# DETERMINING THE BREEDING VALUE OF KARAKUL EWES AFTER COMPLEX SELECTION INDEX

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**Abstract**

*The aim of this work was the elaboration a method for estimating the breeding value of Karakul ewes by building and applying complex selection indices. The research was conducted on Moldavian Karakul sheep from flock of National Institute of Animal Husbandry and Veterinary Medicine from Maximovca village, Anenii Noi district, Republic of Moldova. In the paper have been examined construction methodology complex selection index of ewes from Moldavian Karakul race. It was found that, previous, for construction complex selection index has been reduced the number of characters and skins traits of lambs at the evaluation marks from 29 to 7, and the latter have been synthesized into a single character - class of lamb expressed in points after the decimal system. Have been identified 3 basic morph-productive characters (the descendents skins quality, the own body weight, the ewe milk production) and followed by the selection of sheep. It was determined the economic value (share) of each selection character in the total income from one animal per year. For each selection character partly was calculated phenotype aggregate coefficient ($C_{fa}$) which allows expression of the value of each character in single units of measure, using the following formula:*

$$C_{fa} = \frac{P_{ve}}{M_s} \qquad (1)$$

*where,* $C_{fa}$ *– coeficient of phenotype aggregat;*

$P_{ve}$ *– share economic value of the selection character;*

$M_s$ *– phenotypic size standards of selection character*

Having the coefficients of phenotype aggregate for each selected character apart, we have built complex selection index formula of ewe, after following formula:

$$I_{cs} = (M_{fp} \cdot C_{fap}) + (M_{fmc} \cdot C_{famc}) + (M_{fpl} \cdot C_{fapl}) \qquad (2)$$

*where,* $I_{cs}$ *– complex selection indices of ewe;*

$M_{fp}$ *– phenotypic size of descendents skins quality;*

$C_{fap}$ *- coefficient of phenotype aggregate of skins character;*

$M_{fmc}$ *– phenotypic size of own body weght of ewes;*

$C_{famc}$ *- coefficient of phenotype aggregate of body weght character;*

$M_{fpl}$ *– phenotypic size of ewes milk production;*

$C_{fapl}$ *- coeficient of phenotype aggregate* of *milk production;*

**Key words**: Selection complex index, ewes, Karakul

## INTRODUCTION

The value of animals breeding represent productive phenotypic and genotypic potential can be estimated by different zootechnics methods for assessing the degree of manifestation of the selection character (assessment by scoring, measuring, weighing) and animal evaluation marks. Determining the objective value as possible, breeding complex of different animals species present an actual problem, in the result of breeding that concern researchers and livestock specialists in the field. Appreciation of the ordinary of animals after more characters long applied in animal husbandry. However, that ordinary assessment by summary of accumulated points cannot be considered and complex one, because does not reflect the importance of the economic value of each selected character. In this context, zootechnical specialists in the field on the different animal species (poultry, pigs, cattle) began to apply the so-called complex selection

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indices [8, 9, 11, 16, 17]. The animal class summary, determined after evaluation marks, represent in its essence, an index, but it is not complex, because in the class summary all characters have the same value, while in the index complex selection each character finds the economic value and breeding value [7]. The effect of selection after complex indexes, according to data [16, 17] - about 10% after additional information [15] - by 20-50% and in some cases [10] - even 2.0 times greater than the selection based on the method of character selection limits independent.

The sheep on the Moldavian Karakul type possess a mixed productivity (skins, milk, meat), which determines the need for selection of animals after a character complex, which can be organized by different methods: in tandem, after limits independent or after the selection complex indices. The last method is considered the most modern, efficient and scientifically justified [14]. Determination of complex selection index of represent animal, in fact, a wide breeding assessment of its after main selected characters taking into account the productive performance and economic value.

