EVALUATION OF GENETIC POTENTIAL FOR MILK PRODUCTION IN THE ROVASI SHEEP BREED

C. Pascal[1,2*], C. Cristian[2], D. Bulmagă[2]

[1]Iasi University of Life Sciences, Faculty of Food and Animal Sciences, Romania
[2]Research and Development Station for Sheep and Goat Breeding, Secuieni-Bacău, Romania

Abstract

The main purpose of conducting milk production control is to identify high-performing milk-producing ewes that can serve as the foundation for future selection nuclei, aiming to obtain offspring with superior productivity potential. The practical importance of establishing elite nuclei is also ensured by the fact that future ram dams will be selected only from the females forming this elite group. The research was conducted on two batches of lactating females (L1 and L2). In order to evaluate their milk production potential as objectively as possible, control works were carried out both during the suckling period of the lambs and during the exclusive milking period of the ewes. Accepted working methods were used for both periods, and the two groups benefited from identical conditions. Statistical analysis of the data for the suckling period indicates the existence of differences between the groups (P < 0.01). Regarding the total milk production obtained in the respective lactation, it was observed that the highest quantity was obtained from L2, which provided a superior production by 28.75% compared to L1.

Key words: *sheep milk, Rovasi, Țigaie, nursing, milking, lambs*

INTRODUCTION

Sheep milk production represents an important objective of sheep breeding in Romania. Maintaining the local sheep populations at the current level of productivity and reproduction is not profitable because keeping them at a low production level results in low economic efficiency. Therefore, the development of breeding programs for different breeds and rearing areas is a top priority measure (Pascal, 2015).

In order to be useful and meet the requirements, the development of the breeding program must take into account all the biological aspects and specific characteristics of sheep, focusing on those that can influence the achievement of the desired objectives.

Currently, sheep milk production, as well as the industrialization and commercialization of dairy products, is mainly concentrated in Central Europe, particularly in countries around the Mediterranean Sea and partially in some African and Asian countries (Pulina et al., 2018).

Currently, the most well-known sheep breeds raised for milk production are the East Friesian, Lacaune, Sarda, Assaf, and Awassi, which provide yields of over 400 liters per lactation (Li et al., 2022).

In animal milk production, it is known that the production and composition of milk are primarily determined by genetic factors, nutrients, and living conditions (Legarra et al., 2014; Ogorevc et al., 2008; Pascal et al., 2021).

Furthermore, there is a strong international interest in obtaining new sheep populations that can provide higher milk yields, and Romania has aligned with this trend. In 2010, the Palas Milk Breed was approved, and in 2021, the Rovasi breed was also recognized. Both of these sheep breeds achieve average yields of over 200 liters in a lactation period of approximately 200 days.

Current research is also aligned with this trend, aiming to obtain scientific and practical data specific to a sheep population with higher

*Corresponding author: pascalc@uaiasi.ro
The manuscript was received: 01.09.2022
Accepted for publication: 25.04.2023

milk yields. The formation of this new genotype began in the 1980s when Awassi parents were imported from Israel to Romania. Starting from this nucleus and following a guided breeding plan with the local Tigaie breed, a new population was obtained that is well adapted to the pedoclimatic conditions of the Central Moldavian Plateau and has higher milk yields compared to the local populations with which it coexists in this area.

The results obtained so far oblige all stakeholders to reanalyze and optimize all factors involved so that the animals can express their potential at a higher level (Nechifor et al., 2022).

MATERIAL AND METHOD

The biological material consisted of two batches (L1 and L2) formed by adult lactating ewes. The first group (L1) included only Tigaie sheep, while the second group (L2) consisted of females belonging to the Rovasi breed.

Throughout the entire lactation period, both groups received the same maintenance and feeding conditions, as well as the same experimental treatment.

To eliminate the influence of age on lactogenic capacity, both groups were composed of ewes in their first four lactations.

The evaluation of performance regarding the quantity of milk obtained during lactation was based on the planning of successive productive controls, using accepted methods in experimental techniques.

For the lactation period corresponding to the nursing length, the Nica method was used (this method takes into account the fact that 1 kg of daily growth for lambs during the lactation period is achieved with 4.5 kg of milk until the age of 60 days). To evaluate the amount of milk consumed by the lambs during the nursing period, three weight control actions were planned: at birth, at 30 days, and at 60 days after birth, using the model presented by Ghită et al., 2006. Based on the resulting differences in live weight and by multiplying the total growth obtained in each control interval by the transformation coefficient, the average quantity of milk consumed by the lambs was determined. For the period when the females were exclusively milked, the AT4 method was used, following the technical specifications proposed by ICAR (International Committee for Animal Recording).

