EVALUATION OF BREEDING VALUE OF YOUTH KARAKUL SHEEP AFTER THE COMPLEX SELECTION INDICES

I. Buzu[1*]

[1]*Institute of Zoology of Science Academy from Moldova, Chisinau, Republic of Moldova*

Abstract

The aim of the research was to reveal the methodological principles and to elaborate the formulas for evaluating the breed value of youth Karakul sheep according to the complex selection indices. The scientific researches were carried out on a batch of youth Moldavian Karakul sheep of the National Institute of Animal Husbandry and Veterinary Medicine from village Maximovca, Anenii Noi. The complex selection indices for youth Karakul sheep was built on the basis of three selected morpho-productive characters: furskin quality, expressed in points; own body mass (kg) and mother's milk production (kg). The complex selection indices of youth were built according to the formula $I_{cs}=(M_{fp}\cdot C_{fap})+(M_{fmc}\cdot C_{famc})+(M_{fpl}\cdot C_{fapl})$, *where:* I_{cs} *– complex selection indices of youth;* M_{fp} *– the phenotypic size of the furskin quality;* C_{fap} *- coefficient of aggregate phenotype of furskin quality;* M_{fmc} *- the phenotypic size of the body mass of the youth;* C_{famc} *- coefficient of aggregate phenotype of body mass;* M_{fpl} *- the phenotypic size of the mother's milk production;* C_{fapl} *- coefficient of aggregate phenotype of milk production of ewe-mothers.*

Scientific research has shown that for the assessment of sheep youth's breeding value according to the comlex selection indices it was necessary to establish the race standard after all three selected morpho-productive characters. Subsequently, the coefficients of the aggregate phenotype for each selected character were determined. As a result, it has been found that the determination of Karakul sheep youth's breeding value according to the complex selection indices is one of the most objective and effective methods, because it contains both phenotypic and genotypic elements of appreciation. The complex selection indices for youth sheep can be determined at any age, from birth to adult age. Determining the breeding value of Karakul lamb after complex selection indices is of scientific and practical importance because they are often marketed at early ages. The specificity of determining the aggregate phenotype coefficient for body mass is a particularity of the principles of construction of the complex selection indeces of youth Karakul sheep. The size of the aggregate phenotype coefficient of body mass in youth sheep varies according to the standard of body mass not only at standard ages but also at intermediate ages.

Key words: indices, complex, selection, youth, sheep, Karakul

INTRODUCTION

In zootechnics several methods of assessing the value of animals are known: according to the values of their own morpho-productive performances, expressed in absolute units of the International Metric System, in scores, percentages, or other relative units; according to the morpho-productive characters of the collateral relatives, ascendants or descendants. In all cases of estimation of animal breeding value according to the simple parameters of the morpho-productive characters and the selection, either by the tandem method or by the independent boundary method of the selected character values, there is no guarantee of increasing the economic efficiency, because in these cases the economic values of the selection characters are not considered.

In the second half of the 20th century and the beginning of the 21st century the zootechnics increasingly began to apply the methods for estimating the value of breeding animals by complex selection indices, expressed in specific formulas, which reflects in themselves some ratios of values economic

[*]Corresponding author: ionbuzua@gmail.com
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features of morpho-productive characters, combined with the erytability, repeatability, variability or other genetic parameters of populations [9, 10, 12]. A wider spread of selection methods according to complex indices of morpho-productive characters occurred in poultry [11, 14-17, 20], pigs [18, 25] and taurines husbandry [26]. For these animal species, the most diverse and complex selection indices have been built and applied.

Most specialists and researchers, who have developed and implemented animal selection methods according to complex indices, state that they provide greater efficiency in selection. According to data [25, 26], the effect of animal selection on complex indices is about 10% higher than the selection based on the independent boundary method of selection characters. Other authors [21, 23, 24] consider that the effect of selection by complex indices increases by 20-50%, and the third [19], states that the application of an integrated scheme to the genetic amelioration of sheep populations using indices selection based on computerized technologies allows the selection effect to be accelerated even 2-4 times.

Application of selection indices at Karakul race is not widespread. Only some publications on the use of selection indices for lambs' growth potential in the postnatal period of ontogenesis [27, 28] and on curl size, modeling and quality the fiber [23, 24] are known in karakulture. But these (indices) are not complex, therefore, they can not be used to determine the overall breeding value of the animal. In our previous research [8], we have shown that some researchers at Namibia's Karakul Sheep Research Center [23] have mentioned that "*general indices of Karakul lamb selection in ready form does not exist, nor does it need to exist. But, for the flock of the Neidam Experimental Station, such indices have been elaborate*".

The author brings the selection index of Karakul lambs according to the qualities of furskin $I = 20 + 1Q + 4P + 2S$

where: I – the selection indice of Karakul lambs according to the qualities of furskin;
20 – the constant calculated by the author;
Q – the quality of pilous fibers, appreciated in points;
P – curls modeling, appreciated in points;
S – the size of curls, appreciated in points.

