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Honamli Goats Breed in South of Turkey I- Serum Mineral Analysis[#]

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ABSTRACT

The objectivity of this study was to investigate some blood minerals and parameters in Honamli goats reared under semi-intensive conditions. 90 goats (2-4 ages) in different three herds kept under similar manage mental conditions were chosen as research materials in Teke Border of Antalya Province. Serum Ca 6.786±0.206 mg/dL, P 4.094±0.173 mg/dL, Cl 111.105±0.582 mmol/L, K 4.519±0.066 mmol/L, Mg 2.161±0.05 mg/dL, Na 148.047±0.508 mmol/L, Fe 110.706±2.510 µg/dL, UIBC 155.025±4.333 µg/dL and Tp 7.055±0.120 g/dL were determined by Roche Diagnostics, Cobas 8000 modular analyser series, immunoassay. After then, total iron- binding capacity (TIBC), transferrin (Tf), transferrin saturation (TSAT) and Ca++ levels were calculated from each other using different biochemical formulas. Ratios between the some minerals were calculated and presented in the text. Also, very high significant differences (P<0.0001) were found between herds for P, Cl, TIBC and Tf. However, no significant differences were found for Ca, Na, TSAT, TP and Ca results. Coefficients of variation (CV) were within 2 % and 35 % for all outcome parameters. In Pearson correlation analysis, negative and different two significant values (P<0.01 and P<0.001) were calculated between Fe and unsaturated iron binding capacity (UIBC) for all analysed groups. Controversially, positive and very high significant correlations (P<0.0001) were detected between Cl and Na. The results obtained from this study could serve as reference values for Honamli goats breeding in Mediterranean Region of Turkey.

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Introduction

Quite a large number of known minerals that necessary for breeding of sheep (*Ovis aries*) and goat (*Capra hircus*) are responsible for ensuring the proper orderly functioning of organisms (Ogunleke et al., 2014). When the level of minerals in the blood falls below normal, all of the organism's resistance, health, functioning and production mechanisms are gradually affected (Anonymous, 2018a).

It is generally accepted that the formation of mineral deficiency depends on 3 main factors. Firstly, the most common cause of deficiencies is inadequate quality of traditional grazing meadows (Kawas et al., 2010; Xin et al., 2011). Secondary causes of mineral deficiencies are known as deficiencies caused by absorption problems in the digestive system and the adverse effects of some other minerals. Mg is in efficiently absorbed from the rumen. High Mg deficiency causes Grass tetany (Lactation tetany) in sheeps and goats. As an example of tertiary cause, it can be shown that the amount of K in the diet and the amount of excess Ca affect the Mg absorption. The other an important point related with body cover of sheep and goat, similar to some other animals' cover, the appearance and analysis values of wool, hair and mohair are indicative of the mineral level of these organism. Also this situation contains reflects especially both food and nutrition quality (Patkowska-Sokola et al., 2009). The fleece-eating, associated with mineral imbalances and deficiencies, is quite common an important health problem leading financial losses in small ruminants. This clinical disease is particularly located at very low levels of blood S and Mo in small ruminants. If the organism has these inadequacies, it may need to be identified at some other important mineral levels such as Ca, P, Fe, Mn, Zn, Cu, Co and Se (Patkowska-Sokola et al., 2009). Because in consequence this inadequacy in minerals instinctively creates an act of eating wooll in small ruminants.

As an another example of interaction between minerals is Fe. The Fe, a necessary trace element, involved in a large number of biological processes (Dlouhy and Outten, 2013; Yee and Tolman, 2015) is the effective in transition processes in metabolism in all living organisms. From other side, Fe level in blood is important because of prevents uptake of other some minerals that are in very small quantities, such as Zn. Because minerals interact with each other and with other food items. In the meantime, excessive intake of a mineral can cause the lack of another food item. For these reasons, it is necessary to be sure that ruminant animals are healthy, to know their various blood mineral levels and to be use cation when nutritional supplement is necessary. In the case of such a requirement, only a healthy interpretation can be made when the reference intervals for blood mineral levels are known.

This study was carried out in Antalya (36° 47' 12.728" N and 31° 26' 28.615" E) located in the Teke region and at elevation 61 meters above sea level, where Honamli goats are grown extensively. This geographical region includes both Antalya and Burdur, Isparta, Mugla, Denizli. Honamli goats are heavily cultivated by the nomads in this region. The Honamli nomads spend winter months in the Mediterranean region, especially in the provinces of Antalya's districts: Serik, Manavgat, Alanya and spend summer months on the Toros Plateau and south of Konya as wandering. The Mediterranean climate that dominates this region is dependent on the Summer heats, the Sun rays, the drought and downward air movements. In addition, annual temperature average is 18 °C, snow and frost are very rare in winter months. While amount of maximum rainfall occurs in winter months, amount of minimum level rainfall occurs in summer months. Actually, the plant cover in this area is the forest. But, Makis are formed by the destruction of this forests in low areas (0-800 m). Maki is a plant community that can tolerate summer drought and grows from short dwarf trees like Mersin, Laurel, Olive, Oleander, Carob.

