

Effect of Sex on Some Biochemical and Hematological Parameters in Healthy Boer x Hair Goat Crossbreed

Özgür Yaşar ÇELİK*¹, Kıvanç İRAK², Gülşah AKGÜL¹

¹*Siirt University, Faculty of Veterinary Medicine, Department of Internal Medicine, Siirt-TURKEY*

²*Siirt University, Faculty of Veterinary Medicine, Department of Biochemistry, Siirt-TURKEY*

ABSTRACT

The aim of this study was to determine some hematological and biochemical parameters in male and female Boer x hair goat crossbreed (n=34). Blood samples were collected from the jugular vein in sample tubes with and without anticoagulants. A Mindray BC2800 fully-automated device was used to measure the WBC, RBC, Hgb, Hct, MCV, and MCH values and ADVIA 1800 brand auto-analyzer was used to obtain Na, K, Cl, Mg, Ca, Crea, Tp, Alb, Gluo, Chol, Trig, AST, ALT, and ALP values. WBC (p<0.01), RBC (p<0.05), HCT (p<0.01) and MCV (p<0.05) levels were found to be statistically higher in female specimens, while HGB and MCH levels were found to be statistically identical for both sexes. Meanwhile, males had statistically higher levels of K (p <0.001) and Mg (p<0.01) levels compared to females. Crea (p<0.001), Tp (p <0.05), Alb (p<0.05), Gluo (p<0.001) levels were also statistically higher in males, while Chol level was statistically higher in females (p<0.001). No statistically significant variation was detected between the Trig values of the sexes. ALT, ALP activities of males were found to be statistically higher in males than in females (p<0.05). The results of the study revealed that some hematological and biochemical parameters of Boer x hair goat crossbreeds are affected by sex.

Keywords: Boer x Hair goat crossbreed, Biochemical and Hematological Parameters, Sex.

Sağlıklı Boer x Kıl Keçisi Melez Irklarında Cinsiyetin Bazı Hematolojik ve Biyokimyasal Parametreler Üzerine Etkisi

ÖZ

Bu çalışmada, erkek ve dişi Boer x Kıl keçisi melezlerinde bazı hematolojik ve biyokimyasal parametrelerin belirlenmesi amaçlandı. Hayvanların vena jugularisinden antikoagulanlı ve antikoagulanlı tüplere kan örnekleri alındı. WBC, RBC, Hgb, Hct, MCV, MCH değerleri Mindray BC2800 tam otomatik kan sayım cihazında, Na, K, Cl, Mg, Ca, Crea, Tp, Alb, Gluo, Chol, Trig, AST, ALT ve ALP analizleri ADVIA 1800 marka otoanalizörde yapıldı. WBC (p<0.01), RBC (p<0.05), HCT (p<0.01) ve MCV (p<0.05) düzeylerinin dişilerde erkeklere göre istatistiksel olarak daha yüksek olduğu, HGB, MCH düzeyleri karşılaştırıldığında ise istatistiksel olarak iki cinsiyet arasında fark olmadığı belirlendi. K (p <0.001) ve Mg (p <0.01) seviyeleri erkeklerde dişilere göre daha yüksek tespit edildi. Erkeklerde Crea (p <0.001), Tp (p <0.05), Alb (p <0.05), Gluo (P<0.001), düzeyleri dişilere göre yüksek, Chol seviyesi ise dişilerde erkeklerden istatistiksel olarak yüksek bulundu (p <0.001). Cinsiyetler arasında Trig değerleri bakımından fark tespit edilmedi. ALT (p <0.05), ALP (p <0.05) aktiviteleri karşılaştırıldığında erkek hayvanların dişilere göre daha yüksek değerlere sahip olduğu belirlendi. Sonuç olarak, Boer x Kıl keçisi melezlerine ait bazı hematolojik ve biyokimyasal parametrelerin cinsiyetten etkilendiği, bazılarında ise cinsiyet faktörünün etkili olmadığı belirlendi.

Anahtar Kelimeler: Boer x Kıl Keçisi, Biyokimyasal ve Hematolojik parametreler, Cinsiyet.