Other Kazakhstan researchers [19, 21, 22, 27] have reported the application of selection indices of lambs and adult Karakul sheep after the harmony of body conformation, including some ratios of the measurements of external dimensions with the animal's body weight, as are: body mass, thorax perimeter and oblique length of the trunk.

The sheep type Moldavian Karakul possesses mixed (combined) productivity, which determines the need to select the animals according to a complex of characters and can be organized by different methods: in tandem, after the independent limits of the selected character value or by the complex indices of selection. The last method, as afirm many authors [19, 23 - 26], is considered one of the most effective in the selection. Determining the selection indices is a complex appreciation of the characters, both by productive value and by economic value. At present, according to the Karakul Sheep Evaluation Instruction with amelioration principles in the Republic of Moldova in force [2], the sheep breeding value (class) is determined only by the qualities of the furskin, without taking into account the most important morpho-productive selection, such as milk and meat production (body mass). The main drawback of these Instruction is that furskin production is considered to be the only basic character expressed by the lamb class, and the body mass and milk production are considered as secondary (secondary) characters and are never taken into account in the determination of the breeding value of the animal (class). Thus, between the values of the main morpho-productive characters and the breeding value of the animal, there is an obvious rupture, requiring bound access in an integral complex of the phenotypic, genotypic and economic values of the animal. Here is the urgent need to improve these Instructions, by developing and including in the selection methodology effective methods for assessing the value of the breed with the application of complex selection indices.

In our previous research [3, 7, 8] we have demonstrated the methods of assessing the breeding value of adult sheep (ewes and rams) according to complex selection indices.

At the same time, the method of assessing the breeding value of Karakul youth at different ages, from birth to adulthood (2-2.5 years), according to the complex selection criteria, presents a less elaborate problem, though quite important. Taking into account the fact that the method of assesing the breed value of Karakul youth after the complex selection criteria can be applied in estimating its marketing value, its elaboration becomes an innovative, practical and extremely current segment.

In this context, the purpose of the research was to reveal the methodological principles and to elaborate the formulas for evaluating the breeding value of the youth Karakul sheep according to the complex selection criteria.

MATERIALS AND METHODS

The scientific researches were carried out on a batch of Moldavian Karakul youth sheep of the National Institute of Animal Husbandry and Veterinary Medicine from village Maximovca, Anenii Noi.

To proceed with the elaboration of complex selection indices, first, we examined the possibility of reducing the number of selected morpho-productive characters. Taking into account the recommendations of professor Iliev F.V. [13], referring to the decrease in the number of selected characters, and taking into account the fact that the efficiency of multiple character selection is inversely proportional to the square root of the number of selected characters ($1 / \sqrt{n}$), we limited them to up to 3 main morpho-productive characters, such as: quality of lamb's furskin at birth, body mass of youth sheep, and ewes-mothers milk production. The quality of lamb furskins Karakul was evaluated at 1-2 days after birth, according to the provisions of the official Instruction evaluation Karakul sheep with amelioration principles in the Republic of Moldova [2]. In order to appreciate the quality of the lamb furskin, the number of evaluated characters was reduced from 29 to only 7 synthetic characters, finally expressed by class and score [4].

Body weight of youth sheep was appreciated several times a year at different ages, with different technical scales, according to our own advanced methods [3, 6]. At birth, the lamb was weighed with the hand scale, with a capacity of 6-8 kg and a precision of 0.1 kg. At 20 days, the lambs were weighed individually with a medical weighing scale for children, with a capacity up to 15 kg and a precision of 0.1 kg. Starting at the age of 3 and 6 months, as well as in the autumn, at the end of October at the age of 1.5 and 2.5 years, youth sheep was annually weighed individually at technical scales with the capacity of 100-150 kg and an accuracy grade of 0.1 - 0.2 kg. To perform the weighing of the youth, a narrow cage (box) with two doors (entry and exit) was installed and fixed on the weighing platform. The dimensions of the cage were thus projected so that a sheep could be enclosed relatively tightly. In front of the scales was arranged a enclosure (rodeo) (with a capacity of 50 sheep) with an entrance corridor. At the exit of the cage, another enclosure with a capacity of 50-200 sheep was built. At the simultaneous opening of the doors, the youth in the entrance vault, seeing through the cage the sheep from the opposite tide (from the exit), voluntarily entered the cage, after which the doors were immediately closed. After weighing, at the opening of the exit door, the sheep went out of the cage. This weighing technique allowed recording the animal's body weight without stress and trauma. Sheep weighing data were recorded in the Register of body weight of the sheep Karakul (F-10K).