Application of selection indices at the Karakul race, in general is not widespread. Some publications are only known [10, 12, 13, 14, 15, 18], regarding the selection indices of lambs after qualities of skin and growth potential after Karakul lambs during postnatal of ontogenesis. For example Нел Дж. А. [15] «mentioned that *general indicator selection Karakul lambs in ready form does not exist and not should exist. But, the breeding flocks of the Experiment Station Neidam, such indices have been elaborated.*" The authors bring the index selection of Karakul lambs after skins qualities.

$$I = 20 + 1Q + 4P + 2S$$

where: I – selection index of Karakul lambs after skins qualities;

20 – constant calculated by author.

Q – quality of hair fibers, viewed as points;

P – modeling curls appreciated in points;

S – seze of curls, appreciated in points.

The researchers from Kazakhstan [10, 12, 13, 18] communicates about the application of selection indices Karakul lambs and adult ewes after harmony body conformation, which include some aspect exterior rapport with animal body weight, such as body weight, chest perimeter and oblique trunk length.

Mentioned that the selection indices of Karakul sheep proposed by the nominees authors above have not a complex character, because it reflects only some of the characters exterior ratios and body conformation. Therefore, these indices cannot be used to determine the overall weight of the animal breeding.

According to the Instructions breeding of Karakul sheep with principles for improvement in force in the Republic of Moldova [2], in determining the general value of breeding (class) Moldavian Karakul sheep, are not taken into account some of the most important characters morph-productive selection such as: production of milk and meat - body weight). In fact, the main flaw of the Instructions in force is that the production of skins is considered only basic character, voiced by class lamb and body weight, and milk production are considered characters related (secondary) and are not considered anymore in determining the breeding of the animal (class). So, between the values of the main morph-productive characters and breeding value of the animal there is a clear rupture, requiring integrated into a single complex of phenotypic, genotypic and economic values of animal. Hence, there is urgent need to improve these Instructions through the elaboration and inclusion it in the methodology of selection of modern methods for estimating the value of breeding with application the complex selection indices.

For this, the present work was proposed to develop a method for estimating the breeding value of Karakul ewes through the construction and implementation of complex selection indices.

## MATERIALS AND METHODS

The research was conducted on Moldavian Karakul ewes from the flock of the National Institute of Animal Livestock and Veterinary Medicine from Maximovca village, Anenii Noi district, Republic of Moldova.

As a first step, according to methodological recommendations of prof. Iliev T. V. [7] and, taking into account that the efficiency after more character selection is inversely proportional to the square root of the number of selected characters ($\frac{1}{\sqrt{n}}$), first of all, we have been limited the number of selected characters in assessing the quality of skins lambs, from 29 to 7, and the latter have been systematized, generalized and summarized in a single character - class lamb expressed in points after decimal system [4]. Finally, for the construction of complex selection indices adult Karakul ewes have identified only three major morph-productive characters:

- *skin quality* - the skins lamb value (score) at the evaluation marks, or average value of the lambs-descendants skins (in case of test results after ewes skin qualities of several descendants), expressed in score after the decimal system appreciation;
- *body weight* of own ewe, determined annually (in October), in autumn before the start the breeding company, by individual weighing at the technical weigh with 150 kg capacity [6];
- *milk production* of ewe expressed in kilograms and determined according to the methodology perfected by us [1].

The second step, taken by us in the way of building complex selection indices was to determining *the economic value of the three selection characters* and establishing its share in total income from a ewe per year [5]. Systematizing and generalizing the research results above, we have been deduced the following shares of economic values of selection character:

- The quality of skins - 12%;
- The body weight - 28%
- The milk production - 60%.

Because the mentioned selection characters have been metrics and different phenotypic values, to summary construct complex selection indices, we proceeded to calculate *coefficients of phenotype aggregate that* allow transform the phenotypic size of the character in the economic value weighted single of complex selection index of animal.

As a landmark for determining the phenotype coefficients aggregate served the standard phenotypic size (Ms) of selection character, which represent the race standard (level class I) for each age and sex group of animals partly, elaborated by us for the sheep Moldavian Karakul type [3].

