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THE EVALUATION OF THE PRESENT STAGE OF FORMATION OF THE GRIZZLED COLOURED VARIETY FROM THE KARAKUL DE BOTOŞANI BREED

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Abstract

The aim of the research was to evaluate the current stage of the formation of a new variety of colour within the Karakul de Botoşani breed. In this respect, the research objectives were represented by the assessment of the effective size of the active population, the inbreeding rate and the subdivision of the analysed population, as well as the determinations regarding the degree of reproductive isolation and the intergenerational interval. The biological material was represented by males and females of known origin, which form the active population of the Karakul de Botoşani breed and as working methods were used mathematical techniques as they provide solutions to predict the frequencies of genetic constituents specific to animal populations. The conducted research shows that there is a difference in the inbreeding rate from the active population. This aspect is due to the fact that the population has a live stock of a small number of reproductive individuals, fact confirmed by the ratio of sexes that had very high values, from 1 to 12.62 in the population from the forming area, to a ratio of 24.46 females at one nursery ram in the other areas. The existence and keeping of this report at a rather tight level is a consequence of the fact that the reproduction is based on the directed mount, but also of the high degree of subdivision of the breed in relation to the colour shades which appear in this variety. The present inbreeding degree specific to the active population is of 7.41 with variations from 8.48 at the grizzled Karakul population from coterminous areas and of 7.31at the population within the forming area. The analysis of the genealogical files and of the records of the mounts and of the bringing forth showed that the intergenerational interval has an average duration close to 4 years, arguing that the population has a rather high degree of precocity in comparison with other sheep breeds.

Key words*: Karakul de Botoşani, pelts, genetic parameters.*

INTRODUCTION

Karakul de Botoşani represents an animal population characterized through distinct phenodeme and genome and has as a basic objective in formation, improvement and breeding especially pelt production.

The first grizzled colour individuals from the Karakul de Botoşani breed appeared after the crossings practiced between brown rams with females of black colour and grey heterozygous (Ursu, 1998). This colour is better known in the speciality literature and under the name of agouti or lupe colour. To obtain the present type, from the early stages of the formation of this new variety a rigorous selection has been applied and has intervened in conducting mattings to enhance the colour shades and the desired type of loop. Presently, the population represented by individuals who have a composed colour of dark heterochromatic type evolves reproductively, the purpose being of to increase the degree of resemblance and fixation of the main characters on which the pelt quality depends.

MATERIALS AND METHODS

The biological material under investigation belongs to the Karakul de Botoşani breed of known origin, included in one of the forms specific to the control of the production performances with proven belonging to the grizzle colour variety. In order to assess the actual population size, inbreeding rate and the degree of subdivision, were subjected to research the sheep of grizzle colour from the forming county of the Karakul de Botoşani as well as other populations from holdings situated in adjacent areas.

The working methods used were specific to the field of pelt production and statistical data

processing. To accomplish the research objectives, a complex task was initiated to identify the data related to the estimation of the degree of reproductive isolation.

For this purpose, analysis of the zoo technical records have been carried out from several active populations from the Karakul de Botoşani breed of grizzle variety, located in the breeding area of the respective breed. The population surveyed was of 747 adult females and daughter of the 47 rams, and for calculating the effective population size, the following calculation relation was used:

$$Ne = \frac{4NmxNf}{Nm+Nf};$$

where: Nm = number of males

Nf = number of females

Based on the value determined for the actual size of the population, it was possible to highlight the homozygous growth rate for each new generation of animals (ΔF) and the genetic effect due to inbreeding, knowing that ΔF = 1/2 Ne.

In order to determine the present status of reproductive isolation of the effective belonging to the grizzle colour variety, from the Karakul de Botoşani breed, based on the data from husbandry records, the value of the reproductive isolation coefficient was calculated, the formula used being the one described by Wright, 1921 , cited by Drăgănescu in 1972 and 1979, namely:

$$CIR = \frac{AA-(AI+II)}{AA+AI+II};$$

where: CIR = reproductive isolation coefficient;

AA = the number of individuals admitted to the range, studied from the core nucleus and having both native parents;

AI = the number of individuals admitted to the range, studied from the core nucleus and having one native parent and another immigrant;

II = the number of individuals admitted to rang, studied from the core nucleus and having both immigrant parents.

All the data utilized to establish the effective size of active population, and also the ones based on which was determined the reproductive isolation degree and kinship degree with other varieties of the breed were taken from Register of mating and calving which is in the archive of SCDCOC Popăuți-Botoşani, as well as from Genealogical Register of Karakul de Botoşani breed.

