Determination of hematological and biochemical parameters in healthy Arabian and thoroughbred racehorses

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Abstract
In this study, it was aimed to determine the differences in terms of race, age, and gender by examining the hemogram and biochemical parameters of healthy thoroughbred racehorses brought to the equine hospital for routine examination. The study material comprised 86 healthy horses (51 Thoroughbred and 35 Arabian Horses) of both genders (31 female and 55 male). The horses were divided into three groups according to their ages (3 years and younger, 4 years, and 5 years and older). Blood samples were analyzed on the hemogram and biochemistry devices after sampling. There was no statistically significant difference in the parameters examined between the breeds ($p>0.05$). Hematologically, it was determined that white blood cell (WBC), lymphocyte (LYM), mean corpuscular hemoglobin (MCH), and red cell distribution width (RDW) values were at the highest level in those aged 3 and younger, and neutrophil (NEU), mean corpuscular volume (MCV), and MCH values were at the highest level in 5 years and older. Biochemically, it was determined that aspartate transferase (AST), alkaline phosphatase (ALP), lactate dehydrogenase (LDH), albumin (ALB), and phosphors (P) values were at the highest level in those aged 3 and younger, and total protein (TP) values were at the highest level in those aged 5 and older. In terms of gender, WBC, red blood cell (RBC), Mean corpuscular hemoglobin concentration (MCHC), RDW, AST, ALP, gamma-glutamyl transferase (GGT), LDH, Creatine kinase (CK), creatinine (CREA), ALB, and P values were higher in males compared to females, while MCV, MCH, Mean platelet volume (MPV), and TP values were higher in females compared to males. As a result, although the Thoroughbred and Arabian Racehorses examined in the study were healthy, there might be significant differences in hemogram and biochemistry values in terms of age and gender.

Keywords: *Age, biochemistry, breed, gender, hemogram, racehorse*

INTRODUCTION

Thoroughbreds have been bred in different geographies and in countries around the world for many years (Milosevic et al., 2020). In addition, Thoroughbred and Arabian horses are bred for racing around the world and in Türkiye with great effort, and meticulous attention is paid to the health of these economically important horses. The health status of these horses, which have high economic value, affects their racing performance, and they are regularly kept under control. Because the illness of horses negatively affects racing performance and investments (Paksoy & Ünal, 2010).

For horses to exhibit better racing performance, they must also have superior performance characteristics such as large lung volume, high hemoglobin concentration, and cardiac output, the ratio of large muscle mass to body weight, high skeletal muscle density, and oxidative enzyme activity (Essen-Gustavsson & Lindholm, 1985; Hinchcliff & Geor, 2008; Munoz et al. 2017; Fails, 2020; Mukai et al.2023).

Although blood values differ in animals according to species, they also show a wide distribution within the same species depending on age, race, gender, region of breeding, and diet (Alilovic et al., 2022; da Conceição et al., 2022; Shawaf et al., 2018; Turgut, 2000). It is reported that revealing the differences in serum biochemistry parameters depending on race will provide a more accurate determination of diseases or metabolic problems that may occur (Akyüz et al., 2020). In addition, training or exercise status, pregnancy, circadian rhythm, health status, and the blood collection process affect hematological and biochemical parameters in horses (McGowan & Hodgson, 2014; Satue et al., 2012).

The number of studies on the hematological and biochemical parameters of blood in thoroughbred racehorses in Türkiye is limited. In studies conducted on horses, data on the effect of exercise on hematological and/or biochemical parameters have usually been presented (Allaam et al., 2014; Burlikowska et al., 2015; Demirel et al., 2022; Güzelbektaş et al., 2006; Klobučar et al., 2019; Kocaman & Fidancı, 2016; Oruç et al., 2017; Pourmohammed et al., 2019; Tepeoğlu, 2018). In addition, the effect of certain active ingredients on race performance in specific horse breeds has been investigated (de Oliveira et al., 2015; Fenger et al., 2014; Harking et al., 1992). However, comparative and detailed research on different races, ages, and genders could not be found in Türkiye. In the previous studies, hematological and/or biochemical parameters were evaluated only in terms of race (Bilal & Meral, 2002), age (Gürgöze & İçen, 2010), the relationship with element concentrations (Yipel et al., 2022), race

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and gender in a certain age group (Demirtaş, 2018), and gender and age in a certain race (Altınsaat, 2008; Ayhan & Gürgöze, 2024; Uluışık et al., 2013). For this reason, the presented study aims to reveal the hematological and biochemical parameters of healthy Thoroughbred and Arabian Horses in terms of race, age, and gender, respectively.

