CHARACTERISTICS OF GENETIC AND PRODUCTIVE QUALITIES IN KARAKUL SHEEP

Silvia EVTODIENCO, Vitalii PETCU

National Institute for Applied Research in Agriculture and Veterinary Medicine,
100 Ialoveni Str., MD 2070, Chisinau, Republic of Moldova

Corresponding author email: silvia.evtodienco7@gmail.com

Abstract

At a Karakul sheep farm was carried out the study of the genetic qualities of the lambs at birth and the productive indices of the whole flock. As a result of the controlled mating, lambs of different colors and shades were obtained, which were appreciated according to the bonitation instruction. The flock primarily consisted of lambs from elite and first-class rankings, with the majority having flat and ribbed types of lambskin curls. The lambs' pilosity is characterized by excellent density and with the intense gloss. The sheep from the breeding selection nucleus during the fall period inventories were characterized with a good body development intensity and the animals exceed the breed standard.

Key words: body weight, curl type, density, gloss, ranking.

INTRODUCTION

The level of production in various animal species largely depends on genetic traits inherited from ancestors (parents) and manifested during growth, reproduction, and productivity periods. The purpose of scientific research is to identify and highlight animals' capabilities for increasing productivity and improving quality, to develop well-founded recommendations for enhancing genetic traits, and to maintain the achieved performance results.

In the Republic of Moldova, several sheep breeds specialized for milk, wool, and meat production, as well as their crossbreeds, are raised and bred. The Karakul sheep breed is primarily specialized in lambskin production, with milk production being a secondary specialization. The slaughter of lambs for lambskins allows the sheep to provide not only lambskins but also carcasses and rennet, while the ewes are milked shortly after lambing. The lactation period lasts approximately 6-7 months, depending on the lambing date. Currently, due to the declining demand on the lambskin market this unique breed, which has adapted over centuries to the country's conditions is endangered.

This breed originates from Central Asia, where it thrives in arid climatic conditions and adapts to the region's specific nutritional resources. In countries such as Uzbekistan, Kazakhstan, Tajikistan, and Turkmenistan, where Karakul sheep are raised in large flocks, research and selection efforts are continuously carried out in specialized institutions. These efforts focus on adopting new breeding and exploitation methods that align with market demands. In Uzbekistan, where the Karakul sheep population is estimated at around 5.9 million, concentrated in three regions, research has focused on improving the quality of lambskins. This has led to the development of large sheep populations of different types, consistently transmitting productive e qualities to their offspring. Since 2000, ten types of Karakul sheep of various colors have been created, approved, and patented, with the majority being gray in color (Aripov et al., 2016; Shaptakova & Gaziev, 2023).

In Kazakhstan, Karakul sheep breeding plays a crucial role in utilizing arid lands, providing a valuable raw material reserve for processing industries, manufacturing fur products, and supporting export activities (Nurumbetov et al., 2019). Current research focuses on obtaining additional production beyond lambskins, such as increasing meat (Boboculov et al., 2016; Parzhanov et al., 2016) or milk production. Studies indicate that for gray Karakul sheep of the Gray Karakalpak type, milk production in the first 20 days was notably high, ranging from

1125-1213 g/day (Urimbetov & Bobokulov, 2022).

Regarding research into lambskin quality, specific directions in these countries (Aripov et al., 2016) align with those in Moldova and meet market requirements. The primary aim is to increase the number of sheep with flat, tubular, and ribbed curls of different colors through classical selection methods, enhancing growth and reproduction traits (Ghighineishvili, 1976; Rizaeva & Bakhronov, 2021; Tafta et al., 1997; Pascal, 2007; Zakirov & Karimov, 1987).

The selection of Karakul sheep is complex due to the evaluation of multiple indices, each possessing distinct qualities and hereditary transmission patterns. Different selection methods are applied in various breeding flocks (Omirzak et al., 2017; Gaziev et al., 2017; Baibekov & Posaeva, 2019; Alibaev et al., 2014). Some researchers propose innovative methods using inferred formulas for multiple indices, increasing the economic efficiency of selection (Karynbaev et al., 2014).