According to the technology applied in sheep milk production and the established methodology for productive control, the total duration of the monitored lactation was set at 200 days. In this lactation period, the weaning lambs was performed at 60 days, and the first control was planned 28 days after weaning, with subsequent controls placed at regular intervals of 28 days.

Individual milk yields determined at the time of each control were recorded alternately, during morning and evening milkings for the following control interval and so on.

The estimation of the total average milk production was carried out using the Fleischmann method, as follows:

$$\text{Milk yield [kg]} = L_1 . \text{int}_1 + \sum_{i=2an} \left(\frac{(L_i + L_{i-1}}{2} . \text{int}_i \right) + L_n . 14$$

where:
L_1 = milk yield of the 1st monthly test;
L_i = milk yield of the i^{th} monthly test (i = 1,..., n);
L_n = milk yield of the last test;
int_1 = number of days from kidding to 1st monthly test;
int_i= number of days between monthly tests (i-1) and i (i = 1,...,n);
n = total number of monthly test for a specific animal.

The obtained results were entered into the database and used to run statistical analyses using the REML (Restricted Maximum Likelihood) algorithm, which allows for analysis of estimators within normal limits. The REML estimator maximizes the probability estimation of parameters using only information that is not contained in the regression vector estimation, thus automatically correcting the degrees of freedom values that are lost in the estimation of the regression vector.

RESULTS AND DISCUSSIONS

In production conditions, one of the first and most important decisions a farmer must take is to determine which core productions to

focus on. Including multiple major objectives in breeding programs can slow down the improvement of a breed, even if there are no reported antagonistic relationships between these objectives. However, solely exploiting a single breed is not an efficient form of growth. Therefore, through human intervention, numerous breeds have been created, with most being multi-purpose breeds (Simeanu et al., 2023), meaning they are mixed breeds suitable for a specific type of production, such as meat, milk, wool, and rarely for three core productions.

1. Evaluating milk production during the nursing period. The milk production consumed by lambs during the nursing period is of particular importance due to the following aspects: high biological value, serving as a primary source of nutrition for lambs in the early weeks of life, and being a raw material for the production of various highly valued consumer products. From an economic perspective, in order to obtain larger quantities of commercial milk, lambs in some countries are weaned at 60 days of age or later, and those resulting from specialized dairy breeds are completely separated from their mothers after 30 days postpartum or even earlier.

In both situations, lamb growth relies on artificial feeding. By adopting this approach, the ewes become available for exclusive milking when the lactation curve reaches its highest levels, resulting in a greater quantity of milk for commercial purposes. Through conducted research, the total amount of milk for each interval and the entire nursing period has been determined (Table 1 and Figure 1).

Table 1. Milk production in nursing period (kg)

Batch	Milk production								
	At 30 days			At 60 days			Total nursing period		
	n	$\bar{X} \pm s_{\bar{x}}$	V %	n	$\bar{X} \pm s_{\bar{x}}$	V %	n	$\bar{X} \pm s_{\bar{x}}$	V %
L1 (Tigaie)	80	26.98±0.82	12.9	78	32.48±0.18	10.9	60	59.46±0.40	13.7
L2 (Rovasi)	80	27.80±0.15	13.3	80	38.20±0.88	11.7	60	66.00±0.16	14.9
Difference and the significance of difference									
First phase of suckling (from birth to 30 days)			- 0.82			N.S. – F (1.3114) < Fα (4.0068) P < 0.05			
Second phase of suckling (30 - 60 days)			- 5.72			** – F (10.1346) > Fα (7.0931) P < 0.01			
Total period of suckling			- 10.40			*** – F (41.7187) > Fα (12.7141) P > 0.001			

