Araştırma Makalesi / Research Article

Color and marking distribution in Arabian and Thoroughbred horses

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ABSTRACT

Horses, used for various purposes for centuries, are today commonly used for sporting purposes. It is critical to identify the horses that are used in this way by using the coat color and markings on the horse. The animal material for this research consisted of 101 Arabs and 206 Thoroughbreds. The most common coat color was BAY (56.6%). The least common coat colors were BLACK (0.3%) and DUN (0.3%). The presence of head marks on horses rated 0, 1, 2, 3, 4, and 5, and the rate of presence of the head mark were 17.2%, 29.2%, 7.5%, 6.8%, 26.0%, and 13.3%, respectively. When examining leg markings, the most common mark was the half-stocking (16.9%) on the left back leg, while the stocking (1.3%) was the least frequent mark on the front right leg. According to the findings of the study, which was conducted to analyze the condition of Arab and Thoroughbred horses, BAY was the most common coat color seen in horses in general. Leg markings were rarely seen on both Arabians and Thoroughbreds. Consequently, this both situation is due to the preferences of breeders and horse owners.

Arap ve İngiliz atlarında don rengi ve nişanelerin dağılımı

ÖZET

Yüzyıllar boyunca çeşitli amaçlarla kullanılan atlar günümüzde daha çok sportif amaçla kullanılmaktadır. Bu şekilde kullanılan atların kimliklendirilmesi büyük önem taşımakta ve bunun için atların don rengi ile nişanelerinden faydalanılmaktadır. Bu araştırma ile Türkiye'de yetiştirilen 101 Arap ve 206 İngiliz olmak üzere toplam 307 yarış atında don ve nişanelerin dağılımı incelenmiştir. Genel olarak atlarda % 56,5 ile en çok DORU don rengi gözlemlenirken, en az BOZ (% 0,3) ve YAĞIZ (% 0,3) don renkleri görülmüştür. Atlara baş nişaneleri bulduğu bölgelere göre 0; 1; 2; 3; 4 ve 5 olarak puanlanmıştır. Buna göre baş nişanelerinin bulunma oranları sırasıyla % 17,2; % 29,2; % 7,5; % 6,8; % 26,0 ve % 13,3 olmuştur. Atlarda sekiler incelendiğinde % 16,9 ile en çok sol arka bacakta Yüksek Seki, en az ise sağ ön bacakta Çizme Seki (% 1,3) görülmüştür. Sonuç olarak atların soy kütüklerine kayıdedilmesinde önemli bir yeri olan Don rengi ve Nişanelerin, Arap ve İngiliz atlarındaki durumunun incelenmesi amaçlanan bu çalışmada atlarda en çok DORU don renginin görüldüğü belirlenmiştir. Arap ve İngiliz atlarında bacak nişaneleri nadiren görüldü. Bu iki durumun yetiştiricilerin ve at sahiplerinin tercihlerinden ileri geldiği sonucuna varılmıştır.

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1. Introduction

Horses were domesticated 5,500 years ago at Botai (ancient Turkestan), located in Kazakhstan (1-9). There had been evidence of bitting, tethering, milking, and corralling, all of which point to human-controlled management (5,10).

The domestication of horses had a significant impact on human history in many ways, including the acceleration of civilization; the revolutionization of warfare, transportation, and agriculture; food production; trade; and the training of horsemanship (2,3,6,9,11-15). The recent evolution of domestic horses has been influenced by human activities, especially the practice of using highly selective breeding to create multiple breeds, each with unique characteristics (13). The height of an animal as measured form its withers, the color of its coat, its locomotion (the way it moves), and its racing performance are the phenotypic characteristics that are easiest to observe and also the ones that are considered to be the most important (12, 13).

Currently, there are almost 60 million horses on earth (16). The majority of horse breeds are presently being selectively improved for qualities related to beauty and performance, with appearance being the primary focus (12). In some countries, they are primarily restricted to the sports, hippotherapy, scientific studies, and recreation industries, although they continue to play important roles in other countries, such as providing transportation, plowing force, meat, milk, hair, and leather (2,3,6,9,11,14,15,17). In all periods and cultures, horse racing has been a popular and intriguing hobby for people of all walks of life (18). As the popularity of racing grew, breeders began to select horses that were both quicker and more durable than their predecessors (15,18). In Turkey, horses are generally bred for racing and various sporting events, and only Arabian and Thoroughbred horses can participate in horse races (3,9). For the purpose of identification and registration of pedigrees, the coat colors and markings of racing horses are critical (3,6,9,11,15,19,20).