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ORCID ID: ÖYÇ: 0000-0001-6365-2688, Kİ: 0000-0001-9765-0330, GA: 0000-0003-4804-6502

*Corresponding author e-mail: oyc@siirt.edu.tr

INTRODUCTION

Sheep and goat farming have an important place in Turkey's economy. According to the June 2017 data of the Turkey Statistics Institute (TÜİK), 11 million goats exist in Turkey, 464 thousand of which are positioned in the city of Siirt (Anonymous 2018). While numerous native goat breeds are being raised in different places of Turkey based on the particular location's geographical configuration and climatic conditions, the studies are also being carried on to obtain high-yield crossbreed breeds. Approximately 98% of goats in Turkey are hair goats (Anonymous 2018). In addition to being a combined-product breed, the hair goats have high adaptability to insufficient care and nutrition, and to severe environmental conditions; thus they are bred in all regions of Turkey (Bolacali *et al.* 2017b).

The Boer goat breed was developed in South Africa and was then brought forth to Europe (Casey and Van Niekerk 1988). The most important characteristics of Boer goats are their high genetic potential, extraordinary resistance against diseases, and their ability to adapt to arid climatic and harsh conditions (Malan 2000). Boer goats were imported by numerous countries as a means to increase their overall meat production levels. Boer goats often have been crossbred with Spanish, Ankara, and Nubian goat breeds (Malan 2000; Urge *et al.* 2004). There were also studies to crossbreed hair and Boer goats in Turkey (Bolacali *et al.* 2017a; Bolacali *et al.* 2017b). The determination of the reference values for hematological and biochemical parameters of healthy animals offers valuable reference data for the veterinarian, and are influential in early diagnosis, etiology, and clinical outcome of diseases. Numerous variables like nutrition, stress, temperature, climate conditions, diseases, amount of muscular activity, age, sex, and breed may actively influence the blood parameter levels (Awah and Nottidge 1998; Gündüz 2000; Haliloğlu and Cinar 2004).

Determination of reference values of blood parameters for various breeds is also important. Due to this fact, many studies in the literature inspect biochemical and hematological parameter levels for numerous goat breeds cultivated at various locations all around the world (Rastogi and Singh 1990; Mbassa and Poulsen 1993; Kumar *et al.* 1997; Azab and Abdel-Maksoud 1999; Njidda *et al.* 2013). While there are some studies conducted in Turkey about the determination of various hematological and biochemical parameters in Kilis (Iriadam 2004), Siirt hair (Tanrıtanır *et al.* 2010), and Ankara goats (Aşkın 2013), no such studies exist for Boer x hair goat crossbreeds. The aim of

this study was to investigate some hematological and biochemical blood parameters in male and female Boer x hair goat crossbreeds.

MATERIALS and METHODS

Animal Material

All applicable international, national, and/or institutional guidelines for animal testing, welfare, animal care and use of animals were taken into account and followed by the authors. The material of the study consisted of 17 male (min: 621, max: 687, mean: 663.71 days old), and 17 nonpregnant female (min: 616, max: 689, mean: 663.94 days old) a total of 34 goats raised in Siirt province. All animals were raised under similar condition through intensive *ad-libitum* breeding in a goat farm. The female goats allocated in the study were never been pregnant before.

Hematological and Biochemical Analyzes

Blood samples were collected from jugular veins of animals in the morning into the sample tubes both with and without an anticoagulant. A fully-automated blood panel device (Mindray BC2800, China) was used to measure white blood cell (WBC), red blood cell (RBC), hemoglobin (Hgb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) values in the sample tubes with an anticoagulant. Meanwhile, the samples in the tubes without an anticoagulant were kept in room temperature for 30 minutes, followed by a 10-minute centrifugation in 3000 rpm, after which the serum were transferred into Eppendorf tubes. The sera in these tubes were analyzed using an auto-analyzer (Siemens, ADVIA 1800, Germany) to determine the sodium (Na), potassium (K), chloride (Cl), magnesium (Mg), calcium (Ca), Creatinine (Crea), total protein (Tp), albumin (Alb), glucose (Gluo), cholesterol (Chol), triglyceride (Trig), Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), and Alkaline Phosphatase (ALP) levels.