Coefficients phenotype aggregate for each selected character partly was calculated using the following formula:

$$C_{fa} = \frac{P_{ve}}{M_s} \qquad (1)$$

where,

$C_{fa}$ - phenotype coefficient aggregate;

$P_{ve}$ - share economic value of the selection character;

$M_s$ - phenotype size standards of selection character.

Having the coefficients phenotype aggregate for selected each character, we have been deducted complex selection index of the ewe, after following formula:

$$I_{cs}=(M_{fp}\cdot C_{fap})+(M_{fmc}\cdot C_{famc})+(M_{fpl}\cdot C_{fapl}) \qquad (2)$$

where,

$I_{cs}$ - complex selection index of the ewe;

$M_{fp}$ - phenotypic size of quality of descendent lamb skins;

$C_{fap}$ - coefficient of phenotype aggregate of skin character;

$M_{fmc}$ - phenotypic size of ewes body weight;

$C_{famc}$ - coefficient of phenotype aggregate of body weght character;

$M_{fpl}$ - phenotypic size of ewes milk production;

$C_{fapl}$ - coefficient of phenotype aggregate of milk production, determined by their lactation, because phenotypic standard size of milk sheep production with lactation I (primary), lactation II and lactation III differs.

According to our research [1], we determined that ewes milk production with I lactation shall be 74% and of sheep by II lactation - 90% of the milk production of sheep with III lactation and higher. If the case of the standard sheep milk production with III lactation is set at 70 kg, then the primary sheep it is 52 kg, and at the sheep

with lactation II - 63 kg. For these standards sizes, still, were calculated coefficients of phenotype aggregate for milk production of ewes with different lactation.

## RESULTS AND DISCUSSIONS

According to research results, complex selection index, determined according to the formula above, combines, through coefficients phenotype aggregate value summary of the three main characters of sheep selecting. The numerical value of the index is expressed in numbers without units, in the range of two or three-digit integer and one (tenths) or two (hundredths) rounded figures after the decimal point. If the phenotypic size of the three selection characters will coincide exactly with the race standard, selection index value will be equal to 100. Depending on the size of the selection phenotype characters, complex selection index can has lower or higher value than 100. In principle, complex selection index indicates the animals breeding value compared to the breed standard, and also shows the extent to which it yield approaching or exceeding this standard. If the selection index value exceeds 100, we conclude that the ewe breeding value exceeds the race and, conversely, if the ewe index is below 100, breeding value does not correspond to its breed standard.

At the Moldavian Karakul sheep race have been built complex selection index of ewes, establishing the following sequence of calculating it.

**1.** Determination of genotype aggregate of selection characters.

1.1. Given the formula (1), the coefficient phenotype aggregate for quality ewe skin was:

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

where,

$C_{fap}$ - coefficient of phenotype aggregate of skin quality;

$P_{ve}$ - share economic value of skin character established of 12%;

$M_s$ - phenotype standard size of skins quality character of the level class I = 6 points.

As a result of calculations performed, the coefficient of phenotype aggregate of quality skin character for sheep is equals with 2.0.

1.2. The coefficient of phenotype aggregate for ewes body weight was:

$$C_{famc} = \frac{P_{ve}}{M_s} = \frac{28}{48} = 0.583$$

where:

$C_{famc}$ - the coefficient of phenotype aggregate for ewes body weght;

$P_{ve}$ - share economic value of body weight = 28;

$M_s$ - standard phenotypic size of body weight for ewes 48 kg.

As a result of performed calculations, the coefficient of phenotype aggregate of ewes' body mass character is equal to 0.583.

