STUDY OF THE DYNAMICS OF CERTAIN MORPHOLOGICAL CHARACTERISTICS IN SHAGYA ARABIAN HORSE BREED

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Abstract

This paper aimed to reveal the dynamics of several morphological traits that characterize the public breeding stallions reared between 2000-2015 and the mares from the brood stock registered between 1989-2018, in Rădăuţi stud farm, Suceava county, Romania. To show the evolution of the Shagya Arabian breed the average values of height at withers, thoracic and cannon circumferences, as well as the massiveness, bone, and digital-thorax indexes were calculated. The results revealed that the limits of height for females ranged between 156.7±0.069 cm and 159.9±0.102 cm, while for males the average values for this parameter were 157.66±1.21 cm - 161.22±0.84 cm; the hearth girth had 180.1±0.151 cm - 180.8±0.153 cm for broodmares and 177.25±4.09 cm - 183.33±1.83 cm for stallions; the cannon circumference ranged from 18.0±0.11 cm - 18.8±0.09 cm for the first category of breeders and from 18.5±0.77 cm to 19.16±0.31 cm for the second one. All the bloodlines registered average values of the height higher for males than females, except for El-Sbaa bloodline; the hearth girth had lower average values for the females from Dahoman and Koheilan bloodlines and the cannon circumference was higher in males, except for Hadban bloodline, where a slightly difference was noticed. The stallions had higher values of massiveness than females (113.21% vs. 113.06%) and digital-thoracic index (11.11% vs. 10.55%), while for the bone index the males had lower results (11.81% vs. 11.93%).

Key words: *Shagya, dimensions, body indexes, dynamics*

INTRODUCTION

It is a fact well known that the study of horses interested man through the idea of understanding their needs. (Dulugeac, 2005; Brown et.al.,2003) Since for this species the external characters, the functional type, and the economic skills are strongly correlated with each other, and the energy potential is expressed in their physical performance, it is necessary to know the morphological parameters, while also taking into account the importance of reproduction process in exploitation techniques through which genetic progress is achieved. (Doliş et. al., 2006; Pânzaru et. al., 2019; Pânzaru et. al., 2020; Doliş et. al., 2019)

The current and future problems of the Shagya Arabian breed were discussed in 1991, at Bábolna, by the organization "Pure breed Shagya Arab Society International". The regulation stated that it must present different characteristics than Purebred Arabian breed in terms of morphological type, height at withers, body frame, and skeleton, and in the 4th generation, out of 16 ancestors are not allowed more than 9 individuals of Arabian Purebred; its height at withers have to range between 150-162 cm, and the cannon girth have to be at least 18 cm. (Association of breeders and owners of Arabian horses from Romania, 2006)

In the latest records mentioned in the Rădăuţi Stud farm Registers, endurance, jumping, leisure, and hippotherapy are the main skills of Shagya Arabian breed. Also, the amelioration objectives were: to increase their body dimensions (for mares – height at withers of 156 cm, heart girth of 178 cm,

cannon girth of 19.5 cm, and for stallions – height at withers of 158 cm, heart girth of 178 cm, cannon girth of 20.5 cm), the galloping energy capacity, reproductive indices, and constitutional endurance. (Original registers of Rădăuți stud farm; Doliș et. al., 2017)

MATERIAL AND METHOD

The assessment of horse's exterior is done by applying certain techniques that provide precise information over the researched parameters. (Borisenko, 1954; Doliș et. al., 2011; Ivancia et. al., 2019) In order for the results to be as conclusive as possible, horse study according to exterior is done both through the analytical examination, which aims to observe each body area separately, and through the synthesis examination which consists in evaluating the animal as a whole. In order to do a correct assessment, it is also necessary to calculate some body indices that help classifying horses from certain perspective. (Petlachova, 2012; Roman, 2015; Kosťuková et.al., 2013).

Data collected from Rădăuți stud farm (registers and ranking papers), were analyzed by calculating the main estimators–descriptors (arthimetic average, ±StDev - standard deviation, ±$s_{\bar{x}}$ - standard error of average, V% - coefficient of variation) for the genealogical bloodline level and by making interline comparisons, using the unifactorial ANOVA algorithm. The obtained results were exposed in tables and figures.