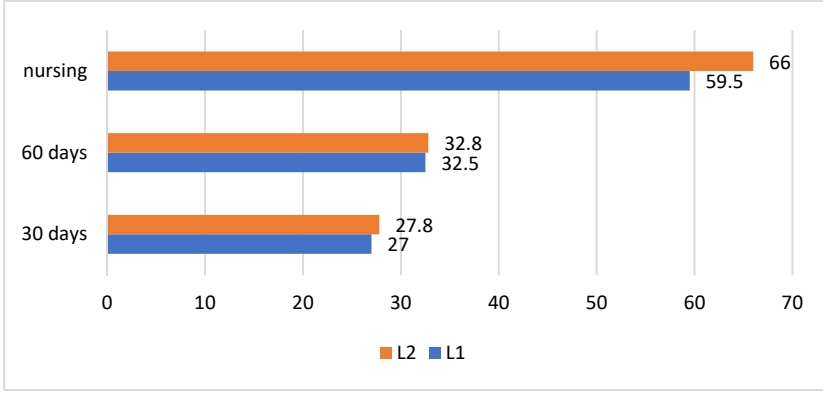

Figure 1. Distribution of the mean values of milk production consumed during the nursing period (kg)

Figure 2. The development of the mammary gland in Rovasi breed and ewes with lambs at 30 days postpartum

For batch L1, consisting only of Ţigaie breed females, the estimated milk quantity for the first 30 days of nursing was 26.98±0.82 kg, which was lower than the values reported by Radu et al., 2010, who indicated an average production of 30.45 kg of milk for the same time interval. For the 30-60 days nursing period, it is observed that the mean values obtained between the two groups were 32.48±0.18 kg for L1 and 38.20±0.88 kg for the L2 group. The statistical analysis showed a significant difference in the average milk production between the two groups, favoring the group composed of females belonging to the new type. The difference between the groups was 5.72 kg, which was significant at $P < 0.01$.

Analyzing the mean values of the total milk production consumed by the nursing lambs, it is observed that the ewes in the L2 group have a superior lactogenic potential, allowing the lambs obtained from this group to have higher average body weights at weaning at 60 days.

For the same interval, L1 had a lower mean milk production consumed by the lambs by approximately 10% compared to the average production determined for L2. The statistical analysis of the data indicates that L2 had a significantly higher average milk production of 10.40 kg, with a significance level of $P > 0.001$.

2. Evaluation of milk production during the milking period. Milk production monitoring is the main technical activity that forms the basis for evaluating animals in terms of milk quantity. In European countries, milk production monitoring is primarily carried out in those located in the Mediterranean basin and is applied to herds raised in different farming systems. According to ICAR, recording milk productions in sheep flocks should be done using several methods. The codified methods A, B, C, and E, are considered official (Astruc et al., 2004; Barillet, 2002).

The time interval between two control days was 28 days, and each control day was placed in the middle of that interval. By doing so, we attempted to eliminate the influence of meteorological changes, which can occur more frequently over a longer period of time and may affect the lactogenic potential of the exclusively milked ewes.

Based on the specific technical actions of performance monitoring and the data obtained from the control milking, the quantity of milk for each established time interval was determined on the respective control day.

Analyzing the obtained values (Table 2), it can be observed that the highest absolute difference was recorded during the interval corresponding to the third control. For this interval, the performance of the L2 ewes was superior by 11.23 kg of milk compared to the milk production obtained by L1. In practice, for this control interval, the milk production of L2 was higher by 46.29% compared to the performance of L1 ewes. On the other hand, the smallest difference was recorded for the milk production obtained during the first control interval. Data analysis indicates that during the first control, the milk production of L2 was only 31% higher. Expressing the difference observed during the first control in absolute values, it indicates a higher milk production of 5.65 kg in the L2 group.

At the end of lactation, based on the average values obtained for each control interval, the average milk production was determined, which is equivalent to the quantity of marketable milk. Essentially, this quantity is also the one intended for commercialization and contributes to generating income during the grazing season.

Table 2. Milk production obtained in milking period exclusively (kg)

	L1 (Ţigaie)			L2 (Rovasi)			
	n	$\bar{X} \pm s_{\bar{x}}$	V%	$\bar{X} \pm s_{\bar{x}}$	V%	The absolute difference ±	
						±	%
Control I	60	12.55±0.82	16.90	18.20±0.43	13.66	+ 5.65	31.04
Control II	60	13.38±0.63	13.53	20.05±0.56	14.93	+ 6.67	33.25
Control III	60	13.03±0.34	14.84	24.26±0.70	14.01	+ 11.23	46.29
Control IV	60	13.85±0.17	12.56	21.58±0.33	13.54	+ 7.73	35.82
Control V	60	12.65±0.28	13.18	20.30±0.24	12.62	+7.65	37.68
Control IV	60	9.95±0.41	12.85	18.90±0.84	11.57	+ 8.95	14.00
Total quantity of marketable milk (milked)		75.41±0.22	12.22	123.29±0.37	10.48	+ 47.88	38.83