1.3. The phenotype coefficient aggregate for ewes milk production is based on its lactation and constituted:

a) for ewes with I lactation

$$C_{fapl} = \frac{P_{ve}}{M_s} = \frac{60}{52} = 1.154$$

b) for ewes with II lactation

$$C_{fapl} = \frac{P_{ve}}{M_s} = \frac{60}{63} = 0.952$$

c) for ewes with III lactation and above

$$C_{fapl} = \frac{P_{ve}}{M_s} = \frac{60}{70} = 0.857$$

where:

$C_{fapl}$ - coefficient of phenotype aggregate for ewes milk production;

$P_{ve}$ - share economic value of milk production = 60;

$M_s$ - standard phenotypic size of ewes milk production: în I lactation = 52 kg; in II lactationa = 63 kg, in III lactation and above = 70 kg.

As a result of calculations performed, the coefficient of phenotype aggregate character of ewes milk equals: in the I lactation - with 1.154; in the II lactation - with 0.952 and in the III lactation - with 0.857.

**2.** Determination of ewes complex selection index.

Thus, having the coefficients phenotype aggregate of selection characters for the ewes, we built the following formula of complex selection index for ewes:

$$I_{cso}=(M_{fp}\cdot 2.0)+(M_{fmc}\cdot 0.583)+(M_{fpl}\cdot 0.857, \text{ or } 0.952, \text{ or } 1.154) \quad (3)$$

where,

$I_{cso}$ - the complex selction index of ewes;

$M_{fp}$ - phenitypic size of own skin quality (the lack of appreciation after skin qualities of descendents);

$M_{fmc}$ - phenotypic size of own body weight;

$M_{fpl}$ - phenotypic size of milk production;

2.0 - coefficient of phenotype aggregate of skin quality;

0.583 - coefficient of phenotype aggregate of ewes body weight;

0.857; 0.952 or 1.154 - coefficient of phenotype aggregate of ewes milk production.

Depending by lactation, complexes selection indices for ewes were following formulas:

2.1) *complex selection index for ewes with I lactation*

2.1.1) Coeficient of phenotype aggregate for skins quality coefficient will be the same as the other animals, equal to 2.0.

2.1.2) Coeficient of phenotype aggregate for ewes body weight with I lactation, will be same the other ewes with lactation II and III, equal with 0.583.

2.1.3) Coefficient of phenotype aggregate of ewes milk production with I lactation will be 1.154.

So, complex selection index for ewes with I lactation constitued:

$$I_{csoiI} = (M_{fp} \cdot 2.0) + (M_{fmc} \cdot 0.583) + (M_{fpl} \cdot 1.154) \quad (4)$$

where:

$I_{csoiI}$ - complex selection index of ewes with I lactation;

$M_{fp}$ - phenotypic size of descendent skin quality ascendant born in lactation year expressed in points;

$M_{fmc}$ - phenotypic size of own body weight;

$M_{fpl}$ - phenotipyc size of own milk production in lactation year of evaluation

2.2) *complex selection index for ewes with II lactation*

2.2.1) The coefficient of phenotype aggregate for skin quality will be the same as the other animals, equal to 2.0.

2.2.2) The coefficient of phenotype aggregate for ewes body weight with lactation II will be the same as the ewes with I and II lactation, equal to 0.583.

2.2.3) The coefficient of phenotype aggregate for ewe milk production with II lactation will be different from that of sheep with I and III lactation, and will be 0.952.

Thus, complex selection index for ewes lactation II is:

$$I_{csoiII} = (M_{fp} \cdot 2.0) + (M_{fmc} \cdot 0.583) + (M_{fpl} \cdot 0.952) \quad (5)$$

where:

$I_{csoiII}$ - complex selection index of ewes with II lactation;

$M_{fp}$ - phenotypic size of descendent skin quality ascendant born in lactation year expressed in points;

$M_{fmc}$ - phenotypic size of own body weight;

$M_{fpl}$ - phenotipyc size of own milk production in lactation year of evaluation.

2.3) *complex selection index for ewes with III lactation and above*

2.3.1) Coeficient of phenotype aggregate for skin quality coefficient will be the same as the other animals, equal to 2.0.

2.3.2) Coeficient of phenotype aggregate for ewes body weight with III lactation, will be same the other ewes with lactation I and I, equal with 0.583.

