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PARTICULARITIES OF BODY CONFORMATION OF THE MOLDAVIAN KARAKUL LAMBS

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Abstract

The purpose of this research was to reveal the variability of the morpho-productive characters that determine the development of body conformation, as well as to identify the factors that influence its optimization. The researches were carried out on the batches of lambs from the classic Karakul and Moldavian Karakul races, born in the experimental households: the state farm "Kotovschii", Dumbrăveni district and the experimental agricultural station "Tevit", Anenii Noi district, Republic of Moldova. The results of the research demonstrated that the body conformation of the Moldavian Karakul lambs is typical of the classic (Asian) Karakul sheep race, with some particularities related to the development of body mass, body length and constitution. Moldavian Karakul lambs are quite full-bodied at birth, with an average body mass of 4.7-5.0 kg, and in some years over 5.0 kg, this being a biological peculiarity of the new type of sheep. Variability of lamb body mass at birth is hereditarily determined (genotypic correlation coefficient r_{xy} = 0.63; h^2 = 0.36; repeatability coefficient $K_{0\text{-}6\ months}$ = 0.26; $K_{0\text{-}18\ months}$ = 0.23) and influenced environmental conditions, in particular, the nutrition of pregnant ewes. The body mass of the lambs at birth is in a direct-proportional phenotypic relationship with: age of the ewes at calving, body length (r_{xy} = 0.49), skin thickness (r_{xy} = 0.45), fiber length (r_{xy} = 0.22-0.31), furskin surface (r_{xy} = 0.64), loop size and constitution; inversely proportional to: the prolificacy of the ewes in the term and the calving period; curvilinear with: the qualities of own furskin (weight in the flock at calving of the higher class Elita lambs). Lamb body length at birth is in the same similar phenotypic relationships as body mass, including with: skin thickness (r_{xy} = 0.54), fiber length (r_{xy} = 0.15-0.18), furskin area (r_{xy} = 0.78). The constitution of the lamb at birth is in a phenotypic relationship: directly proportional - with its own body mass, body length, thickness and skin reserve; inversely proportional - to skin density.

Key words*: body conformation, Moldavian Karakul lambs.*

INTRODUCTION

The body conformation of the Karakul lamb at rating is of particular importance, because the commercial qualities and the value of the furskin depend on its particularities (the qualities of the fibers and curl, the surface, the thickness and the weight of the skin, the sale price of the furskin), the body development and the weight of the carcass (the production of meat) obtained from the slaughter of the lamb for the furskin. The body conformation is related to the robustness of the body and the degree of manifestation of the race characteristics, which reflects its breeding value as a whole. The notion of body conformation of the lamb includes external features, body mass, body length and constitution.

The Karakul lamb at birth, unlike other sheep races, is quite large. In lambs of the Asian Karakul race, the normal body weight at birth is considered to be on average 4.0-4.5 kg, which is about 8-10% of the body weight of the adult sheep, compared to 7.7% in the race Precocious and 6.4% in the Ghisar race (Ilyev, 1969; Vasin, 1971).

"*The dimensions of the Karakul lamb at birth are of particular importance. The fuller lamb, as a rule, is more developed, has a robust constitution, possesses increased viability, its furskin has a larger surface, which, under equal conditions, is valued at a more advantageous price. But, here, what is required is not a large lamb in general, but one of optimal size and normal development according to all its characters*" (Koshevoy, 1975).

Optimizing the body size of Karakul lambs at birth is achieved through their sustainable selection according to a complex of characters, such as: body mass, body length, constitution

and others. These morpho-productive characters are in phenotypic correlation both with each other and in correlation with other characters that influence their variability and quality, such as: the quality of the skin and the hair cover, the quality of the curls and the type of curl, the commercial qualities and the value of the furskins in assembly.

In order to make the selection process of Karakul lambs according to body conformation more efficient, detailed knowledge of the correlative links between the multitude of morpho-productive characters in tangent with body conformation, their variability and the factors that determine the development of the respective characters is necessary.

In this context, the purpose of this research was to reveal the variability of the morpho-productive characters that determine the development of body conformation, as well as to identify the factors that influence its optimization.

MATERIALS AND METHODS

The researches were carried out on the batches of lambs from both the classic Karakul race and the Moldavian Karakul race, raised in the experimental farms: the state farm "Kotovschii", Dumbrăveni district and the experimental agricultural station "Tevit", Anenii Noi district.

The body conformation of the lambs was evaluated according to the external characteristics, constitution, mass and body length, which were assessed at the rating, according to the methods developed by us (Buzu, 2021).

The external features were appreciated when the lambs were rasing by the visual method. Lambs that had a relatively tall and elongated body, a long neck, an elongated back, a long and tapered rump, the height at the rump was 1-2 cm higher than at the withers, the head was elongated, dry were considered typical for the Karakul race, with a ram (convex) profile, covered with bright embers, the ears were long and pale, or medium long, the tail, at the base, was wide with fat deposit in the shape of a small kurdiuk, and the thin tip curved in the shape of the letter " S", which reached up to the hocks.

The body weight of the lambs at birth was determined by weighing the lambs at the time of rating with a hand scale, with a capacity of up to 7.0 kg and an accuracy of 0.1 kg. For weighing with the hand scale, the lamb was wrapped with a string around the chest on the thin, which was hooked to the hook of the scale held by the hand of the scorer, and the lamb was hanging freely, at the moment when the scorer visually fixed the graduation on the scale. According to the developed methodology, the body mass of Karakul lambs at birth was differentiated into the following categories: *very large* with body mass > 5.0 kg; *large* with 4.5-5.0 kg, *medium* with 4.0-4.5 kg, *reduced* with 3.5-3.9 kg and *small* < 3.5 kg. Lambs with large, very large and medium body mass were the most requested for selection and reproduction. Lambs with reduced and small body mass were not allowed for reproduction.

The body length of the Karakul lamb was determined at rating using the method developed by us (Buzu, 2021), which consists in measuring with a millimeter tape the distance between the base of the neck, from the front edge of the withers and the base of the tail, located on the line drawn at the ischials (Figure 1).