This study was conducted in February month when, Honamli goats gain to the most benefit from the Maki plant coverings and had high amounts of milk yield. In this way, some mineral values of healthy Honamli goats raised under native husbandry practice in Antalya Teke Plateau calculated and presented. Thus, it is aimed to serve as a reference source for future work.

Materials and Methods

Randomly selected 30 Honamli goat, from among 2-4 years old, known be healthy and free of external, internal and blood parasites bred at the three different herds were main material of this study. Also, each herds had similar maintenance and feeding conditions.

Blood samples were collected from goats in order to see and associate with blood minerals values. For this purpose, standard method was done during the blood collection process, and blood samples were taken from the goats via jugular venipuncture using a 5 mL syringe. These samples were then transferred in tubes without anticoagulants for serum removed. Samples guarded in the cold chain were brought to the laboratory to be centrifuged. In the laboratory, centrifugation was performed at standard room temperature for 10 minutes at 1500 g. Obtained serums by this process were transferred to polypropylene micro centrifuge tubes for subsequent biochemical analyses and stored at -20°C in the deep freeze.

Mineral values were determined at ppm level using Roche Diagnostics, Cobas 8000 modular analyser series (Bieglmayer et al., 2004) in the biochemistry laboratory at the University of Health Sciences, Education and Research Hospital in Van, Turkey. For this purpose, concentrations of the substances to be identified were made by subtracting the measurement curve after calibrating using the device's standard concentration values. Standard solutions were used for calibration procedures (Demir et al., 2011). After then, total iron-binding capacity (TIBC), transferrin (Tf), transferrin saturation (TSAT) and Ca++ levels were calculated from each other using different biochemical formulas (Anonymous, 2018b; c) as reported by Kunish and Small (1970) and were presented in the below.

$$TIBC = Fe + UIBC$$
$$Ca^{++} = (Ca \times 6 - TP/3) / TP + 6 \text{ (Raphael, 1983)}$$
$$TSAT = Fe / TIBC \times 100$$
$$Tf = Fe \times 71.24 / TSAT$$

However, calculated results to be in accordance with the literature were presented as mg/dL for Ca, P, Mg; µg/dL for Fe; mmol/l for Cl, K and Na. Data were analysed using variance procedure (SPSS Base 7.5 for Windows 1997). Significant differences at a probability of ($P<0.05$) were compared using Duncan’s procedure of the same software. Then, the relationships between minerals were analyzed to put forward for revealing with Pearson Correlation Coefficient at the significant level of $P<0.05$.

Results

Mean concentration ± standard error (x±Sx), minimum-maximum (min-max), median and CV values (%) of serum minerals and their derivatives were presented in Table 1. When the mineral values were examined, it was determined that there was no statistical significant ($P>0.05$) between the groups in terms of Ca, Na, TSAT, TP and Ca++ values, while three different level statistical significant between the groups were significant in K and Fe levels ($P<0.05$); Mg and UIBC level ($P<0.01$); P, Cl, TIBC and Tf level ($P<0.001$). It was determined that the highest values of parameters except P and K were in the 1st herd. At the statistically significant parameters, while the Fe (67.768±0.438 mg/dL) value of total herd was close to the value of 1st herd, all of the other mineral's (P, Cl, K, Mg, UIBC, TIBC, Tf) values were close to the values of 2nd herd. According to these results, most of the values of the total herd can be considered to represent with 2nd herd's values. Moreover, when the median values were examined, the 2nd herd had the closest values to the total herd for P, K, Mg, Fe, UIBC, TIBC, TSAT and Tf. Furthermore, the CV % (Coefficient of variation) values has been found undesirably high levels except Cl (4.884 %) and Na (3.197 %) in this study (Table 1).