MATERIAL and METHODS

This manuscript was written without the assistance of any artificial intelligence programs.

Animals and experimental design

The study was carried out on 86 racehorses of different breeds, ages, and genders brought to the Turkish Jockey Club Adana Yeşiloba Hippodrome Equine Hospital for routine control. According to pedigree information, 35 horses were grouped as purebred Arabian and 51 as Thoroughbred. A systematic physical examination of the horses was performed. Within this scope, heart frequency, body temperature, number of breaths, lymph nodes examination, skin turgor and examination, digestive system examination (including stool examination), and urinary system examination were performed. According to the results of this examination, horses that did not find an abnormal physical examination were included in the study. The horses in the study were housed individually in concrete stables (4 m x 4 m) at the Turkish Jockey Club Adana Yeşiloba Hippodrome. They were fed with 4 kg of oats, 3 kg of barley, 7 kg of dried grass, 4 pieces of apples, and 4 pieces of carrots as 3 meals per day. The water needs of the horses were met ad libitum. Sawdust was preferred as a substrate.

Sampling method

The study included 86 horses that were found to be healthy according to anamnesis, clinical examination, and then no abnormalities in the reference values were detected according to the species in the laboratory findings. Blood samples were taken from all horses ,4 mL, duly from the *vena jugularis* into tubes with EDTA (BD Vacutainer® Becton, Dickinson and Company, Franklin Lakes, NJ, USA) for hemogram analysis and into tubes without anticoagulant (BD Vacutainer® Becton, Dickinson and Company, Franklin Lakes, NJ, USA) for biochemical analyses in the morning, when on the horses were hungry and before training.

Laboratory analysis

Hemogram analyses were performed with a hematology analyzer (Symex XT-1800i ®, Sysmex Corporation, Kobe, Japan), and WBC, LYM, NEU, monocyte (MONO), RBC, hemoglobin (HBG), hematocrit (HCT), MCV, MCH, MCHC, RDW, Platelet Count (PLT), and MPV values were determined. Blood samples in anticoagulant-free tubes were centrifuged at 4.000 rpm for 5 min, and serum samples were obtained. Biochemical parameters were determined with an automatic biochemistry analyzer (Siemens Dimension® Xpand®, Siemens Healthcare Diagnostics, Tarrytown, NY, USA), and values of AST, ALP, GGT, LDH, CK, lactic acid (LA), TP, ALB, CREA, blood urea nitrogen (BUN), calcium (Ca), magnesium (Mg), and P were determined.

Statistical analysis

In the research, the statistical package program SPSS V22 (IBM, Ehningen, Germany) was used to analyze the averages, standard errors, and data belonging to the groups. General Linear Model "UNIVARIATE" test was used to evaluate the results of the analyses according to race, age, and gender group. A correlation analysis was also performed between the analyses. The model Yijk = μ + ai + bj + eijk was used in the statistical analysis of the blood analyses. In this model; Yijk: Value of the examined trait of any individual; μ: the overall mean; ai: is the effect of gender (i: male and female); bj: effect of age group (j: 3,4,5+): and eijk: experimental error.

RESULTS

The age range of the horses was between 2 and 7 years, and the gender distribution was 31 females and 55 males. The horses included in the study were divided into 3 groups: 39 horses aged 2-3 years, which was the age of starting racing life; 26 horses aged 4 years; and 21 horses aged 5 years and older who were considered mature.