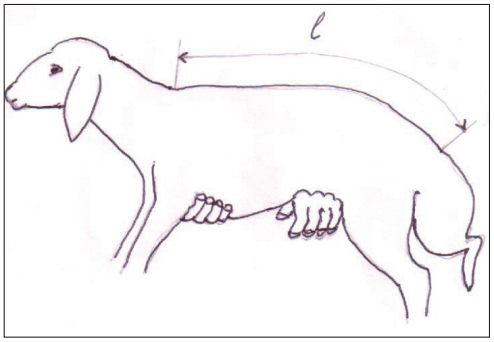

Figure 1. Body length measurement outline at Karakul lamb (l = body length)

When measuring, the millimeter tape was stuck to the body for the entire measured distance. In addition to this condition, the lamb had to be kept with its back straight. In its natural position, the line of the back and rump of the Karakul lamb is slightly convex (bent with the middle up). Body length was measured on the lamb held by the shepherd with one hand under

the chest and with the other - under the abdomen.

According to the developed methodology, the length of the lamb was differentiated into the following categories: *very long* (> 35 cm), *suitably long* (30-35 cm), *reduced* (26-29 cm) and *short* (< 26 cm). Lambs with very long and suitable length were the most requested for selection and breeding.

The constitution of the lambs was assessed at the rating by examining the general condition of the body, the body conformation and the exterior. According to the developed methodology (Buzu, 2021), four types of constitution were differentiated: *coarse, robust, fine* and *weak*.

Coarse constitution was considered when lambs had high body development, coarse bone, with curl usually chewed, curls spread, long fibers with low silkiness, low or dull gloss, bulky head with obvious ram profile, long, broad ears, hanging, thick or thickened skin. Physiologically, they were strong, they stood well on their feet. Lambs with coarse constitution type were partially accepted for breeding.

The robust constitution was found when the lambs had high or medium body development, body regions proportionally developed and typical for the race, well-developed bones, dense, medium-thick skin, thick, silky, glossy hair coat. The ears were long and fluffy. Long head with slightly rammed profile. Wide tail in the shape of a typical kurdiuk and with the tip bent into an "S" shape. The lamb, after birth, was vigorous, stood well after 5-10 minutes after birth and found the mother's nipples for sucking on its own. The lambs with the robust constitution type were the most requested for selection and reproduction.

Fine constitution was found when the lambs had a fine-normal skeleton. Body development was medium or small. The curl, as a whole, was small to medium in size. Loop expansion was excellent or fair. The head was fine, with the profile, as a rule, slightly rammed, the ears of medium length. The skin was thin, the hair cover - dense or reduced, the length of the fibers - as a rule, short. After the birth, they got up harder in search of the nipples. Depending on their physiological state, lambs of fine constitution were partially admitted to reproduction.

Weak constitution was considered when lambs had very little body development, weak-thin bone, very thin skin, sparse, short and thin fibers, very small curls, usually pea-shaped and corkscrew-shaped, small-weak head, with straight profile, short ears, thin triangular tail without fat deposits. The physiological condition of the lambs was sickly. Lambs with a weak constitution were not allowed to reproduce.

RESULTS AND DISCUSSIONS

The research results have shown that the conformation of Moldovan Karakul lambs has a series of specific peculiarities, formed in the process of sustainable selection applied to the creation of this new race of Karakul sheep.

The exterior. Moldavian Karakul lambs, at birth, differ essentially from other types of sheep in appearance, first of all, by the specific shapes of the body regions. They are relatively tall and elongated, the neck is long, the back elongated, the rump long and tapered. The head is elongated, dry with ram (convex) profile, covered with bright dead embers (Figure 2).

The entire surface of the body is covered with a hair covering composed of relatively short (6-9 mm) and medium-short (9-13 mm) fibers, dense (> 40 follicles/mm^2) or fairly dense (35-40 follicles/mm^2), excellent or suitable silky and elastic, forming curls of various types (wave, tube, grain, ribs, manes, dies). In greyish lambs, the hair coat is composed of a mixture of black and white fibers. Depending on the shade and color of the furskin, the mixture of black and white fibers has a certain co-ratio, from 60/40% - for dark shade furskins (of grizzle, mother-of-pearl colors), up to 53/47% (for marble coloration), 47/53% (for bluish coloration), 33/67% (for silver coloration) and 21/79% (for milky coloration).

Figure 2. Purerace Moldavian Karakul lamb

Figure. 3. Purerace Moldavian Karakul lamb, with pointed ears

The most requested colors in the greyish furskins (such as: marble, blue, pearl) are formed from the ratios of 53-42% of black fibers and 47-58% of white fibers (Buzu, 2017).

On the surface of the main body regions (back, rump) of the Moldavian Karakul lamb, valuable curls are obviously observed, such as: long and medium-long waves, tubular, costal, flat or milled mane, arranged parallel-concentrically to each other, parallel-scale or mixed-sinusoidal, which forms an original ornament (drawing), quite aesthetically pleasing.

On the sides of the lamb there are waves of short length and grain, which continue that patterning, forming the specific ornament of the hair covering of the furskin.

The extremities of the lambs (limbs, abdomen, head, tail) are covered with less valuable curls, grain, short manes or with dead and shiny embers.

The ears of Moldavian Karakul lambs, as a rule, are long and flat (hanging down), but there are also individuals with medium-long or even short ears (tips) (Figure 3).

The tail, at the base, is wide with a fat deposit in the shape of a small kurdiuk, and the thin tip is curved in the shape of the letter "S", which reaches to the hock. These external characteristics of the Moldavian Karakul lambs were taken into account in the selection of individuals of the required type in the piggery lots.

Body mass. Our research (Buzu et al., 1989; Buzu et al., 1992; Buzu, 1995; Buzu, 2000a, 2000b; Buzu, 2001; Buzu, 2003a, 2003b; Buzu et al., 2009a; Buzu et al., 2009b; Buzu, 2012; Buzu, 2014) demonstrate that the Moldavian Karakul lambs are quite corpulent at birth.

Their body mass is much higher than the standard of the Asian Karakul race (4.0-4.5 kg) and is on average 4.7-5.0 kg, and in some years even over 5.0 kg. This is a biological peculiarity of the new type of sheep.

The body development of the lamb at birth depends on many factors, among which are the hereditary factors (race, line, genotype of the ancestors) (Vasin et al., 1971; Karymbaev, 2011; Kudrik, 2011; Litovchenko & Esaulov, 1972), environmental factors (sheep nutrition, maintenance technology) (Dyachkov, 1980; Ivanov, 1964c; Koshevoy, 1975; Matter, 1975; Mashtykov, 2010; Nikolaev & Erokhin, 1987; Ombaev, 2010) and bio-productive factors (prolificity, ewe age at calving, calving period, etc.) (Matter, 1975).