Statistical Analysis

The obtained data were analyzed using the SPSS 22 package software. Independent Sample T-test was used to determine the statistical variance between male and female group. Results are given as mean \pm SEM (Standard Error Mean). Differences were considered significant when p values were less than 0.05.

RESULTS

Table 1 displays the results of tested hematological parameters for male and female Boer x hair goat crossbreeds. WBC ($p < 0.01$), RBC ($p < 0.05$), Hct ($P < 0.01$), and MCT ($P < 0.05$) levels of female

specimens were found to be statistically higher compared to males', while Hgb and MCH levels were found to be not statistically different between gender.

Table 2 displays the results of biochemical parameters in male and female Boer x hair goat crossbreds. While K ($p<0.001$) and Mg ($p<0.01$) levels of male specimens were found to be statistically higher compared to females, no statistical difference was detected in the Na, Cl, Ca levels between the sexes. Males had statistically higher Crea ($p<0.001$), Tp ($p<0.05$), Alb ($p<0.05$), Gluo ($p<0.001$) levels compared to females, while females had statistically higher Chol ($p<0.001$) level compared to males. No statistical difference was detected in the Trig levels between the sexes. Finally, the ALT ($p<0.05$), and ALP ($p<0.05$) levels of the male specimens were found to be significantly higher compared to females. No statistically significant variation was detected in AST values.

DISCUSSION

It was reported that hematological and biochemical parameters of animals may vary based on factors like breed, age, and sex (Iriadam 2004; Njidda *et al.* 2013; Simsek *et al.* 2015). Determination of the reference levels for these parameters for various animal species or breeds present important guidelines for veterinary practitioners (Aşkın 2013). For goats, the WBC level was reported to be between 4000-13000 μL (Schalm *et al.* 1975; Kramer 2000), and the findings of the present study are higher than these values. WBC levels were determined for Kano Brown goats as 18.3 ± 0.65 ($\times 10^9/\text{L}$) for males and 20.3 ± 1.33 ($\times 10^9/\text{L}$) for females, while in Borno White goats it was determined as 13.3 ± 0.6 ($\times 10^9/\text{L}$) for males and 33.4 ± 0.4 ($\times 10^9/\text{L}$) for females. The relatively high WBC level for the goats was interpreted as a well-developed immune system (Njidda *et al.* 2013). In our study, the WBC level findings are in line with the findings of (Njidda *et al.* 2013), and was determined as (25.28 ± 1.68) in females, higher than that of males (18.23 ± 1.1). It is possible to evaluate the relatively high WBC levels in Boer x Hair goat crossbreds as a characteristic property for the breed.

RBC levels of Boer x hair goat crossbreds in the present study were found to be lower in males ($p<0.05$) compared to females, and that this difference between sexes is thought to be a characteristic of the breed. Similarly, the RBC levels of male Ankara goats were found to be lower than females ($p<0.05$) (Aşkın 2013).

While in this study the hematocrit levels for male and female specimens were within the reference limits of (%22–38) specified by Schalm *et al.* (1975), the females' hematocrit value was higher than the males', and the difference was found to be statistically significant ($p<0.01$). High hematocrit value indicates either an increase in the RBC count in the circulation, or the decrease in the plasma volume (Aşkın 2013). The increase of hematocrit percentage in the present study is in accordance with the increase in RBC count. In Borno White goats (Njidda *et al.* 2013) and in healthy Ankara goats (Aşkın 2013), the hematocrit percentages of females were found to be higher than the females', paralleling the findings of our study. In mature (3+ years of age) Kilis goats, the high hematocrit values ($\% 37.60\pm 1.90$) were interpreted as a characteristic of the breed (Iriadam 2004). Various researchers have reported the hemoglobin values, and particularly hematocrit values, are affected by the altitude of the animals, and their nutrition (Egbe-Nwiyi *et al.* 2000; Adejumo 2004; Addass *et al.* 2010; Isidahomen *et al.* 2010).