Table 1. Mineral levels and derivatives in serum samples

	Herd	N	Mean±Std. E	Min-Max	Median	% CV	P
Ca mg/dl	1	25	7.342±0.299^a	4.510-9.580	7.260	20.335	0.101^{NS}
	2	29	6.295±0324^a	1.680-9.940	6.410	27.673	
	3	22	6.804±0.438^a	2.560-9.800	6.970	30.199	
	Total	76	6.786±0.206	1.680-9.940	6.830	26.460	
P mg/dl	1	29	3.197±0.111^c	2.130-4.510	3.190	18.649	0.0001***
	2	29	4.036±0.164^b	2.900-6.700	3.930	21.814	
	3	13	6.222±0.476^a	2.740-8.930	5.680	27.593	
	Total	71	4.0935±0.173	2.1300-8.930	3.660	35.677	
Cl mmol/l	1	30	114.830±1.175^a	106.700-140.600	114.050	5.604	0.0001***
	2	30	109.260±0.654^b	102.400-118.600	108.750	3.278	
	3	27	109.015±0.678^b	96.000-116.300	109.000	3.233	
	Total	87	111.105±0.582	96.000-140.600	109.800	4.884	
K mmol/l	1	30	4.269±0.075^b	3.420-5.180	4.240	9.658	0.0143*
	2	30	4.583±0.148^a	3.250-6.350	4.490	17.694	
	3	27	4.729±0.090^a	4.060-5.890	4.670	9.910	
	Total	87	4.519±0.066	3.250-6.350	4.460	13.679	
Mg mg/dl	1	27	2.366±0.105^a	0.010-3.010	2.400	22.965	0.0034**
	2	27	2.169±0.073^a	1.280-2.910	2.230	17.541	
	3	22	1.900±0.095^b	1.060-2.650	2.060	23.484	
	Total	76	2.161±0.057	0.010-3.010	2.255	22.828	
Na mmol/l	1	30	148.903±1.173^a	142.200-176.000	147.800	4.314	0.2437^{NS}
	2	30	146.907±0.590^a	137.400-155.700	146.800	2.197	
	3	29	148.363±0.721^a	132.000-154.100	148.800	2.524	
	Total	89	148.047±0.508	132.000-176.000	147.900	3.197	
Fe µg/dl	1	29	112.786±3.762^a	67.600-144.100	115.100	17.963	0.0166*
	2	29	115.479±3.932^a	77.800-175.000	111.500	18.337	
	3	14	96.507±4.996^b	64.600-130.600	99.050	19.370	
	Total	72	110.706±2.510	64.600-175.000	110.950	19.236	
UIBC µg/dl	1	29	165.735±6.524^a	107.500-230.800	165.400	21.200	0.0031**
	2	30	160.037±6.984^a	61.300-240.500	155.600	23.902	
	3	18	129.417±7.454^b	67.100-175.400	131.200	24.436	
	Total	77	155.025±4.333	61.300-250.500	155.800	24.527	
TIBC µg/dl	1	28	278.796±5.857^a	211.700-344.700	290.400	11.116	0.0001***
	2	29	276.648±6.572^a	217.100-361.400	274.300	12.793	
	3	14	224.186±7.613^b	166.400-269.800	227.450	12.706	
	Total	71	267.151±4.570	166.400-361.400	269.800	14.415	
TSAT %	1	28	40.911±1.543^a	22.930-54.040	42.505	19.956	0.6332^{NS}
	2	29	42.253±1.670^a	24.840-74.060	41.860	21.286	
	3	14	43.599±2.540^a	28.050-59.680	44.895	21.798	
	Total	71	41.989±1.034	22.930-74.060	41.960	20.742	
Tf g/l	1	28	180.037±4.685^a	126.360-232.760	189.320	13.771	0.0001***
	2	29	178.319±5.258^a	130.680-246.120	176.440	15.878	
	3	13	136.686±6.568^b	90.120-172.840	140.360	17.326	
	Total	70	171.274±3.666	90.120-246.120	172.840	17.908	
TP g/dl	1	29	7.242±0.115^a	7.210-8.780	7.180	8.526	0.0911^{NS}
	2	29	6.722±0.125^a	4.270-8.270	6.700	9.978	
	3	26	7.218±0.298^a	2.730-9.410	7.625	21.033	
	Total	84	7.055±0.120	2.730-9.410	7.120	14.412	
Ca^{++}	1	25	3.135±0.119^a	1.992-4.014	3.201	18.957	0.3169^{NS}
	2	27	2.878±0.129^a	1.624-4.253	2.813	23.328	
	3	22	2.838±0.199^a	0.924-4.437	2.904	32.943	
	Total	74	2.953±0.086	0.924-4.437	2.925	25.012	

UIBC= unsaturated iron binding capacity, TIBC= total iron-binding capacity, TSAT= transferrin saturation, ^{NS} P>0.05 * P<0.05 ** P<0.01 *** P<0.001, ^{a,b,c} Differences between the values involving different letters in the same column were found to be statistically significant at P<0.05

The results of mineral ratios of this study were shown in Table 2. According to this, the proportional values of the 6 minerals (Ca, P, Mg, Na, K, Fe) known to be effected at high levels of each other were presented as 4 groups (Ca/P, Ca/Mg, Na/K, P/Fe). Moreover, while Ca/P, Ca/Mg, P/Fe ratios obtained by making necessary calculations were presented in mg/dL, Na/K in mmol/L in Table 2. In the presented study, the most common mineral proportions in terms of biochemical interactions were calculated as Ca/P 1.666, Ca/Mg 3.233, Na/K 32.792 and P/Fe 42.51.

