Lactation					Average/
Area	I	II	III	IV	V	year
2016	**95**	**96**	**96**	**95**	**97**	**96**
BN	85	88	87	87	88	87
MM	104	104	104	104	105	104
2017	**104**	**105**	**101**	**101**	**101**	**102**
BN	103	104	104	102	103	103
MM	104	105	98	100	100	101
2018	**113**	**116**	**115**	**111**	**115**	**114**
BN	102	102	100	102	101	101
MM	125	130	130	119	130	127
2019	**123**	**127**	**123**	**125**	**126**	**125**
BN	127	130	128	126	128	128
MM	119	124	119	124	123	122
Average/ lactation	**109**	**111**	**109**	**108**	**110**	**109**

Suckling period duration

The duration of the suckling period is the period in which the lambs are suckled by the mother sheep. Following the analysis, in Table 3 we can see that the average duration of the suckling period in 2016-2019, for the selected sheep herd, is 71 days.

The duration of the suckling period in the Tsurcana breed is usually 2-3 months. The result found in this analysis is in the literature data (Tafta, 2003).

Table 3. Average suckling period duration (days)

Year	Lactation					Average/
Area	I	II	III	IV	V	year
2016	**78**	**75**	**76**	**79**	**79**	**77**
BN	91	84	87	92	90	89
MM	66	66	66	66	67	66
2017	**60**	**59**	**60**	**68**	**67**	**63**
BN	65	63	67	75	73	69
MM	56	55	54	60	61	57
2018	**73**	**90**	**74**	**70**	**65**	**74**
BN	83	86	54	86	54	73
MM	63	94	94	53	75	76
2019	**66**	**67**	**68**	**64**	**77**	**68**
BN	67	62	70	68	69	67
MM	65	73	66	60	84	70
Average/ lactation	**69**	**73**	**70**	**70**	**72**	**71**

Lactation period

The lactation period represents the sum, in days, of the suckling period and of the milking period. This can be also calculated as the difference, in days, between the delivery date and the end of lactation.

According to our data, an average suckling period duration of 71 days was obtained, respectively 109 days for the average milking period duration. According to the first calculation method, the lactation period represents the sum of the two periods, respectively 180 days. The same result can be observed in Table 4, where we find that, for the period 2016-2019, the sheep population from the Bălă ecotype of the Tsurcana breed from the two areas of interest (MM and BN) has an average lactation period of 180 days.

Table 4. Average lactation period (days)

Year	Lactation					Average/
Area	I	II	III	IV	V	year
2016	**173**	**171**	**172**	**174**	**175**	**173**
BN	176	172	174	179	179	176
MM	170	170	170	170	172	170
2017	**164**	**164**	**161**	**169**	**169**	**165**
BN	169	167	171	178	176	172
MM	159	160	152	160	161	158
2018	**186**	**206**	**189**	**180**	**180**	**188**
BN	185	188	154	188	155	174
MM	187	224	224	172	205	203
2019	**189**	**194**	**192**	**189**	**202**	**193**
BN	194	192	198	194	197	195
MM	184	197	185	184	207	191
Average/ lactation	**178**	**184**	**178**	**178**	**182**	**180**

Reported on each of the five lactations, we have the following results: 178 days for lactation periods I, III and IV, 184 days for

lactation II, and 182 days for lactation V (Figure 1).

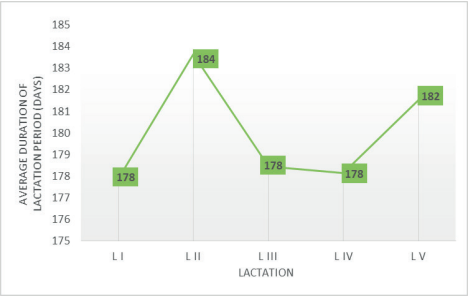

Figure 1. Average lactation period (days)

Total milk production

The total milk production represents milk production from the milking period in the case of lactation after the suckling period. According to the *Norms for the appreciation of sheep and goats for breeding, Order no. 22 of January 20, 2006,* only milk production during milking can be part of the registration of milk on the farm.

Thus, the data extracted from the Genealogical Register represented the basis for calculating the total milk production of the livestock, taking into account the milk after the weaning and the duration of this period which begins with the weaning of the lambs and ends at the end of lactation (Order no. 22, 2006).