2.3.3) The coefficient of phenotype aggregate for ewes milk production with III lactation will be different from that of sheep with I and II lactation, and will be 0.857.

Thus, complex selection index for ewes lactation III is:

$$I_{csoiIII} = (M_{fp} \cdot 2.0) + (M_{fmc} \cdot 0.583) + (M_{fpl} \cdot 0.857) \quad (6)$$

where:

$I_{csoiIII}$ - complex selection index of ewes with III lactation;

$M_{fp}$ - phenotypic size of descendent skin quality ascendant born in lactation year expressed in points;

$M_{fmc}$ - phenotypic size of own body weight;

$M_{fpl}$ - phenotipyc size of own milk production in lactation year of evaluation.

According to these formulas we have been calculated complex selection indices for the researched sheep flock (Tab. 1).

Table 1 Complex selection index of the first 19 ewes in the register flock

| No. d/o | No. register ewe | Average points skin | Body weight ewe, kg | Milk production of ewe/ lactation, kg | Complex selection index |
|---|---|---|---|---|---|
| 1 | 6122 | 7 | 54 | 86/III | 119.2 |
| 2 | 0432 | 9 | 56 | 65/II | 112.5 |
| 3 | 3396 | 3 | 46 | 50/I | 90.5 |
| 4 | 0095 | 6 | 55 | 71/II | 111.7 |
| 5 | 5421 | 5 | 53 | 69/IV | 100.0 |
| 6 | 2503 | 4 | 47 | 65/V | 91.1 |
| 7 | 1059 | 7 | 52 | 52/III | 88.9 |
| 8 | 4104 | 8 | 54 | 52/I | 107.5 |
| 9 | 3012 | 4 | 51 | 56/I | 102.3 |
| 10 | 0126 | 7 | 49 | 66/II | 105.4 |
| 11 | 2347 | 5 | 45 | 51/III | 79.9 |
| 12 | 3015 | 6 | 57 | 78/II | 119.4 |
| 13 | 1222 | 4 | 50 | 48/I | 92.5 |
| 14 | 2254 | 8 | 57 | 75/IV | 113.5 |
| 15 | 3156 | 3 | 49 | 58/I | 101.5 |
| 16 | 0102 | 7 | 50 | 52/I | 103.1 |
| 17 | 2054 | 6 | 52 | 70/II | 109.0 |
| 18 | 1101 | 6 | 48 | 65/II | 101.9 |
| 19 | 0203 | 8 | 50 | 70/III | 105.2 |
| etc | | | | | |

For the most clearer view, we present such ewes in the form of string rank (Tab. 2).

From the presented data is seen that the most valuable after complex selection index are the first 5 ewes with index comprised among the range of 119.5 to 111.7.

First place in the string ranking, of these female sheep, occupy ewes with registration no. 3015, that in II calving brought a lamb of class I (6 points), with the lactation milk production of 78 kg and autumn had weighed 57 kg body weight. The complex selection index of this ewes was:

$$I_{o3015} = (6 \cdot 2.0) + (78 \cdot 0.952) + (57 \cdot 0.583) = 12 + 74.2 + 33.2 = 119.4$$

As valuable, after complex selection index, is the sheep no. 6122, which calved a lamb I class, appreciated the evaluation marks with 7 points, the milk production in the III lactation was by 86 kg, the own body weight was by 54 kg own. The complex selection index constituted:

$$\mathbf{I_{o6122}} = (7 \cdot 2.0) + (54 \cdot 0.583) + (86 \cdot 0.857) = 14 + 31.5 + 73.7 = 119.2$$

The third rank in the hierarchy of breeding values of flock occupy no. 2254, which gave birth to a lamb elite class, the evaluation marks appreciated by 8 points, the ewe body weight was 57 kg, but milk production in the IV lactation was 75 kg. The complex selection index constituted:

$$\mathbf{I_{o2254}} = (8 \cdot 2) + (57 \cdot 0.583) + (75 \cdot 0.857) = 16 + 33.2 + 64.3 = 113.5$$