The ewe and the ram with a large body mass possess hereditary capacities to reproduce a corpulent offspring. Mating ewes with full-bodied rams contributes to obtaining full-bodied lambs. Research results (Buzu, 2014) demonstrated that, in one and the same herd, under similar conditions of growth and maintenance, from corpulent rams, with a mass of 86-100 kg, the most corpulent offspring with body mass at birth was obtained of 5.16±0.03 kg.

From the rams of batch II, with an average body mass of 71-85 kg, offspring with an average body mass of 4.78±0.04 kg were obtained, and from the rams of batch III, with a low body mass of 60-70 kg, the offspring with the lowest body development of 4.45±0.04 kg was obtained. The progeny of corpulent rams from batch I exceeded their congeners from batch II by 0.38 kg or 7.9% (P<0.001), and those from batch III - by 0.71 kg or 16.0% (P<0.001). The lambs-descendants of the rams from batch II exceeded, according to the body weight at birth, their congeners from batch III by 0.33 kg or 7.4% (P<0.001). This demonstrates that there is an obvious genotypic correlation between the body mass of the father rams and the body mass of the offspring lambs at birth (r_{xy} = 0.63±0.05; t_r = 12.6; h^2 = 0.36).

Researchers from different countries (Brădățan et al., 2001a; 2001b; Kuzembayuly, 2010; Yudin & Kotov, 1951), independently of each other, came to the conclusions that good nutrition of pregnant Karakul ewes positively influences lamb development at birth.

Our research (Buzu, 2017) demonstrates that the body mass of Moldavian Karakul lambs at birth varies in different years, depending on the forage base of the year and twinning (Table 1).

Table 1. Body mass of Moldavian Karakul lambs at birth depending on the fodder base of the year and the type of calving

Type of calving	N	Body mass of lambs, kg		
		M ± m	σ	C_v,%
1997 *(year with good fodder base)*				
Uniparous	615	4.92 ± 0.03***	0.72	14.6
Twin	12	4.00 ± 0.19*	0.67	16.7
1998 (*year with good fodder base)*				
Uniparous	353	4.84 ± 0.05***	0.98	20.2
Twin	36	3.84 ± 0.15*	0.91	23.7
1999 *(year with poor fodder base)*				
Uniparous	304	4.16 ± 0.04	0.76	18.3
Twin	18	3.33 ± 0.20	0.86	25.8
2000 *(year with poor fodder base)*				
Uniparous	222	4.42 ± 0.05***	0.77	17.4
Twin	92	3.21 ± 0.07	0.65	20.2

Note: *- P<0.05; ***- P<0.001, compare with 1999.

In the years with a good fodder base (1997, 1998) the body mass of lambs at birth was higher, compared to the years with a poor fodder base (1999, 2000), by 18.3-9.5% - in uniparous lambs (P <0.001) and, by 20.1-19.6% - in twin lambs (P<0.001). In these years, under equal conditions, lambs born from single births (uniparous) had a body mass at birth higher than those born with twins by 0.83-1.21 kg or 24.9- 37.7% (P<0.001). The weight of the lambs at birth depends on the level of prolificacy of the ewes in herd (Table 2).

Table 2. Body mass of Moldavian Karakul lambs at birth depending on the prolificacy of the ewes

Year	Prolificacy, %	N	Body mass of lambs, kg		
			M ± m	σ	C_v,%
1997	101.0	626	4.90 ± 0.03***	0.73	14.9
1998	104.9	389	4.75 ± 0.05***	1.01	21.3
1999	108.9	322	4.12 ± 0.04	0.78	18.9
2000	117.2	314	4.06 ± 0.05	0.92	22.7

Note: ***- P<0.001 compared to the year 2000.

We found that the higher the prolificacy of the ewes in the flock, the lower the weight of the lambs at birth and, conversely, if the prolificacy is lower, the weight of the lambs is higher.

The body mass of lambs born in the ewes flock, when the prolificacy was 101%, was higher compared to their congeners born in the same flock, when the prolificacy was 104.9%, by 0.15 kg or 3.2% (P<0.01), when prolificacy was 108.9%, with 0.78 kg or 18.9% (P<0.001) and when prolificacy was 117.2%, with 0.84 kg or 20.7% (P<0.001). So, with the increase in prolificacy from 101.0% to 117.2%, the body mass of lambs decreased from 4.90 kg to 4.06 kg or 17.2% (P<0.001).

From the economic point of view, twin calvings in karakultur are convenient to the extent that the genotype of the parents and the nutritional conditions of the ewes ensure the production of offspring weighing at least 3.5 kg at birth, from which furskins with at least the middle surface - 900 cm^2.

Otherwise, when lambs with a body mass of less than 3.5 kg are born in twin lambs, their economic benefit does not reach the level of single lambs, because the furskins obtained from these lambs are assigned, by surface, to the "small" category, and their commercial value is 4-5 times lower, compared to large surface furskins (>1400 cm^2), obtained from lambs with a body weight of over 4.0 kg.

The weight of the lambs at birth depends on the age of the ewes at calving (Table 3).

Table 3. Body mass of Moldavian Karakul lambs at birth depending on the age of the ewes at calving

Age of ewes at calving	N	Body mass of lambs, kg		
		M ± m	σ	C_v, %
13-14 months (early age)	244	4.20 ± 0.05	0.74	17.6
2 years (primary)	342	4.80 ± 0.04***	0.68	14.2
>3 years (adults)	4953	5.01 ± 0.02***	0.83	16.6

Note: ***-P<0.001 compared to 13-14 month old ewes.

For example, in the same flock, the ewes, which were inseminated at an early age (8-9 months) and calved at the age of 13-14 months, produced lambs with a body mass of 4.20±0.05 kg, which which is lower than lambs of primiparas by 0.6 kg or 12.5% (P<0.001). Primiparous ewes gave birth to lambs with a body mass of 4.80±0.04 kg, or smaller than adult ewes by 0.19 kg or 4.4% (P<0.001). Adult ewes (>3 years old) gave birth to the most developed lambs with a body mass of 5.01 ± 0.02 kg, which is higher than lambs obtained from ewes inseminated at an early age (8-9 months) by 0.81 kg or 19.3% (P<0.001), and than in lambs obtained from primiparous ewes by 0.21 kg or by 4.4% (P<0.001).