Table 5. Average daily milk production (g)

Year / Area	Lactation I	II	III	IV	V	Average/ year
2016	**772**	**742**	**731**	**727**	**701**	**735**
BN	1036	963	957	943	896	959
MM	509	521	504	510	506	510
2017	**710**	**706**	**696**	**724**	**726**	**712**
BN	763	775	724	722	741	745
MM	657	638	668	726	711	680
2018	**803**	**815**	**736**	**803**	**700**	**771**
BN	840	835	687	835	644	768
MM	765	795	786	771	755	774
2019	**828**	**781**	**832**	**774**	**730**	**789**
BN	702	717	710	699	694	704
MM	954	844	954	849	767	874
Average/ lactation	**778**	**761**	**749**	**757**	**714**	**752**

According to the analyzes carried out on 80-head sheep lots, on each of the five lactations, in the period 2016-2019, it turns out that the average daily milk production (obtained from the controls carried out) is 752 g. Regarding the control years, the largest daily registrations for milk production were made in 2019, with an average daily production of 789 g (Table 5). The results from Table 6 show that the average of total milked milk production calculated for the period 2016-2019, for the sheep livestock selected from the two areas in the north-western region of Romania is 82 kg, with relatively close records for each of the five lactations: 84 kg for L I and L II, 81 kg for L III and L IV, respectively 78 kg for L V (Figure 2).

Table 6. Average of total milked milk production (kg)

Year / Area	Lactation I	II	III	IV	V	Average/ year
2016	**70**	**69**	**68**	**67**	**66**	**68**
BN	88	84	83	82	79	83
MM	53	54	52	53	53	53
2017	**73**	**74**	**70**	**73**	**74**	**73**
BN	79	81	75	74	76	77
MM	68	67	66	73	71	69
2018	**90**	**94**	**85**	**88**	**82**	**88**
BN	86	85	68	85	65	78
MM	95	103	102	92	98	98
2019	**101**	**99**	**102**	**97**	**92**	**98**
BN	89	93	91	88	89	90
MM	113	104	114	105	94	106
Average/ lactation	**84**	**84**	**81**	**81**	**78**	**82**

Figure 2. Evolution in 2016-2019 period for the average total milk production (kg)

According to the characteristics presented in the standard of the Tsurcana breed, the total milk production at the Tsurcana breed on the whole lactation is 100-120 kg, and the average of milked milk production is 60-70 kg, with an accuracy of ± 40 g.

In order to make a comparison between the average milk production for the sample selected from the Bălă ecotype, with the average production made by the population of sheep of the Tsurcana breed, specified in the

breed standard, the t-statistical test was applied to the selected sheep sample, which tests whether the difference between the average production of the sheep sample and the average production of the population is statistically significant.

The test involves the formulation of the null hypothesis, meaning the hypothesis that there is no statistically significant difference between the average value of the production for the studied sample and the estimated one at the population level, with a probability of 95% (p = 0.95).

Thus, for a sample size n = 3200 and a significance level $\alpha = 0.05$ (1-p), we verify the hypothesis H_0: $\overline{x} = \mu$, where $\overline{x}$ represents the sample mean, and μ represents the Tsurcana breed mean. The alternative hypothesis is H_1: $\overline{x} \neq \mu$, meaning that the average milk production of the sample is different from the average milk production of the population.

In Table 7 are presented: the average value of the sample, the minimum and maximum limit, the standard deviation and the standard error of the mean.

Knowing the sample data, respectively its size n = 3200, the sample mean $\overline{x}$= 82, the standard deviation s = 17.31, and the population mean μ = 70 (according to the breed standard, the maximum limit of the range 60-70 kg), the t_{calc} statistical value calculation is performed using the calculation method of the t test for a single sample in the SPSS program.

Table 7. Sample descriptive statistics

One-Sample Statistics						
	N	**Mean**	**Minimum**	**Maximum**	**Std. Deviation**	**Std. Error Mean**
Total milk production (kg)	3200	81.82	46.79	199.29	17.31	.306

In order to decide whether hypothesis H_0 is rejected or accepted, it is necessary to compare the calculated value t_{calc} with the critical value t_{crit} (given by the significance level). According to the results presented in Table 8, $t_{calc} < 0.01$, that is $t_{calc} < t_{crit}$.