Table 2 String rank of ewes after complex selection index value

| Rank | No. register ewe | Average points skin | Body weight ewe, kg | Milk production of ewe/ lactation, kg | Complex selection index |
|---|---|---|---|---|---|
| 1 | 3015 | 6 | 57 | 78/II | 119.4 |
| 2 | 6122 | 7 | 54 | 86/III | 119.2 |
| 3 | 2254 | 8 | 57 | 75/IV | 113.5 |
| 4 | 0432 | 9 | 56 | 65/II | 112.5 |
| 5 | 0095 | 6 | 55 | 71/II | 111.7 |
| 6 | 2054 | 6 | 52 | 70/II | 109.0 |
| 7 | 4104 | 8 | 54 | 52/I | 107.5 |
| 8 | 0126 | 7 | 49 | 66/II | 105.4 |
| 9 | 0203 | 8 | 50 | 70/III | 105.2 |
| 10 | 0102 | 7 | 50 | 52/I | 103.1 |
| 11 | 3012 | 4 | 51 | 56/I | 102.3 |
| 12 | 1101 | 6 | 48 | 65/II | 101.9 |
| 13 | 3156 | 3 | 49 | 58/I | 101.5 |
| 14 | 5421 | 5 | 53 | 69/IV | 100.0 |
| 15 | 1222 | 4 | 50 | 48/I | 92.5 |
| 16 | 2503 | 4 | 47 | 65/V | 91.1 |
| 17 | 3396 | 3 | 46 | 50/I | 90.5 |
| 18 | 1059 | 7 | 52 | 52/III | 88.9 |
| 19 | 2347 | 5 | 45 | 51/III | 79.9 |

Quite high is and breeding value of sheep no. 0432, which gave birth to a lamb elite appreciated by 9 points, the milk production in the II lactation is 65 kg, own body weight is 56 kg. Complex selection index of this ewe constituted:

$$\mathbf{I_{o0432}} = (9 \cdot 2.0) + (56 \cdot 0.583) + (65 \cdot 0.952) = 18 + 32.6 + 61.9 = 112.5$$

Given the size of complex selection index, this ewe exceeding the standard race 12.5 - 19.4% and presents the most valuable nucleus in the flock which may be intended to produce breeding rams.

Analysis of complex selection indices of ewes shown in the table allows finding that 73.7% of the ewes flock correspond and exceed, after their breeding value, the requirements level of the race standard. At the same time, in the flock are 26.3% of ewes are, that after their breeding value, do not reach and yield the standard levels of the race. Among them, the lowest breeding value have ewes no. 2347 and 1059, which have the lowest parameters of selected morph-productive character and smaller complex selection indices. These ewes are recommended to be reformed and taken out of the breeding flocks.

Generalizing results of building complex selection indices at the ewes, have been find that the constructive principle of complex selection index is based on the integration of the three selection characters, such as, skin quality, body weight and milk production, with consideration of their economic value. The difference between complex selection indices of each ewe, consist in the diversity of phenotypic values of skin qualities descendents, own body weight and their milk production, last two characters being the decisive in the calculating formula for the complex selection index

Having the above formulas, zoo technical specialist, at the end of the year calculates the complex selection index and determines the breeding value of each animal. These calculated indices, is entered in the summary register of complex evaluation marks of sheep. In based on these entries, the specialist determines the rank of animals in the respective folks, selecting the most valuable of these in the batches of breeding for reproduction.

## CONCLUSIONS

1. Assessing the breeding value of ewes after complex selection index, reflects more objectively the actual quality of breeding, full combining three important selection characters such as skin quality, body weight and milk production.

2. Implementation the method for estimating the value of animal breeding after complexes selection indexes will help increase the selection efficiency of Moldavian Karakul sheep.

3. The method for estimating the breeding value of ewes after complex selection index will to be formalized by inclusion of these zootechnical norms (instructions) and certification of breeding genitor sheep material rules, with their approval in the established manner.

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