The color of an animal's coat has three important functions: it serves to conceal the animal, communicate with it, and regulate physiological processes (21). So many wild animal species are similar in color, and these colors provide them with a competitive edge over their non-uniformly colored counterparts in terms of camouflage, reproductive success, adaptation, and disease tolerance (21). Wild horses known as Przewalski and Tarpan are considered to be the progenitors of domesticated horses on earth (22). Researchers discovered that the color of horses' coats, which are the best way to conceal them from natural predators, and the color of the current Przewalski horse are very similar in their appearance (2,6). Approximately 11–12 thousand years ago, the appaloosa and the black coat color first appeared (6). While horses have dark-colored coats in the wild, it is reported that the colors of coats that are seen today occurred rapidly since people used certain coat colors in breeding right after domestication (2,4,6,23). Horse owners and scientists from all over the world have been fascinated by the phenomenon of coat color for centuries (7,13). This fascination can be attributed to the fact that its phenotypic properties are easy to recognize; as a result, tracing the transmission of characteristics from one generation to the next is much easier (12). Coat color has been the subject of genetic research in recent decades due to its considerable economic, aesthetic, and health implications (7,12).

The mass of genes determined coat colors. The melanocortin-1 receptor gene (MC1R/Extension-E) constituted the primitive coat colors (2,6,20). Other genes, including the agouti signalling protein (ASIP/Agouti-A) gene, act by changing or closing the effects of the "E" gene. "E" and "A" genes together are effective in the formation of common coat colors such as black, bay, and chestnuts (2,6,15,20). The recessive "e" gene has an epistatic effect on the recessive "A" gene, resulting in the phenotype of chestnut coat color (2,20). The "A" gene is effective in the distribution of black regions in horses with chestnut coat colors; in other words, the "A" gene is responsible for the formation of basic coat colors with black regions and constitutes most coat colors (2,6,20). The function of the dominant "A" allele, which has a high incidence, is to create a BAY coat color by limiting the distribution of black areas in the body (2,6,20). The recessive "a" allele results in a completely black coat color (2,6,20). Dilution genes created variations of these three basic coat colors, such as (2,6,20). In most horse breeds, the frequency of the Bay

coat color is higher than the other coat colors (2,20). There are other basic coat colors in several breeds where the BAY coat color cannot be observed (2,20). The Syntaxin 17 (STX17/G) genes, together with the "E" and "A" genes are responsible for horses' grey coat colors (2,6,20). Horses are born with normal pigmentation, but as they grow older, their pigmentation begins to fade (24). By the time they are 6–8 years old, they have become white, with dark skin pigmentation remaining (24). The dark colors dominated the birth of foals whose coats were affected by the gene's "E" and "A," while grey coat colors appeared when, over the course of time, they displayed the activity of the gene "G" (2,6,20). Grey coat colors are common among horse breeds such as Thoroughbred, Arabian, and Percheron (2,6,20). The formation of head and leg marks used in the recognition of horses is under the control of both genes and the environment (2,6,20,25).

Nowadays, horse breeding is a globally significant sector that involves substantial investments in terms of labor, time, and finances. Phenotypically and genetically superior horses fetch high prices in international markets. The racing industry, overseen by the Turkish Jockey Club, holds official horse races at nine different tracks across Turkey (26,27,28). So, it is critical to pedigree horses produced for racing using coat color and markings. The purpose of this study was to ascertain the prevalence of different coat colors and markings on Arabian and Thoroughbred horses in Turkey.

