



biochemical and hematological parameters (Naresk et al. 1997, Iriadam 2004, Kaneko et al. 2008). In addition, different nutritional conditions can cause differences in hematological and biochemical values (Akyuz et al. 2020). Determination of the biochemical and hematological levels is important to specify the patients' health status and follow-up the diseases (Meyer and Harvey 2004, Gürgöze and Gökalp 2018). Breed can effective on hematological and biochemical values in farm animals. Accordingly, the effects of different factors such as the breed and gender on blood values were investigated in the goats (Tanrıtanır et al. 2010, Piccione et al. 2012, Piccione et al. 2014, Balamurugan et al. 2015, Barwary et al. 2016, Madan et al. 2016, Gürgöze and Gökalp 2018). Some blood parameters may give different results between goat breeds, and this may be due to other factors such as environment and altitude (Er and Ok 2020). Hematological evaluations of Gurcu bucks and does were not found in the literature searches. Kuru et al. (2017a) conducted research on the reproductive properties of Gurcu goats. Akyüz et al. (2020) examined the levels of biochemical parameters such as glucose, lactate dehydrogenase, triglyceride, total protein, calcium, aspartate aminotransferase, magnesium, low density lipoprotein in Gurcu goats during different feeding periods. In this study, it is aimed to determine some clinical, hematological, and biochemical parameters in the traditionally fed Gurcu bucks and does. We think that this study will obtain important data on healthy Gurcu bucks and does.

## MATERIALS and METHODS

This study was carried out after the approval (KAU-HADYEK 2020-079) received from Kafkas University Animal Experiments Local Ethics Committee.

The study included clinically healthy Gurcu does (n=15) between the ages of 2-4, not lactating and found to be not pregnant by transrectal ultrasonography, and Gurcu bucks (n=15) between the ages of 2-4, clinically healthy and found to have normal andrological and examination findings. The study was carried out on the bucks and does under the routine feeding conditions at Kafkas University Veterinary Faculty Education, Research, and Application Farm. The rectal temperatures, heart rate, and respiratory rate of the animals were recorded. Ten milliliters of blood was collected by *vena jugularis* venipuncture and amount of 8 milliliters placed in tubes without anticoagulant (BD Vaktainer®, BD, UK) allowed to clot, and centrifuged at 2000 x g for 10 minutes (Hettich Rotina 380R®, Hettich, Germany). After extraction, glucose (mg/dL), calcium (mg/dL), total protein (g/dL), albumin (g/dL), magnesium (mEq/L), phosphorus (mg/dL), urea nitrogen (mg/dL), creatine (mg/dL) concentrations were measured by fully automatic biochemistry device (Mindray BS120®, Mindray Medical Technology, Istanbul, Turkey). Remaining the 2 mL was used for complete blood cell count (CBC) analysis. For CBC analysis, tubes containing K<sub>3</sub>EDTA were used and after sample collection, the analysis was immediately made by a CBC analyser (VG-MS4e®, Melet Schloesing, France) within 30 minutes.

### Statistical analysis

Statistical analysis of the data was done using SPSS® (SPSS 18.0, Chicago, IL, USA) program. In the first step of the statistic evaluation, normality of data distribution was tested by Shapiro-Wilk test. Normally distributed data were analyzed using Independent Samples T-Test. If the data was not normally distributed, data were analyzed by nonparametric Mann-Whitney U tests. Data were

presented as means ± standard error (SEM) and min-max values. Differences were considered significant when  $p < 0.05$ .

## RESULTS

Our results showed that total leukocytes, monocytes, lymphocytes, granulocytes, and platelets were significantly higher in does than bucks. Also, the hematocrit, percent of the granulocytes, and mean platelet volumes were significantly higher in the bucks compare to does (Table 1). Total leukocytes were higher in Gurcu does than Gurcu bucks ( $p < 0.001$ ). Monocytes, lymphocytes, granulocytes counts were found higher in females than males at statistical significance level ( $p < 0.001$ ). On the contrary, the percentage of hematocrit was found to be lower in females compared to males ( $p < 0.001$ ). In addition, platelet count and platelet percentage were higher in females than males ( $p < 0.05$ ). There were no significant differences in the clinical data and serum biochemistry parameters between does and bucks (Table 2). While glucose, total protein, urea nitrogen, creatinine, calcium, phosphorus levels were found higher in females than males, albumin and magnesium levels were found to be low ( $p > 0.05$ ). The hematological, biochemical, and clinical data of all goats (male and female) irrespective of gender were presented in Table 3.