Mother's milk production was determined by control milking, performed systematically on each sheep once every 15 days throughout lactation, according to method of T. Nică [15], with the improvements we developed [1]. The technical principle of this method is that sheep are subjected to control milking once a day, as a rule, in the morning milks. To determine the quantity of milk produced by sheep throughout the control day, the quantity of milk produced by it on the morning of the control day shall be multiplied by the control coefficient. This coefficient is determined by the formula:

$$K_c = \frac{Pt}{Pd} \cdot C_r \qquad (1)$$

where: K_c –control coefficient;

P_t – the total quantity of milk from lactating ewes on the day of control;
P_d - the amount of milk from lactating ewes on the morning of the control day;
C_r – milk retention coefficient:

- for ewes with infant lambs C_r=1,3;
- for ewes in the first two weeks after weaning lambs C_r=1,2;
- for the other lactating ewes C_r=1,0.

To control the quantity of milk, each ewe was individually milked in the cup, afterwards the milk was weighed to the electronic scales with capacity of 1000 g, after which the milk was poured into the storage can. The data on the matriculation number of each milking ewe and the quantity of milking milk under control were entered in the Milk Production Control Sheet (F-8K). Subsequently, the control sheet data on the amount of milking milk on the control day was transcribed into the Register of Milk Production of Karakul sheep (F-7K) where the individual milk production of each ewe on each control period was calculated. By summing the quantities of milk calculated in all control periods, the milk production of each ewe was deducted for the entire lactation.

The second step taken by us to build selection indices was to determine the *economic value of the three selection characters* and to determine its share in the total income obtained from one ewe per year [5]. By systemizing and generalizing research results, we inferred the following shares of the economic values of the selection characters:

- furskin quality - 12 %;
- body mass - 28 %;
- milk production - 60 %.

Since these selection characters have different measurements and phenotypic values to construct summative complex selection indices, we have calculated the *coefficients of the aggregate phenotype* that allow the phenotypic size of the character to be transformed into the single weighted economic value of the complex animal selection indices.

As a benchmark for determining the coefficients of the aggregate phenotype, we used the standard phenotypic size (M_S) of the selection character, which represents the race standard (level class I), for each group of age and sex of the animals, developed by us for the sheep type Moldavian Karakul [3].

The coefficient of the aggregate phenotype of youth sheep was calculated for each selected character in part by the following formula:

$$C_{fa} = \frac{P_{ve}}{M_s} \qquad (2)$$

where, C_{fa} – coefficient of the aggregate phenotype;
P_{ve} – the weight of the economic value of the selection character;
M_s – the standard phenotypic size of the selection character.

Given the coefficients of the aggregate phenotype for each selected character, we deduced the complex selection index for youth, according to the following formula:

$$I_{cs}=(M_{fp}\cdot C_{fap})+(M_{fmc}\cdot C_{famc})+(M_{fpl}\cdot C_{fapl}) \qquad (3)$$

where, I_{cs} - the complex selection index for youth;
M_{fp} – the phenotypic size of the furskin quality;
C_{fap} - coefficient of the aggregate phenotype of the furskin character;
M_{fmc} - the phenotypic size of the body mass of the youth;
C_{famc} - coefficient of aggregate phenotype of body mass character;
M_{fpl} - the phenotypic size of the mother's milk production;
C_{fapl} - coefficient of aggregate phenotype of milk production of ewes-mothers.

It should be noted that the coefficient of the aggregate phenotype of the quality of its own furskin of the youth sheep's remains constant from birth to life for life. At the same time, the coefficients of the aggregate phenotype for body mass and mother's milk production vary according to the age at which the young and the most productive lactation of the mother's lactations are evaluated.

RESULTS AND DISCUSSIONS

Scientific research has shown that for the assessment of youth sheep breeding value, according to the comlex selection criteria, it is necessary to establish the race standard

after all three selected morpho-productive characters. For the quality of the furskin, the Moldavian Karakul race standard is the average of the Classe I, expressed by the "appropriate" symbol and valued at 6 points.

Based on the results of the multiannual researches, parameters of Karakul Moldovenesc youth sheep race standard were developed and the two selected morpho-productive characters, such as body mass and milk production. For body mass, the standard of the race varies according to youth age and is set in the following parameters (Tab. 1).