There was no significant difference between Arabian Horses and Thoroughbreds in haemogram and biochemistry values according to breed ($p>0.05$).

A statistically significant difference was found in hemogram values according to the age factor; WBC (p=0,010), LYM (p=0,000), NEU (p=0,000), MCV (p=0,001), MCH (p=0,000), and RDW (p=0,014) values ($p<0.05$). NEU, MCV, MCH, and RDW values increased with age, whereas WBC and LYM values decreased. Moreover, WBC and LYM values were found to be the highest in the age group of 3 years and younger and the lowest in the age group of 5 years and older (Table 1).

Considering the biochemistry values according to age, a statistically significant difference was found in AST, ALP, LDH, TP, ALB, and P values ($p<0.05$). According to age, Ca and P concentrations in horses were in the range of reference values. Blood concentrations (mg d/L) were ranked as Ca>P>Mg for macroelements. AST, ALP, LDH, ALB, and P values decreased with advancing age, whereas TP values increased. Moreover, AST, ALP, LDH, ALB, and P values reached the highest level in those aged 3 years and younger, whereas TP values decreased to the lowest level in those aged 5 years and older (Table 2).

A statistically significant difference was found in the WBC, RBC, MCV, MCH, MCHC, and MPV values from hemogram parameters according to gender factor ($p<0.05$). Of these values, WBC, RBC, and MCHC values were higher in males than females, while MCV, MCH, and MPV values were higher in females than males (Table 1).

From the point of view of gender, AST, ALP, GGT, LDH, CK, TP, ALB, CREA, and P values of biochemical parameters were statistically significantly different between males and females ($p<0.05$). Of these values, it was determined that AST, ALP, GGT, LDH, CK, ALB, CREA, and P values were high in males compared to females, while the TP value was high in females compared to males (Table 2).

It was determined that the values of WBC, MCV, and

Table 1. *Hemogram values of healthy horses according to breed, age, and gender (Mean ± Standard deviation)*

Parameter (Unit)	Reference Ranges	3 years and younger	4 years old	5 years and over	F	P	Female	Male	F	P	Thoroughbred	Arabian	F	P
		X±S	X±S	X±S			X±S	X±S			X±S	X±S		
WBC (x10^3/µL)	5.4-14.3	7.95±0.15	7.26±0.17	7.48±0.22	4.877	0.010*	7.29±0.16	7.82±0.13	6.388	0.013*	7.56±0.13	7.72±0.16	0.554	0.459
Lymphocyte (x10^3/µL)	17-68	42.33±1.17	40.62±1.22	34.51±1.20	9.858	0.000*	38.60±1.41	40.64±0.93	1.589	0.211	40.09±1.11	39.63±1.04	0.084	0.773
Neutrophil (10^3/L)	22-72	51.04±1.20	52.58±1.23	58.71±1.32	8.848	0.000*	54.70±1.43	52.63±0.96	1.542	0.218	52.93±1.15	54.03±1.06	0.453	0.503
Monocyte (10^3/L)	0-14	0.40±0.01	0.39±0.02	0.36±0.02	1.275	0.285	0.38±0.15	0.40±0.12	0.725	0.397	0.40±0.013	0.37±0.14	1.707	0.195
RBC (x10^9/µL)	6.8-12.9	9.89±0.15	9.86±0.19	9.38±0.14	2.449	0.093	9.33±0.14	9.99±0.12	11.479	0.001*	9.86±0.13	9.59±0.15	1.795	0.184
Hemoglobin (g/dL)	11.0-19	14.35±0.26	14.90±0.28	14.40±0.20	1.310	0.275	14.20±0.21	14.71±0.21	2.640	0.108	14.68±0.20	14.31±0.23	1.349	0.249
Hematocrit (%)	32-53	37.65±0.60	39.22±0.61	38.06±0.50	1.842	0.165	37.74±0.49	38.51±0.48	1.078	0.302	38.58±0.49	37.71±0.51	1.434	0.234
MCV (fL)	37-59	38.16±0.42	39.92±0.46	40.69±0.57	7.883	0.001*	40.55±0.48	38.61±0.34	11.115	0.001*	39.23±0.39	39.43±0.45	0.114	0.736
MCH (pg)	12-20	14.51±0.13	15.13±0.13	15.39±0.18	10.180	0.000*	15.24±0.16	14.73±0.11	7.592	0.007*	14.90±0.13	14.93±0.14	0.033	0.857
MCHC (g/dL)	31-39	38.07±0.18	37.96±0.25	37.86±0.19	0.247	0.781	37.62±0.17	38.19±0.16	5.410	0.022*	38.02±0.14	37.93±0.22	0.119	0.731
RDW (%)	24-27	33.77±0.29	34.63±0.22	34.85±0.25	4.502	0.014*	34.67±0.24	34.09±0.22	2.834	0.096	34.42±0.22	34.12±0.25	0.762	0.385
PLT (10^9/L)	100-350	152.08±4.98	148.31±4.52	138.24±7.54	1.480	0.234	150.35±5.43	145.82±4.05	0.510	0.477	148.10±4.40	146.77±4.78	0.040	0.842
MPV (fL)	5.6-8.3	3.29±0.58	4.55±0.67	5.45±0.69	2.907	0.060	5.91±0.48	3.23±0.48	13.246	0.000*	3.98±0.49	4.52±0.60	0.489	0.486