2. Material and Methods

The research material consists of 307 (101 Arabian and 206 Thoroughbred) horses. The data was collected in 2018 from private farms where horses are bred and a hippodrome. The coat colors and markings of the horses were determined according to the statements of Özbeyaz (9). For the headmarkers, faces are divided into five parts in accordance with the descriptions by Gücüyener-Hacan and Akçapınar (29):

a) The area between the eye line and the poll,
b) The area extending from the lower border of the eye to the nostrils,
c) The area between the nostrils and below them,
d) Upper lip area,
e) Lower lip and chin area.

Scores ranging from 0 to 5 were made for each horse according to the number of regions where the markings are located. Accordingly, if there are no markings on the horse's head, it is scored as 0; if there are markings in the a, b, or c regions, it is scored as 3; if there are markings in the a, b, c, d, and e regions, it is scored as 5.

Leg markings of all 307 horses were inspected according to Akçapınar and Özbeyaz (1)'s reports, and the general distribution of leg markings is given in Table 6.

The SPSS 18 statistics package programme was used in frequency analysis to determine the distribution of coat colors and markings on horses.

3. Results

Arabian and Thoroughbred horses were 31.1% and 66.9%, respectively, of the 307 horses, which are research materials. Likewise, out of 307 horses, 62.0% were female, and 38.0% were male (Table 1). 51.0% of Arabian horses were male, 49.0% were female, and 31.6% of Thoroughbreds were male, and 68.4% were female (Table 2). The age of the horses used in the study varied from 1 to 21 (Table 3).

Tablo 1: Atların Irk ve Cinsiyete Göre Genel Dağılımı
Table 1: General Distribution of Horses by Breed and Gender

	Arabian	Thoroughbred	Total
Male	51	65	116
Female	50	141	191
Total	101	206	307

Tablo 2: Arap ve İngiliz Atların Cinsiyete Göre Dağılımı
Table 2: Distribution of Arabian and Thoroughbred horses by Gender

	Rate (%)	
	Arabian	Thoroughbred
Male	50.5	31.6
Female	49.5	68.4
Total	100.0	

Tablo 3: Arap ve İngiliz Atların Yaşa Göre Genel Dağılımı
Table 3: General Distribution of Arab and Thoroughbred Horses by Age

Age	Rate (%)			Frequency		
	Arabian	Thoroughbred	General	Arabian	Thoroughbred	General
1	-	3.4	2.2	-	7	7
2	10.8	14.0	13.0	11	29	40
3	31.7	16.5	21.5	32	34	66
4	13.8	5.3	8.1	14	11	25
5	13.8	11.2	12.1	14	23	37
6	9.9	7.8	8.5	10	16	26
7	5.0	10.7	8.8	5	22	27
8	4.0	7.8	6.5	4	16	20
9	2.0	4.4	3.6	2	9	11
10	3.0	3.4	3.3	3	7	10
11	2.0	0.5	1.0	2	1	3
12	1.0	3.9	2.9	1	8	9
13	2.0	1.9	2.0	2	4	6
14	-	1.9	1.3	-	4	4
15	-	1.5	1.0	-	3	3
16	-	1.9	1.3	-	4	4
17	1.0	2.9	2.3	1	6	7
19	-	0.5	0.3	-	1	1
21	-	0.5	0.3	-	1	1
Total	100			101	206	307

The distribution of horse coat colors in the study was 27.6% chestnut, 56.5% bay, 15% grey, 0.3% dun, and 0.3% black (Table 4). The scoring rates according to the number of regions where horses have head marks were 17.2%; 29.2%; 7.5%; 6.8%; 26.0% and 13.3% for 0; 1; 2; 3; 4 and 5 areas, respectively (Table 5). The distribution of the leg markings according to the leg is given in Table 6.

Tablo 4: At donlarının genel dağılımı
Table 4: General distribution of horse coat colors

Coat Color	Rate (%)			Frequency		
	Arabian	Thoroughbred	General	Arabian	Thoroughbred	General
Chestnut	36.3	23.3	27.6	37	48	85
Bay	20.6	74.2	56.5	21	153	174
Grey	43.1	1.5	15.0	43	3	46
Dun	-	0.5	0.3	-	1	1
Black	-	0.5	0.3	-	1	1
Total		100		101	206	307

Arabian horses: Out of the total population of 101 Arab horses, 50.5% males and 49.5% females made up the population (Table 2). The age of Arabian horses, which are research materials, varies between 2 and 17 years (Table 3). The distribution of coat colors in Arabian horses was 36.3% chestnut, 20.6% bay, and 43.1% grey (Table 4). The scoring rates according to the number of regions where Arabian horses have head marks were 9.8%, 13.7%, 2.0%, 6.9%, 36.3, and 31.4% for 0, 1, 2, 3, 4, and 5 areas, respectively (Table 5). The distribution of the leg markings according to the legs of Arabian horses is given in Table 6.