Currently, the number of purebred Karakul sheep farms in Moldova is limited. One notable example is the peasant household (PH) "Cocieru Vitalie T. ", which maintains over 500 heads in the Hâncești district. Scientific research on testing, selection, and homologation of this sheep population is actively conducted at this location.

MATERIALS AND METHODS

The research on the Moldovan Karakul sheep breed (lambskin-meat-milk production) was carried out at the farm known as Peasant Household "Cocieru Vitalie Tudor", located in Hâncești district (Figure 1).

Figure1. Subtle shades (own source)

Testing of the sheep, aimed at continuously maintaining and improving the productive qualities of the purebred animals, was conducted following the methods and techniques outlined in the "Instructions for Bonitation with Genetic Improvement Principles of Moldovan Karakul Sheep" (Buzu, 2022) and "Recommendations for Sheep Product Production in the Republic of Moldova" (Buzu, 1993).

The establishment of selection nucleus, to obtain offspring with the desired productive capacities, was carried out using the method of independent selective limits.

The main stages of the research and the indicators considered in the study included:

 - Recording of sheep lambing and calculating prolificacy;
 - Bonitation of Karakul offspring at 1-2 days old after birth;
 - Determining the density and silkiness with sheen of the pilosity;
 - Recording birth body weight;
 - Determining the color patterns of grayish lambs;
 - Assessing the body weight of sheep through individual weighing of the entire flock in the fall period;
 - Creating of the selection nucleus by calculating the selection difference and intensity, which included the following groups: breeding rams, breeding ewes, yearlings, and 16-18-month-old lambs. The selection nucleus included animals that exceeded the minimum productive indices required for the breed. The results obtained numerically from the investigations were biometrically processed through Microsoft EXCEL, using classical methods (Plohinsky, 1969). Statistical revealing (P) between the average values of the studied parameters was determined using the Student's T-test (Plohinsky, 1969). Economic efficiency of the selection nuclei relative to the breed standard and the flock average was calculated according to the VNIIPI method (Loza et al., 1983).

RESULTS AND DISCUSSIONS

In 2023, testing and evaluation of Karakul sheep were carried out at the "Cocieru Vitalie Tudor" farm on a total livestock of 594 sheep and 233 lambs at birth selected for breeding. This

Peasant Household is characterized by a sheep population where gray and black sheep predominate, noted that the gray color is recessive, while the grayish ones are in the minority (Figure 2).

Figure 2. Offspring on adult sheep's background (own source)

Following the evaluation (bonitation) of the lambs, it was determined that out of the 233 lambs born, 99 (42.5%) were black, 90 (38.6%) were gray, and 44 (18.9%) were grayish. The flock included: 77 lambs (33.0%) of the elite class, 137 lambs (58.8%) of the first class, and 18 lambs (7.7%) of the second class (Table 1).

The quality of the lambskins, expressed by ranking and type of curl, has a special significance because they are the basic components of the economic value of the main production of these sheep. Curls that are spread over the surface of the hair cover have different shapes, size, length and form individual original drawings that are not repeated. Each lamb is unique and combines the genetic qualities of both parents and as a result lambs of different colors, shades and colorations are obtained. Following the implementation of the mating scheme, the offspring are obtained mostly of black color, which is confirmed by the results obtained at this farm, then succeed buhar and grayish lambs which possess fibers of different length, thickness and have silky and gloss characteristic of the curl type.