Table 1 Parameters of the minimum standard of body weight of Moldavian Karakul youth sheep at different standard ages, kg

Age of sheep	Class:		
	Elite	Class I	Class II
At birth (1-2 days)	4.7	4.5	4.0
At 2 months: male	17	16	15
female	16	15	14
At 6 months: male	34	32	30
female	31	29	27
At 18 months: male	65	60	55
female	47	45	42
Adult sheep (>2,5 years): male	80	75	-
female	50	48	45

Having the body mass parameters at standard ages, zootechnical specialist can deduct intermediate body mass parameters ($M_{st.inter}$) at any intermediate age by adding to the body mass of the lower standard age ($M_{st.min}$) of the calculated mass mass (M_{calc}) this being determined by multiplying the daily average additions in the period between the standard ages and the number of intermediate days ($N_{z.inter}$) that exceeds the standard at a lower age. Standard body mass at intermediate age is calculated according to the following formula:

$$M_{st.inter}=M_{st.min}+\left(\frac{Mst.\max-Mst.\min}{Nz.st}\right)\bullet N_{z.inter} \quad (4)$$

where: $M_{st.inter}$ – standard body mass at intermediate age;
$M_{st.min}$ – standard body mass at younger age;
$M_{st.max}$ - standard body mass at older age;
$N_{z.st}$ – the number of days of the intermediate period between the standard ages;
$N_{z.inter}$ – the number of days of the interimediate period.

For an elucidation of this method, let's solve an example in practice. It is necessary to determine the standard value of the body weight of the ram no. 8448 at the intermediate age of 126 days. From Table 1 we know the values of the body mass of the male lambs at the age of 2 months (60 days) equal to 16 kg and at the age of 6 months (180 days) equal to 32 kg. As we can see, the intermediate age of the ram in our example lies between the two standard ages of 2 and 6 months. The average daily body weight gain during this standard period is 133.3 g / day (16 kg : 120 days = 0.1333 kg). From the age of 60 days to 126 days, the ram gained 8.8 kg (0.1333 kg • 66 days). Therefore, the standard body weight of the ram at intermediate age of126 days is 24.8 kg (16 + 8.8 = 24.8 kg). Thus, after this example the standard body weight of youth sheep at any intermediate age can be calculated. The race standard for the production of milk by mother-ewes has been developed and varies according to the successive lactation completed on the date of youth sheep breeding value using the complex selection index method. The data on milk production of mother-ewes are transcribed from the Register of milk production of ewes Karakul (F-7K), in which milk production of ewe is determined individually for the whole lactation, or from the Bulletin of general evaluation of Karakul sheep (F-8K). Parameters of the race standard after ewes milk production are developed according to ewes lactation (Tab. 2).

Table 2 Parameters of minimum standard of milk production of ewes Moldavian Karakul, kg

Depending on lactation	Class:		
	Elite	Class I	Class II
For ewes in III or higher lactation	70	60	50
For ewes in II lactation	63	54	45
For ewes in I lactation	53	45	40

If it is necessary to forecast (equalize) the production of milk by mature ewe, produced by young ewes in lactation I or II, then recalculate it by means of established correction coefficients. For the recalculation of milk production from lactation I to mature lactation, its value is multiplied by the coefficient 1.35. For the recalculation of milk production in lactation II, its value is multiplied by the coefficient 1.11. These coefficients are used to equate lactation of daughters for genotypic testing of ewes after milk production of the descendants. By providing the standard values of the morpho-productive characters selected for sheep youth, we can proceed to construct the complex selection indices needed to assess its breeding value, especially at the marketing stage.

Complex selection index for lambs at birth. Breeders of Karakul sheep often practice lambs commercialization (selling / buying) at 1-5 days after birth. If the buyer buys the lamb without a mother, it is further grown with the bottle. When assessing the commercial value of the lamb, priority is given primarily to phenotypic characters such as furskin quality and body development. In some localities of the Republic of Moldova the sheep breeders organize fairs-exhibitions of animals where the lambs Karakul are exposed. Some of them are for sale, and some are exposed for public viewing and advertising. Ram lambs exposed for public viewing, subsequently being raised for breeding, have a high demand (from Karakul ewes owners) for use in autumn mating sheep and getting a better descendants.

Lately, some buyers of lamb Karakul, assisted by specialists in the field, are increasingly interested in mothers' milk production. In this case, a genotypic assessment of the breeding value of the lamb is already taking place, even if it is done unofficially. In elite farms, the breding value of lambs is officially assessed after a complex of characters (furskin quality, body mass, mother's milk production). From breeding farms, Karakul lambs are exposed at fairs-exhibitions accompanied by a breed certificate, which includes evaluation dates with morpho-productive character selection indices. For young sheep of Moldavian Karakul breed of any age, the complex selection indices are built according to the methods developed by us.

For lambs Karakul at birth, the complex selection index is determined by the above-mentioned formula (3), based on the phenotypic character values of the character and the coefficients of the aggregate phenotype of the three selected morpho-productive characters.

First, we calculate the coefficients of the aggregate phenotype for each character, based on the weight of the economic value of the character and its standard phenotypic size.

Thus, we calculate the coefficients of the aggregate phenotype of the selection characters.

The coefficient of aggregate phenotype for furskin quality will be,

$$C_{fap} = \frac{P_{vt}}{M_s} = \frac{12}{6} = 2.0$$

where: C_{fap} – the coefficient of aggregate phenotype for furskin quality of lamb;
P_{ve} – the weight of the economic value of the furskin character set by us = 12;
M_s – the standard phenotypic size of the furskin quality class I = 6 points.