Abbrevetion: WBC: White Blood Count, RBC: Red Blood Count, MCV: Mean Corpuscular Volume, MCH: Mean Corpuscular Hemoglobin, MCHC: Mean Corpuscular Hemoglobin Concentration, RDW: Red Cell Distribution Width, PLT: Platelet, MPV: Mean Platelet Volume (Weiss & Wardrop, 2011).

*: $p<0.05$, Differences between groups are statistically significant.

Table 2. *Biochemistry values of healthy horses according to breed, age, and gender (Mean ± Standard deviation)*

Parameter (Unit)	Reference Ranges	3 years and younger	4 years old	5 years and over	F	P	Female	Male	F	P	Thoroughb-red	Arabian	F	P
		X±S	X±S	X±S			X±S	X±S			X±S	X±S		
AST (U/L)	226-336	322.26±10.75	296.69±12.03	257.67±11.98	7.281	0.001*	250.77±8.64	325.80±8.24	34.593	0.000*	289.63±9.86	312.06±10.22	2.357	0.128
ALP (U/L)	143-395	169.95±6.65	131.92±4.91	137.95±18.92	4.847	0.010*	133.94±11.80	160.05±6.23	4.638	0.034*	143.06±8.70	161.69±7.00	2.408	0.125
GGT (U/L)	4.5–32.5	31.26±2.21	30.81±2.57	27.00±2.33	0.801	0.452	25.10±1.67	32.89±1.86	7.847	0.006*	30.55±1.85	29.40±2.11	0.164	0.687
LDH (U/L)	162-412	252.95±8.84	212.69±10.87	185.05±9.61	12.199	0.000*	181.97±6.21	247.81±7.74	34.585	0.000*	217.42±8.14	232.47±10.29	1.337	0.251
CK (U/L)	60-330 (Merck)	189.44±5.27	222.65±63.30	137.86±9.67	1.298	0.278	131.55±5.49	218.07±29.55	4.758	0.032*	166.77±6.54	216.20±46.82	1.568	0.214
LA (mg/dL)	1,11-1,78	0.94±0.06	0.90±0.07	0.82±0.06	0.812	0.448	0.81±0.05	0.94±0.05	3.192	0.078	0.92±0.46	0.86±0.60	0.642	0.425
TP (g/L)	52,0-79,0	59.44±0.46	60.69±0.77	62.55±0.86	5.442	0.006*	62.29±0.67	59.61±0.44	12.030	0.001*	60.81±0.50	60.27±0.65	0.448	0.505
ALB (g/L)	26-37	37.13±0.44	36.63±0.39	35.24±0.62	3.731	0.028*	35.01±0.44	37.41±0.31	20.560	0.000*	36.46±0.39	36.62±0.41	0.071	0.791
CREA (mg/dL)	1,2-1,9	1.56±0.04	1.48±0.04	1.47±0.06	1.355	0.264	1.43±0.04	1.56±0.03	6.025	0.016*	1.55±0.04	1.47±0.04	2.280	0.135
BUN (mg/dL)	10-24	14.79±0.48	14.12±0.50	13.81±0.65	0.920	0.403	13.81±0.52	14.65±0.38	1.741	0.191	14.84±0.40	13.63±0.48	3.865	0.053
Ca (mg/dL)	11,2-13,6	11.62±0.06	11.65±0.06	11.61±0.06	0.136	0.873	11.61±0.05	11.64±0.05	0.104	0.748	11.66±0.05	11.58±0.05	1.549	0.217
Mg (mg/dL)	2,2-2,8	2.33±0.06	2.40±0.09	2.27±0.06	0.711	0.494	2.30±0.07	2.36±0.05	0.368	0.546	2.40±0.06	2.25±0.05	3.469	0.066
Phos (mg/dL)	3,1-5,6	3.87±0.12	3.52±0.14	3.20±0.16	6.028	0.004*	3.33±0.14	3.75±0.10	6.323	0.014*	3.65±0.12	3.52±0.11	0.607	0.438