Table 1. List of lambs at bonitation

Specification	n	Elite		Ist Class		IInd Class		Excluded	
		heads	%	heads	%	heads	%	heads	%
Black	99	35	35.4	52	52.5	11	11.1	1	1.0
Grayish	44	8	18.2	33	75.0	3	6.8	-	-
Gray	90	34	37.8	52	57.8	4	4.4	-	-
Total	233	77	33.0	137	58.8	18	7.7	1	0.4

On the lamb groups, the highest proportion of elite class lambs was recorded among the gray lambs, with 34 heads (37.8%), and among the black lambs, with 35.4%. It is important to note that over the last 10-15 years, the primary goal of the farm owner has been to create a predominantly gray flock. Consequently, gray sheep with long curls, short fibers, and good lambskin pelt qualities were selected for breeding. As for the grayish lambs, 8 heads (18.2%) were produced, which can be explained by the fact that only in the last 2-3 years has a grayish ram been used for mating, and the selection work is still in its early stages. A total of 33 first-class grayish lambs were obtained, representing 75%. Among the gray and black lambs of the first-class, 52 heads of

each were produced, accounting for 57.8% and 52.5%, respectively. The proportion of second-class lambs ranged from 4.4% to 11.1%. These indicators show that, as a result of the selection work, the flock possesses individuals with high-performing genes, particularly regarding curl quality, including curl shape, length, and fiber quality, what indicates a tangent with the results of other authors (Alibaev et. al. 2014).

Testing the lambs based on curl type showed that the majority in this flock had flat and ribbed curls, which together accounted for 88.8%. Out of the total lot of 233 heads, 127 lambs (54.5%) had flat curls, and 80 lambs (34.3%) had ribbed curls. Lambs with jacket-type curls numbered 21 heads, which constituted only 9% of the total lot (Table 2).

Table 2. The type of curls of the lambs at bonitation

Specification	n	Jacket		Ribbed		Flat		Caucasian	
		heads	%	heads	%	heads	%	heads	%
Black	99	5	5.0	25	25.3	65	65.7	3	3.0
Grayish	44	3	6.8	16	36.4	24	54.5	-	-
Gray	90	13	14.5	39	43.3	38	42.2	-	-
Total	233	21	9.0	80	34.3	127	54.5	3	1.2

Depending on the color of the lambs' pilosity, the highest proportion based on curl type was observed in the black lambs' group with flat curls, a total of 65 heads, or 65.7%. Among the grayish lambs we got 24 heads (54.5%) with flat curls, while 38 heads (42.2%) of the gray lambs had the same curl type. The group of lambs with ribbed curls was also significant. In the gray lamb group, 39 heads (43.3%) had ribbed curls, while 16 heads (36.4%) of the grayish lambs displayed as well this curl type. The proportion of lambs with jacket-type curls, depending on their color, ranged between 5% and 14.5%.

Thus, the data obtained from the testing and evaluation of the lambs' pelt quality allow us to conclude that the sheep from this farm possess various valuable genotypes. This is reflected in the high ranking of lambs in the elite and first classes, comprising 91.8%, with the desirable flat, ribbed, and jacket curl types accounting for 88,8 %. The evaluation of the lambs' fleece quality revealed that the silkiness and sheen were expressed equally across the flock. The average silkiness index for the flock was 7.73±0.07 points (Table 3).

Table 3. Density of hair pilosity at lambs

Specification	n	Excellent		Suitable		Low		Mean±SEM points
		heads	%	heads	%	heads	%	
Blsck	99	56	56.6	41	41.4	2	2.0	7.63±0.13
Grayish	44	27	61.4	17	38.6	-	-	7.84±0.14
Gray (buhar)	90	58	64.4	32	35.6	-	-	7.77±0.10
Total	233	141	60.5	90	38.6	2	0.9	7.73±0.07

The proportion of lambs with excellent density was 60.5%, while those with suitable density made up 38.6%. Among the grayish lambs, the average density's index was 7.84±0.14 points, showing a tendency to increase compared to black ones. The proportion of grayish lambs with excellent density was 61.4%, while those with suitable density comprised 38.6%. For the gray lambs, the average density index was 7.77±0.10 points, with 64.4% having excellent density and 35.6% suitable density. Among the black lambs, the average density was 7.63±0.13 points, with the majority 56.6% having excellent density, and 41.4% suitable density. The differences in density indices between the lamb groups based on color are not significant.
The evaluation of the lambs' fleece sheen showed that, overall, 60.5% of the flock had intense sheen, while 38.6% had suitable sheen