Therefore, because the value of the calculated statistical parameter of the test does not belong to the critical region, the null hypothesis is accepted. Thus, we can say that there is no statistically significant difference between the average value of the production for the studied sample and the estimated one at the population level, that is the difference of 11.82 kg between the average of the sheep population from the Bălă ecotype and the average of the Tsurcana breed is statistically insignificant.

Table 8. Results of the t-statistic test in SPSS

One-Sample Test						
	Test Value = 70 (μ)					
	t_{crit}	**df (n-1)**	**Sig. (2-tailed) (t_{calc})**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					Lower	Upper
Total milk production (kg)	38.650	3199	.000	11.82	11.22	12.42

CONCLUSIONS

With a percentage of over 73% of the total number of sheep registered in the Official Production Control (OPC), the sheep from the Tsurcana breed represent a point of interest for the sheep farmers in Romania.

The evolution of sheep milk production in Romania has seen an upward trend in recent years, in 2019 being registered a total milk production of 5924 thousand hl of sheep milk, increasing by 53% over 2018.

The objective of this paper was to analyze these performances at the Bălă ecotype, which is part of the White variety of the Tsurcana breed. In this respect, the sheep herds analyzed were relevant to obtain results corresponding to this ecotype, being selected from farms with a majority of sheep from the Bălă ecotype.

The results of the study show that, for the sheep sample from the Bălă ecotype, the average

duration of the suckling period in 2016-2019 is 71 days, the average duration of the milking period is 109 days and the average lactation period is 180 days.

In terms of milk production, the standard of the Tsurcana breed presents two values to which the milk production of the Bălă ecotype is reported, namely: the average of total milk production per lactation which at the Tsurcana breed is 100-120 kg/lactation and the milked milk production which is 60-70 kg.

The data presented show that the average milked milk production calculated for the period 2016-2019, at the sheep herds selected from the two areas in the north-western region of Romania, belonging to the Bălă ecotype, is 82 kg, with relatively close records for each of the five lactations: 84 kg for L I and L II, 81 kg for L III and L IV, respectively 78 kg for L V.

In order to obtain relevant data regarding the quantitative performances in milk production at the Bălă ecotype, it was considered the comparison of the average milk production estimated for the lots of sheep analyzed with the breed standard, respectively an individual average of 82 kg of milk compared to the upper limit of 70 kg established in the breed standard. Performing the statistical test on the sample of 3200 sheep results heads show a mean difference of approximately 12 kg.

From the obtained results we can say that there is no statistically significant difference between the average value of the production estimated for the studied sample and the average production at the breed level.

In conclusion, we can appreciate that the Bălă ecotype has a productive performance in milk production within the breed standard, without major difference.

REFERENCES

ASRO (2006). *The standard of the Tsurcana sheep breed* - SR 13502. Retrieved from Asociation of Standardization in Romania: http://www.asro.ro.

Buzu, I. (2017). Worldwide trends development of sheep breeding. Chișinău, Republic of Moldova: *Scientific Papers, Series D. Animal Science,* LX.

FAO (2019, March 23). FAOSTAT. Retrieved from Food and Agriculture Organization Corporate Statistical Database: http://www.fao.org/faostat/en/#data.

GR Tsurcana (2020). *Genealogical Register of the Tsurcana breed.* Retrieved from Association of Shepherd Breeders "Păstorul Crișana" Arad : http://pastorulcrisana.ro/.

ICAR Guidelines. (2019). Retrieved from International Committee for Animal Breeding: https://www.icar.org.

Mohapatra, A. A. (2019). Sheep milk: A pertinent functional food. *Small Ruminant Research*, 181, 6-11.

NAAB (2019). National Agency for Animal Breeding. Retrieved from NAAB: http://www.anarz.eu

NIS (2019). National Institute of Statistics. Statistical Yearbook of Romania 2019. Retrieved from https://insse.ro/cms/ro/tags/anuarul-statistic-al-Romaniei.

Order no. 22. (2006). NAAB. Retrieved from The National Agency for Animal Breeding: http://www.anarz.eu.

Pascal, C. (2007). *Breeding of sheep and goats.* Iasi: PIM Publishing House.

Stanciu, S. (2014). *Romanian milk market analysis*. SEA - Practical Aplication of Science, 1(2 (4)), 373-380.

Taftă, V. N. (2003). *Sheep breeding in small and medium farms*. Bucharest, RO: Ceres Publishing House.