Mineral ranking of 7 minerals analysed in the serum samples according to the obtained results were shown in Table 3. Ranking, on the converted value in mg/dL was made by calculating. Also, it was seen that the mineral rating was the same for all herds. According to this, Cl was at the highest level, while Fe was at the lowest level at all herds. And rankings were as follows: Cl>Na>K>Ca>P>Mg>Fe

In Table 4, the results of correlation of the data obtained from this study were presented. In this instance, correlations were analyzed for each herd and total. 78 main correlation groups were seen in the presented correlation table. Positive statistical significances at the highest level (P<0.001) were between Ca-Ca++, P-K, Cl-Na, Fe-TSAT, UIBC-TIBC, UIBC-Tf and TIBC-Tf. Also, when the table was examined, it was clear that there were negative correlations as well as positive correlations. According to this, negative statistical significances at the highest level (P<0.001) were between UIBC-TSAT, TIBC-TSAT, TSAT-Tf. Besides, low level positive correlations (P<0.05) were between Ca-TP, Cl-TIBC, Cl-Tf, Na-Fe, Fe-TIBC and Fe-Tf. The other hand, different levels negative statistical significant in total herd were between P-Cl, Fe-UIBC (P<0.05); UIBC-TSAT (P<0.001); TBC-TSAT, TSAT-Tf (P<0.001).

Table 2. Mineral proportions in serum samples

Herd	Mineral proportion							
	N	Ca/P	N	Ca/Mg	N	Na/K	N	P/Fe
		mg/dl		mg/dl		mmol/l		mg/dl
1	25	2.319	25	3.144	30	34.880	29	28.292
2	28	1.551	26	2.999	30	32.055	29	35.096
3	11	1.077	23	3.600	27	31.538	11	64.144
Total	64	1.666	74	3.233	87	32.792	69	42.511

Table 3. Mineral ranking in serum samples

Herd	Mineral ranking (mg/dl)												
	1		2		3		4		5		6		7
1	Cl	>	Na	>	K	>	Ca	>	P	>	Mg	>	Fe
2	Cl	>	Na	>	K	>	Ca	>	P	>	Mg	>	Fe
3	Cl	>	Na	>	K	>	Ca	>	P	>	Mg	>	Fe
Total	Cl	>	Na	>	K	>	Ca	>	P	>	Mg	>	Fe

Discussion and Conclusion

Some of the topics such as morphological characteristics (Alizadehasl and Unal, 2011; Elmaz et al., 2012a; Gok et al., 2015), descriptive characteristics (Gok et al., 2011; Elmaz et al., 2012), improvement studies (Gok et al., 2014a), genetic (Gok et al., 2011; Gok et al., 2014b) and fattening performance-carcass characteristics (Aktas et al., 2015) have been studied on Honamli goats by some researchers in the last 10 years. Despite that, the only study of the biochemical values of Honamli goats belonged to Devrim et al. (2015). These researchers studied on the values of alkaline phosphatase (ALP), alanine transaminase (ALT), aspartate transaminase (AST), creatine kinase (CK), calcium, cholesterol, creatinine, iron, magnesium, phosphorus, total lipids, triglycerides and uric acid on Honamli and Native Hair goats during pubertal development. In this presented study, the results obtained and the varieties presented by them are extensively mentioned.

Calcium: In this study, the mean Ca value of the total herd was 6.786±0.438 mg/dL. Moreover, the minimum-maximum Ca values ranged from 1.680 to 9.940 mg/dL, and no statistical significant (P>0.05) was between 3 Honamli herds.

Devrim et al. (2015) reported that the Ca values in 12 months old Honamli goats were 11.21±0.19 mg/dL. It was also transferred that no statistical significant (P>0.05) found in Ca level in 4, 8 and 12 months old Honamli goats. Sovende et al. (2008), reported as Ca 5.39±0.21 mmol/L the result of blood minerals of Wad goats grazing in the natural pastures. In another study (Fujihara et al., 2006) conducted blood mineral concentration of grazing goats in Luzon Island of Philippines, it was reported that Ca level as 94.58±2.61 mg/L and 100.03±3.34 mg/L in the dry and wet season, respectively. But Ca result presented by Fujihara et al. (2006) were higher than critical level reported by McDowell (1985) in the same study as Ca 90 mg/L. While the level of Ca in this study was lower than study conducted by Devrim et al (2015), it was higher than Sovende et al (2008). On the other hand, Ca level in the total of 3 herds was found to be lower compared to the one reported by Fujihara et al. (2006), while result was higher than critical level reported by McDowell (1985). Also, no statistical significant (P>0.05) between 3 Honamli herds were found like as a similar result of Devrim et al. (2015).

Phosphor: In this presented study, the mean P value of the total herd was 4.094±0.173 mg/dL. Moreover, the minimum-maximum P values ranged from 2.130 to 8.930 mg/dL, and a fairly high level statistical significant (P<0.001) was between 3 Honamli herds.

