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SOME MORPHOLOGICAL TRAITS OF THOROUGHBRED HORSES IN TURKEY

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Abstract

This is the first document on Thoroughbred Horses in Turkey. The aim of this study was to define body coat colour and some morphological traits of Turkish Thoroughbred horses used for race in Balikesir and Konya regions. In this study, a total of 52 Thoroughbred horses, 14 males and 38 females, were analyzed in two age groups of 4-5 and 6-9 years, respectively. Descriptive statistics gave the following means: withers height 164.1 ± 0.64 cm, height at rump 162.7 ± 0.65 cm, body length 167.3 ± 0.72 cm, heart girth circumferences 193.3 ± 0.43 cm, chest depth 79 ± 0.57 cm, and cannon circumferences 20.1 ± 0.18 cm. In this study, the frequencies of body coat colour of the sampled horses for bay colour was 34.6%, chestnut 30.8%, black 25%, and gray 9.6%. It can be concluded that Turkish Thoroughbred Horses is almost similar to other Thoroughbred Horses raised in other countries.

Key words: *Body measurement, coat colour, genetic resources, phenotypic trait*

INTRODUCTION

The horse (*Equus caballus*) is a large odd-toed ungulate mammal, one of the species of the genus *Equus* [6]. Kafesoglu [12] reported that the materialistic Turkish culture was based on the invention of forging (wrought) iron and domestication of horse. According to some writers, the horse was firstly domesticated by Turks in Middle Asia [7, 14, 16, 18, 21]. During Gok-Turk Age, they had 11 different kinds of horse breed [19].

The Thoroughbred horse is a breed of horse that is known for its use in horse racing. With a well-chiselled head shape on a long neck, the Thoroughbred is one of the most easily recognizable horse breeds in the world. Though the word of thoroughbred is generally used to refer to any breed of purebred horse, this word technically refers only to the Thoroughbred breed [15].

The Thoroughbred is developed by crossing some English mares to three Arabian stallions which were Turkish horse breeds imported from Ottoman Empire lands. The names of three stallions were the Byerley Turk, the Darley Arabian and the Godolphin Arabian. All modern Thoroughbred horses can trace their pedigrees to those three stallions. Apart from those three stallions, there were also less influential stallions which were named as Alcock Arabian, D'Arcy's White Turk, Leedes Arabian, Curwen's Bay Barb and Brownlow Turk also mostly imported from Ottoman Empire lands [8, 10, 11, 15, 22].

The main Turkish horse breeds and types are Midilli of Ayvacık (Ayvacik Midillisi), Canik, Jereed (Cirit), Kula of Camardi (Camardi Kulasi), Cukurova, East Anatolian (Dogu Anadolu), Kolukisa of Hinis (Hinisin Kolukisasi), Karacabey, Malakan, Trakya, Turkish Arabian (Turk Arap), Turkish Nonius (Turk Nonyus), and Uzunyayla Horses [5, 8, 10, 11]. A group of Coloured (Alaca) horse is also focused in Ardahan and Kars provinces [23].

Wilson [21] reported from Mason that male and female Kyrgyz horses stand 155 and 145 cm respectively. The New Kyrgyz horses derived from the Kyrgyz via many infusions of exotic blood, including Don, English Thoroughbred and other breeds in the late 19th century.

As seen in Table 1, there was some information on Thoroughbred horses [8, 9, 10, 11] and

Arabian horses [3, 4, 7, 8, 9, 13, 17, 22, 23]. On Thoroughbred horses, only Yarkin [21] reported data that withers height was average 158-162 cm. Hendricks [11] reported that average withers height was 152-173 cm. According to Wikipedia [9], same value was 157 to 173 cm.

Table 1. Some morphologic traits on Thoroughbred horses

Source	Withers height (cm)
Yarkin (1962)	158 to 162
Hendricks (1995)	152 to173
en.wikipedia.org (2011)	157 to 173

The aim of this study was to define body coat colour and some morphological traits of Turkish Thoroughbred horses used for horse racing in Turkey.