## DISCUSSION

In animals, many features such as environmental factors, geography, gender, age, nutrition and breed cause significant differences in hematological and biochemical parameters (Bhargava 1980, Iriadam 2004, Kaneko et al. 2008, Akyuz et al. 2020). In a study on Kilis goats by Iriadam (2004) total leukocyte, red blood cell, hemoglobin, hematocrit, mean red blood cell hemoglobin concentration, and lymphocyte percentage found to be higher than the results of our study. On the contrary, the average hemoglobin volume, mean red blood cell hemoglobin, granulocyte, and monocyte percentages reported to be lower. It was thought that these differences in blood values could be caused by genetics and environmental factors such as different diet patterns and altitude. In our study, hematological parameters such as total leukocyte, red blood cell count, hemoglobin concentration were found in the reference ranges and it was parallel to the results of the previous study performed by the Jackson and Cockcroft (2002). In addition, our findings showed that the total leukocyte, monocyte, and granulocyte values were found to be higher in females than males, while the low hematocrit value seen in the female gender ( $p < 0.001$ ). These findings may be indicated that gender can be affecting some hematological parameters (Bhargava 1980, Iriadam 2004, Kaneko et al. 2008). We think that changes in blood parameters may occur as a result of the effect of hormonal balance changing depending on the gender. Er and Ok (2020) reported that some blood parameters may be affecting by environmental factors such as altitude. Kaneko et al (2008) have been demonstrated that some hematological parameters such as red blood cell count, hemoglobin concentration, and hematocrit percentage can be affected by altitude and environmental factors. It was concluded that the pressure of the atmosphere decreases as it rises higher and the oxygen molecules in it become sparse, so blood levels may vary depending on the altitude. Therefore, Iriadam (2004), Irak et al. (2017) and so on the

results obtained from our study showed that the number of red blood cells, hemoglobin concentration and the percentage of hematocrit, were found to be different from

each other although they were determined between reference values depending on the effect of both environmental factors and breeds.

**Table 1.** Hematological values of female and male goats in the study

Parameters	Gender	Mean value	Standart error	Minimum value	Maximum value	P value
<b>Total leukocytes count (x10<sup>3</sup>/μL)</b>	Female	11.96	0.32	10.50	14.03	<0.001
	Male	8.19	0.11	7.49	8.71	
<b>Lymphocytes (%)</b>	Female	57.92	1.94	52.40	75.00	0.232
	Male	51.45	4.93	46.10	63.90	
<b>Monocytes (%)</b>	Female	14.31	0.90	6.40	17.20	<0.001
	Male	7.65	0.24	6.20	8.90	
<b>Granulocytes (%)</b>	Female	27.77	1.21	18.60	33.90	0.002
	Male	33.57	1.25	28.80	44.20	
<b>Lymphocytes count (x10<sup>3</sup>/μL)</b>	Female	6.96	0.41	5.75	10.52	<0.001
	Male	4.82	0.15	3.62	5.46	
<b>Monocytes count (x10<sup>3</sup>/μL)</b>	Female	1.67	0.09	0.89	2.00	<0.001
	Male	0.62	0.02	0.53	0.73	
<b>Granulocytes count (x10<sup>3</sup>/μL)</b>	Female	3.30	0.13	2.62	4.17	0.001
	Male	2.75	0.08	2.32	3.32	
<b>Red blood cell count (x10<sup>6</sup>/μL)</b>	Female	14.22	0.46	12.43	18.13	0.350
	Male	18.46	0.29	16.72	19.93	
<b>Mean red cell volume (fL)</b>	Female	21.63	0.34	18.90	23.00	0.488
	Male	21.34	0.25	19.40	22.30	
<b>Hematocrit (%)</b>	Female	30.56	0.76	26.70	35.10	<0.001
	Male	39.42	1.06	32.40	44.20	
<b>Mean erythrocyte hemoglobin (pg)</b>	Female	6.17	0.11	5.50	6.60	0.074
	Male	6.48	0.13	5.42	6.90	
<b>Mean erythrocyte hemoglobin volume (g/dL)</b>	Female	28.71	0.34	26.20	30.90	0.450
	Male	26.79	2.45	23.50	31.20	
<b>Erythrocyte distribution width (fL)</b>	Female	12.78	7.52	11.10	14.50	0.345
	Male	12.55	0.23	11.50	14.20	
<b>Hemoglobin (g/dL)</b>	Female	7.32	0.80	6.10	10.10	0.360
	Male	8.75	1.32	7.20	11.50	
<b>Platelet count (x10<sup>3</sup>/μL)</b>	Female	370.80	29.21	167.00	509.00	0.014
	Male	287.60	6.00	250.00	318.00	
<b>Mean platelet volume (fL)</b>	Female	4.60	0.04	4.40	4.80	<0.001
	Male	4.83	0.03	4.60	5.00	
<b>Platelets (%)</b>	Female	0.17	0.01	0.08	0.22	0.045
	Male	0.14	0.01	0.12	0.15	
<b>Platelet distribution width (fL)</b>	Female	6.84	0.16	6.20	8.20	0.360
	Male	7.01	0.08	6.50	7.50	