Devrim et al. (2015) state that P levels in 12 months old Honamli goats were as 6.43±0.33 mg/dL in they study. In addition, a statistical significant (P<0.05) between 4, 8 and 12 months old Honamli goats has been reported. Sovende et al. (2008) reported the result of P of Wad goats as 3.48±0.12 mmol/L. On the other hand, Fujihara et al. (2006) examined blood mineral levels of goats in Luzon Island of Philippines and, they were reported that P levels were 65.14±3.38 mg/L and 63.59±3.37 mg/L in the dry and wet season, respectively. In relation to this mineral results obtained from the study, P levels were higher than reported critical level P 40 mg/L by McDowell (1985) in the same study. However, the P value of this presented study is very close to the values reported by Sovende et al. (2008) and reported as critical by McDowell (1985). However, defined P value was also lower than both the value declared by Devrim et al. (2015) and studied on Wad goats by Fujihara et al. (2006). Whereas, P level in the total of 3 herds in this study was found to be lower compared to the ones reported by Fujihara et al. (2006).

Table 4. Correlation levels of minerals and derivatives in serum samples

	H	N	P	N	Cl	N	K	N	Mg	N	Na	N	Fe
Ca	1	25	-0.218^{NS}	25	-0.273^{NS}	25	-0.197^{NS}	25	-0.243^{NS}	25	-0.465*	25	-0.391*
	2	28	-0.132^{NS}	29	0.236^{NS}	29	0.211^{NS}	27	0.145^{NS}	29	0.102^{NS}	28	0.367^{NS}
	3	10	0.240^{NS}	22	-0.043^{NS}	22	0.2629^{NS}	21	0.320^{NS}	22	0.106^{NS}	12	0.370^{NS}
	T	63	-0.163^{NS}	76	0.066^{NS}	76	0.072^{NS}	73	0.076^{NS}	76	-0.080^{NS}	65	0.077^{NS}
P	1			29	-0.060^{NS}	29	0.360^{NS}	27	0.115^{NS}	29	0.129^{NS}	29	0.242^{NS}
	2		1.000	29	-0.132^{NS}	29	0.281^{NS}	26	-0.001^{NS}	29	0.116^{NS}	29	0.088^{NS}
	3			13	0.147^{NS}	13	0.815***	9	0.280^{NS}	13	0.337^{NS}	10	0.306^{NS}
	T			71	-0.0250*	71	0.425***	62	-0.203^{NS}	71	0.114^{NS}	68	-0.098^{NS}
Cl	1					30	0.523**	27	-0.012^{NS}	30	0.895***	29	0.196^{NS}
	2				1.000	28	0.192^{NS}	28	0.290^{NS}	26	0.757***	28	0.379*
	3					27	0.322^{NS}	22	-0.043^{NS}	27	0.842***	14	0.049^{NS}
	T					87	0.094^{NS}	76	0.196^{NS}	87	0.795***	72	0.226^{NS}
K	1							27	0.280^{NS}	30	0.560***	29	0.184^{NS}
	2						1.000	27	-0.361^{NS}	30	-0.010^{NS}	29	0.249^{NS}
	3							22	-0.138^{NS}	27	0.269^{NS}	14	0.278^{NS}
	T							76	-0.181^{NS}	87	0.190^{NS}	72	0.176^{NS}
Mg	1									27	0.177^{NS}	27	0.370^{NS}
	2								1.000	27	0.340^{NS}	26	0.012^{NS}
	3									22	0.058^{NS}	12	-0.494^{NS}
	T									76	0.183^{NS}	65	0.193^{NS}
Na	1											29	0.352^{NS}
	2										1.000	29	0.457*
	3											14	0.233^{NS}
	T											72	0.301*
Fe	1												
	2												1.000
	3												
	T												
	H	N	UIBC	N	TIBC	N	TSAT	N	Tf	N	TP	N	Ca++
Ca	1	25	0.380^{NS}	24	0.200^{NS}	24	-0.456*	24	0.200^{NS}	25	0.613***	25	0.976***
	2	29	-0.144^{NS}	28	0.077^{NS}	28	0.266^{NS}	28	0.077^{NS}	28	0.404*	27	0.985***
	3	14	-0.110^{NS}	12	0.240^{NS}	12	0.163^{NS}	11	0.255^{NS}	22	-0.104^{NS}	22	0.977***
	T	68	0.067^{NS}	64	0.118^{NS}	64	-0.000^{NS}	63	0.141^{NS}	75	0.267*	74	0.975***