Schalm *et al.* (1975) reported on the MCH and Hgb reference values for goats as 5.2-8.0 pg and 8-12 g/dL, respectively. In the present study, the MCH and Hgb levels of male specimens were found as 7.59 ± 0.82 pg and 11.36 ± 1.35 g/dL respectively, and the females' MCH and Hgb levels were determined as 6.94 ± 0.11 pg and 11.22 ± 0.31 g/dL respectively. All of these results are within the reported reference values and no statistically significant variation between sexes was detected for these parameters. This result is in line with the results of the study of Elitok (2012), who reported no statistical difference in terms of MCH and Hgb levels between male and female Saneen goats older than 8 months.

The reference value for MCV for goats is reported as 16-25 g/dL (Schalm *et al.* 1975). In the present study, the level of MCV in male goats was found to be lower (15.61 ± 0.34) than the reported reference limits, while it was found to be within the reference limits (17.01 ± 0.44) for female goats. Adult Ankara female goats were reported to have statistically higher MCV values by Aşkın (2013), while Njidda *et al.* (2013) reported that in Borno White goats (adult males and young females) had statistically higher MCV values compared to their counterparts.

Biochemical parameters help veterinary practitioners to evaluate the health condition and metabolic activities of the animals. Factors like sex and age may influence the physiologic levels of the blood parameters (Yigit *et al.* 2002; Bozdoğan *et al.* 2003; Cenesiz *et al.* 2011). The reference values for Na, Cl, and Ca levels of goats have been reported

as 142-166 mmol/L, 98-110 mmol/L, and 8,9-11,7 mg/dL respectively (Kaneko *et al.* 1997; Karagül *et al.* 2000). In the present study, the levels of Na, Cl, and Ca of the specimens were found to be perfectly within the reference values given in the literature, and no significant differences were detected between the sexes in this regard.

Serum K levels of males were reported to be statistically higher than those of females in Kano Brown, Borno white, and Sokoto red goats by Njidda *et al.* (2013), and for Ankara goats by Aşkın (2013). The findings of the present study are concordant to the findings of the studies of Njidda *et al.* (2013) and of Aşkın (2013). Serum K levels were higher in male Boer x Hair goat crossbreeds compared to females', which could be surmised as a racial characteristic. A literature survey has revealed that only a few studies had inspected Mg levels in goats. The mean Mg levels of specimens determined in the present study were lower than the reference values of 2,8 -3,6 mg/dL reported by Karagül *et al.* (2000). Male specimens having lower Mg values compared to females, however, they are in accordance with the findings of Aşkın (2013).

The serum creatinin levels are affected by factors like the muscle mass, glomerular filtration, and tubular reabsorption (Guignard and Drukker 1999; Otukesh *et al.* 2012). In the present study, the comparison of male and female specimens reveals a similar relative height of male creatinin levels compared to females, which was found to be statistically significant ($p < 0.001$), in line with other studies in literature (Aşkın 2013; Njidda *et al.* 2013). It is possible to interpret the lower amounts of creatinin level in females to the lower muscle mass, which results in lower secretion of creatinin (Alex and Laverne 1983).

Kaneko *et al.* (1997) and Karagül *et al.* (2000) have reported the total protein and albumin values as 6 - 7 mg/dL and 2,7 - 3,9 mg/dL respectively. The findings of the present study are within these reference values, and both parameters were found to be statistically higher in males compared to females ($p < 0.05$). The literature studies also report that Pasmına (Sharma *et al.* 1990) and Raini (Sakha *et al.* 2009) goats' total protein levels vary between sex and are lower in adult females compared to adult males.

Kaneko *et al.* (1997), Karagül *et al.* (2000) and Mert (1996) have reported a glucose level varying

between 50 and 75 mg/dL for goats. In the present study, the females' blood glucose levels ($52,82 \pm 2,51$ mg/dL) were within the reference limits given in the literature, while males' ($101,06 \pm 6,29$ mg/dl) were higher. The statistically relevant ($p < 0.001$) difference between the glucose levels of sexes might be related to the metabolism differences.