As a result of the performed calculations, the coefficient of aggregate phenotype of the quality of the furskin is equal to 2.0.

The coefficient of aggregate phenotype for lamb body mass at birth, both for ewe lambs and for ram lambs, is the same, and constitutes:

$$C_{famc} = \frac{P_{ve}}{M_s} = \frac{28}{4.5} = 6.22$$

where: C_{famc} – the coefficient of aggregate phenotype for lamb body mass;
P_{ve} – the weight of the economic value of the body mass = 28;
M_s – the standard phenotypic size of body mass for lambs at birth is 4.5 kg.

The coefficient of the aggregate phenotype for mothers' milk production will be:

For ewes with I lactation,

$$C_{fapl} = \frac{P_{ve}}{M_s} = \frac{60}{45} = 1.33$$

where: C_{fapl} – coefficient of the aggregate phenotype for milk production;
P_{ve} – the weight of the economic value of milk production = 60;
M_s – the standard phenotypic size of milk production of ewe with I lactation = 45kg.

For ewes with II lactation,

$$C_{fapl} = \frac{P_{ve}}{M_s} = \frac{60}{54} = 1.11$$

where: C_{fapl} – coefficient of the aggregate phenotype for milk production;
P_{ve} – the weight of the economic value of milk production = 60;
M_s – the standard phenotypic size of milk production of ewe with II lactation = 54 kg.

For ewes with III lactation,

$$C_{fapl} = \frac{P_{ve}}{M_s} = \frac{60}{60} = 1.0$$

unde: C_{fapl} – coefficient of the aggregate phenotype for milk production;
P_{ve} – the weight of the economic value of milk production = 60;
M_s – the standard phenotypic size of milk production of ewe with III lactation = 60kg.

Thus, the complex selection index of *lambs at birth* will have the following formula:

$$I_{mn}=(M_{fp}\cdot 2.0)+(M_{fmc}\cdot 6.22)+(M_{fpl}\cdot 1.33;\ or\ 1.11;\ or\ 1.0) \quad (5)$$

where: I_{mn} – the complex lamb selection index at birth;
M_{fp} – the phenotypic size of the quality of the own furskin, expressed in the score;
M_{fmc} - the phenotypic size of its own body mass, expressed in kg;
M_{fpl} - the phenotypic size of the mother's milk production, expressed in kg.

It should be mentioned that the numeric value of the index is expressed in figures without units of measurement, ranging from two to three full digits and one (tenths) or two (hundreds) digit rounded by comma. If the phenotypic size of the three selection characters coincide exactly with the race standard, the selection index value will be 100. Depending on the phenotypic size of the selection characters, the complex selection index may be less than or equal to 100. In principle, the complex selection index indicates the level of the breeding value of the animal compared to the breed standard, and at the same time shows the extent to which it yields or exceeds that standard. If the value of the selection index exceeds 100, we can conclude that the breeding value of the animal is higher than the breed standard and, conversely, if the animal's index is below 100, the breeding value of the animal does not match the breed standard. According to the value of the complex selection index, the sheep youth of each age group can be divided into lines of ranks, showing the value of the animal in the sheep hierarchy.

Exaemples:

a) lamb Karakul no. 8145 has the furskin quality "exc.-8", the body weight at birth of 4.9 kg and the milk production of the mother in the second lactation equal to 68 kg. Based on these data, the complex selection index of this lamb will constitute,

$$I_{8145} = (8\bullet 2.0)+(4.9\bullet 6.22)+(68\bullet 1.11) = 16 + 30.48 + 75.48 = 121.96;$$

b) lamb Karakul no. 8216 has the furskin quality " red.-4", the body weight at birth of 4.2 kg and the milk production of the mother in the IV lactation equal to 52 kg. Based on these data, the complex selection index of this lamb will constitute,

$$I_{8216} = (4\bullet 2.0)+(4.2\bullet 6.22)+(52\bullet 1.0) = 8 + 26.12 + 52 = 86.12;$$

c) lamb Karakul no. 8206 has the furskin quality "potr.-7", the body weight at birth of 4.1 kg and the milk production of the mother in the first lactation equal to 46 kg. Based on these data, the complex selection index of this lamb will constitute,

$$I_{8206} = (7•2.0)+(4.1•6.22)+(46•1.33) = 14 + 25.50 + 61.18 = 100.68;$$

From the provided examples, we find that lamb no. 8145, having a complex selection index of 121.96 is the most valuable, far exceeding the standard of breed after the breeding value. On the contrary, lamb no. 8216 has a low breed value because the complex selection index of 86.12 is well below the breed standard. The third lamb, no. 8206, having the complex selection index equal to 100.68, after the breeding value is situated at the breed standard. In the decreasing series of the centralizing bulletin evaluation of the lamb's breeding value according to the complex selection index of the herd, the first lamb is among the highest ranks. The second lamb is among the lower ranks of the herd, and the third lamb is found in the middle of the sheep flock.