(Table 4). The average fleece sheen across the flock was 7.71±0.08 points.
Among the grayish lambs, 61.4% had intense sheen, while 38.6% had suitable sheen. The average sheen index for the grayish lamb group was 7.89±0.148 points, significantly exceeding that of the black lambs (P<0.05). Among the gray lambs, 64.4% had intense sheen, and 35.6% had suitable sheen, with an average sheen index of 7.77±0.10 points. For the black lambs 56.6 % had intense sheen, and 41.4 % had suitable sheen, with an average of 7.58±0.14 points. From the presented data we observe a high correlation between these two traits (density and sheen), which remains consistent across the lamb groups, depending on their color. In the works of Razieva & Bahronov (2021), the importance of sheen and gloss of the lambs' hair cover for increasing the economic efficiency of the branch is confirmed.

Table 4. The gloss of the Lambs ' hair cover

Specification	n	Intence		Suitable		Low		Mean±SEM points
		heads	%	heads	%	heads	%	
Black	99	56	56.6	41	41.4	2	2.0	7.58±0.14
Grayish	44	27	61.4	17	38.6	-	-	7.89±0.14*
Gray (buhar)	90	58	64.4	32	35.6	-	-	7.77±0.10
Total	233	141	60.5	90	38.6	2	0.9	7.71±0.08

*P<0.05

The evaluation of the sheep in the autumn period determined that at this Karakul breeding farm, the animals are typical of this pure breed, well-developed, and meet the required standards. For example, the breeding rams in a group of 6 elite-class animals had an average body weight of 101.23 kg, ranging from 96.4 to 105.5 kg (Table 5). The ewes, in turn, in a group of 325 heads, reached an average body weight of 60.8 kg, with a range from 44.8 to 81.7 kg. The flock also included 3 young rams with an average body weight of 75.8 kg, ranging from 74 to 77.9 kg. In a group of 125 18-month-old yearlings, the average body weight was 52.72 kg, with a range from 38 to 62.3 kg. This year, 4 young rams were selected for breeding, which at 6 months of age had an average body weight of 49.45 kg, with a range from 43.2 to 54.4 kg.

Table 5. Body weight of sheep (kg)

Gender and age group	n	Mean±SEM	SD	Lot limits
Breeding rams	6	101.23±1.52	3.72	96.4-105.5
Ewes	325	60.8±0.35	6.39	44.8-81.7
Lamb rams at 18 months	3	75.80±1.50	2.60	74-77.9
18-month-old yearlings	125	52.72±0.41	4.6	38-62.3
Young rams at 6 months	4	49.45±2.72	5.44	43.2-54.4
Female lambs at 6 months	131	36.27±0.33	3.76	28.2-53.3

Additionally, 131 ewe lambs were selected for breeding, with an average body weight of 36.27 kg, ranging from 28.2 to 53.3 kg. The analysis of the presented data allows us to conclude that the sheep at this farm are kept and exploited under efficient conditions, adhering to favorable nutritional standards, which lead to high productive performance indices. Following the evaluation of the sheep, a total of 22 heads were selected and introduced into the breeding closed population at the farm. Stud rams were also included in this breeding schedule at a rate of 83.3%, with an average body weight of 102.2 kg. The selection differential was 0.97 kg. From the group of ewes, 296 heads were selected for this group, with an average body weight of 61.5±0.31 kg (Table 6).

Table 6. Body mass of sheep in the breeding nucleus, kg

Gender and age group	n	Mean±SEM	SD	Standard purpose
Breeding rams	5	102.20±1.43	3.21	85-100
Ewes	296	61.5±0.31	5.42	52-55
Lamb rams at 18 months	3	75.80±1.50	2.60	65-70
18-month-old yearlings	98	54.44±0.34	3.36	40-45
Young rams at 6 months	3	51.53±2.47	4.29	35-40
Female lambs at 6 months	117	36.99±0.30	3.28	30-35