RESULTS AND DISCUSSIONS

Regarding the average height of each genealogical bloodline analyzed for broodmares, calculated for the entire period, it was noticed that the minimum value was registered at Koheilan bloodline (156.7 ± 0.069 cm), and the maximum at El-Sbaa bloodline (159.9 ± 0.102 cm).

For all genealogical bloodlines, the coefficient of variation (V%) ranged between 0.21-0.42%, which indicates that height is a very homogeneous character. But in the end, it emerged that there were values expressing insignificant and also very significant statistical differences between some of the bloodlines in several comparisons (Table 1).

Table 1 The average values of height at withers (cm) for broodmares

	The Shagya Arabian bloodlines (cm)						
	Hadban	Dahoman	Shagya	Siglavy-Bagdady	El-Sbaa	Mersuch	Koheilan
$\overline{X}$	157.7	157.9	156.9	156.9	159.9	156.9	156.7
Min.	156.4	156.4	156.3	156.3	159.1	156.0	156.1
Max.	158.8	159.0	157.9	157.6	161.2	157.6	157.6
±StDev	0.647	0.665	0.442	0.335	0.561	0.401	0.382
±$s_{\bar{x}}$	0.118	0.121	0.080	0.061	0.102	0.073	0.069
V%	0.410	0.421	0.281	0.213	0.350	0.255	0.243
n.s. (p>0.05)	Hadban vs. Dahoman; Shagya vs. Siglavy-Bagdady; Shagya vs. Mersuch; Shagya vs. Koheilan; Siglavy-Bagdady vs. Mersuch; Siglavy-Bagdady vs. Koheilan.						
f.s. (p<0.001)	Hadban vs. Shagya; Hadban vs. Siglavy-Bagdady; Hadban vs. El-Sbaa; Hadban vs. Mersuch; Hadban vs. Koheilan; Dahoman vs. Shagya; Dahoman vs. Siglavy-Bagdady; Dahoman vs. El-Sbaa; Dahoman vs. Mersuch; Dahoman vs. Koheilan.						

±StDev = standard deviation; ±$s_{\bar{x}}$ = average standard error; V% = variation coefficient; Min.= minimum value of height (cm); Max.= maximum value of height at withers (cm); n.s.= non-significant; f.s.= very significant.

Data from Table 2 describes the situation of average values of hearth girth calculated for broodmares; thus, it was observed that the minimum value of the average dimension, was recorded at Shagya bloodline (180.1 ± 0.151 cm), and the maximum for Mersuch bloodline (180.8 ± 0.153 cm), a fact that indicates very small differences. Performing an inter-line comparison in order to establish the extremes, it was revealed that the minimum value was 178.5 cm, identified at Hadban, Dahoman, Shagya, Siglavy-Bagdady, and El-Sbaa bloodlines, and the maximum at Mersuch line (182.3 cm).

Analyzing the coefficient of variation for studied genealogical bloodlines, it was observed that the value of hearth girth (0.43-3.76%), indicates a relatively low individuality. But using the one-factor analysis of variance algorithm for inter-line comparison, distinctly significant differences were observed between Shagya vs. Mersuch and significant for Siglavy-Bagdady vs. Mersuch. The same algorithm used to compare the values obtained each year, showed insignificant differences in this case (p>0.99) (Table 2).

