Analysis of Sexual Dimorphism in a Population of Dogs of the *Romanian Mioritic Shepherd Dog* Breed

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Abstract
Romanian Mioritic Shepherd Dog was selected from a natural population breed in Carpathian Mountains of Romania. The aim of this study was to analyze the existence and size of sexual dimorphism in a population of 26 males and 23 females of the *Mioritic Shepherd Dog* breed, for 10 body measurements: withers height, middle back height, croup height (iliac), base of tail height (coccyx), croup width, body length, tail length, thorax depth, thorax width and thorax perimeter. The animals were registered with the Romanian Mioritic Association Club from Romania. Following the study on the significance of statistical differences between body measurements recorded in 26 males and 23 females, it was concluded that sexual dimorphism is evident in the population of the Romanian Mioritic shepherd dog studied in this paper. We recommend that dog breeders of this breed take into account the genetic improvement programs, also the results presented in this paper.

Key words: sexual dimorphism, *Romanian Mioritic Shepherd Dog*, males, females, body measurements

1. Introduction

In developing and optimizing genetic breeding programs for a particular population of animals, it is important that in addition to the genetic parameters of the targets for selection characters, to know the existence and size of sexual dimorphism. Sexual dimorphism for a certain character is given by the differences in phenotypic expression in the two sexes, male and female [1].
In dogs, as well as in other animal species, the external appearance of the body is one of the basic criteria for selection. By assessing the external appearance of the body, the researchers can obtain information for breed affiliation, the degree of breed improvement compared to its standard, the presence of defects that reduce the biological value of animals, the animal health status, and how was carried out the growth and development until to that stage.
In complex and full assessment of dogs, the health status of animals, appetite, temperament, behavior towards neighboring animals and to the examiner, the skills, origin and transmission of useful qualities at descendants are very important [2].
It is recognized that the phenotypic value of one character at the isolated individuals or at one population is the consequence, in the first place, of the type of gene (additive or non-additive), quality and their combination (genotypes), as well as of interaction which it realizes genes with the environment where the animals develops and performs [1].
If known phenotypic value of a character in a population and its variance, in this case, by

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special statistical methods, it can estimate the value of additive genetic variance, non-additive and environmental variance, of that population. An estimate of additive and non-additive genetic variance suggests "genetic reserves" existing in population and it can focus us on which method to turn our attention to change more effectively the population genetic structure [1].
The aim of this study was to analyze the existence and size of sexual dimorphism in a population of 26 males and 23 females of the *Mioritic Shepherd Dog* breed, for 10 body measurements: withers height, middle back height, croup height (iliac), base of tail height (coccyx), croup width, body length, tail length, thorax depth, thorax width and thorax perimeter. The animals were registered with the Romanian Mioritic Association Club from Romania [3,4].

2. Materials and methods

We know from practice that there is a directly proportional correlation between the sexual dimorphism and the heritability of a character, meaning that if the sexual dimorphism is high and the heritability is high too, which means that that character is mainly determined by genes with additive interaction.
Romanian Mioritic Shepherd Dog is an excellent shepherd, watch and company dog, at which breeding is important to remember the factors that contribute to its success [2].
Romanian Mioritic Shepherd Dog, was selected by from a natural population breed from Carpathian Mountains, for which reason they are resistant and rustic for feeding and maintenance [5]. The nutrition can be assured with various both animal and vegetal components, and it can be administered as mush or granules.
Romanian Mioritic Shepherd Dog has the ability to adapt at different breeding conditions, which are accepted easily. The dog feels better when is maintained in the yard of the house, where it has enough space to move, play and rest.
The somatometry consists into body regions measures of the dog, in order to obtain the data on the overall animal development and the proportions between different parts of body. In order to achieve correct body measurements, the dog should be placed on horizontally ground, in orthostatic position, with body weight uniform distributed on four legs, the head and neck with their natural position and direction. The body regions are measured between certain anatomical points of reference, which can be determined relatively easily and that employing the anatomical basis of the respective region [6].
For 26 males and 23 females from *Romanian Mioritic Shepherd Dog* from Romanian Mioritic Association Club, were measured 10 body measurements: withers height, middle back height, croup height (iliac), base of tail height (coccyx), croup width, body length, tail length, thorax depth, thorax width and thorax perimeter.
Analyzing the significance of the statistical differences between the body measurements recorded in the 26 males and 23 females from *Romanian Mioritic Shepherd Dog*, it was possible to establish the existence and size of sexual dimorphism. We considered these criteria very important, because if for a quantitative character the size of the sexual dimorphism is known, the size of the heritability coefficient can be estimated with a certain probability, which gives us indications regarding the type of genes that mainly determine that character and therefore the way of improvement to be followed. The study was completed with recommendations made to the dog breeders for this breed in the development and optimization of genetic improvement programs.

3. Results and discussion

In table 1, we present the statistical differences between the average body measurements recorded for 26 males and 23 females from *Romanian Mioritic Shepherd Dog*, for the 10 studied characters.