Research has shown that lambs born in winter lambings (January, February) were more developed than those born in spring (March, April) (Table 4).

Table 4. Body mass of Moldavian Karakul lambs at birth depending on the calving season

Calving season (month)	N	Body mass of lambs, kg		
		M ± m	σ	C_v, %
Rams				
January	357	5.63 ± 0.03***	0.65	11.5
February	365	5.48 ± 0.04***	0.67	12.2
March	325	5.21 ± 0.04	0.73	14.0
April	77	5.12 ± 0.09	0.81	15.8
Ewes				
January	285	5.40 ± 0.04***	0.68	12.6
February	354	5.18 ± 0.04**	0.71	13.8
March	368	5.10 ± 0.03*	0.66	12.8
April	61	5.01 ± 0.04	0.73	14.6

Note: * - P<0.05; ** - P<0.01; *** - P<0.001; Compared to lambs born in April.

For example, rams born in January-February surpassed those born in March-April by 0.42-0.57 kg and 0.27-0.36 kg, respectively, or 8.1-10.0% and 5.2-7.0% (P<0.001). The same situation is found in youtht ewes. With the advance of lambing dates from January to April, the body mass of lambs at birth decreased, in rams, from 5.63 kg to 5.12 kg, or by 0.51 kg (7.8%) (P<0.001) and in ewes - from 5.4 kg to 5.01 kg or by 0.39 kg (7.2%) (P<0.001).

As a hypothesis to explain this phenomenon, we believe that ewes born in the winter months (January, February) better preserve the reserves of nutrients stored in the body from the fall, which ensure the optimal nutrition of the fetus. And, on the contrary, in the spring months (March, April) the reserves of the stores of nutrients in the body of pregnant ewes are exhausted, which negatively influences the development of the lamb.

Some researchers (Bastaev, 2005) state that the body mass of the Karakul lamb and the meat production correlate negatively with the furskin qualities. According to us, these statements do not exactly correspond to reality, at least for the Moldavian Karakul race.

Our research (Buzu, 2014) demonstrated that the lamb's body mass at birth has a curvilinear relationship with the lamb's furskin quality, expressed in the lamb class (Figure 4).

This relationship is manifested by the fact that, with the increase in the body mass of the lambs at birth to an optimal level, specific for each flock (sheep population), their furskin quality improves and, as a result, the share of class lambs increases superior (Elite).

Thus, in the researched herd, with the increase in the body weight of the lambs at birth from 2.75 kg to 5.25 kg, the share of elite class lambs increased from 16.7% to 27.9%, or 1.7 times (P<0.001).

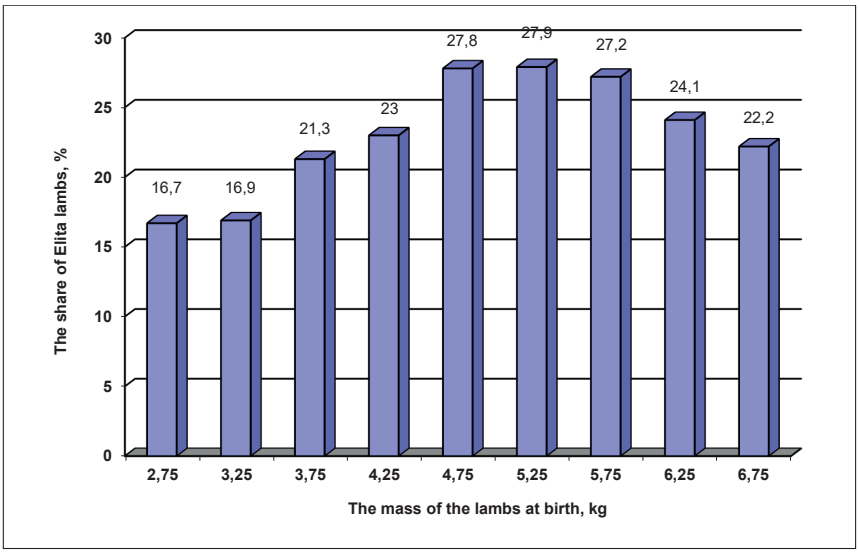

Figure 4. The relationship between the body mass of the lambs at birth and the share of the Elita lambs

The highest percentage of Elite lambs was recorded in those with a body mass in the range of 4.75-5.25 kg. The highest point, 27.9%, was reached in the group of lambs with a body mass of 5.25 ±0.15 kg. We consider that this level of body mass is characteristic for the model lamb of the Moldavian Karakul type.

With the increase in the body weight of the lambs above 5.25 kg, the weight of the higher class lambs decreases.

This is manifested by the loosening of the skin and its thickening. As a result, the length of the fibers increases, the resistance of the loop decreases, the compactness and quality of the loop are reduced (Ivanov, 1964a; Koshevoy, 1975; Bogdanovich et al., 1982).

An obvious correlation is manifested between the body mass of the lamb at birth and the size of the curls, skin thickness and constitution (Table 5).

From the analysis of the data in the table, it appears that the larger the curls, the higher the body mass and, conversely, the smaller they are, the lower the body mass of the lamb at birth.

We found that lambs with large curls exceeded those with medium curls by 0.27 kg (P<0.001), those with small curls - by 0.61 kg (P<0.001) and those with very thick curls. small - by 0.69 kg (P<0.05). As loops decreased from very large to very small size, the body weight of lambs at birth decreased from 5.18 kg to 4.30 kg or 0.88 kg (17.0%; P<0.001).

Table 5. Body mass of Moldavian Karakul lambs at birth depending on the size of the curls, the thickness of the skin and constitution

Specification	N	Body mass of lambs, kg	
		M ± m	C_v, %
Depending on the size of the curls[1]			
Very large (>12 mm)	20	$5.18 \pm 0.14^{***}$	8.3
Large (9-12 mm)	136	$4.99 \pm 0.05^{***}$	12.2
Middle (6-8 mm)	372	$4.72 \pm 0.03^{***}$	14.2
Small (4-5 mm)	88	4.35 ± 0.07	16.6
Very small (< 4 mm)	10	4.30 ± 0.34	26.5
Depending on the thickness of the skin[2]			
Subtle	129	4.31 ± 0.06	15.5
Middle	304	$4.69 \pm 0.04^{***}$	13.2
Thickened	172	$4.98 \pm 0.05^{***}$	13.1
Thick	21	$5.55 \pm 0.18^{***}$	12.6
Depending on the constitution[3]			
Coarse	43	$5.79 \pm 0.10^{***}$	9.8
Robust	503	$4.80 \pm 0.02^{***}$	11.5
Fine	80	3.80 ± 0.07	16.1

Note: ***- P<0.001; 1 - compared to "Small"; 2 - compared to "Thin"; 3 - compared to "Fine".