Abbrevetion: AST: Aspartate Aminotransferase, ALP: Alkaline Phosphatase, GGT: Gamma Glutamyl Transferase, LDH: Lactate Dehydrogenase, CK: Creatinine Kinase, LA: Lactic Acide, TP: Total Protein, ALB: Albumin, CREA: Creatinine, BUN: Blood Urea Nitrogen, Ca: Calcium, Mg: Magnesium, Phos: Phosphate (Kaneko et al., 2008; Merck, 2022).

*: $p<0.05$, Differences between groups are statistically significant.

MCH from the hemogram parameters and the values of AST, ALP, LDH, TP, ALB, and P from the biochemical parameters were significant according to both age and gender factors (Table 1 and Table 2).

DISCUSSION

Blood parameters are frequently used for clinical examination, routine control, and to investigate the presence of disease. It is reported that hematological and biochemical tests, which are routinely used in human medicine, can also be widely used in veterinary medicine for the evaluation of diagnosis and treatment (Babaeski, 2023). In this context, hematological and biochemical parameters have an important place in the evaluation of racehorse health (Waller et al., 2009). There are numerous studies indicating that hematological and/or biochemical parameters are influenced by factors such as race, age, gender, nutritional level, type of activity, and physiological condition (Adamu et al., 2013; Arslan et al., 2002; Ayhan & Gürgöze, 2024; Benashour et al., 2024; Bonhomme et al., 2023; Bos et al., 2018; Çetelioğlu et al., 2001; Demirel et al., 2022; Fazio et al., 2011; Güzelbektaş et al., 2006; Harris et al., 1998; Kedzierski et al., 2009; Oktay & Eren, 2014; Tepeoglu, 2018).

In the present study, the mean values of WBC, NEU, MCV, MCH, and MPV were higher in Arabian Horses than in Thoroughbreds, but there was no statistically significant difference between the breeds ($p>0.05$). Similar to the results of this study, Bilal & Meral (2002) found no statistically significant difference in erythrocyte phase indices (MCV, MCH, MCHC) in Thoroughbred and Arabian horses in terms of breed in their study conducted at Veliefendi Hippodrome in Istanbul. Demirtaş (2018) conducted a study at the Istanbul Veliefendi Hippodrome and found that RBC, Hb, and HCT values were statistically significantly higher in 3-year-old Thoroughbreds than Arabian horses. This study evaluated that the lack of difference in terms of race may be due to the geographical location and altitude difference between the Adana and Istanbul regions.