Table 2 The average values of heart girth (cm) for broodmares

	The Shagya Arabian bloodlines (cm)						
	Hadban	Dahoman	Shagya	Siglavy-Bagdady	El-Sbaa	Mersuch	Koheilan
$\overline{X}$	180.2	180.4	180.1	180.2	180.4	180.8	180.5
Min.	178.5	178.5	178.5	178.5	178.5	179.5	178.8
Max.	181.7	181.7	181.6	181.6	181.7	182.3	181.9
±StDev	0.849	0.679	0.827	0.865	0.679	0.840	0.786
$\pm s_{\overline{x}}$	0.155	0.124	0.151	0.158	0.124	0.153	0.143
V%	0.471	0.470	0.459	0.480	3.763	0.464	0.435
n.s. (p>0.05)	Hadban vs. Dahoman; Hadban vs. Shagya; Hadban vs. Siglavy-Bagdady; Hadban vs. El-Sbaa; Hadban vs. Mersuch; Hadban vs. Koheilan; Dahoman vs. Shagya; Dahoman vs. Siglavy-Bagdady; Dahoman vs. El-Sbaa; Dahoman vs. Mersuch; Dahoman vs. Koheilan; Shagya vs. Siglavy-Bagdady; Shagya vs. El-Sbaa; Shagya vs. Koheilan; Siglavy-Bagdady vs. El-Sbaa; Siglavy-Bagdady vs. Koheilan; El-Sbaa vs. Mersuch; El-Sbaa vs. Koheilan; Mersuch vs. Koheilan.						
d.s. (0.001<p<0.01)	Shagya vs. Mersuch;						
s. (0.01<p<0.05)	Siglavy-Bagdady vs. Mersuch						

±StDev = standard deviation; ± s_x̄ = average standard error; V% = variation coefficient; Min.= minimum value of the heart girth (cm); Max.= maximum value of the heart girth (cm); n.s.= non-significant; d.s = significant differences, f.s.= very significant, s.= significant differences.

Table 3 shows the situation of the average values of cannon girth for broodmares ranged between 18.0 ± 0.112 cm (Mersuch) and 18.8 ± 0.096 cm (El-Sbaa).

In all the studied cases, the coefficient of variation ranged between 2.81-3.73%, indicating a reduced influence of the individuality of the cannon girth in each of the genealogical bloodlines studied and therefore the homogeneity of this character. However, using the variance algorithm to determine interlinear differences, regarding the cannon girth, revealed differences when comparing some Shagya Arabian bloodlines, as the table shows (Table 3).

Table 3 The average values of cannon girth (cm) for broodmares

	The Shagya Arabian bloodlines (cm)						
	Hadban	Dahoman	Shagya	Siglavy-Bagdady	El-Sbaa	Mersuch	Koheilan
$\overline{X}$	18.6	18.7	18.2	18.2	18.8	18.0	18.2
Min.	17.5	17.5	16.8	17.0	18.0	17.1	17.3
Max.	19.6	19.6	19.6	19.6	19.6	19.5	19.5
±StDev	0.664	0.675	0.680	0.590	0.529	0.615	0.536
$\pm s_{\overline{x}}$	0.121	0.123	0.124	0.107	0.096	0.112	0.097
V%	3.569	3.609	3.736	3.241	2.813	3.416	2.945
n.s. (p>0.05)	Hadban vs. Dahoman; Hadban vs. Shagya; Hadban vs. Siglavy-Bagdady; Hadban vs. El-Sbaa; Hadban vs. Koheilan; Dahoman vs. El-Sbaa; Shagya vs. Siglavy-Bagdady; Shagya vs. Mersuch; Siglavy-Bagdady vs. Koheilan; Mersuch vs. Koheilan.						
d.s. (0.001<p<0.01)	Hadban vs. Mersuch; El-Sbaa vs. Koheilan.						
s. (0.01<p<0.05)	Dahoman vs. Shagya; Dahoman vs. Siglavy-Bagdady; Dahoman vs. Mersuch; Dahoman vs. Koheilan.						
f.s., p<0.001	Shagya vs. El-Sbaa; Siglavy-Bagdady vs. El-Sbaa; El-Sbaa vs. Mersuch; Shagya vs. Koheilan; Siglavy-Bagdady vs. El-Sbaa; El-Sbaa vs. Mersuch.						

±StDev = standard deviation; ± s_x̄ = average standard error; V% = variation coefficient; Min.= minimum value of the cannon girth (cm); Max.= maximum value of the cannon girth (cm); n.s.= non-significant; d.s = significant differences, f.s.= very significant, s.= significant differences.