Tablo 5: Atlardaki baş nişanelerinin bölgelere göre genel dağılımı
Table 5: General distribution of head marks on horses by region

Head Mark	Arabian		Thoroughbred		General	
	Rate (%)	Frequency	Rate (%)	Frequency	Rate (%)	Frequency
0	9.8	10	20.9	43	17.2	53
1	13.7	14	36.9	76	29.2	90
2	2.0	2	10.2	21	7.5	23
3	6.9	7	6.8	14	6.8	21
4	36.3	36	20.9	43	26.0	79
5	31.4	32	4.4	9	13.3	41
Total	100.0	101	100.0	206	100.0	307

Thoroughbred horses: The total number of Thoroughbred horses was 206 heads, of which 31.6% were male and 68.4% were female (Table 2). The ages of Thoroughbred horses ranged from 1 to 21 (Table 3). The coat colors of Thoroughbred horses were distributed as follows: 23.3% were chestnut, 74.2% were bay, 1.5% were grey, 0.5% were dun, and 0.5 were black (Table 4). The scoring rates according to the number of regions where Thoroughbred horses have head marks were 20.9%, 36.9%, 10.2%, 6.8%, 20.9, and 4.4% for 0, 1, 2, 3, 4, and 5 areas, respectively (Table 5). Leg markings were found on just a small percentage of the 307 horses, including Arabians and Thoroughbreds that were investigated. The distribution of the leg markings according to the legs of horses is given in Table 6.

Tablo 6: Atlarda bacak işaretlerinin bacaklara göre genel dağılımı (%)
Table 6: *General distribution of leg markings in horses according to legs (%)*

		Leg			
		Front		Back	
		Right	Left	Right	Left
No Mark	Arabian	54.9	53.9	36.3	24.5
	Thoroughbred	77.7	76.7	62.6	53.4
	Total	70.1	69.2	53.9	43.8
Coronet	Arabian	11.8	3.9	8.8	10.8
	Thoroughbred	6.8	6.3	5.3	7.8
	Total	8.4	5.5	6.5	8.8
Pastern	Arabian	8.8	7.8	12.7	19.6
	Thoroughbred	5.8	7.8	9.2	10.2
	Total	6.8	7.8	10.4	13.3
Ankle	Arabian	6.9	11.8	12.7	12.7
	Thoroughbred	6.3	6.3	11.7	17.0
	Total	6.5	8.1	12.0	15.6
Half-Stocking	Arabian	16.7	20.6	26.5	30.4
	Thoroughbred	1.9	1.5	9.7	10.2
	Total	6.8	7.8	15.3	16.9
Stocking	Arabian	1.0	2.0	2.9	2.0
	Thoroughbred	1.5	1.5	1.5	1.5
	Total	1.3	1.6	1.9	1.6

4. Discussion and Conclusion

In total, it examined 307 horses. 33.1% were Arabian, and 66.3% were Thoroughbred. 38.0% of the horses were male, and 62.0% were female. A total of 44.4% of male horses were Arab and 55.6% were Thoroughbred. 26.2% of the female horses were Arab, and 73.8% were Thoroughbred. While 50.5% of Arabian horses were male and 49.5% were female, 31.6% of Thoroughbred horses were male and 68.4% were female. The ratio of males to females in Arabian and Thoroughbred horses was found to be higher in Arabians, but the percentage of females in Thoroughbred horses was found to be much higher.