In this study, WBC, LYM, NEU, MCV, MCH, and RDW parameters were found to be statistically significant in racehorses ($p<0.05$). MCV, MCH, and MCHC are routine erythrocyte indices commonly used in the clinic (Zhang et al., 2022). It was determined that at four years of age and above, WBC and LYM values were significantly lower compared to three years of age and below, and NEU, MCH, MCV, and RDW values were high (Table 1). The height determined in WBC and LYM values in foals compared to the older horses is in line with many research findings (Ayhan & Gürgöze, 2024; Cebulj-Kadunc et al., 2002; Lassen & Swardson, 1995; Mikniene et al., 2014; Satue et al., 2020). The decrease in the number of WBCs with advancing age found in the study was determined by Mcfarlane et al. (2001); as reported, it can be explained by a decrease in the level of immunity due to ageing. In the present study, NEU levels increased with ageing, and LYM levels decreased with ageing. Similar to the results of this study, it has been reported that NEU's are higher in older horses than in young horses (Czech et al., 2019; Jawor et al., 2007), while LYM counts decrease significantly with ageing, leading to a higher NEU/LYM ratio in older horses than in foals (Satué et al., 2010; Smith et al., 2002). This study showed a statistically significant increase in erythrocyte indices (MCV, MCH, and RDW values) with ageing. In this study, the erythrocyte indices MCV, MCH, and RDW values increased statistically significantly with aging. Among these findings, the increase observed in MCV and MCH values with ageing is consistent with the findings of many researchers (Benashour et al., 2024; Cebulj-Kadunc et al., 2020; Hodgson & Rose, 1994; Lassen & Swardson, 1995). In the current study, MCV, RDW, and MCH values were found to be higher during the ageing period. This is thought to result from an increased erythrocyte regeneration rate, which may be attributed to the rise in performance caused by the growing number of races the horses participated in and the higher oxygen demand required for transport.

Regarding gender, WBC, RBC, and MCHC values were higher, and MCV, MCH, and MPV values were lower in male horses than in female horses. In this study, the higher WBC and RBC values in male horses compared to females were found to be compatible with the findings of Cebulj-Kadunc et al. (2002), Kisadere et al. (2019) for WBC values, and Czech et al. (2019), Satue et al. (2020), Tomenendalova et al. (2014), and Weiss & Wardrop (2011) for RBC values. In terms of gender, it has been reported that androgens that stimulate erythropoiesis may be the reason for the high levels of hematological parameters in males compared to females (Kelani & Durotoye, 2002). The fact that the MCHC value was lower in female horses than in male horses is consistent with the literature (Mikniene et al., 2014; Udeh et al., 2021). It has been evaluated that the MCHC value may cause differences due to the physiological characteristics of male and female horses depending on gender. The MCV value was different from Ayhan & Gürgöze (2024), and Udeh et al. (2021), and MCH values were found to be lower in purebred male horses than female horses by Czech et al. (2019), and Weiss & Wardrop (2011), while compatible with Ayhan & Gürgöze (2024), and Udeh et al. (2021) with a difference. The fact that the MPV value was higher in females than in male horses is consistent with the literature (Isovic et al., 2023; Mesaric et al., 2023).

In the pathophysiology of the liver (ALP, GGT, AST, ALT, bilirubin, and albümin), globulin protein tests are important parameters (Comba et al., 2017). When biochemistry values were examined according to age, statistically significant differences were found in AST, LDH, ALP, TP, ALB, and P values ($p<0.05$). It was determined that AST, ALP, LDH, and ALB values decreased with advancing age ($p<0.05$), while TP values increased ($p<0.05$). Moreover, it was found that the values of AST, ALP, LDH, and ALB reached the highest level in those aged 3 and younger (Table 2). While the decrease observed in enzyme levels with advancing age was consistent with AL-Hadithy (2011) for AST and Munoz et al. (2012) for LDH, other researchers (Gürgöze et al., 2010; Halo et al., 2020; Oktay & Eren, 2014). The decrease observed in enzyme levels with advancing age is consistent with AL-Hadithy (2011) and Benashour et al. (2024) for AST and Munoz et al. (2012) for LDH, while it differs from the findings of other researchers (Gürgöze & İçen, 2010; Halo et al., 2020; Oktay & Eren, 2014). In this study, the high ALP levels determined in foals by many researchers (Czech et al., 2019; Gürgöze & İçen, 2010;