The selection differential for the ewes was only 0.7 kg, while the selection intensity for this group reached a fairly high index of 91.1%. All the young rams (100%) were also included in the breeding selection nucleus. From the group of 18-month-old yearlings, 98 heads were selected for the breeding nucleus, with an average body weight of 54.44 kg. The selection differential for

this group was 1.72 kg, and the selection intensity was 78.4%. Additionally, 3 six-month-old young rams with an average body weight of 51.53 kg were selected for the closed breeding population. The selection differential was 2.08 kg, and the selection intensity was 75%. From the group of six-month-old ewe lambs, 117 heads with an average body weight of 36.99 kg were included in the closed breeding population. The selection differential was 0.72 kg, while the selection intensity was 89.3%. The presented selection data show that all animals in the breeding closed population, regardless of sex and age groups, exceed the standard breed target indices.

The economic efficiency for this flock was calculated solely based on the body weight of the animals in each sex and age group. Lamb slaughter for pelt production was limited at this farm and was not considered in the calculation. The milk production of the ewes will be studied in future planned research.

The calculation of the economic efficiency of the average flock indices compared to the minimum standard indices showed an increased income of 307.33 MDL per head on average for the flock (Table 7), and for the breeding nucleus, in comparison to the average flock indices, the increase was 27.10 MDL per head.

Table 7. The economic efficiency of the selection work

Gender and age group	Produc-tion	Productivity of sheep,(kg)			Production surplus at 1 head, %		Price of making 1 kg of production, lei	Economic effect to 1 head,(lei)	
		min requirements.	flock average	selected nuclei	min requirement	flock average		min requirements.	flock average
Breeding rams	Body weight	85	101.23	102.20	20.24	0.96	35	451.61	25.51
Ewes	Body weight	52	60.8	61.5	16.92	1.15	35	230.96	18.35
Lamb rams	Body weight	65	75.80	75.80	16.62	0	35	283.58	0
18-month-old yearlings	Body weight	40	52.72	54.44	31.80	3.26	35	333.90	45.12
Lamb rams at 6 months	Body weight	35	49.45	51.53	41.29	4.21	35	379.35	54.65
Female lambs at 6 months	Body weight	30	36.27	36.99	20.90	1.99	35	164.59	18.95
Average (produc.)								307.33	27.10

Analyzing the presented data, we observe that the animals raised on this farm significantly exceed the minimum breed standard, and the surplus production per head, depending on the sex group and age, varied from 16.62% in mature rams to 41.29% in 6-month-old lambs. According to calculations, the economic effect per head in MDL varied from 451.61 MDL for the breeding ram lot to 164.59 MDL for the 6-month-old ewe lamb lot. Due to the fact that the sheep on this farm are uniform and very well-developed, which is confirmed by the small selection difference ranging from 0 to 2.08 kg, and the selection intensity varied from 75% to 100%, the economic effect relative to the flock average was 27.10 MDL per head.

potential, confirmed by the ranking of lambs as elite and exhibiting the flat and ribbed desired types of curls. The lambs' pilosity is characterized by excellent density and intense gloss.

A total of 522 sheep were included in the selection nucleus, which showed good body development which on all sex and age groups exceed the breed standard. The intensity of selection at this sheep farm depending on the age group and sex ranged from 75 to 100%.

Given the current conditions, it is proposed to maintain the achieved production level and to continue testing, selection work, and implementing directed mating based on rankings, curl type, color of the sheep, etc.

CONCLUSIONS

The Karakul sheep farm "Cocieru Vitalie Tudor" possesses a flock with valuable genetic

ACKNOWLEDGEMENTS

support for valorization the resources in the zoo veterinary area, selection and adaptation of new breeds and hybrids to curative technologies and methods in conditions of climate resilience" for the years 2024-2027.

REFERENCES

Alibaev, N., Baybekov, E., Parzhanov Z., & Eskara, M. (2014). Breeding a new breed of Karakul sheep of greyish blue color in the south of Kazakhstan. *Agriculture and forestry. Science news of Kazakhstan, 2*(120), 12-23.

Aripov, U.K., Aliev, D.D., & Berkinov D. (2016). Tasks and current issues of selection work in Karakul breeding. *Collection of articles "Formation and development of agricultural science in the 21st century"*, Solenoe Zaimishche, 485-487.