MATERIAL AND METHOD

Experimental animals

In this study, a total of 52 Thoroughbred horses, 14 males and 38 females, were analyzed in Eregli, Konya (37°30'N; 34°03'E) and Burhaniye, Balikesir (39°30'N; 26°58'E) in Turkey [25]. The sampled horses were aged between four and nine years, grouped into two age groups of 4-5 and 6-9 years respectively. Sample horses were stud horses which were raised for horse racing.

Measurements

This study was conducted in January 2011. Linear measures such as withers height (WH), rump height (HR), body length (BL), and chest depth (CD) were measured using a measuring stick. Other linear measures such as hearth girth circumference (HGC), and cannon circumference (CC) were measured with a specially graduated metal measuring tape. Horses were provided to stand on a hard, level surface. The traits measured were as follow:

WH: Vertical distance between the highest point of shoulders (withers) and level surface.

HR: Vertical distance between the highest point of rump (*Tuber sacrale*) and level surface.

BL: Horizontal distance between *Caput humeri* and *Tuber ischii*.

HGC: Peripheral distance around chest just behind shoulders.

CD: Vertical distance between the highest point of shoulders (withers) and sternum.

CC: Peripheral distance around cannon bone (third *metacarpal*) [20].

Ages were determined from the information given by stud owners.

Statistical analysis

The data were analyzed using the Minitab 15 statistical software program. Descriptive statistics for body dimensions were analyzed using ANOVA and Student's t-Test that also determined the impact of sex, region, body coat colour, and age group on the response variables of WH, HR, BL, HGC, CD, and CC [1].

RESULTS AND DISCUSSIONS

This is the first document on Thoroughbred Horses in Turkey. In this study the frequencies of the different body coat colours were as given in Table 2. About two third of horses were bay and chestnut coloured and one fourth was black. The last colour of gray was just about 9.6%.

Table 2. Frequencies of body coat colour of Thoroughbred horses

	Bay	Chestnut	Black	Gray	Total
n	18	16	13	5	52
%	34.6	30.8	25.0	9.6	100.0

According to Yarkın [21], in Thoroughbred horses bay colour is about four fifth and chestnut is about one fifth. Gray and black colours are rare.

In the Midilli of Ayvacik breed, the most common coat colour is bay. The roan colour can be seen, but rarely. However, Batu [4] reported that the Midilli of Ayvacik are commonly bay, and Yılmazer [24], in an MSc thesis on the same breed, reported only a chestnut coat colour for those horses.

Aral [2] reported that the bay colour is common in Uzunyayla horses. Black and gray colours also could be seen, but the chestnut colour is disliked by owners.

Batu [4] reported that gray, bay, chestnut and black colours were common in Turkish Native horses, and buckskin and other colours could be seen.

Batu [4] also reported that Malakan horses are commonly black.

According to Emiroğlu and Yuksel (2009), Uzunyayla and Canik horses generally were of a bay colour. In the Kolukisa of Hinis breed, each coat colour could be seen, but bay was the most common.

The Turkish Coloured horse has a mixed colour pattern controlled by a dominant gene. One parent must therefore be a 'coloured' horse for the pattern to occur. The 'colour' gene produces white-haired, pink-skinned patches on a base coat colour. There are various terms for this combination in the literature, depending on the size, distribution and proportion of the colours as they relate to the white areas. For simplicity, the terms 'piebald' and 'skewbald' are applied here, and this general type of horse will be described as 'Coloured' [23].

As seen in Table 3, there were no significant differences between male and female horses for all traits. Results for WH, BL and CC females yielded higher values than males, but results for HGC, and CD males yielded higher values than females. For the trait of HR, males and females yielded the same value.

