

RESEARCH ARTICLE

ARAŞTIRMA MAKALESİ

# Reference Values for Hematological and Biochemical Parameters in Saanen Goats Breeding in Afyonkarahisar Province

Bülent ELİTOK\*

Kocatepe Vet J (2012) 5 (1): 7 - 11

**Key Words**

Afyonkarahisar  
Biochemistry  
Hematology  
Saanen Goat

**Anahtar Kelimeler**

Afyonkarahisar  
Biyokimya  
Hematoloji  
Saanen Keçisi

Afyon Kocatepe Üniversitesi  
Veteriner Fakültesi  
İç Hastalıkları AD  
AFYONKARAHİSAR

\* Corresponding author

Email:

elitok1969@hotmail.com

Tel: 90 (272) 228 13 12

**S U M M A R Y**

The aim of the study was to determine various hematological and blood biochemical changes in Saanen goats breeding in Afyonkarahisar Province near Kütahya Border. Seventy two Saanen goats aged between < 1 month and four years in their different ages and gender come from one commercial herd were used in the present study. Clinically healthy animals were monitored for hematological and biochemical parameters. The blood samples of each group were analysed in terms of erythrocyte and leukocyte counts, haemoglobin concentration, haematocrit, MCH, MCV and MCHC values. In addition, serum total protein, albumine, glucose, urea, creatinine, total cholesterol, LDL, HDL, triglyceride and total bilirubin concentrations were determined. Serum AST, ALT, ALP and GGT levels were also detected. The results obtained from this study could serve as reference values for Saanen goats breeding in Turkey and the other countries having similar climatical and nutritional conditions.

●●●

## Afyonkarahisar İlinde Yetiştirilen Saanen Keçilerinin Hematolojik ve Biyokimyasal Referans Değerleri

**ÖZET**

Bu çalışmanın amacı Kütahya sınırına yakın, Afyonkarahisar ilinde yetiştirilen Saanen keçilerinin değişik hematolojik ve biyokimyasal değişikliklerini saptamaktır. Bu çalışmada bir aydan küçükten 4 yaşına kadar olan farklı yaş ve cinsiyetteki 72 Saanen keçisi kullanılmıştır. Klinik olarak sağlıklı oldukları belirlenen hayvanlarda hematolojik ve biyokimyasal parametreler incelenmiştir. Her bir gruptan alınan kan örneklerinde eritrosit, lökosit sayıları, hemoglobin konsantrasyonları, hematokrit, MCH, MCV ve MCHC düzeyleri analiz edilmiştir. Ayrıca, serum total protein, albümin, glukoz, üre, kreatinin, total kolesterol, LDL, HDL, trigliserid ve total bilirubin konsantrasyonları belirlenmiştir. Aynı zamanda serum AST, ALT, ALP ve GGT düzeyleri de saptanmıştır. Bu çalışmadan elde edilen sonuçlar, Türkiye ve benzer iklim ve beslenme koşullarına sahip diğer ülkelerde yetiştirilen Saanen keçileri için referans değerler olarak kabul edilebilecektir.

## INTRODUCTION

Saanen goats are the largest of the goat dairy breeds. Saanens are white or cream-colored breed of goat. Name of this species derived from Saanen valley in Switzerland. This goat breed produces the most milk on average, and tends to have a lower butterfat content, about 2.5%–3.0%. A Saanen nanny produces milk around 1 gallon (3.8 litres) a day. They typically breed every year, give birth from one to four kids (Smith and Sherman, 2009) Owing to their adaptability to different climatic conditions, one of the most significant characteristics of Saanens, they can adapt to different places easily (Ince 2010, Pugh and Baird 2012).

The gradual increase seen in demand for goat products in the world in recent years has also shown its impact in Turkey, especially Aegean Region where Afyonkarahisar Province is located within this region. Saanen goats were brought to Turkey in 1959 and it is still being raised as pure and crosses. Particularly, the demand for goat milk led to intensive goat breeding in modern facilities instead of breeding under completely extensive conditions. In Turkey, milk goats are raised mainly in Aegean region as well as Marmara and Thrace regions (Günlü and Alaşahan 2010, Ince 2010, Pala et al 2005, Ocak et al 2006).

The aims of this study were to describe hematological and biochemical characteristics of breeding Saanen goat under climatic conditions of Afyonkarahisar Province. However, the data obtained from this study show reference values of clinically normal Saanen goats which have different age and sex.

## MATERIAL AND METHODS

### Animals

This study was conducted on a herd which has 72 Saanen goats aged from 20 days to 4 years on a farm in Afyonkarahisar Region near border of Kütahya Province. In this study, animals were categorised by neonate (< 1 month; 6 female and 7 male, n= 13 totally), nursing (from 1 to 4 months; 6 female and 8 male, n= 14 totally), juvenile (4 to 8 months; 11 female and 8 male, n= 19 totally ) and adult (> 8 months; 14 female and 12 male, n=26 totally ) males and females. In the autumn-winter season, the animals were fed with alfalfa hay, straw, cotton seeds and sugar-beet pulp. In summer wheat bran, straw and barely were added to diet. Goats were kept extensively and spent about 10 hours a day

on pasture at least in summer. The adult females were milked in the morning and in the evening. Their daily production of milk ranged between 3 lt and 5 lt of milk per goat. The animals used in the present study were clinically healthy their general clinical experiments along with rectal temperature, heart and respiratory rates etc. according to Pugh and Baird (2012).