The average values of the massiveness index of broodmares ranged from 110.04% to 115,62%. Given that massiveness index indicates the development of width and depth of the body (body mass) compared to the height of the animal, it can be stated that calculated limits correspond to a more massive horse than the Purebred Arabian, as it was aimed when creating the Shagya Arabian breed (fig. 1).
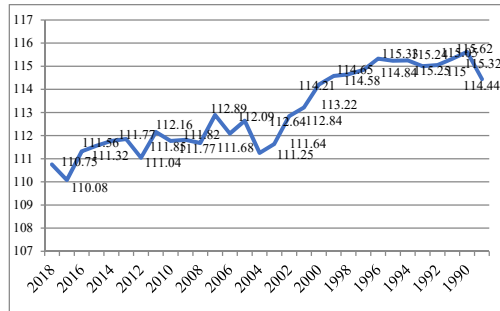

Fig. 1 Massiveness indexes of Shagya Arabian broodmares (%)

The bone index calculated for the broodmares ranged from 11,12% to 12.79%, revealing a higher massiveness of Shagya Arabian compared to the Purebred Arabian breed, as it was the purpose when the breed was created (fig. 2).
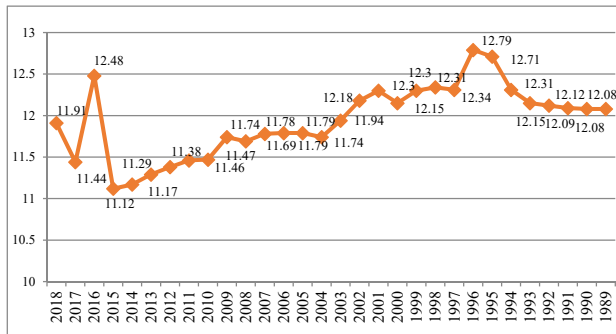

Fig. 2 Bone indexes of Shagya Arabian broodmares (%)

The average values of the digital-thoracic index calculated for broodmares revealed that the limits had values from 9.96% up 11.21% (fig. 3).

Fig. 3 Digital-thoracic indexes of Shagya Arabian broodmares (%)

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A number of 47 stallions, registered in the ranking sheets, were analyzed regarding the body dimensions and the average values of their height are revealed in table 4; it was noticed that these ranged from 157.66 ± 1.21 cm to 161.22 ± 0.84 cm. The coefficient of variation oscillated between 0.99-2.32%, which indicates low individuality within each bloodline regarding the average value of the height. Also, using the variance algorithm, insignificant differences were recorded in the interlinear comparisons (Table 4).

Table 4 The average values of height at withers (cm) for stallions

Genealogical bloodline	N	$\overline{X}$	S^2	±StDev	±s_x	V%	Min.	Max.
Dahoman	8	158.50	2.50	1.581	0.55	0.99	156	160
Hadban	4	157.66	5.86	2.422	1.21	1.53	154	160
Gazal	5	158.87	5.26	2.295	1.02	1.44	157	164
El-Sbaa	8	158.76	3.02	1.739	0.61	1.09	156	161
Mersuch	3	159.00	7.33	2.708	1.56	1.70	157	163
Koheilan	7	161.22	4.94	2.223	0.84	1.37	158	166
Shagya	7	158.90	13.69	3.700	1.39	2.32	151	164
Siglavy-Bagdady	5	158.62	4.83	2.199	0.98	1.38	157	162

Table 5 describes the case of the average values of the hearth girth and the revealed limits were between 177.25 ± 4.09 cm and 183.33 ± 1.83 cm. Within the studied bloodlines, the coefficient of variation oscillated between 1.30-3.99% in all cases, which indicates a reduced individuality within each bloodline regarding the average values of hearth girth, a character that can be considered very homogeneous. Also, using the variance algorithm, no significant differences were recorded in interlinear comparisons (Table 5).

Table 5 Average values of hearth girth of stallions from Shagya Arabian genealogical bloodlines (cm)

Genealogical bloodline	N	$\overline{X}$	S^2	±StDev	±s_x	V%	Min.	Max.
Dahoman	8	181.90	19.43	4.408	1.55	2.42	156	190
Hadban	4	179.66	38.66	6.218	3.10	3.46	168	186
Gazal	5	179.25	22.21	4.713	2.10	2.62	172	185
El-Sbaa	8	178.46	9.43	3.071	1.08	1.72	173	184
Mersuch	3	177.25	50.25	7.088	4.09	3.99	171	186
Koheilan	7	183.33	23.50	4.847	1.83	2.64	176	190
Shagya	7	179.63	5.45	2.335	0.88	1.30	175	184
Siglavy-Bagdady	5	179.12	36.69	6.057	2.70	3.38	171	187

Regarding the average values of cannon girth it was observed that limits ranged between 18.5 ± 0.77 cm and 19.16 ± 0.31 cm placing the males in the specific limits of this breed. Regarding studied genealogical bloodlines, the value of coefficient of variation oscillated between 2.88-4.80%, an aspect that indicates a reduced individuality within each line for the average value of the cannon girth (Table 6).