Baibekov, E., & Poshaeva, G. (2019). Selection of brown Karakul sheep. *Journal Current scientific research in the modern world*, *8-1*(52). Public organization "Institute of Social Transformation", 45.

Buzu, I.A. (1993). *Recommendations on the technology of sheep breeding products in the Republic of Moldova.* Agroinformreclama, Chisinau.

Buzu, I., & Evtodienco, S. (2022). *Instructions for bonitation with principles of genetic improvement of the Moldovan Karakul Sheep*. Chisinau, MD: Tipografia Centrală Publishing House.

Bobokulov, N. A., Popova, V. V., Ibragimov, Z. K., & Parmanova, D.M. (2016). Intensification of meat production methods in karakul breeding. *Collection of articles «Formation and development of agricultural science in the 21st century»*, Salty Place, 440-445.

Gaziev, A., Fazylov, U., Yusupov, S., & Mamatov, B. (2017). Heredity and variability of lambskin's traits of Karakul sheep. *Research Institute of Karakul Sheep Breeding and Desert Ecology, Samarkand, Uzbekistan, Animal husbandry, feed production and veterinary medicine*, 370-375.

Ghighineishvili, N.S., (1976). *Breeding work in colored karakul breeding*. Moscow, RU: Kolos Publishing House

Karynbaev, A.K., Azhimetov, N.N., & Tlegenova, K.B. (2014). Economic efficiency index estimation sheep breeding and its significance. *International Journal of Applied and Fundamental Research*. South-West Scientific Research Institute for Livestock and Crop Production LLP «KazAgroInnovation» JSG Ministry of Agriculture of the Republic of Kazakhstan, Shymkent, 404-408.

Loza, G.I. et al. (1983). *Methodology for determining the economic efficiency of the use in agriculture of research and development work, new technology, inventions and rationalization proposals*. Moscow, RU: VNIIPI Publishing House.

Nurumbetov, T.Z., Botabayev, N.E., Akbasheva, A.A., & Bektursunova, A.K. (2019). Status and forecast of development of karakul sheep breeding in the Republic of Kazakhstan. *Textile Industry Technology, 1*(379), 259.

Omirzak, T., Saparbekova, A., Aitkulova, R., & Shoinbaeva K. (2017). Selection of Karakul sheep according to key traits. *Scientific works of SKSU, South Kazakhstan State University named after M.O. Auezov*, Shymkent, Kazakhstan, 177-180.

Parzhanov, Z.A., Azhibekov, B.A., & Akhmetshiev, A. (2016). Creation of a factory type of black Karakul sheep with improved meat qualities. *TOO "South-West Research Institute of Animal Husbandry and Plant Growing", Shymkent, Republic of Kazakhstan.*

Pascal, C. (2007). *Sheep and goats breeding*. Iași, RO: PIM Publishing House

Plohinsky, N.A. (1969). *Guide to biometrics for livestock specialists*. Moscow, RU: Kolos Publishing House.

Rizaeva, D.T., & Bakhronov, O. K. (2021). Quality indices of the wool pilosity of black sheep in sandy desert conditions. *Veterinary Medicine in the 21st century: the role of biotechnology and digital technologies: Proceedings of the International Scientific and Practical Conference of Students, Masters and Young Scientists*, Vitebsk, Samarkand, 229-231.

Shaptakova, L. E., & Gaziev, A. (2023). Creation of Mubarek factory type and selection achievements in Karakul breeding. https://repo.vsavm.by/handle/123456789/23202

Tafta, V., Vintila, I., & Zamfirescu, S. (1997) *Sheep production, improvement and breeding*. Bucharest, RO: Ceres Publishing House

Urimbetov, A.A., & Bobokulov, N.A. (2022). Milk production of Karakul sheep of sur color of Karakalpak breed type. *Journal*: *Sheep. Goats. Wool business,* 1, 24-26.

Zakirov, M., & Karimov, K. (1987) *Lambskin production*. Tashkent, Uzbekistan: MEHNAT Publishing House, 190.