Complex selection indexes for lambs at 2 months age. The age of 2 months is standard, as lambs of Moldavian Karakul reaching this age are weaned and separated from their mothers. For the 2-month lambs, complex selection indices are similar to those of lambs at birth, only the value of the aggregate phenotype coefficient of body mass is different, which is different in ram lambs and ewe lambs, constituting:

-ram lambs

$$C_{famc} \quad \frac{P_{ve}}{M_s} = \frac{28}{16} = 1.75$$

- ewe lambs

$$C_{famc} \quad \frac{P_{ve}}{M_s} = \frac{28}{15} = 1.87$$

Thus, the complex selection index for *2-month ram lambs* will have the following formula

$$I_{b2}=(M_{fp}\cdot 2.0)+(M_{fmc}\cdot 1.75)+(M_{fpl}\cdot 1.33;\text{or } 1.11;\text{ or } 1.0) \quad (6)$$

where: I_{b2} – the complex selection index for 2-month ram lambs;
M_{fp} – the phenotypic size of the quality of the own furskin, expressed in the score;
M_{fmc} - the phenotypic size of its own body mass, expressed in kg;
M_{fpl} - the phenotypic size of the mother's milk production, expressed in kg;

The complex selection index for ewe lambs of 2 months will have the following formula

$$I_{m2}=(M_{fp}\cdot 2.0)+(M_{fmc}\cdot 1.87)+(M_{fpl}\cdot 1.33;\text{ or } 1.11;\text{ or } 1.0) \quad (7)$$

where: I_{m2} – the complex selection index for 2-month ewe lambs;
M_{fp} – the phenotypic size of the quality of the own furskin, expressed in the score;
M_{fmc} - the phenotypic size of its own body mass, expressed in kg;
M_{fpl} - the phenotypic size of the mother's milk production, expressed in kg.

Example: to calculate the complex selection index for ram lamb No. 7124 with the quality of furskin "exc.-9", which at the age of 3.5 months (105 days) had a body weight of 25 kg and the milk production of the mother in the second lactation is 63 kg.

The standard size of the coefficient of aggregate phenotype for furskin quality is 2.0.

To determine the aggregate phenotype coefficient of body mass, it is necessary to adjust the standard body mass at the 105-day intermediate age, which is between standard ages of 2 and 6 months. From Table 1, we see that standard daily additions to ram lambs during this period are 0.133 kg / day. From the standard age of 2 months to the intermediate age of 3.5 months, the lamb should add at least 5.98 kg (45 days • 0.133 kg = 5.98 kg). Therefore, the standard body weight of Karakul ram lamb at the intermediate age of 105 days is 21.98 kg (16 + 5.98). Hence, the coefficient of aggregate phenotype of the ram lamb body mass at this age is:

$$C_{famc} = \frac{P_{ve}}{M_s} = \frac{28}{21,98} = 1.27$$

The standard size of the aggregate phenotype of sheep in lactation II is 1.11.

Thus, with the phenotypic sizes of the selected ram lamb no. 7124 and aggregate phenotype coefficient sizes for these characters, we can proceed to calculate the complex selection index, which will constitute:

$$I_{7124}=(9•2)+(25•1.27)+(63•1.11)=18+31.75+69.93 = 119.68$$

Therefore, having the size of the complex selection index far above the breed level, the ram lamb no. 7124 has a high breed value and occupies a high rank in the descending row of the centralizing bulletin evaluating the value of the youth sheep of the flock.

Complex selection index for 6-month-old youths. The age of 6 months is considered to be standard, as it coincides with the assessment of the sheep's body development by weighing the entire flock in the autumn.

For the construction of 6-month-old youths complex selection indices for both ewe and ram lambs, the same coefficients of aggregate phenotype of furskin quality equal to 2.0 and maternal milk production according to lactation (*Lactation I =1.33; Lactation II =1.11; Lactation III =1.0*). The difference between ram and ewe lambs is only the coefficient of the aggregate phenotype of the body mass, which constitutes:

- at ram lambs

$$C_{famc} \quad \frac{P_{ve}}{M_s} = \frac{28}{32} = 0.875$$

- at ewe lambs

$$C_{famc} \quad \frac{P_{ve}}{M_s} = \frac{28}{29} = 0.965$$

Thus, the complex selection index for *6-month rams* will have the following formula:

$$I_{b6} = (M_{fp} \cdot 2.0) + (M_{fmc} \cdot 0.875) + (M_{fpl} \cdot 1.33; \text{ or } 1.11; \text{ or } 1.0) \quad (8)$$

where: I_{b6} – the complex selection index for 6-month rams;
M_{fp} – the phenotypic size of the quality of the own furskin, expressed in the score;
M_{fmc} - the phenotypic size of its own body mass, expressed in kg;
M_{fpl} - the phenotypic size of the mother's milk production, expressed in kg.