Table 6 The average values of cannon girth (cm) for stallions

Genealogical bloodline	N	$\overline{X}$	S^2	±StDev	±s_x	V%	Min.	Max.
Dahoman	8	19.05	0.63	0.797	0.28	4.18	18	20
Hadban	4	18.41	0.74	0.861	0.43	4.67	17.5	19.5
Gazal	5	18.5	0.28	0.534	0.77	2.88	18	19.5
El-Sbaa	8	18.76	0.60	0.780	0.27	4.15	17.5	20
Mersuch	3	19.00	0.83	0.912	0.52	4.80	18	20
Koheilan	7	19.16	0.68	0.829	0.31	4.32	18	20
Shagya	7	18.59	0.49	0.700	0.26	3.76	17.5	20
Siglavy-Bagdady	5	18.68	0.35	0.593	0.26	3.17	18	19.5

The values of massiveness index for stallions ranged between 105.55% and 120.25%. All other calculated values were within these limits, placing the analyzed stallions in midline conformation, which also indicates the specifics of Shagya Arabian breed (fig. 4).

Fig. 4 Massiveness indexes of Shagya Arabian public breeding stallions (%)

The values of bone indices, show that the minimum was obtained at Shagya bloodline (10.34%) and the maximum at Dahoman bloodline (12.82%), limits that obviously place the Shagya Arabian in intermediate breeds category. (fig. 5)

Fig. 5 Bone indexes of Shagya Arabian public breeding stallions (%)

The values of digital-thoracic indices support the previously stated conclusions as the limits of this calculation ranged between 9.77-11.56%. (fig. 6)

Fig. 6 Digital-thoracic indexes of Shagya Arabian stallions

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CONCLUSIONS

In conclusion, the following aspects related to the analysis of morphological parameters of Shagya Arabian broodmares registered between 1989-2018 can be stated:

-the minimum value regarding the average height, was recorded at Koheilan bloodline (156.7 ± 0.069 cm) and the maximum at El-Sbaa bloodline (159.9 ± 0.102 cm);

-the minimum value regarding the hearth girth was recorded at Shagya line (180.1 ± 0.151 cm) and the maximum was calculated at Mersuch line (180.8 ± 0.153 cm);

-the average values of cannon girth had limits between 18.0 ± 0.112 cm (Mersuch) and 18.8 ± 0.096 cm (El-Sbaa);

-regarding the body indices, the minimum value of the massiveness index was in 2017 (110.08%) and the maximum in 1990 (115.62%); for the bone index, the minimum value was 11.12% and the maximum was 12.79%; regarding the digital-thoracic index, the minimum registered was 9.96% and the maximum 11.21%; all these values are highlighting the slightly massified conformation compared to Purebred Arabian breed;

Regarding the analysis of morphological parameters of stallions, registered in the ranking sheets between 2000-2015, the following conclusions are drawn:

-the analysis of average values of stallions' height, calculated for all bloodlines, revealed that the minimum calculated value was registered at Hadban bloodline (157.66 ± 1.21 cm), and the maximum at the Koheilan bloodline (161.22 ± 0.84 cm);

-the analysis of hearth girth revealed that the average values ranged between 177.25 ± 4.09 cm (Mersuch line) and 183.33 ± 1.83 cm (Koheilan);

-regarding the average values of cannon girth, the limits were between 18.5 ± 0.77 cm (Gazal bloodline) and 19.16 ± 0.31 cm (Koheilan);

-regarding the values of the massiveness index, it was observed that the limits ranged between 105.55-120.25%; the bone index had values between 10.84-12.82%, and the average values of digital-thoracic index were placed between 9.77-11.56%, facts which

sustain the idea of a more massive breed than the Purebred Arabian, the one which was created from.

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