P	1	29	0.080^{NS}	28	0.249^{NS}	28	0.059^{NS}	28	0.250^{NS}	29	0.176^{NS}	25	-0.300^{NS}
	2	29	0.343^{NS}	29	0.426*	29	-0.191^{NS}	29	0.426*	28	-0.419*	26	0.227^{NS}
	3	13	-0.415^{NS}	10	-0.098^{NS}	10	0.416^{NS}	10	-0.098^{NS}	13	-0.530^{NS}	10	0.212^{NS}
	T	71	-0.171^{NS}	67	-0.113^{NS}	67	-0.036^{NS}	67	-0.113^{NS}	70	-0.313**	61	-0.121^{NS}
Cl	1	29	0.010^{NS}	28	0.138^{NS}	28	0.069^{NS}	28	0.138^{NS}	29	0.200^{NS}	25	-0.338^{NS}
	2	28	-0.042^{NS}	28	0.176^{NS}	28	0.241^{NS}	28	0.176^{NS}	27	0.069^{NS}	26	0.299^{NS}
	3	18	0.056^{NS}	14	0.361^{NS}	14	-0.130^{NS}	13	0.365^{NS}	26	-0.165^{NS}	22	-0.066^{NS}
	T	77	0.105^{NS}	71	0.251*	71	0.023^{NS}	70	0.248*	84	0.074^{NS}	74	0.032^{NS}
K	1	29	0.178^{NS}	28	0.327^{NS}	28	-0.041^{NS}	28	0.327^{NS}	29	0.211^{NS}	25	-0.266^{NS}
	2	30	0.284^{NS}	29	0.440*	29	-0.024^{NS}	29	0.440*	29	0.143^{NS}	27	0.205^{NS}
	3	18	-0.352^{NS}	14	-0.250^{NS}	14	0.415^{NS}	13	-0.252^{NS}	26	-0.484*	22	0.229^{NS}
	T	77	0.031^{NS}	71	0.187^{NS}	71	0.057^{NS}	70	0.213^{NS}	84	-0.113^{NS}	74	0.050^{NS}
Mg	1	27	-0.160^{NS}	26	0.065^{NS}	26	0.293^{NS}	26	0.065^{NS}	27	-0.134^{NS}	25	-0.234^{NS}
	2	27	-0.095^{NS}	26	-0.335^{NS}	26	0.006^{NS}	26	-0.034^{NS}	27	0.093^{NS}	26	0.136^{NS}
	3	14	0.123^{NS}	12	-0.274^{NS}	12	-0.282^{NS}	11	-0.277^{NS}	22	-0.066^{NS}	21	0.314^{NS}
	T	68	0.078^{NS}	64	0.208^{NS}	64	0.011^{NS}	63	0.208^{NS}	76	-0.114^{NS}	72	0.100^{NS}
Na	1	29	-0.094^{NS}	28	0.122^{NS}	28	0.226^{NS}	28	0.122^{NS}	29	0.116^{NS}	25	-0.516**
	2	30	-0.159^{NS}	29	0.088^{NS}	29	0.361^{NS}	29	0.088^{NS}	29	0.017^{NS}	27	0.280^{NS}
	3	18	0.232^{NS}	14	0.579*	14	-0.119^{NS}	13	0.585*	26	-0.034^{NS}	22	0.042^{NS}
	T	77	-0.056^{NS}	71	0.137^{NS}	71	0.167^{NS}	70	0.144^{NS}	84	0.066^{NS}	74	-0.089^{NS}
Fe	1	29	-0.503**	28	0.084^{NS}	28	0.819***	28	0.084^{NS}	29	0.007^{NS}	25	-0.432*
	2	29	-0.413*	29	0.150^{NS}	29	0.801***	29	0.150^{NS}	28	0.082^{NS}	26	0.479*
	3	14	-0.458*	14	0.147^{NS}	14	0.781***	13	0.150^{NS}	14	0.1113^{NS}	12	0.358^{NS}
	T	72	-0.277*	71	0.280*	71	0.723***	70	0.274*	71	-0.097^{NS}	63	0.154^{NS}
UIBC	1			28	0.818***	28	-0.905***	28	0.818***	29	0.316^{NS}	25	0.357^{NS}
	2		1.000	29	0.838***	29	-0.866***	29	0.838***	29	-0.121^{NS}	27	-0.080^{NS}
	3			14	0.812***	14	-9.03***	13	0.812***	18	0.367^{NS}	14	-0.185^{NS}
	T			71	0.845***	71	-0.850***	70	0.843***	76	0.139^{NS}	66	0.109^{NS}
TIBC	1					28	-0.499**	28	1.000***	28	0.388*	24	0.135^{NS}
	2				1.000	29	-0.461*	29	1.000***	28	-0.013^{NS}	26	0.200^{NS}
	3					14	-0.492^{NS}	13	1.000***	14	0.543*	12	0.141^{NS}
	T					71	-0.447***	70	1.000***	70	-0.033^{NS}	62	0.208^{NS}
TSAT	1							28	-0.499**	28	-0.208^{NS}	24	-0.458^{NS}
	2						1.000	29	-0.461*	28	0.082^{NS}	26	0.283^{NS}
	3							13	-0.491^{NS}	14	-0.245^{NS}	12	0.220^{NS}
	T							70	-0.446***	70	-0.073^{NS}	62	0.014^{NS}
Tf	1									28	0.388*	24	0.135^{NS}
	2								1.000	28	-0.013^{NS}	26	0.200^{NS}
	3									13	0.712**	11	0.146^{NS}
	T									69	0.018^{NS}	61	0.219^{NS}
TP	1											25	0.428*
	2										1.000	27	0.136^{NS}
	3											22	-0.303^{NS}
	T											74	-0.001^{NS}