Table 3. Descriptive statistics and comparison results of the phenotypic traits for different sexes, regions, and ages in Thoroughbred horses

Trait			WH (cm)	HR (cm)	BL (cm)	HGC (cm)	CD (cm)	CC (cm)
	Overall	(n=90)	164.1 ± 0.64	162.7 ± 0.65	167.3 ± 0.97	193.3 ± 0.43	79 ± 0.57	20.1 ± 0.18
Sex	Male	(n=87)	163.7 ± 1.03	162.6 ± 1.38	165.8 ± 1.76	194.1 ± 0.57	79.5 ± 0.95	19.8 ± 0.42
	Female	(n=3)	164.2 ± 0.79	162.7 ± 0.75	167.8 ± 1.16	192.9 ± 0.55	78.9 ± 0.71	20.1 ± 0.20
Region	Balikesir	(n=32)	165.2b ± 0.79	163.1 ± 0.85	168.6 ± 1.34	193.3 ± 0.48	80b ± 0.75	20.3 ± 0.26
	Konya	(n=20)	162.3a ± 0.96	162.0 ± 1.03	165.2 ± 1.22	193.3 ± 0.84	77.5a ± 0.79	19.6 ± 0.21
Age (Years)	4-5	(n=27)	163.4 ± 0.94	162.0 ± 0.87	166.0 ± 1.40	193.3 ± 0.56	78.0 ± 0.65	19.7 ± 0.25
	6-9	(n=25)	164.8 ± 0.96	163.4 ± 0.98	168.6 ± 1.30	193.2 ± 0.68	80.1 ± 0.93	20.4 ± 0.26
Coat Colour	Bay	(n=18)	164.0 ± 1.23	162.5 ± 1.33	167.5 ± 1.49	191.6a ± 0.77	79 ± 1.07	20.1 ± 0.31
	Chestnut	(n=16)	164.8 ± 0.91	163.0 ± 1.15	165.0 ± 1.31	194.0b ± 0.62	79.9 ± 0.79	20.2 ± 0.21
	Black	(n=13)	162.5 ± 1.22	162.8 ± 1.27	169.2 ± 2.49	194.8b ± 0.91	77.7 ± 0.84	19.7 ± 0.49
	Gray	(n=5)	166.0 ± 2.51	162.0 ± 1.02	168.9 ± 3.79	193.0ab ± 0.44	80.2 ± 3.32	20.6 ± 0.67

a, b: $P<0.05$

* There were no significant differences between means indicated by the same letters in the same column and factor groups.

WH= withers height, HR= height at rump, BL= body length, HGC= heart girth circumference, CD= chest depth, and CC= cannon circumference.

In this study, samples were gathered from two different regions of Balikesir and Konya which were about 600 km far from. There were no significant differences among horses between two regions except traits of WH and CD ($P<0.05$). Thoroughbred horses raised in Balikesir yielded higher WH and CD results than the horses raised in Konya.

As indicated in Table 3, the age factor was not significant for all traits. Sample horses were older than 4 years old. It can be concluded that Thoroughbred horses reach to adult growth body size after 3 years of age.

For the factor of body coat colour, there were no significant differences traits except the trait of HGC ($P<0.05$). The horses in bay colour yielded the lowest value and chestnut and black colour yielded the highest value. Gray colour was in the middle.

Related with withers height, Yarkin [21] reported the value of 160 (158-162), Hendricks [11] 162.5 (152-173) and en.wikipedia.org [9] 162.5 (152-173). The result of this study of 164.1 cm was almost similar and in minimum and maximum ranges related with literature results cited in previous sentence.

The phenotypic correlation values displayed in Table 4 showed that all observed traits were affected by selected factors except the phenotypic correlation between CC and other traits. The highest values were found between HR and WH ($r=0.93$) ($P<0.01$). Other high values were found between BL and WH ($r=0.63$), BL and HR ($r=0.66$), HGC and WH

(r=0.62), CD and WH (r=0.65) which were higher values than r = 0.60 (P<0.01). The lowest value (r=0.06) (P<0.05) was found between CC-HGC.