**Table 2.** Clinical and biochemical data of male and female goats in the study

Parameters	Gender	Mean value	Standard error	Minimum value	Maximum value	P value
<b>Body temperature (°C)</b>	Female	38.46	0.14	37.20	39.20	0.234
	Male	38.25	0.09	37.60	38.70	
<b>Pulse rate per minute</b>	Female	91.00	3.63	72.00	120.00	0.836
	Male	90.13	2.01	76.00	96.00	
<b>Respiratory rate per minute</b>	Female	28.33	1.41	22.00	36.00	0.534
	Male	29.33	0.72	24.00	32.00	
<b>Glucose (mg/dL)</b>	Female	48.04	1.99	31.77	59.18	0.588
	Male	46.05	3.04	30.93	65.73	
<b>Total Protein (g/dL)</b>	Female	7.40	0.13	6.32	7.96	0.529
	Male	7.26	0.19	6.23	8.23	
<b>Albumin (g/dL)</b>	Female	2.49	0.08	1.94	3.01	0.326
	Male	2.64	0.12	1.84	3.63	
<b>Blood urea nitrogen (mg/dL)</b>	Female	26.11	1.04	20.03	32.09	0.784
	Male	25.73	0.94	20.34	31.09	
<b>Creatinine (mg/dL)</b>	Female	0.68	0.05	0.45	1.10	0.536
	Male	0.64	0.04	0.42	0.92	
<b>Calcium (mg/dL)</b>	Female	8.78	0.22	7.14	9.62	0.383
	Male	8.47	0.28	6.28	9.60	
<b>Magnesium (mg/dL)</b>	Female	2.72	0.08	2.04	3.18	0.229
	Male	2.83	0.04	2.62	3.09	
<b>Phosphorus (mg/dL)</b>	Female	4.41	0.13	3.63	5.13	0.722
	Male	4.35	0.12	3.57	5.32	

**Table 3.** Hematological, biochemical and physical data of all goats in the study

Parameters	Mean value	Standard error	Minimum value	Maximum value
<b>Total leukocyte count (x10<sup>3</sup>/μL)</b>	10.07	0.39	7.49	14.03
<b>Lymphocytes (%)</b>	54.69	2.67	46.10	75.00
<b>Monocytes (%)</b>	10.98	0.77	6.20	17.20
<b>Granulocytes (%)</b>	30.67	1.01	18.60	44.20
<b>Lymphocytes count (x10<sup>3</sup>/μL)</b>	5.89	0.29	3.62	10.52
<b>Monocytes count (x10<sup>3</sup>/μL)</b>	1.15	0.11	0.53	2.00
<b>Granulocytes count (x10<sup>3</sup>/μL)</b>	3.03	0.09	2.32	4.17
<b>Red blood cell count (x10<sup>6</sup>/μL)</b>	16.34	0.48	12.43	19.93
<b>Mean red cell volume (fL)</b>	21.49	0.21	18.90	23.00
<b>Hematocrit (%)</b>	34.99	1.04	26.70	44.20
<b>Mean erythrocyte hemoglobin (pg)</b>	6.32	0.09	5.50	6.90
<b>Mean erythrocyte hemoglobin volume (g/dL)</b>	27.75	1.23	23.50	31.20
<b>Erythrocyte distribution width (fL)</b>	12.66	3.76	11.10	14.50
<b>Hemoglobin (g/dL)</b>	8.04	0.77	6.10	11.50
<b>Platelet count (x10<sup>3</sup>/μL)</b>	329.20	16.56	167.00	509.00