The complex selection index for *6-month ewes* will have the following formula:

$$I_{m6} = (M_{fp} \cdot 2.0) + (M_{fmc} \cdot 0.965) + (M_{fpl} \cdot 1.33; \text{ or } 1.11; \text{ or } 1.0) \quad (9)$$

where: I_{m6} – the complex selection index for 6-month rams;
M_{fp} – the phenotypic size of the quality of the own furskin, expressed in the score;
M_{fmc} - the phenotypic size of its own body mass, expressed in kg;
M_{fpl} - the phenotypic size of the mother's milk production, expressed in kg.

Examples of 6-month-old youths breeding value assessment after complex selection indices:

a) the ram lamb no. 9057 had the quality of the furskin apreciated with the grade "exc.-8". At autumn weighing (at the age of 6 months) it had 35 kg. The milk production of the mother in the IV lactation was 61 kg. The coefficient of aggregate phenotype for furskin quality is the same as for lambs and is 2.0. The coefficient of aggregate phenotype for body mass at 6 months will be:

$$C_{famc} = \frac{P_{ve}}{M_s} = \frac{28}{32} = 0.875$$

where: C_{famc} – coefficient of aggregate phenotype for body mass;
P_{ve} – the weight of the economic value of body mass = 28;
M_s – the standard phenotypic mass size for 6-month-old rams of 32 kg.

The coefficient of the aggregated phenotype for the ewe mother with lactation IV will be standard and equal to 1.0.

Thus, having the phenotypic size of the selected morpho-productive characters and the coefficients of the aggregate phenotype, the selection index of ram lamb no. 9057 will be:

$$I_{9057} = (8 \bullet 2) + (35 \bullet 0.875) + (61 \bullet 1.0) = 16 + 30.62 + 61 = 107.62$$

b) ewe lamb no.9101 had the quality of the furskin appreciated with the grade "potr.-5". At autumn weighing (at the age of 6 months) it had 28 kg. The milk production of the mother in the V lactation was 58 kg. The coefficient of aggregate phenotype for furskin quality is the same as for the above-mentioned ram lamb - 2.0. The coefficient of aggregate phenotype for body mass at 6 months will be:

$$C_{famc} = \frac{P_{ve}}{M_s} = \frac{28}{29} = 0.965$$

where: C_{famc} – coefficient of aggregate phenotype for body mass;
P_{ve} – the weight of the economic value of body mass = 28;
M_s – the standard phenotip size of body weight for 6 months lambs equal to 29 kg.

The coefficient of the aggregate phenotype for the lactating V of ewe-mother will be a standard of 1.0.

Thus, having the phenotypic size of the selected morpho-productive characters and the coefficients of the aggregated phenotype, the complex selection index for lamb no. 9101 will be:

$I_{9101} = (5•2)+(28•0.965)+(58•1.0) = 10+27.02+58 = 95.02$

Therefore, from the given examples we see that the ram lamb no. 9057 has a higher breed value than Moldavian Karakul breed standard, because the complex selection index exceeds 100 points by 7.62 points. At the same time, the breeding value of ewe lamb no. 9101 is below the race standard because the complex selection index is less than 100 with about 5 points. In the raw ranks of 6 month old ovine in the herd, the evaluated ram is situated among the advanced ranks, and the mentioned ewe, on the contrary, is among the lower ranks.

Complex selection index for 18-month-old rams. The age of 18 months is considered standard, since sheep youth is normally included in the reproductive process through directed mating. For this group of youth, the complex selection index will consist of the value of the quality of its own furskin, valued at its own level, of the body's own body mass and of the milk production of the mother. The coefficient of aggregate phenotype for own furskin quality will be the same as for other youth groups equal to 2.0 Thecoefficient of the aggregate phenotype for the body mass of the youth rams will be:

$$C_{famc} = \frac{P_{ve}}{M_s} = \frac{28}{60} = 0.467$$

where: C_{famc} – coefficient of aggregate phenotype for body mass;
P_{ve} – the weight of the economic value of body mass = 28;
M_s – the standard phenotypic mass of 18-month rams with 60 kg.

The coefficient of the aggregate phenotype for the milk production of the mother will depend on its lactation and will be the same as for the other groups of youth (*Lactation I =1.33; Lactation II =1.11; Lactation III =1.0*).

Thus, the complex selection index for 18-month-old rams will have the following formula:

$$I_{b18} = (M_{fp}\cdot 2.0)+(M_{fmc}\cdot 0.467)+(M_{fpl}\cdot 1.33;\ or\ 1.11;\ or\ 1.0) \quad (10)$$

where: I_{b18} – the complex selection index for 18-month-old rams;
M_{fp} – the phenotypic size of the quality of the own furskin, expressed in the score;
M_{fmc} - the phenotypic size of its own body mass, expressed in kg;
M_{fpl} - the phenotypic size of the milk production of ram's mother, expressed in kg.