In determination of genetic distance between actual population represented by individuals which form the gray variety, in according with evolutionary theory, we suppose that genetic similarity is close not only to founding breeds represented by Asian Karakul and German Karakul but also with other Karakul populations located in different rearing units from forming area. To estimate this genetic parameter was utilized the standard method described by Nei (1972) based on construction of dendrograms in which the data were organized in subcategories till reaching of the desired detail level.

Dendogram was constructed using the neighbour-joining (NJ) method (Saitou and Nei 1987). Nei's standard distances (Ds; Nei 1972), observed heterozygosity (Ho) and expected heterozygosity (He), neighbour-joining trees and bootstrap values were computed using the computer package DISPAN (Ota 1993).

RESULTS AND DISCUSSIONS

The grizzle variety belonging to the Karakul de Botoşani breed is at this moment in the stage of increasing the degree of similarity between individuals of this population and the fixing of the valuable characters specific to pelts, which is why the population evolves reproductively closed. In order to assess the current stage of formation of a new variety of colour inside the Karakul de Botoşani breed, a detailed analysis of some important aspects was carried out, such as: evaluating the effective size of the population, determining the degree of reproductive isolation, intergenerational interval assessment.

Actual size, inbreeding rate, and subdivision of analysed population. The size and rhythm of inbreeding in different populations is extremely important because it influences not only the evolution but also the changes occurring in its genetic structure and has direct consequences on the effects due to inbredness, genetic derivation and costs necessary to implement improvement programs and indirectly on the effect of selection (Mochnacs et al., 1978; Vicovan, 2008; Popa et al., 2012).

If the size of the effective (Ne) is high, it also attracts a more intense effect due to the selection, and the chances that there may be effects in such populations due to genetic derivation are extremely limited.
In diminished populations, the evolutionary effects will be affected by effects due primarily to genetic derivation and to a lesser extent than those due to strict selection. In this last case, the effect of selection tends to zero, because the depressive effects lead to an increase in homozygosity and a strong restriction of genetic variation (Pipernea, 1979).
In the case of the researches carried out, the actual size of the active population belonging to the grizzle variety from the Karakul de Botoşani breed was determined. It also sought to determine the structure of the active population by gender and to determining the actual rhythm of inbreeding.

Table 1. Actual size, sex ratio and inbred rate in the population represented by Karakul de Botoşani – grizzle variety

Specification	Rams (Nm)	Females (Nf)	Sex ratio Nm/Nf	Actual size (Ne)	Inbred rate (ΔF)	Reproductive isolation index
In the forming area	34	429	12.62	126.01	7.31	-
In adjacent areas	13	318	24.46	49.96	8.48	-
Total population	47	747	15.89	176.87	7.41	0.68

The analysis of the data obtained shows that the values of the actual size of the active populations varies, depending on the holding and the area, from the minimum of 49.46 to the ones located near the forming area to 126.1 in the holdings within the forming area of the Karakul de Botoşani breed, which corresponds to a growth rate of inbreeding ranging from 0.48 to respectively 0.73. For the entire population, the actual size was of 176.87 and the inbreeding rate was 7.41.
The existence of a difference in inbreeding rate is due to the fact that the gender ratio is 15.89 females to a male with variations from a ratio of 1 to 12.62 and mother sheep in the forming area, to a ratio of 24.46 females to a nursery ram in other areas. The existence and keeping of this report at a rather tight level is a consequence of the fact that the reproduction is based on the directed mount, but also of the high degree of subdivision of the breed in relation to the shades of colour appearing in this variety.
Knowing the degree of inbreeding in animal populations where the effective size is small is an extremely important activity as this .indicator is due to mating to more closely related animals than the average population. Any "in-endogamy reproduction of a population leads to inbreeding, the extent of which depends on the size of the population, selection and management of mating.
All individuals in "closed populations" are, after a certain number of generations, the more closely related to each other as the effective size is reduced (Popescu Vifor, 1979). The degree of kinship is determined with the coefficient of inbred (F) that can be estimated on the pedigree, as it represents 1/2 of the degree of kinship.
In the case of the present researches it was found that at this moment, the inbreeding degree of the population is of 7.41 and shows variations from 8.48 at the population of grizzle Karakul from the breeding areas placed near Botoşani County and of 7.31 at the population within the forming area.
On the basis of all these values, it is concluded that at this point the population is at a moderate to close inbred level. The existence of this indicator at values higher than 6.0 is a consequence of the fact that in the activity of forming, improvement and fixation of the desired characters is made easier when there is a moderate inbreeding within the population. Subsequently, after reaching the desired type, the reduction of this indicator can be achieved by bringing or exchanging breeders from different ecological areas and the mating control is done after careful analysis of the individual pedigree.