Other low correlation values were found between CC and WH (r=0.21), CC and HR (r=0.22), CC and BL (r=0.22), CC and CD (r=0.11) (P<0.05). There were no negative correlations between all traits as seen in Table 4.

Table 4. Phenotypical correlation coefficients (r) between body measurements in Malakan Horses

Traits	WH	HR	BL	HGC	CD	CC
HR	0.93**					
BL	0.63**	0.66*				
HGC	0.62**	0.58**	0.60**			
CD	0.65**	0.57**	0.38**	0.46**		
CC	0.21	0.19	0.12	0.06	0.11	
HL	0.48**	0.51**	0.41**	0.22*	0.28**	0.33**

*P<0.05, **P<0.01

CONCLUSIONS

It can tentatively be concluded that Turkish Thoroughbred Horses is almost similar to other Thoroughbred Horses raised in other countries.

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THE MANAGEMENT OF ERYTHROCYTE MEMBRANE PERMEABILITY IN RATS FED ON CHOLESTEROL RICH DIET AND THE ROLE OF THE 1H NMR METHOD

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Abstract

*The aim of this study was related with the investigation of erythrocyte membrane permeability of rats fed on rich cholesterol diet by means of the 1HNMR technique. Three groups of 32 months old rats received rich cholesterol diet for 6 weeks combined with Aslavital or Procaine (4 mg/kg body weight). Group **(A) Control.** The animals fed on cholesterol rich diet were divided into 3 groups: group **(B)** - hypercholesterolemic diet, group **(C)** also with Aslavital i.m. (4 mg/kg corp); group **(D)** - also with Procaine treatment (4 mg/kg corp) to test its properties as an antiatherosclerotic drug. Our data pointed out a decrease of proton half time within erythrocite which accounts for an accelerated proton exchange in all groups of rats with high level of serum cholesterol. In controls the exchange of water through red blood cell membrane is accelerated in parallel with increase in local temperature. Red blood cell membrane permeability towards water can be accounted as an index of cardiovascular system recovery, important in maintaining a dynamic balance with vascular destruction due to high blood pressure.*

Key words**:** *Aslavital, atherosclerosis, erythrocyte membrane permeability, Procaine, cholesterol, 1H Nuclear Magnetic Resonance*

INTRODUCTION

High blood pressure and its major complications is one of the major problems of medical research, attention being concentrated towards the elucidation of the physio-pathological mechanisms which interfere during the evolutionary stages of the illness.
The aim of this paper was related with the investigation of some biophysical aspects which seem to be altered in aging animals fed on cholesterol rich diet; they received an Aslavital-based treatment which contains Procainne chlorhydrate, glutamic acid (as activator factor) and benzoic acid (as an antiaterogenic factor). This drug has an regenerative eutrophic, antiaterogenic (lipotrop) action, as well as a fat and cholesterol regulation metabolism which is used for the prophylactic and curative treatment of cerebral and cardiovascular aging.

MATERIAL AND METHOD

Our study on experimental hyperthensive animal models using biophysical methods was designed to investigate the proton transverse relaxing times of intracellular water and membrane permeability to water.

1. Biological Material

Our study was done on: 32 months old White Wistar rats group fed for six weeks on rich cholesterol diet (animal fat) and on the Control Group (A). The group of animals fed on rich cholesterol diet was divided into: group **(B)** - which received Procaine tretment along with high rich cholesterol diet. Group **(C)** - which also received Aslavital treatment (Intra peritoneal injections with Aslavital 4 mg/kg body weight); Group **(D)** - which received tretament with Procaine (I.P injections with

Procaine solution 4 mg/kg body weight). The Procaine-based treatment was aimed to establish if the drug formula was efficient in preventing the atherosclerotic effect of high rich cholesterol diet.