We elucidated that the thinner the skin of the lambs at birth, the lower the body mass and vice versa, the thicker the skin, the higher the body mass. Lambs with thick skin had a body mass at birth higher by 0.52 kg (t_d=3.25; P<0.01) compared to lambs with thickened skin, by 0.86 kg (t_d=5.54; P <0.001) compared to lambs with medium skin and by 1.24 kg (t_d=7.75; P<0.001) compared to the batch with thin skin. With skin thickening from thin to thick, the body mass of lambs at birth increased

from 4.31 kg to 5.55 kg, or 1.24 kg (28.8%) (P<0.001). The correlation coefficient between body mass and skin thickness is r_{xy} =0.45±0.05 (t_r=9.0; P<0.001). The data included in the table confirm that the body mass of lambs with a coarse constitution was higher, compared to those with a robust constitution by 0.99 kg or 20.6% (P<0.001) and, compared to those with a fine constitution, by 1.99 kg or 52.3% (P<0.001).

The body mass of the lambs at birth also correlates with other characters, such as the body length, the furskin surface, the length of the fibers on the rump and on the withers (Table 6).

Table 6. Correlation coefficient (r_{xy}) of body mass of Moldavian Karakul lambs at birth with some its morphological characters

Caracters	N	$r_{xy} \pm m_r$	t_r
Body length	859	0.49 ± 0.030	16.3***
Skin thickness	297	0.45 ± 0.057	7.89***
The surface of the skin	164	0.64 ± 0.062	10.3***
To the greyish lambs			
Black fiber length:			
on the rump	115	0.31 ± 0.096	3.2**
on the withers	115	0.30 ± 0.089	3.4**
Length of white fibers:			
on the rump	115	0.22 ± 0.092	2.4*
on the withers	115	0.14 ± 0.093	1.5

Note: *- P < 0.05; **- P < 0.01; ***- P < 0.001.

Of particular importance is the positive correlation between body mass, body length and furskin surface, not only from the genetic (theoretical) point of view, but also from the practical (economic) point of view of raising Karakul sheep. The phenotypic correlation coefficient of the body mass of the lamb at birth with body length is r_{xy} = 0.49±0.03, and with the skin surface is r_{xy} = 0.64±0.06.

This correlation is very important for selection, because it has an additive influence on productive-useful characters, such as furskin surface and carcass mass at slaughter, determining their qualities and marketing prices.

In greyish lambs, both black and white fibers are positively correlated with body mass (r_{xy} = 0.14-0.31). The more developed the lamb, the longer the fibers. From the point of view of selection, this statistically positive correlation is actually "negative" for selection, because as the fibers increase in length, most of the furskin qualities decrease.

The body mass of the lamb at birth is related to its subsequent development at different early age intervals in the postnatal period (Table 7).

The repeatability of this character, starting from birth and later up to different ages in the postnatal period, is quite significant and expressive.

Table 7. The relationship between the body mass of Moldovan Karakul lambs at birth and their development in different intervals of the postnatal age

Masa corporală la naştere, kg	N	Masa corporală la diferite vârste, M ± m, kg			
		20 zile	90 zile	6 luni	18 luni
> 5.1	32	10.13±0.40***	16.87±0.52**	23.29±0.80***	43.00±1.07***
4.6-5.0	39	8.88±0.20***	16.35±0.66*	22.75±1.36**	41.14±1.26***
4.1-4.5	22	8.14±0.27***	15.06±0.87	22.20±0.70***	41.00±1.51**
3.6-4.0	14	7.07±0.37*	13.60±1.02	21.86±0.71**	38.86±1.08**
< 3.5	8	5.90±0.36	11.98±1.70	18.17±0.88	27.50±3.55
$r_{xy} \pm m_r$	115	0.47±0.07	0.39±0.09	0.26±0.08	0.23±0.09

Note: *- P<0.05; **- P<0.01; ***- P<0.001; Compare with "< 3.5 kg".

For example, at the age of 20 days, lambs that had a body mass of 3.6-4.0 kg at birth exceeded those that had a mass of <3.5 kg by 1.17 kg or 19.8% (P<0.05); those who weighed 4.1-4.5 kg at birth exceeded them by 2.24 kg or 38.0% (P<0.001); those who weighed 4.6-5.0 kg exceeded them by 2.98 kg or 50.5% (P< 0.001), and those who weighed >5.1 kg at birth exceeded their congeners, who were <3.5 kg at birth with 4.23 kg or 71.7% (P<0.001). Such legitimacy (repeatability) of the body mass of lambs is also observed at the age of 90 days, 6 and 18 months, as well as mature age. Thus, the correlation coefficient (repeatability) between the body mass of the lambs at birth and at 20 days was r_{xy} = 0.47±0.07; at 90 days r_{xy} = 0.39±0.09; at 6 months r_{xy} = 0.26±0.08; at 18 months r_{xy} = 0.23±0.09. Despite the fact

that, with the advancing age of the sheep youth, a tendency to decrease the repeatability coefficient of the body mass was observed, however, by selecting from generation to generation, at the validation, well-developed lambs according to the body mass, we can obtain animals corpulent and at a mature age, with increased skills in meat production. From well-developed lambs at birth with a body mass of 5-6 kg, carcasses of 3.5-4.0 kg were obtained, at the age of 3 months - carcasses of 8.3 kg, at 8 months - of 14.1 kg, at 20 months - 21.9 kg, at 32 months - 25.6 kg.

Therefore, knowing the correlations (including negative ones) of the body mass of the lamb at birth with other characters is of great importance in directing the selection process in the direction of obtaining a large surface furskin and a better conformed carcass, in creating the new type of Corpulent Moldavian Karakul sheep.