H: Herd, T: Total, UIBC= unsaturated iron binding capacity, TIBC= total iron-binding capacity, TSAT= transferrin saturation, NS $P > 0.05$ * $P<0.05$ ** $P<0.01$ *** $P<0.001$

Chloride: In this study, the mean Cl value of the total herd was 111.105±0.582 mmol/L. Moreover, the minimum-maximum Cl values ranged from 96.000 to 140.600 mmol/L, and a fairly high level statistical significant (P<0.001) was between 3 Honamli herds.

In the study conducted by Piccione et al. (2010), determining the reference values in Girgentana goats, Cl levels varied 103.40±1.09 mmol/L, 103.90 ± 0.56 mmol/L and 106.60±1.45 mmol/L in 3 groups (1-2, 3-4 and 5-6 years), respectively. This indicates that the age factor did not significantly affect the Cl level, but the Cl level had a fairly high level statistical significant (P<0.001) between 3 Honamli herds in this study.

Potassium: In this presented study, the mean K value of the total herd was 4.519±0.066 mmol/L. Moreover, the minimum-maximum K values ranged from 3.250 to 6.350 mmol/L, and a statistical significant (P<0.05) was between 3 Honamli herds.

The control group of Altug et al. (2013) had a higher value Na (5.30±0.55 mEq/L) than the presented study's value (4.519±0.066 mmol/L).

Magnesium: In this study, the mean Mg value of the total herd was 2.161±0.057 mg/dL. Moreover, the minimum-maximum Mg values ranged from 3.250 to 6.350 mg/dL, and a high statistical significant (P<0.01) was between 3 Honamli herds. Devrim et al. (2015) detected that 12 months old Honamli goats had both 3.03±0.12 mg/dL Mg level and a statistical significant (P<0.05) between 3 groups. Besides, Sovende et al. (2008) reported that the blood minerals of Wad goats grazing in the natural habitat were Mg 0.72±0.03 mmol/L. On the other hand, Fujihara et al. (2006) reported that Mg levels were 30.05±1.11 mg/L and 29.40±1.09 mg/L, in the dry and wet season respectively. Fujihara et al. (2006) reported higher Mg values than reported by McDowell (1985) as Mg 15 mg/L. Mg levels in the total of 3 herds were found to be lower compared to the ones reported by Fujihara et al. (2006), while results were higher than critical levels reported by McDowell (1985) in the presented study. In spite of the fact that, there is no difference between the results Devrim et al. (2015), Fujihara et al. (2006) and this study.

Sodium: In this presented study, the mean Na value of the total herd was 148.047±0.508 mmol/L. Moreover, the minimum-maximum Na values ranged from 132.000 to 176.000 mmol/L, and no statistical significant (P>0.05) was between 3 Honamli herds.

In a study conducted by Altug et al. (2013) on Native goats with chronic fluorosis, the serum Na level of the control group was determined as 142.1±11.5 mEq/L. These two study's results overlap with each other.

Iron: In this study, the mean Fe value of the total herd was 148.047±0.508 μg/dL. Moreover, the minimum-maximum Fe values ranged from 132.000 to 176.000 μg/dL, and a statistical significant (P<0.05) was between 3 Honamli herds.

AL-Dujaily and AL-Hadithy (2014) explained Fe level of normal goats as 11.8±0.22 μmol/L. When this unit is translated, the following result is obtained: 244.306 μg/dL. Which can be said to be quite high compared to the value obtained as a result of this study. On the other hand, Devrim et al. (2015) reported that no statistical difference (P>0.05) between the level of blood Fe levels was in the 4, 8 and 12 month old Honamli goats. At the same time, 12 month old goats blood Fe levels was defined as 143.3±3.91 μg/dL by them. Which coincides with the result of the study and can be used to refer to the value of healthy goats.

UIBC: In this presented study, the mean UIBC value of the total herd was 155.025±4.333 μg/dL. Moreover, the minimum-maximum UIBC values ranged from 61.300 to 250.500 μg/dL, and a high statistical significant (P<0.01) was between 3 Honamli herds.