Table 1. The significance of statistical differences between body measurements of 26 males and 23 females from *Romanian Mioritic Shepherd Dog* [cm]

Nr crt	Character	Value				Differences between averages		Signification
		Male		Female		Absolute values	Relative values	
		n	X±Sx	n	X±Sx	(cm)	(%)	
1	Withers height	26	72.60±0.494	23	67.30±0.68	5.30	92.70	xxx
2	Middle back height	26	73.37±0.943	23	64.50±1.50	8.87	87.91	xx
3	Croup height (iliac)	26	72.56±1.015	23	64.00±1.00	8.56	88.20	xx
4	Base of tail height (coccyx)	26	60.20±1.356	23	49.00±2.00	11.20	81.40	x
5	Croup width	26	12.55±0.694	23	13.50±0.50	-0.95	107.57	ns
6	Body lenght	26	79.50±0.943	23	74.00±0.82	5.50	93.08	xxx
7	Tail length	26	48.10±3.831	23	45.67±2.67	2.43	94.95	ns
8	Thorax depth	26	35.33±0.629	23	36.22±1.49	-0.89	102.52	ns
9	Thorax width	26	20.00±0.786	23	19.00±0.00	1.00	95.00	ns
10	Thorax perimeter	26	88.81±1.655	23	80.50±1.26	8.31	90.64	xx

Thus, from the analysis of the presented data, it can be observed that if for the withers height character, the males achieved an average phenotypic value of 72.60 ± 0.494cm, the females registered a value of 67.30 ± 0.68cm. The difference between the two averages was 5.30 cm in absolute values, and in relative values 92.70%. As a result of the statistical analysis, our conclusion was that the *Mioritic Romanian Shepherd* males are significantly superior to the females in this population, regarding the withers height ($p < 0.001$).

For the second studied character, respectively middle back height, males achieved an average performance of 73.37 ± 0.943 cm, and females of 64.50 ± 1.50 cm, the differences between the two sexes being 8.87 cm in absolute values and 87.91%, in relative values. Also for this character, following the analysis of statistical differences between the two sexes, the conclusion was that males are significantly higher compared to females ($p < 0.01$).

The average croup height (iliac) at the 26 males taken in this study was 72.56 ± 1.015 cm and for the females we recorded an average value of 64.00 ± 1.00 cm, the differences being this time in favor of males, respectively 8.56 cm in absolute values and 88.20%, in relative values. Also for this character, the significance tests confirmed that males *Romanian Mioritic Shepherd Dog* are significantly superior ($p<0.01$), compared to females from the analyzed population for this character.

The average tail base height (coccyx) was 60.20 ± 1.356 cm, for males and females recorded an average value of 49.00 ± 2.00 cm, the absolute differences being 11.20 cm, and the relative values being 81.40%. Analyzing the significance of statistical differences between measurements, we concluded that they are significant ($p < 0.05$), of course – in favor of males.

For the next character, respectively croup width, the situation was reversed, in the sense that females registered a value 0.95 cm higher than the males, which in relative values represents 107.57%. The values reached for this character were 12.55 ± 0.694 cm for males, and 13.50 ± 0.50 cm for females. Analyzing the significance of statistical differences, we observed that although females have higher values than males for this character, they are insignificant ($p > 0.05$).

The next character studied was body length, which in males had an average value of 79.50 ± 0.943 cm, and in females the average value was 74.00 ± 0.82 cm. Making the difference between the two averages, we found that males have a plus of 5.50 cm (93.08%), the difference being significant ($p<0.001$).

The seventh character analyzed in the 26 males and 23 females was tail length. For males the average value of this character was 48.10 ± 3.831 cm, and for females the average character was 45.67 ± 2.67 cm. In absolute values the difference was 2.43 cm in favor of males (94.95%). Analyzing the differences significance for this character, respectively length of the tail, we found that they are insignificant ($p > 0.05$).

The next character studied was thorax depth, which in males recorded an average value of 35.33 ± 0.629 cm, and in females 36.22 ± 1.49 cm. This time we found that the average value of females was 0.89 cm (102.52%), higher than in males, but the difference is insignificant ($p > 0.05$).

For the thorax width character, males recorded an average value of 20 ± 0.786 cm, with 1 cm (95.00%) more than the studied females, which have 19.00 ± 0.00 cm, but the difference was insignificant ($p > 0.05$).

The last studied character was the perimeter thorax, which in males had an average value of 88.81 ± 1.655 cm, and in females the average value was 80.50 ± 1.26 cm. In this case, the difference in absolute value was 8.31 cm in favor of males, females reaching only 90.64% of this performance. After analyzing the mentioned difference, the conclusion was that it is significant ($p < 0.01$).

4. Conclusions

Following the analysis on the existence and size of sexual dimorphism in a population of 26 males and 23 females of the *Mioritic Shepherd Dog* breed, from Romanian Mioritic Association Club, for 10 body measurements we established that males are significantly superior to females for withers height ($p<0.001$), middle back height ($p<0.01$), croup height (iliac) ($p<0.01$), base of tail height (coccyx) ($p<0.05$), body length ($p <0.001$), thorax perimeter ($p <0.01$).

For the tail length and thorax width characters, although the males present superior values, the differences between the individuals of the two sexes are insignificant ($p > 0.05$).

The studied females have higher values than males, but insignificant ($p > 0.05$), for croup width and thorax depth.

In conclusion, after all observations of this study we appreciate that the sexual dimorphism is evident in the studied *Mioritic Shepherd Dog* breed population.

We recommend to the breeders, that dogs from this breed to take into account in genetic improvement programs the observations presented in this paper.

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