Bay was the coat color that was most frequently detected in this study of horse coat colors, accounting for 56.6 percent of the total number of horses analysed. Additionally, the coat colors of chestnut, grey, dun, and black were determined to be 7.6%, 15.0%, 0.3%, and 0.3%, respectively. Despite the fact that the most common coat color identified in Arabian horses was grey (43.1%), the most common coat color observed in Thoroughbred horses was bay (74.4%). The high occurrence of grey coat colors in Arabian horses found in this study is consistent with the findings of other studies (8,30).

Gücuyener-Hacan and Akçapınar (29) reported on the coat color of Arabian horses at Sultansuyu State Farm and Mahmudiye Stud Farm, respectively, and the findings of this study were consistent with their findings. However, they were incompatible with the findings of Anadolu and Karacabey State Farms (29) and some other studies (31,32). This misalignment is supposed to be caused by certain Arabs becoming grey after three or more years of age (20).

Whereas the low prevalence of grey coat color in Thoroughbred horses contradicts reports that grey coat color is dominant (2,6,8,20,33), it is thought that this situation is caused by the greying occurrence in Thoroughbred horses at older ages than in Arabs (2,20) and breeder preferences.

The frequency of coat color in Arabs is measured from the most common to the least common color for the coat in this study, such as grey coat color (43.1%), chestnut coat color (36.6%), and bay coat color (20.6%). The bay coat color (74.2%) is the most prevalent coat color seen in Thoroughbred horses, followed by the chestnut coat color (23.3%), the grey coat color (1.5%), the dun color (0.5%), and the black coat color (0.5%). In contrast to Arab horses, dun and black coat colors were observed in Thoroughbred horses.

The general occurrence of head marks on horses was detected by 17.2%, 29.2%, 7.5%, 6.8%, 26.0%, and 13.3% for 0, 1, 2, 3, 4, and 5, respectively. When the breeds were examined, these rates were determined to be 9.8, 13.7, 2.0, 6.9, 36.3, and 31.4% for Arabian horses and 20.09, 36.9, 10.2, 6.8, 20.9, and 4.4% for Thoroughbred horses, respectively. According to the results of the study, the rate of not seeing any head marks at all in one region and two regions of Thoroughbreds was higher than that of Arabs, while the rate of head marks in the three, four, and five regions of Arab horses was higher than that of Thoroughbreds. In the study, the visibility of the head marks of the Arabs has grown from 0 to 5, while it decreases in 2 and rises again in 3. Although it agreed with the data provided by Gücüyener-Hacan and Akçapınar (29) for Arab horses raised in Anatolia, Karacabey State Farms, and Mahmudiye Stud Farm, it was different from the data reported for Arab horses raised in Sultansuyu State Farm.

Generally, when the horses are analyzed according to their leg markings, the most frequent marking is half-stocking (16.9%) seen on the left back leg, while the least common one is stocking (1.3%) on the right front leg. While the condition of leg markings in Arabian horses is similar to the general situation, the most prevalent marking on Thoroughbred horses is ankle markings (17.0%) in the left-back leg.

The high frequency of half-stocking marks found on the back left leg and the low prevalence of stocking marks found on the right front leg in this study resembled the findings from Gücüyener-Hacan and Akçapınar's (29) study of Arabian horses at Anadolu, Karacabey, and Sultansuyu State Farms but are clearly different from the report of the same authors at Mahmudiye Stud Farm.

To summarize, coat colors and marking information are crucial for the identification of horses as well as their usage in the registration of pedigrees. Within the scope of this study, the incidence of coat color and markings in Arab and Thoroughbred racehorses in Turkey has been investigated in order to have a better understanding of the overall condition. Among the Thoroughbreds studied in this study, bay is the most common coat color, while grey is the most common coat color among Arabian horses studied in this study. It can be based on the old belief that bay and grey horses can easily be distinguished from other horses and have a strong reputation among Thoroughbred and Arabian horse breeders. Leg markings were rarely seen on both Arabians and Thoroughbreds. Leg markings were rarely seen on both Arabians and Thoroughbreds. This can be based on the strong belief that lighter legs are easier to break.

Conflict of Interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' Contributions

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Ethical Approval

An ethical statement was received from the authors that the data, information and documents presented in this article were obtained within the framework of academic and ethical rules and that all information, documents, evaluations and results were presented in accordance with scientific ethics and moral rules.

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