There is no evidence in the literature about the value of UIBC in goats. In a study conducted in sheep, serum Fe level has been associated with birth. And in the same study, Cihan et al. (2016) calculated UIBC levels as 265.7±26.3 μg/dL in non-pregnant sheep. In another study conducted on Awassi sheep, this level was 149±5 μg/dL (Al-Hadty and Al-Badawi, 2012). Based on this, it can be said that the result of this study is closer to the result of Awassi sheep.

TIBC: In this study, the mean TIBC value of the total herd was 267.051±4.570 μg/dL. Moreover, the minimum-maximum TIBC values ranged from 166.400 to 361.400 μg/dL, and a fairly high statistical significant (P<0.001) was between 3 Honamli herds.

In the study conducted by AL-Dujaily and AL-Hadithy (2014) for the evaluation of some biochemical parameters in anemic goats, the TIBC level in the control group of female goats was 90.1±0.86 μmol/L. It was found that AL-Dujaily and AL-Hadithy (2014) had 7 times more TIBC value on the control group's goats than this study result when the units were converted (1 μg/dL = 20.703934 μmol/L) of these two results. Against this, Cihan et al. (2016), found that TIBC values of non-pregnant sheep were 477.8±13.6 μg/dL, which supports that the TIBC result of this study can be referenced.

TSAT: In this presented study, the mean TSAT value of the total herd was 41.989±1.034 %. Moreover, the minimum-maximum TSAT values ranged from 22.930 to 74.060, and no statistical significant (P>0.05) was between 3 Honamli herds.

Also, AL-Dujaily and AL-Hadithy (2014) calculated the TSAT was 13.1±0.25 % in normal goats, and they have found that this level has fallen considerably in iron-deficient anaemic goats (4.1±0.23%). Also, the value already presented in this study was close to this reference value of normal goats.

Tf: In this study, the mean Tf value of the total herd was 171.274±3.666 g/L. Moreover, the minimum-maximum Tf values ranged from 90.120 to 246.120 g/L, and no statistical significant (P>0.05) was between 3 Honamli herds.

There is no evidence in the literature about the value of Tf in goat. But, Tf measurement at the body is very important for detection of serum Fe concentration, iron saturation and particularly body iron deposits. Despite this, serum Fe and TIBC values not included in the sensitive tests are widely used to determine the Fe status. In addition, serum Fe is known to be a direct measure of transferrin-bound iron. For this reason, TIBC is considered as an indirect measure of Tf concentration. While a small number of studies have been found related with Tf level (Thoren-Tholling and Martinsson, 1974; Lampreave and Pineiro, 1992; Ilic et al., 2006), many other researchers (Kozat et al., 2006; Eltain 2008; Merhan and Ozcan, 2010; AL-Dujaily and AL-Hadithy, 2014) prefer to use the TSAT value in their study.

TP: In this presented study, the mean TP value of the total herd was 7.055±0.120 g/dL. Moreover, the minimum-maximum TP values ranged from 2.730 to 9.410 g/dL, and no statistical significant (P>0.05) was between 3 Honamli herds.

Cepeda-Palacios et al. (2018) reported that the blood serum TP level was 8.1±0.8 g/dL in total herd, when the post-kidding group TP values was 7.4±1 g/dL. Also this study result was quite close to result declared by Cepeda-Palacios et al. (2018). These researchers declared that there was no statistical significant (P>0.05) between breed groups (Anglonubian, Saanen X Anglonubian), whereas physiological stage (pregnancy, post-kidding, control) had a statistical significant (P<0.05). Here, pregnancy and control groups had similar values and TP value in the post-kidding group decreased was saw. Chen et al. (1999) reported that the reduction of blood serum protein (TP), especially γ-globulin, in Nubian goats promotes breast secretion. Although the goat breeds studied are different, Tp values of this study were similar declared by Cepeda-Palacios et al. (2018). Kaneko et al. (1997) reported that change in serum proteins levels with age is an important in the interpretation of serum proteins. In corroborates this opinion, no statistical significant (P>0.05) was between 3 Honamli herds in the same age group (adult) related with TP levels of this study.

Ca++: In this study, the mean Ca+ + value of the total herd was 2.953±0.086 mg/dL. Moreover, the minimum-maximum Ca++ values ranged from 0.924 to 4.437 mg/dL, and no statistical significant (P>0.05) was between 3 Honamli herds. Also, The importance of determining Ca++ level is that Ca is the physiologically active form and 50-55% of total Ca is found in this form.

Studies on the biochemical and haematological values of goats still continue, but still less than the number of sheep. However, these values of animals are very important in terms of nutrition, reproductive characteristics and relation to disease. Moreover, as presented in this study, besides mineral values, formula calculations, ratio of minerals to each other, mineral ranking and finally correlation values of the data can be needed in interpreting the literature. As a result, serum mineral levels at Honamli goats were within the physiological reference ranges in this presented study. Assuming no difference between the herds, it is considered that the results of the analyses are important in terms of expressing the clinical values of healthy Honamli goats and will be a reference to new studies.

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