The body length of the Karakul lamb is one of the most important body dimensions because it clearly characterizes the exterior and linear body development and provides an indirect preliminary information about the possible furskin surface. The body length of the lamb at birth is determined, first of all, by the genotype of the parents and influenced by the nutrition and maintenance of the ewes during the gestation period, especially in the second half. Well-developed lambs with long and very long body length were obtained from the parents, who had a high body development at birth (long and very long body length), in optimal conditions of nutrition and maintenance during the ewes gestation period**.**

In our research (Buzu, 2001), the repeatability coefficient (K) of this character at birth, 20 days, 3, 6 and 18 months, varies within the limits of 0.16-0.36, being conditioned by many external and internal factors. This means that the targeted selection of lambs to rating according to body length is effective and contributes to the creation of flocks of sheep with large body length.

The body length of the lamb at birth is directly or indirectly related to the furskin surface, body mass, constitution, skin thickness, hair fiber length, etc. (Table 8).

Table 8. Correlation of body length of Moldavian Karakul lambs by birth with some morpho-productive characters

Caracters	N	$r_{xy} \pm m_r$	t_r
Body mass at birth	859	0.49 ± 0.03	16.3***
Surface of the furskin	164	0.78 ± 0.03	26.0***
Skin thickness	282	0.54 ± 0.04	13.5***
Fiber length in black lambs:			
on the rump	199	0.16 ± 0.07	2.3*
on the withers	199	0.15 ± 0.07	2.1*
Fiber length in greyish lambs:			
white fibers: on rump	65	0.15 ± 0.12	1.3
on the withers	65	0.05 ± 0.12	0.4
black fibers: on the rump	65	0.18 ± 0.12	1.5
on the withers	65	0.03 ± 0.12	0.3

Note: *- P < 0.05; ***- P <0.001.

The correlation coefficients of these morpho-productive attributes vary within quite wide limits. The highest correlation coefficient was established between the body length and the standard surface of the furskin (r_{xy}=0.78±0.03; t_r=16.3). This indicates that this character conditions, to a large extent, the surface of the furskin and is in direct relationship with this character.

The regression coefficient of body length with furskin surface is R = 101.4. This means that with the increase in the body length of the lamb by 1 linear cm, the useful surface of the furskin will increase by 101.4 cm^2. Significant positive correlation coefficients are also found with body mass (r_{xy} = 0.49±0.03; t_r = 16.3), skin thickness (r_{xy} = 0.54±0.04; t_r = 26.0), fiber length in black lambs on the rump (r_{xy} = 0.16±0.07; t_r = 2.3) and on the withers (r_{xy} = 0.15±0.07; t_r = 2.1). Therefore, with the increase in body length, there is a tendency to increase some characters that cause the decrease of some furskin qualities, such as the thickening of the skin and the increase in the length of the fibers. These positive correlations, from the genetic point of view, are also negative from the point of view of the influence on some curling qualities.

The analysis of the data on the length of the Karakul lambs demonstrates that it is a function of their body mass, the size of the curls, constitution and skin thickness (Table 9).

Table 9. Body length of Moldavian Karakul lambs at birth according to their mass, curl size, constitution and skin thickness

Specification	N	Body length, cm		
		M ± m	σ	C_v, %
Depending on the body mass[1]				
> 5.1 kg	99	37.56 ± 0.16***	1.55	4.1
4.6-5.0 kg	156	36.14 ± 0.12***	1.49	4.1
4.1-4.5 kg	208	35.00 ± 0.11***	1.56	4.5
3.6-4.0 kg	225	33.43 ± 0.12***	1.80	5.4
< 3.5 kg	297	29.95 ± 0.12	2.08	6.9
Depending on the size of the curls[2]				
Very large (>12 mm)	20	34.73 ± 0.38***	1.81	5.2
Large (9-12 mm)	136	32.91 ± 0.17***	1.99	6.2
Middle (6-8 mm)	372	31.68 ± 0.09***	1.77	5.6
Small (4-5 mm)	88	30.29 ± 0.19	1.81	6.0
Very small (< 4 mm)	10	28.60 ± 0.88	2.75	9.6
Depending on the constitution[3]				
Coarse	43	33.44 ± 0.31***	2.07	6.2
Robust	503	31.89 ± 0.09***	1.95	6.1
Fine	80	29.78 ± 0.22	2.00	6.7
Depending on the thickness of the skin[4]				
Subtle	129	30.25 ± 0.18	2.00	6.6
Medium	304	31.78 ± 0.11***	1.94	6.1
Thickened	172	32.80 ± 0.16***	2.03	6.2
Thick	21	34.86 ± 0.38***	1.74	5.0

Note: ***- P < 0.001; 1 - compared to "< 3.5 kg"; 2 - compared to the "Small" loop; 3 - compared to "Fine"; 4 - compared to "Subtle".

We found that the harmonious development of the lamb's body size during the intrauterine period is closely related to weight gain and the general development of the body. Lambs with a body mass of up to 3.5 kg had the shortest body length and those with a body mass of more than 5.1 kg had the longest body length. Along with the increase in body mass of lambs at birth from 3.1 kg to 5.1 kg, their body length increases from 29.95 cm to 37.56 cm or by 25.4% (P<0.001). Full-bodied lambs, which had a birth weight of more than 5.1 kg, exceeded, according to body length, congeners that had a weight of 3.6–4.0 kg, by 4.13 cm or 12.4% (P<0.001).

Therefore, the higher the body mass of the lambs at birth, the longer their body and, conversely,

the smaller the lambs, the shorter their body.

The length of the body in the lamb is related to the size of the loop. We found that lambs with large and very large curls have the largest body length, respectively, 32.91 and 34.73 cm. The smallest body length was found in lambs with small and very small curls, making up 30.29 and 28.60 cm, respectively, being smaller than the first two batches by 4.44-6.13 cm (P<0.001) and, respectively, by 2.62-4.31cm (P<0.001), or by 12.8-17.7% and 8.0-13.1%. It should be mentioned that, with the increase in the size of the loop from very small to very large, the body length of the lambs increases considerably from 28.60 cm to 34.73 cm or by 6.13 cm (21.4%) (P<0.001).

The body length of the lamb depends on its constitution. We found that lambs with a coarse and robust constitution have a greater body length than those with a fine constitution by 3.66 cm and 2.11 cm, respectively, or 12.3 and 7.1% (P<0.001). The largest body length was found in lambs with a coarse constitution. Lambs with a fine constitution had the shortest body length. Lambs of robust constitution are placed, according to this character, in the intermediate position, between the two batches. Therefore, with the growth of robustness of the lambs at birth, their body length increases. It should be mentioned that the values of the body length of the lambs at birth in the researched herd, within the limits of the averages of 29.78-33.44 cm, are quite high. From the lambs of this flock, furskins with a large and very large surface are obtained. The coefficient of variation of the body length of the lambs at birth in profile on batchs with different types of constitution is small. This denotes the fact that the body length of the Karakul lamb at birth is a trait consolidated genetically and largely determined by heredity.