Analysing the degree of kinship of individuals or reproductive isolation. The problem of determining the degree of reproductive isolation is complex, but it has the role of highlighting the proportion of blood characteristic to the analysed population (Drăgănescu, 1979; Popescu Vifor, 1979; Pipernea, 1979). Reproductive isolation depends on several aspects, being influenced by the age structure, average duration of exploitation and

reproduction applied in the analysed population (Popa, 2009).

The analysis of the evolutionary dynamics of the degree of kinship or genetic similarity with other founding breeds shows that as the generation passes between the current grizzle breeds and other breeds that participated in the formation of the Karakul de Botoşani breed, there is an increase in the genetic distance. The assessment of the degree of kinship shows that if in 2007 the proportion of blood belonging to the Ţurcana breed was 11, in the genetic structure of the current type of grizzle Karakul de Botoşani its gene pool is reduced enough, which makes the genetic distance to register a tendency from 0.036 in 2007 to 0.024 in 2016 (Table 2).

The results also highlight a genetic distance from the Asian Karakul and the Karakul brought from other units from the country (Dulbanu, Ruşeţu), because in 2016 the genetic similarity R_{xy} was of 0.002 with the Asian type and R_{xy} = 0.0081 with the one from other units.

The analysis of the degree of kinship or genetic similarity of the current grizzle type, formed within the Karakul de Botoşani breed, with the German Karakul is not recorded because the breeders have activated in more distant periods and were black and grey.

Table 2. The degree of kinship of the individuals Karakul de Botoşani – grizzle variety with the founding breeds

Breeds	2007	2016	Difference	R_{xy} with breed (%)	
				2007	2016
Ţurcana	11	3	- 8	0.036	0.024
Asian Karakul	14	19	+ 5	0.012	0.002
Dutch Karakul	3	1	- 2	-	-
Karakul from other units	2	-	- 2	0.0110	0.0081

Analysis of the evolution of the intergenerational interval. This indicator is extremely important because it is also an essential factor of improvement, influencing directly the effect of selection on each new generation (Pascal, 2015). The analysis of genealogical records and evidence records of the mounts and bring forth highlights that the active population of the grizzle Karakul de Botoşani breed the intergenerational interval has an average duration close to 4 years, showing a certain degree of high precocity compared to other native breeds.

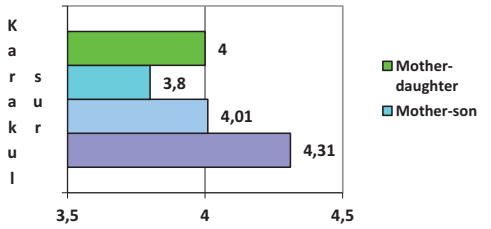

Figure 1. The intergenerational interval in some varieties of Karakul de Botoşani breed

By comparing these values to those determined by other authors, but for other sheep breeds, this intergenerational interval is longer with 6-12 months as a direct effect due to the prolongation of the duration of exploitation of females and rams in the living stock.

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CONCLUSIONS

1. The calculation of the actual size of the active population indicates a variation from a minimum of 49.46 determined for the active population in exploitations near the forming area to a maximum of 126.1 determined by the total flock from the Karakul de Botoşani breeding area.
2. For the entire active population while the degree of reproductive isolation was 0.68, the actual size was 176.87, and the rate of inbreeding was of 7.41.
3. In the active population the sex ratio was 1 to 12.62 in the forming area and 24.46 females to a nursery ram in the other areas.
4. The existence and keeping of a fairly tight relationship is a consequence of the fact that reproduction is based on the directed mount, but also on the high degree of subdivision of the breed in relation to the nuances of colour which appear in this variety.
5. The actual inbreeding degree determined on the total active population for this variety is 7.41 with variations from 8.48 at the grizzle Karakul population in coterminous growth areas and 7.31 at the population within the forming area.

6. The research results show that if in 2007 the proportion of blood belonging to the Ţurcana breed was 11, the genetic structure of the current type of grizzle Karakul de Botoşani its gene pool is reduced quite a lot, which makes the genetic distance to show a distance tendency from 0.036 in 2007 to 0.024 in 2016.
7. In the active population of the grizzle Karakul de Botoşani breed, the intergenerational interval has an average duration close to 4 years, highlighting a high degree of precocity compared to other indigenous breeds.

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