Determinations of 1H Nuclear Magnetic resonance

The biological material used in our study was venous blood harvested on heparin and an adequate volume of $MnCl_2$ such as to obtain a concentration of 20 mM $MnCl_2$ in the extracellular compartment.

The 1H NMR method was used for evaluating Proton transverse relaxing times of intra erythrocyte and extra erythrocyte water, as well as for evaluating the times for exchange of water and calculus for water permeability.

The method principle consists of characterising a system composed of two compartments - A and B - of the two relaxing times - T_{2a} and T_{2b} - of the same type of nuclei originating from the same compartment.

The 1H NMR determinations were performed by using an AREMI`78 Spectrometer in impulses at a frequency of 25 MHz, using the standard sequence CARR-PURCELL-MEIBOOM-GILL with an interval of 1 ms between the impulses. It measured the transverse proton relaxing times in intracellular compartment in the presence of water exchange between the intracellular and extracellular compartment fed with Mn^{2+}, thus obtaining the apparent relaxing time T_{2a}'.

RESULTS AND DISCUSSIONS

Modifications of membrane permeability to water at the level of blood erythrocyte were similar with those at the cardiovascular level and were produced in the same way. Also, water permeability could be modified by changing the proportion and distribution of lipid membranes.

In Control or cholesterol, Aslavital and Procaine treated animals in different combinations.

Fig. 1 presents the aspects related to the dynamics of protons along the erythrocyte membrane and the energetic modifications due to the exchange of water protons. There was a decrease of half life time of the protons in the erythrocyte (**τ**), which suggested an accelerated proton exchange which occurred in all groups where Cholesterol exceeded the normal range, even if the animals received drug therapy or not.

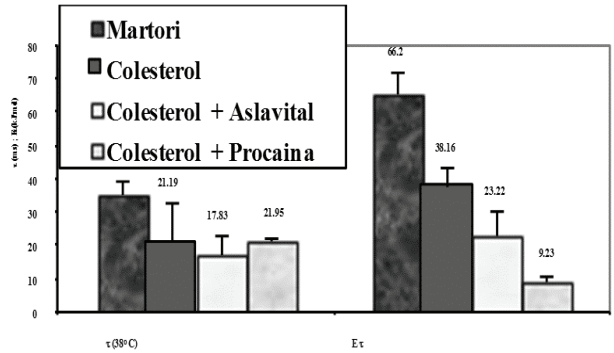

Fig.1 Exchange time of water at the level of erythrocyte membrane (t) and Activation energy of water exchange at the level of erythrocyte membrane Et

The activation enery of water exchange along the erythrocyte membrane (**E_τ**) decreased in the groups fed only on cholesterol rich diet, then in combination with Aslavital, and the smallest values were recorded for the Procaine treated group.

This accounts for the fact that high cholesterol level made water exchange become faster despite the drug administration; the transmembrane exchange process was partially disconected under the influence of thermic processes with heat liberation, being positively affected after drug administration.

When the specific energetic processes of an exchange occurred between the two compartments involved, one of the compartments was responsible for a deviation in the energetic field [1].

By studying the state of the plasma-erythrocyte bio-compartmental system from the viewpoint of activation energy processes of proton relaxation (Fig. 2), we can observe the significant increase of energy activation in the plasma (**E_{plasma}**). In all treated groups, the highest value was obtained in the presence of Procaine`s (7 times higher than in Controls).