The difference and the significance of difference						
Tukey Test	Control I	Control II	Control III	Control IV	Control V	Control VI
Control I		4.86**	6.07**	2.39*	4.11**	2.61*
Control II	-		1.21^{ns}	2.47*	0.75^{ns}	2.25*
Control III	-	-		3.68**	1.21^{ns}	3.46**
Control IV	-	-	-		1.28*	2.78**
Control V	-	-	-	-		1.50*
Control IV	-	-	-	-	-	

*P < 0.05 (w = 1.217); **P< 0.01 (w = 2.740); $^{n.s}$: nonsignificant

The statistical analysis of the data indicates significant differences in the average milk yields for each control interval. This finding also translates into a significant absolute difference in the total quantity of milk, considering the chosen significance thresholds (Table 2).

For L1, during the exclusive milking period, the average quantity of marketable milk was 75.41 kg, while for L2, it was 123.29 kg, resulting in a difference of 47.88 kg. These data indicate that in L2, the quantity of milk in the controlled lactation period was higher by 38.83%.

3. Evaluation of the total milk production obtained during controlled lactation. Assessing the lactogenic capacity of the two sheep populations was the main objective, and the statistical analysis of the data reveals a different lactogenic potential (Table 3). The differences were smaller when evaluating the quantity of milk consumed by the lambs during the first 60 days of lactation. For the Ţigaie breed (L1), based on the lamb weights and the corresponding transformation coefficient for each age group, it was determined that each lamb consumed an average total amount of approximately 60 kg of milk through suckling during the 60-day lactation period.

For L2 (Rovasi Sheep Breed), in the same time frame, season, and under the same feeding and maintenance conditions, it was found that each lamb consumed an average of approximately 66 kg of milk. Thus, during the 60-day nursing period, lambs from the new milk type consumed an average total quantity of milk approximately 10% higher, and their live weight at weaning was approximately 2 kg higher compared to Ţigaie lambs.

After completing the planned controls, it was observed that the quantity of milk obtained from the two groups was also different. Based on the data analysis, it is found that the quantity of milk collected through milking from L2 was 38.83% higher compared to the average quantity determined for L1.

Table 3. The average total milk production obtained during controlled lactation (kg)

Specification	L1			L2			
	n	$\bar{X} \pm s_{\bar{X}}$	V%	$\bar{X} \pm s_{\bar{X}}$	V%	The absolute difference ±	
						±	%
Total milk for nursing	60	59.46±0.40	13.7	66.00±0.16	14.99	+ 6.54	9.90
Total quantity of marketable milk (milked)	60	75.41±0.22	12.22	123.29±0.37	10.48	+ 47.88	38.83
Total quantity of milk		134.87		189.29		+54.42	28.75

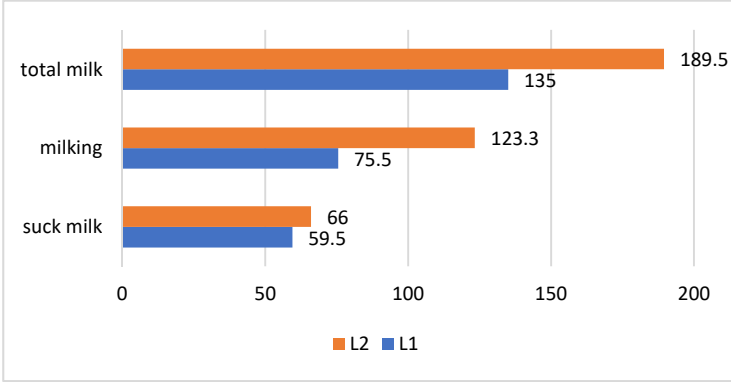

Figure 3. The graphical distribution of values for milk production in controlled lactation (kg)

Regarding the total quantity of milk obtained in the respective lactation, it is observed that the highest amount of milk is obtained from L2. Thus, this batch achieves a total milk production that is 28.75% higher compared to the Țigaie breed (L1).