Example: the ram no. 5617, 18 months old, with furskin quality "exc.-8" with a body weight of 61 kg and milk production of mother in the second lactation of 85 kg, will have the following complex index of selection:

$$I_{b5617} = (M_{fp}\cdot 2.0)+(M_{fmc}\cdot 0.467)+(M_{fpl}\cdot 1.11) = (8\cdot 2.0)+(61\cdot 0.467)+(85\cdot 1.11) = 16+28.49+94.35 = 138.84$$

Examining the value of the calculated index, we can conclude that the ram no. 5617 possesses a breeding value far superior to the standard of breed and is among the highest ranks in the decreasing order of the general bondering bulletin of 18-month-old rams.

Compex selection index for 18-month-old ewes. For ewes in this group of youth sheep the complex selection index will be made up of the same basic elements as the 18-month-old rams, namely: the quality of their own furskins appreciated at evalution, their own body mass and the milk production of the mother.

The coefficient of aggregate phenotype for the quality of own furskin will be the same as for other sheep, equal to 2.0.

The coefficient of aggregate phenotype for body mass will be:

$$C_{famc} = \frac{P_{ve}}{M_s} = \frac{28}{45} = 0.622$$

where: C_{famc} – the coefficient of aggregate phenotype for body mass;
P_{ve} – the weight of the economic value of body mass = 28;
M_s – the standard phenotypic standard of body mass for 18 months old ewes equals 45 kg;

The coefficient of the aggregate phenotype for the mother's milk production will be the same as for the 18-month-old rams and will, depending on the mother's lactation (*Lactation I =1.33; Lactation II =1.11; Lactation III =1.0*).

Thus, the complex selection index for 18-month-old ewes will have the following formula:

$$I_{m18} = (M_{fp} \cdot 2.0) + (M_{fmc} \cdot 0.622) + (M_{fpl} \cdot 1.33; \text{ or } 1.11; \text{ or } 1.0) \quad (11)$$

where: I_{m18} – the complex selection index for 18-month-old ewes;
M_{fp} – the phenotypic size of the quality of the own skin, expressed in the score;
M_{fmc} - the phenotypic size of its own body mass, expressed in kg;
M_{fpl} - the phenotypic size of the mother's milk production, expressed in kg.

Example: Ewe no. 2809, 18 months old, the quality of the furskin "potr.-5" with a body mass 47 kg and the mother's milk production in the first lactation of 55 kg will have the following complex selection index:

$$I_{m2809} = (M_{fp} \cdot 2.0) + (M_{fmc} \cdot 0.622) + (M_{fpl} \cdot 1.33) = (5 \cdot 2.0) + (47 \cdot 0.622) + (55 \cdot 1.33) = 10 + 29.23 + 73.15 = 112.38$$

Based on this index, we can say that the breeding value of the ewe lamb no. 2809 is above the standard of the breed and is in the high ranks of the decreasing row of centralized bulletin evaluating the value of the youth sheep of the flock.

Analyzing and generalizing the results of the researches regarding the breeding value of Moldavian Karakul youth sheep, we find that the principles of the construction of complex selection indices are the same as in the adult sheep. These principles are reflected in the previously published scientific papers [7, 8]. The resemblance refers, first of all, to the value of the aggregate phenotype for furskin quality, which is determined at evaluating (1-2 days after birth) for life. Secondly, the coefficients of the aggregate phenotype for mothers' milk production are also the same as for adult sheep.

At the same time, the aggregate phenotype coefficient for body mass of youth sheep varies greatly depending on its age because the body mass standard is different at different ages. It is important to note that one of the particularity of the principles of constructing the complex indicators of youth sheep selection is the specificity of determining the coefficient of aggregate phenotype for body mass and, in particular, the standard of this morpho-productive character at any age. Having developed standard body mass parameters at standard ages, the zootechnics specialist can determine the standard body mass of youth sheep at any marketing age, necessary to determine the aggregate phenotype and breed value after complex selection indices.

CONCLUSIONS

Determining the breed value of young Karakul sheep after the complex selection indices is one of the most objective and effective methods of assessing sheep quality.

The complex selection index for youth sheep can be determined at any age, from birth to adult age.

Determination of breeding value of Karakul lambs according to the complex selection indices is of scientific and practical importance, because it can be applied to their marketing at early ages.

The specificity of determining the aggregate phenotype coefficient for body mass is a particularity of the principles of construction of the complex selection indexes of youth Karakul sheep.

The size of the aggregate phenotype coefficient of body mass in youth sheep varies according to the standard of body mass not only at standard ages but also at intermediate ages.

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