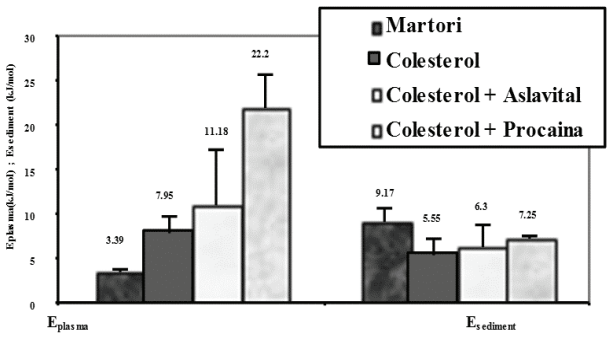

Fig. 2. Water exchange time along erythrocyte membrane (t) and activation energy of water exchange along erythrocyte membrane Et in Controls or cholesterol treated, Aslavital and Procaine in different combinations

The activation energies inside the erythrocyte were modified in a smaller proportion and had different aspects: compared to Controls, they decreased in the cholesterol rich diet animals and increased a little in comparison with the latter, following the treatment with Aslavital and Procaine; it remained unchanged under the Control values.

The erythrocyte membrane permeability to water (PMEA) is a parameter which characterizes both water exchange along the erythrocyte membrane and those which take place in the vascular walls [4].

This correlation is allowed by the presence of the same type of aquaporine - AQP1- both in the erythrocyte membrane and the vascular endothelial membranes at all levels.

In figure 3, it can be observed that permeability to water increased very much in high rich diet animals (from 2.19 cm-s*10^{-3} in Controls to 5.8 cm-s*10^{-3} high rich diet animals). Aslavital and procaine induced decreases of this parameter, but the values were still above the Control values.

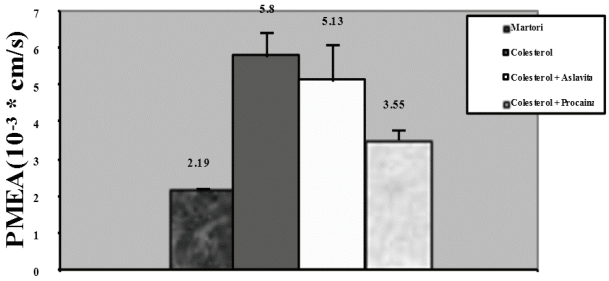

Fig. 3. Erythrocyte membrane permeability for water (PMEA) in Control or treated animals with cholesterol, Aslavital and Procaine in different combinations

From our previous studies [1], we noticed that permeability to water was increased in the onset stages of the illness and was a defense reaction against high blood pressure; after maintaining it at an increased level, there was a sudden decrease, which was correlated with an increased risk of stroke [2].

Therefore, the readjustment of an increased physiological parameter to the normal values in a pathological context of an illness is not always welcomed because the organism adapts, creating a new state of equilibrium; if the primary cause of deregulation of normal equilibrium is not corrected, it can lead to a more serious pathological event [3].

It is mentioned that singular administration of drugs which decrease water permeability of membranes in hyperthensive patients is risky; therefore, it is recommended for these to be associated with drugs that have an opposite effect upon membrane permeability [5].

This study it did not raise this problem because it was demonstrated that Aslavital and Procaine had a very weak effect upon membrane permeability. High EPMW and low values of intracellular T_2 suggested a hydration phenomenon of cells from high rich cholesterol fed animals.

The low milk offer has obliged Romania to import milk in order to assure the raw material for the milk processing industry.

CONCLUSIONS

From the results presented above, we can draw the following conclusions:

- There is a decrease in Proton half life in erythrocytes which suggests an accelerated Proton exchange present in all studied groups of animals where the cholesterol levels exceeds the normal range.
- In young animals (Controls), water exchange along the erythrocyte is accelerated, in parallel with the increase in local or global temperature (generated by the activation of metabolical reactions) with heat release in the intracellular environment, drug administration conducting to the stabilization of water exchanges in the context of high temperature.

- Membrane permeability to water (MPW) may be accounted for as an index of recovery of cardiovascular system which is important în mentaining a dynamic equilibrium with phenomena of vascular destruction due to high blood pressure.
- Aslavital or Procaine treatment exhibits effects which emerge in the same direction, the Procaine effect is more obvious. In general, Aslavital behaves as a more adequate buffered Procaine.

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