Mean platelet volume (fL)	4.71	0.03	4.40	5.00
Platelets (%)	0.15	0.01	0.08	0.22
Platelet distribution width (fL)	6.92	0.09	6.20	8.20
Body temperature (°C)	38.36	0.09	37.20	39.20
Pulse rate per minute	90.57	2.04	72.00	120.00
Respiratory rate per minute	28.83	0.78	22.00	36.00
Glucose (mg/dL)	47.05	1.80	30.93	65.73
Total Protein (g/dL)	7.33	0.11	6.23	8.23
Albumin (g/dL)	2.56	0.07	1.94	3.63
Blood urea nitrogen (mg/dL)	25.92	0.69	20.03	32.09
Creatinine (mg/dL)	0.66	0.03	0.45	1.10
Calcium (mg/dL)	8.62	0.17	6.28	9.62
Magnesium (mg/dL)	2.77	0.05	2.04	3.18
Phosphorus (mg/dL)	4.38	0.09	3.67	5.12

The glucose concentration was measured as as 53.88 mg/dL and 44.44 mg/dL in Angora and Aleppo does, respectively (Gürgöze and Gökalp 2018). Additionally, glucose concentration was found to be 80.33 mg/dL in Baladi bucks (Abd El-Maksoud et al. 2012). In the presented study, the mean (does and bucks) glucose concentration was determined as 47.04 mg/dL. The mean glucose concentration of bucks was measured as 46.05 mg/dL. The bucks glucose concentration in our study may have found different from Abd El-Maksoud et al. (2012) for reasons such as care, breed, nutrition, altitude, environmental factors. The average glucose concentration obtained in our study was found to be compatible with the literature (Gürgöze and Gökalp 2018). The reference values of total protein were reported to vary between 6.2–7.9 g/dL in goats (Jackson and Cockcroft 2002). Total protein and albumin concentration in female Saanen goats were reported as 7.40 g/dL and 3.73 g/dL, respectively (Marutsova and Binev 2020). Average total protein concentration in the Gaddi goats was determined as 9.41 g/dL (Naresk et al. 1997), and 8.65 g/dL in the Kilis goats (Iriadam 2004). In the present study, the total protein concentration was determined as 7.40 g/dL in does, 7.26 g/dL in bucks, and irrespective of the gender was 7.33 g/dL. These values for goats were found in the reference ranges stated by Jackson and Cockcroft (2002). Although the total protein level in our study is within normal limits, we think that differences may occur depending on breed and gender. Mean albumin concentration was found to be 2.56 g/dL in our study, and it was lower than the results stated by the Marutsova and Binev (2020). As mentioned in the literature, different concentrations of total protein and albumin may originate from the breed properties (Bhargava 1980, Iriadam 2004, Kaneko et al. 2008). Er and Ok (2020) have been determined the average creatine concentration as 0.56 mg/dL and the urea nitrogen concentration as 24.23 mg/dL in healthy goats. In our study, these values were 0.66 mg/dL and 25.92 mg/dL for creatinine and urea nitrogen respectively and it was similar to the values reported by Jackson and Cockcroft (2002). Calcium, magnesium, and phosphorus concentrations were determined as 9.99 mg/dL, 4.39 mg/dL, and 5.94 mg/dL, respectively in the one-year-old Baladi goats (Abd El-Maksoud et al. 2012). In our study,

the mean calcium, magnesium, and phosphorus concentrations of both male and female goats were determined as 8.62 mg/dL, 2.77 mg/dL, and 4.37 mg/dL, respectively. Also, in the male gender, these values were measured as 8.46 mg/dL, 2.83 mg/dL, 4.34 mg/dL, respectively. Abd El-Maksoud et al. (2012) found that calcium, magnesium, and phosphorus concentrations of the bucks were higher than our results. Significant differences in the biochemical parameters may have been caused by many factors such as the gender and age (Naresk et al. 1997, Iriadam 2004, Kaneko et al. 2008).

## CONCLUSION

The origin of the Gurcu goats is the Caucasus and this local breed has been adapted to the harsh climatic conditions. In the present study, some clinical, hematological and biochemical parameters of the Gurcu goats were evaluated. Our results reveal that gender is an effective factor in the measured parameters. In light of the present study, the characteristics of this breed goat will be better understood. With this study, the physiological limits of the hematological and biochemical parameters of the Gurcu goat will be better understood.

## CONFLICT of INTEREST

The authors declare that they have no conflict of interest.