Blood cholesterol level reference limits for goats have been reported as 55 - 200 mg/dL in the literature (Karagül *et al.* 2000). In the present study, the female specimens' cholesterol levels were within the reference values, while males were lower ($p < 0.001$). Female Saneen (Elitok 2012) and Kano brown and Sokoto red goats (Njidda *et al.* 2013) were also reported in the literature to have higher cholesterol levels compared to males. Alex and Laverne (1983) have reported that cholesterol levels are influenced by breed, sex, and age.

Elitok (2012) reports that female Saanen goats older than 8 months raised in Afyonkarahisar have higher triglyceride levels compared to males and that the triglyceride level variation between the sexes is statistically insignificant ($p > 0.05$). The findings of the present study are in accordance with the findings of Elitok (2012).

AST is present in numerous tissues of the body but is mostly concentrated in skeletal muscles, cardiac muscles, and in the liver, and its amount can be used as an indicator of tissue damage. Liver damage increases the ALT activity levels. On the other hand, ALP is present in the liver, bones, kidneys, intestines, and placenta, in the form of iso-enzyme groups. It is important to determine the cause of the ALP increase for accurate diagnosis. ALP is known as the most sensitive indicator for cholestasis (Mert 1996). In our study, both sexes had lower AST (167-513 U/L) and ALT (24-83 U/L) activities compared to the values reported in the study of Mert (1996), while the ALP activity levels (93-387 U/L) were within the reference values.

As a result, it was determined that some hematological and biochemical parameters were affected by gender in Boer x Hair goat crossbreeds. The results of this study will hopefully provide useful guide for further studies that will be conducted on Boer x Hair Goat crossbreeds.

Table 1. Results of hematological parameters in male and female Boer x hair goat crossbreds

Parameters	Gender	Mean± SEM	P Values
WBC (x10 ⁹ /L)	Male	18.23±1.1	**
	Female	25.28±1.68	
RBC (x10 ¹² /L)	Male	16.12±0.31	*
	Female	17.60±0.50	
HCT (%)	Male	25.13±0.76	**
	Female	28.99±0.87	
MCH (pg)	Male	7.59±0.82	NS
	Female	6.94±0.11	
HGB (g/dL)	Male	11.36±1.35	NS
	Female	11.22±0.31	
MCV (fL)	Male	15.61±0.34	*
	Female	17.01±0.44	

NS: non-significant (p>0.05), *: p<0.05, **: p<0.01

Table 2. The results of biochemical parameters in male and female Boer x hair goat crossbreds

Parameters	Gender	Mean± SEM	P Values
MINERALS			
Na (mmol/L)	Male	144.24±0.64	NS
	Female	142.29±1.75	
Cl (mmol/L)	Male	103.47±0.80	NS
	Female	100.65±2.04	
Ca (mg\dl)	Male	8.12±0.09	NS
	Female	8.43±0.37	
K (mmol/L)	Male	6.28±0.19	***
	Female	4.18±0.19	
Mg (mg\dl)	Male	2.45±0.08	**
	Female	2.22±0.03	
METABOLITES			
Crea (mg/dL)	Male	0.88±0.04	***
	Female	0.57±0.03	
Tp (g/dL)	Male	7.22±0.12	*
	Female	6.34±0.33	
Alb (g\dl)	Male	3.46±0.04	*
	Female	2.98±0.18	
Gluo (mg\dl)	Male	101.06±6.29	***
	Female	52.82±2.51	
Chol (mg\dl)	Male	46.76±2.66	***
	Female	66.18±4.05	
Trig (mg/dL)	Male	19.59±1.95	NS
	Female	26.24±2.86	
ENZYMES			
AST (U\L)	Male	69.29±2.10	NS
	Female	66.59±3.98	
ALT (U\L)	Male	20.71±0.56	*
	Female	18.35±1.00	
ALP (U\L)	Male	185.35±12.82	*
	Female	139.47±14.16	

NS: non-significant (p>0.05), *: p<0.05, **: p<0.01, ***: p<0.001

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