The body length of Karakul lambs at birth is indirectly related to skin thickness. Research has shown that lambs with a large body length also have thicker skin. From the data included in the table, it can be seen that lambs with thick and thickened skin exceeded, according to body length, their congeners with medium and thin skin, by 9.7-15.2% and 3.2-8.4%, respectively (P<0.001). The greatest body length was found in lambs with thick skin (34.86±0.38 cm) and thickened (32.80±0.16 cm). Lambs with thin skin had the shortest body length (30.25±0.18 cm). Lambs with medium skin thickness had a body length of 31.78 ± 0.11 cm and occupied an intermediate position between the other groups.

Knowing the direct and indirect correlative links of the body length of the lamb at birth

with the other morpho-productive characters allowed us to conclude that this character is one of the important ones. For these reasons, the selection of lambs at birth according to body length was applied to the creation of the Moldavian Karakul sheep type. Lambs with long and very long body length were retained for reproduction in the farrowing batchs.

The constitution of lambs from the Karakul race, as well as from other sheep races, expresses the general state of the organism (morphological, structural and functional), characterized by the body conformation, external and internal (physiological state), which determines the morpho-productive type and the level of productivity. The constitution of lambs at birth is determined by the hereditary capacities of the parents (genotype) and conditioned by external factors (Дъчков et al., 1950; Koshevoy, 1975), by clandestine matings (Borisenko, 1967), by the level of prolificacy of the herd (Koshevoy, 1975), etc.

Based on research, Vasin et al. (1971) affirms that "*The furskin qualities of Karakul lambs, conditioned by heredity, are closely related to the constitutional particularities and, being under the influence of various external actions during the intrauterine period of fetal development, have a great variability*".

The constitution of lambs at birth conditions multiple relationships with different properties of the skin, hair fibers, curls, as well as with their body conformation. The creation of optimal conditions in the respective periods allows the obtaining of vigorous lambs with a robust constitution and the more obvious realization of the potential of furskin qualities, etc. (Vasin et al., 1971; Gigineishvili, 1976; Dyachkov, 1980; Ivanov, 1964b; Ilyev, 1969; Koshevoy, 1975; Yudin, 1943; Kuzembayuly, 2010).

Our research (Buzu, 2017) demonstrated that the constitution of lambs at birth conditions, first of all, the variability of characters related to their body conformation. We found that the constitution is in direct relationship with the body mass of the lambs at birth (Table 10).

Table 10. The relationship between constitution and body mass of lambs Moldavian Karakul at birth

The constitution lambs	N	Rate of lambs (%) with body mass (kg)					
		< 3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	> 5.6
Coarse	43	-	-	4.7**	11.6	18.6***	65.1***
Robust	503	1.0***	9.3***	26.8	32.0***	24.1***	6.8***
Fine	80	37.5	28.7	26.3	7.5	-	-
Total	626	5.6	11.2	25.2	27.5	20.6	9.9

Note: **- P <0.01; ***- P <0.001; Compared to the "Fine" constitution.

Research data show that lambs with coarse constitution have the highest body mass at birth, usually very high.

As a rule, lambs with a robust constitution have a large and medium body mass, and lambs with a fine constitution have the smallest body mass, falling mainly into the reduced and small categories. In the batch of lambs with a coarse constitution, most individuals (83.7%) had a very high body mass at birth (over 5.0 kg), of which 65.1% had a body mass greater than 5.6 kg.

In this batch there were 11.6% of lambs with high body mass (4.6-5.0 kg) and only 4.7% of individuals - with medium body mass (4.1-4.5kg). In the batch of lambs with a robust constitution, most individuals had a high (32.0%) and very high (30.9%) body mass, of which 6.8% had a body mass over 5.6 kg.

At the same time, in this batch, there were also lambs with a medium body weight (26.8%) in a minor proportion. In the batch of lambs with fine constitution, most individuals had low (37.5%) and low (28.7%) body mass. At the same time, in this batch there were, in small numbers, individuals with medium (26.3%) and large (7.5%) body mass. Therefore, based on the analysis of the presented data, we can state that the constitution of Karakul lambs at birth essentially conditions their body mass at this age.

A similar correlation is also observed between the constitution of the lambs and their body length at birth (Table 11).

Table 11. The relationship between constitution and body length of Moldavian Karakul lambs at birth

The constitution of lambs	n	Including, with body length, cm									
		< 26		26 - 29		30 - 33		34 - 37		> 37	
		head	%	head	%	head	%	head	%	head	%
Coarse	43	-	-	-	-	8	18.6***	29	67.4***	6	14.0***
Robust	503	-	-	25	5.0**	336	66.8	139	27.6***	3	0.6***
Fine	80	9	11.3	16	20.0	53	66.2	2	2.5	-	-
Total	626	9	1.4	41	6.6	397	63.4	170	27.2	9	1.4

Note: **- P < 0.01; ***- P < 0.001; Compared to the "Fine" constitution.

Research data demonstrate the fact that lambs with a coarse constitution have the largest body length at birth. As a rule, lambs with a robust constitution have the appropriate long and very long body length, and lambs with a fine constitution have the smallest body length, falling mainly into the short and short length categories. Thus, in the batch of lambs with a coarse constitution, most individuals (81.4%) had a very long body length (over 34 cm), of which 14.0% had a particularly long body length at birth - over 37 cm. In this batch there were also 18.6% of lambs with the suitably body length (30-33 cm). In the batch of lambs with a robust constitution, the overwhelming majority of individuals had the suitably body length (66.8%) and very long (28.2%), of which 0.6% had an especially long body length - over 37 cm. In the batch of lambs with fine constitution, most individuals had the suitably body length (66.2%), reduced (20.0%) and short (11.3%). Therefore, based on the analysis of the presented data, we can state that the constitution of Karakul lambs at birth essentially conditions their body length.

The constitution of the lambs is in direct relationship with the properties of the skin, in particular, with its density (Table 12).