## REFERENCES

- Abd El-Maksoud HAA, Tahia E, Ahmed El-Kharadly WA (2012). Biochemical alterations of experimentally induced hypomagnesaemia in male baladi goats. *BVMJ*, 23 (1), 19-25.
- Akyüz E, Ölmez M, Kuru M, Merhan O, Makav M, Ögün M, Bozokluhan K, Naseri A, Uzlu E, Gökçe G (2020). Dişi gürcü keçilerinde mera öncesi, merada ve mera sonrası dönemde bazı biyokimyasal parametrelerin değerlendirilmesi. *Dicle Üniv Vet Fak Derg*, 13 (1), 33-38.
- Balamurugan R, Durgalakshmi R, Sheeba A (2015). Effect of gender on certain serum biochemical parameters of desi goats in cauvery delta region. *J Anim Nutr and Physiol*, 1, 34-36.
- Barwary MS, Alkass JE, Ahmed SJ (2016). Studies on the effect of selenium and vitamins on some haematological and biochemical parameters in female meriz goats. *J Univ Duhok Agri Vet Sci*, 19 (1), 210-215.

- Batu S (1951)**. Türkiye Keçi Irkları. Ankara Üniversitesi Veteriner Fakültesi Yayınları, Ankara, Türkiye.
- Bhargava SC (1980)**. Haematological studies in goats. *Indian Vet J*, 57, 485-486.
- Er C, Ok M (2020)**. Determination the levels of some biochemical parameters in female hair goats in çukurova region. *Kocatepe Vet J*, 13 (1), 25-29.
- Gürgöze S, Gökçalp E (2018)**. Şanlıurfa yöresi Ankara tiftik ve halep keçi ırklarına ait bazı biyokimyasal kan parametreleri ile malondialdehit düzeylerinin tespiti. *Harran Üniv Vet Fak Derg*, Özel Sayı, 19-23.
- Irak K, Karakoç Z, Mert H, Çelik ÖY, Akgül G, Mert N (2017)**. Relationship between blood iron levels and some liver enzymes and histology in hairy goat crossbred. *Van Vet J*, 28 (3), 145-149.
- İriadam M (2004)**. Kilis keçilerine ait bazı hematolojik ve biyokimyasal parametreler. *Ankara Üniv Vet Fak Derg*, 51, 83-85.
- Jackson P, Cockcroft P (2002)**. Clinical examination of farms animals. Blackwell Science Ltd, Malden, USA.
- Kaneko JJ, Harvey JW, Bruss ML (2008)**. Clinical biochemistry of domestic animals. 6<sup>th</sup> (Ed), Academic Press, San Diego.
- Kuru M, Boğa Kuru B, Kulaksız R, Arı UÇ, Oral H (2017a)**. Gürcü keçilerinin bazı reproduktif özellikleri. *Harran Üniv Vet Fak Derg*, 6 (2), 119-125.
- Kuru M, Boğa Kuru B, Kulaksız R, Arı UÇ, Oral H (2017b)**. Abaza keçilerinde progesteron destekli östrus senkronizasyonunun bazı reproduktif parametrelere etkileri. *Kocatepe Vet J*, 10 (3), 164-171.
- Kuru M, Kulaksız R, Oral H (2018)**. Determination of gestational age by measuring defined embryonic and fetal parameters with ultrasonography in abaza and gürçü goats. *Acta Vet Brno*, 87 (4), 357-362.
- Madan J, Sindhu S, Gupta M, Kumar S (2016)**. Hematobiochemical profile and mineral status in growing beetal goats kids. *J Cell Tissue Res*, 16 (1), 5517-5522.
- Marutsova VJ, Binev RG (2020)**. Changes in blood enzyme activities and some liver parameters in goats with subclinical ketosis. *Bulg J Vet Med*, 23 (1), 70-79.
- Meyer DJ, Harvey JW (2004)**. Veterinary Laboratory Medicine. Interpretation and Diagnosis, 3<sup>rd</sup> (Ed), WB Saunders Company, Philadelphia.
- Naresk K, Rastogi SK, Singh SP, Tyagi SK, Kumar N (1997)**. Variation in leucocytic count some plasma biochemical constituents due to age and sex in gaddi goats. *Indian J Anim Sci*, 67, 312-313.
- Piccione G, Messina V, Vazzana I, Dara S, Giannetto C, Assenza A (2012)**. Seasonal variations of some serum electrolyte concentrations in sheep and goats. *J Comp Clin Pathol*, 21, 911-915.
- Piccione G, Monteverde V, Rizzo M, Vazzana I, Assenza A, Zumbo A, Niutta PP (2014)**. Reference intervals of some electrophoretic and haematological parameters in Italian goats, comparison between gírgentana and aspromontana Breeds. *J Appl Anim Res*, 42 (4), 434-439.
- Tanrıtanır P, Ceylan E, Dede S (2010)**. Sağlıklı Siirt kıl keçilerinde doğum öncesi ve doğum sonrası bazı kan parametrelerinin araştırılması. *YYU Vet Fak Derg*, 21 (2), 103-105.