Halo et al., 2020; Miglio et al., 2019; Mikniene et al., 2014; Tomenendalova et al., 2014) were consistent with their findings. This situation can be explained by the fact that bone tissue growth is higher in foals, similar to Munoz et al. (2012). Gürgöze & İçen (2010) found that total protein levels were higher in older horses than in foals, and Mikniene et al. (2014) reported that a statistically significant increase in TP was detected with advancing age. Munoz et al. (2012) determined that ALB concentrations were lower in foals than adult horses. The TP and ALB levels obtained in this study are consistent with the researchers' findings. These high ALB concentrations may indicate liver function development (Munoz et al., 2012). The finding obtained at the P level was in line with the findings of other researchers (Gürgöze & İçen, 2010; Mikniene et al., 2014; Oktay & Eren, 2014; Tomenendalova et al., 2014). Braithwaite (1975) reported that young animals achieved much higher absorption rates in dietary phosphorus absorption than older animals. In light of Braithwaite's (1975) report, in this study, it is evaluated that the high P level obtained in foals or the P level decreases with advancing age, and the increased absorption in youth is due to the decreasing bone metabolism with advancing age.

In this study, AST, ALP, GGT, LDH, CK, ALB, CREA, and P values were higher in male horses than females, and TP values were lower in male horses than females. From these findings, AST and TP Mikniene et al. (2014), GGT Tomenendalova et al. (2014), LDH and CK Oktay & Eren (2014), ALB Paden et al. (2014), Mikniene et al. (2014) and CREA, on the other hand, many researchers (Kisadere et al., 2019; Paden et al., 2014; Souza et al., 2016) are consistent with the findings. However, from the study findings, GGT, CREA, P, and TP levels were determined by Oktay & Eren (2014), the ALP level was determined by Oktay & Eren (2014), and Paden et al. (2014); the CK level was determined by Paden et al. (2014); the ALB level was determined by Oktay & Eren (2014), and Mikniene et al. (2014). There was a difference in comparison in terms of gender. In this study, although the levels of AST, CK, and LDH, which are biomarkers of muscle damage, were statistically significantly different between females and males, these values were found to be within the normal reference ranges (Kaneko et al., 2008), and no clinical findings related to muscle damage were observed in horses. It was evaluated that the parameters related to muscle enzymes such as CK, Crea, AST, and LDH were higher in males, which may have been caused by the larger heart and muscle mass in male horses compared to female horses.

It is stated that the reference values of hematological and biochemical parameters of various horse breeds may vary depending on genetic factors, breed, geographical region (climate, altitude, etc.), living, and health conditions (nutritional quality, water availability, parasites, etc.), blood sampling time, analysis methodology, and equipment differences (Gürgöze & İçen, 2010; Paden et al., 2014).

CONCLUSION

Routine checks carried out by specialist veterinarians in hippodromes are important for racehorses' performance. Hemogram and antibiogram values are among the most important elements of these controls. Although Arabian and Thoroughbred are included in the same horse breed, there are differences in blood analysis results according to age, race, and gender.

Veterinarians and horse breeders consider these differences when assessing horses' health status. As a result, in horses that are seen as healthy in clinical examination, it has been concluded that there may be differences in hemogram and biochemistry values in terms of race, age, and gender.

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Conflict of interest

The authors declared that there is no conflict of interest.

Ethical statement or informed consent

The study was conducted with the approval of the Selçuk University Faculty of Veterinary Medicine, Experimental Animal Production, and Research Centre Ethics Committee (SÜVDAMEK, 27.12.2022/TS: 2022-15/KS: 2022/143).

Author contributions

The study was designed by NA and HY. YP collected data. MHS performed the statistical analyses. HY, NA, YP, and MHS writed article. Critical Reviews by NA. All authors read and approved the final version.

Availability of data and materials

All data and materials of the study are available in contact with the corresponsible author.

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