Table 12. The relationship between constitution and skin density of Moldavian Karakul lambs at birth

The constitution of lambs	N	Skin density							
		Very dense		Suitable		Reduced		Loose	
		head	%	head	%	head	%	head	%
Coarse	43	-	-	17	39.5**	19	44.2***	7	16.3***
Robust	503	122	24.3	297	59.0	78	15.5**	6	1.2***
Fine	80	21	26.2	54	67.5	5	6.3	-	-
Total	626	143	22.8	368	58.8	102	16.3	13	2.1

Note: **- P <0.01; ***- P <0.001; Compared to the "Fine" constitution.

Research data shows that lambs with a fine constitution have the densest skin at birth. Lambs with a robust constitution usually have the right skin density, and lambs with a coarse constitution have the loosest skin, mostly falling into the reduced and loose categories. Thus, in the batch of lambs with a fine constitution, most individuals had the suitably skin density (67.5%) and very dense (26.2%). In the batch of lambs with a robust constitution, most individuals had the suitably density (59.0%) and very dense (24.3%). In the batch of lambs with coarse constitution, most individuals had skin with reduced density (44.2%) and loose skin (16.3%). Therefore, based on the analysis of the presented data, we can state that the constitution of Karakul lambs at birth essentially conditions the density of their skin.

The research showed that in the batch of lambs with a fine constitution, the majority of individuals had medium (51.2%) and thin (46.3%) skin thickness. In the batch of lambs with a robust constitution, most individuals had medium-thick (49.7%) and thin (17.9%) skins. In the batch of lambs with coarse constitution, most individuals had thickened skin (44.2%) and thick skin (20.9%). The relationship between the constitution of the lambs and the thickness of the skin is quite obvious (Table 13).

Table 13. The relationship between constitution and skin thickness in Moldavian Karakul lambs at birth

The constitution of lambs	N	Skin thickness							
		Thick		Thickened		Medium		Thin	
		head	%	head	%	head	%	head	%
Coarse	43	9	20.9***	19	44.2***	13	30.2*	2	4.7***
Robust	503	12	2.4***	51	10.1**	250	49.7	90	17.9***
Fine	80	-	-	2	2.5	41	51.2	37	46.3
Total	626	21	3.3	172	27.5	304	48.6	129	20.6

Note: *- P <0.05; **- P <0.01; ***- P <0.001; Compared to the "Fine" constitution.

Therefore, based on the analysis of the presented data, we can state that the constitution of Karakul lambs at birth essentially determines the thickness of their skin. The relationship between these two attributes is one of the most pronounced.

The constitution of Karakul lambs at birth influences the skin reserve (Table 14).

Table 14. The relationship between constitution and skin reserve in Moldavian Karakul lambs at birth

The constitution of lambs	N	Skin reserve							
		Pleated		Free		Stretched		Insufficiency	
		head	%	head	%	head	%	head	%
Coarse	43	3	7.0	18	41.8**	15	34.9	7	16.3***
Robust	503	77	15.3*	349	69.4	72	14.3	5	1.0
Fine	80	7	8.8	56	70.0	17	21.2	-	-
Total	626	87	13.9	423	67.6	104	16.6	12	1.9

Note: *- P<0.05; **- P<0.01; ***- P<0.001; Compared to the "Fine" constitution.

Research has shown that in the batch of lambs with a robust constitution, the overwhelming majority of individuals had free (69.4%) and pleated (15.3%) skin reserves. In the batch of lambs with fine constitution, the overwhelming majority of individuals had the skin reserve also free (70.0%). In the batch of lambs with coarse constitution, the majority of individuals had skin with free reserve (41.8%), stretched (34.9%) and insufficient (16.3%). Therefore, based on the analysis of the presented data, we can state that the constitution of Karakul lambs at birth essentially conditions their skin reserve. The increase in robustness of the lambs leads to a decrease in the skin reserve. Analyzing the results of the research on the variability of the constitution of Karakul lambs at birth, we can conclude that with the increase in robustness, from the fine to the coarse, the body mass, body length and skin thickness increase substantially, while the density, suppleness and reserve of the skin decrease. Taking into account the fact that the characters of the body conformation and the skin conditions the development of a series of other properties of the hair fibers and the curl as a whole, knowing the relationships of the constitution of the lambs with the characters and related morpho-productive properties in karakultur acquires a special importance for directing the genetic improvement process of the productive qualities of sheep flocks. Generalizing, in the end, the researches of the degree of manifestation of the body conformation of Moldavian Karakul lambs at birth and the intercorrelation relations of the characters and properties that determine it, we can conclude, in full agreement with the words of the great zootechnician - profesor Panin (1972), that "*The mutual connections of all the characters in the correlational system of the organism are extraordinarily complicated and still very little studied. Without knowledge of these mutual links, it is not possible to correctly determine the direction of artificial selection in the herd or race, it is not possible to scientifically argue the principles of rating and, in particular, the distribution of animals into quality categories - classes, without which any rating loses its practical importance*".

CONCLUSIONS

The body conformation of Moldavian Karakul lambs is typical of the classical (Asian) Karakul sheep race, with some particularities related to the development of body mass, body length and constitution.

Moldavian Karakul lambs at birth are quite corpulent, having an average body mass of 4.7-5.0 kg, and in some years even over 5.0 kg, this being a biological peculiarity of this new type of sheep.

The variability of the body mass of the lamb at birth is hereditarily determined (the coefficient of genotypic correlation $r_{xy} = 0.63$; $h^2 = 0.36$; the coefficient of repeatability $K_{0\text{-}6\ months} = 0.26$; $K_{0\text{-}18\ months} = 0.23$) and influenced by environmental conditions, in particular, by the nutrition of pregnant ewes.

The body mass of the lambs at birth is in a direct-proportional phenotypic relationship with: age of the ewes at calving, body length ($r_{xy} = 0.49$), skin thickness ($r_{xy} = 0.45$), fiber length ($r_{xy} = 0.22\text{-}0.31$), furskin surface ($r_{xy} = 0.64$), loop size and constitution; inversely-proportional to: the prolificacy of the ewes in the flock and the lambing period; curvilinear with: the qualities of furskin (rate in the flock at calving of the higher class Elita lambs).

Lamb body length at birth is in the same similar phenotypic relationships as body mass, including with: skin thickness ($r_{xy} = 0.54$), fiber length ($r_{xy} = 0.15\text{-}0.18$), furskin area ($r_{xy} = 0.78$).

The constitution of the lamb at birth is in a phenotypic relationship: directly proportional - with its own body mass, body length, thickness and skin reserve; inversely proportional - to skin density.

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