Analyzing the proportion of suckled milk and the production obtained through milking in the total milk production of the considered lactation highlights different values between the two lots. In the Țigaie breed (L1), the proportion of marketable milk in the total quantity is 56%, while the remaining 44% represents the quantity of milk obtained through milking. For L2, it is observed that the proportion of suckled milk represents 65%, while the remaining 35% is the quantity of milk obtained through milking.

CONCLUSIONS

Based on the obtained data, we can conclude that the sheep in L2 had a superior milk production in the early stages of lactation, which is also explained by the higher weight gain achieved by the lambs in this lot.

Statistical analysis of the data indicates that there was a difference of 10.40 kg between the two lots during the lactation period, favoring the lot belonging to the new milk type. This difference is significant, intense, and positive ($P \leq 0.001$).

During the exclusive milking period, L1 had an average marketable milk production of 75.41 kg, while L2 achieved a total production of 123.29 kg, resulting in a difference of 47.88 kg.

In the controlled lactation, the batch L2 obtained the highest quantity of milk, producing 28.75% more milk compared to batch L1.

ACKNOWLEDGEMENTS

The research was funded by the Ministry of Agriculture and Rural Development (MADR) in Bucharest, through the ADER 817 project.

REFERENCES

1. Pascal, C. (2015). *Treaty for sheep and goat breeding*. Ion Ionescu de la Brad Publishing House, Iași-Romania

2. Pulina G.; Milán M.J., Lavín M.P., Theodoridis A., Morin E., Capote J.; Thomas D.L.; Francesconi A.H.D. Caja G. (2018). Current production trends, farm structures, and economics of the dairy sheep and goat sectors. *J. Dairy Sci*. 101:1–15, p 1-15
3. Ruonan Li.; Yuehui Ma.; Lin Jiang. (2022). Review: Research Progress of Dairy Sheep Milk Genes. *Agriculture*, *12*(2), 169; doi.org/10.3390/agriculture12020169
4. Legarra A..; Baloche, G.; Barillet, B.; Astruc, JM.; Soulas, S.; Aguerre, X.; Arrese, F.; Mintegi, L.; Lasarte, M.; Maeztu, F.; Beltrán de Heredia I.; Ugarte, E. (2014). Within- and across-breed genomic predictions and genomic relationships for Western Pyrenees dairy sheep breeds Latxa, Manech, and Basco-Béarnaise. *J Dairy Sci*. May;97(5):3200-12.
5. Ogorevc, J.; Kunej, T.; Razpet, A.; Dovc, P. (2009). Database of cattle candidate genes and genetic markers for milk production and mastitis. *Anim. Genet. 40*, 832–851.
6. Pascal, C.; Florea, AM.; Nechifor, I.; Cristian, C. 2021. Research regarding the evaluation of the current status of a new sheep population created in Romania *Sci. Papers-Series D-Anim. Sci.* 64 (1), pp.69-74
7. Nechifor, I., Florea Al.M., Radu Rusu R.M., Pascal, C. (2022). Influence of supplemental feeding on body condition score and reproductive performance dynamics in Botosani Karakul Sheep. Agriculture Basel, ISSN 2077-0472, Vol. 12
8. Simeanu, D., Radu Rusu, R.M. 2023. Animal nutrition and productions *Agriculture*, *13*(5), 94.
9. Ghiță, E.; Călătoiu, A.; Rebedea, M.; Vicovan, A. (2006). Preliminary investigations on the use of ICAR standardised methods to check the milk yield in sheep. Archiva Zootechnica vol. 9, p 135-151.
10. Radu, R.; Enciu, A.; Ida, A.; Vicovan, G.P.; Zamfir, C.Z.; Nicolescu, A. (2010). The improvement of the milk production in the sheep breeds and populations from various climatic areas. *Sci. Papers*- vol. 55, Animal Sciences Series. Vol 55, p 40-43.
11. Astruc J.M.; Barillet F. (2004). Current challenge for milk recording in dairy sheep and goats: the simplification of milk sampling design for chemical composition and somatic cell counts of milk. This session. Proc. of the 34th Session of ICAR, Sousse, Tunisia, 30 May – 3 June 2004.
12. Barillet F. (2002). Report of the ICAR Working Group on milk recording of sheep. Proc. 33rd Biennial Session of ICAR, Interlaken, Switzerland, 26-31 May, EAAP Publication N° 107, Wageningen Pers, 273-287.