### Hematological Analyses

Blood samples were obtained through jugular vein puncture in vacuum tubes containing EDTA (2 ml) (Hema&Tube®, Turkey) as an anticoagulant for haematology. Hematological parameters including total white blood cell count (WBC count), haematocrit (HCT), haemoglobin (Hgb), red blood cell count (RBC), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV), and mean cell haemoglobin (MCH) were measured by automatic analyzer (Mindray BC 2800) within one hour from sampling.

### Blood Biochemical Analyses

Serum samples were separated by centrifugation (3000 rpm for 20 minutes at 20 °C). The serum samples were collected within an hour centrifugation at 4°C for 15 minutes at 3,000 rpm and stored in plastic tubes at –20°C. Serum biochemical analyses included total protein (TP), urea, creatinine, total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), total bilirubine (TB), triglyceride (TG), glucose (GLU) concentrations, and alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT) and lactate dehydrogenase (LDH) activities were measured by standard methods using commercial kits supplied from Rosche Diagnostics (D-68298, Mannheim, Germany) in Roche Cobas C111 Clinical Chemistry Analyzer.

### Statistical Analyses

The hematological and biochemical values were evaluated independently by using general linear models of ANOVA (SAS/STAT, Version 11.0, SAS Institute Inc, Cary, NC). Differences between each groups were compared by using the Duncan multiple comparison test,  $p < 0.01$  considered significant. Suggested reference values represent 95<sup>th</sup> percentile estimates.

## RESULTS

The effect of age and sex on mean hematological and serum biochemical values of Saanen goats were shown in Table 1 and Table 2, as

well as the data related to arithmetic mean, one standard deviation (SD), 2.5% and 97.5 percentile.

The findings obtained from this study were detailed in the discussion section.

**Table 1.** Hematological Values in Saanen Goats Living in Afyonkarahisar Region Near Border of Kütahya Province.

Values	Neonatal <1 month Mean $\pm$ SD (n=13)	Nursing 1 to 4 months Mean $\pm$ SD (n=14)	Juvenile 4 to 8 months Mean $\pm$ SD (n=19)	Adult male >8 months Mean $\pm$ SD (n=12)	Adult female >8 months Mean $\pm$ SD (n=14)
<b>HEMATOLOGY</b>					
Erythrocyte count $\times 10^{12}/L$	10.25 $\pm$ 0.26 <sup>c</sup>	15.15 $\pm$ 1.18 <sup>bc</sup>	18.23 $\pm$ 2.11 <sup>b</sup>	23.09 $\pm$ 3.63 <sup>a</sup>	23.08 $\pm$ 3.12 <sup>a</sup>
Leukocytes $\times 10^9/L$	8.64 $\pm$ 2.02 <sup>c</sup>	10.31 $\pm$ 2.10 <sup>bc</sup>	14.64 $\pm$ 1.88 <sup>b</sup>	16.44 $\pm$ 2.0 <sup>a</sup>	16.82 $\pm$ 1.98 <sup>a</sup>
Hemoglobin (g/dl)	10.30 $\pm$ 1.01 <sup>c</sup>	11.0 $\pm$ 1.28 <sup>bc</sup>	12.05 $\pm$ 1.11 <sup>a</sup>	12.46 $\pm$ 1.12 <sup>a</sup>	12.38 $\pm$ 1.22 <sup>a</sup>
Packed cell volume (%)	25.42 $\pm$ 1.3 <sup>d</sup>	31.60 $\pm$ 2.0 <sup>c</sup>	35.44 $\pm$ 1.4 <sup>b</sup>	37.42 $\pm$ 1.8 <sup>a</sup>	37.10 $\pm$ 2.4 <sup>a</sup>
MCV (fL)	24.76 $\pm$ 2.21 <sup>a</sup>	20.18 $\pm$ 2.10 <sup>b</sup>	19.41 $\pm$ 2.42 <sup>bc</sup>	16.32 $\pm$ 1.84 <sup>c</sup>	16.14 $\pm$ 2.08 <sup>c</sup>
MCH (pg)	10.42 $\pm$ 0.62 <sup>a</sup>	7.26 $\pm$ 0.81 <sup>b</sup>	6.62 $\pm$ 0.44 <sup>c</sup>	5.36 $\pm$ 0.32 <sup>d</sup>	5.38 $\pm$ 0.28 <sup>d</sup>
MCHC (g/dl)	36.41 $\pm$ 1.2	34.82 $\pm$ 1.3	33.94 $\pm$ 1.1	33.22 $\pm$ 1.2	33.35 $\pm$ 1.3

a,b,c,d Within each hematologic variable, a different superscript (a,b,c,d) indicates the age and sex groups differ ( $p=0.01$ ). Findings are presented as mean  $\pm$  SD.

**Table 2.** Blood Biochemical Values in Saanen Goats Living in Afyonkarahisar Region Near Border of Kütahya Province.

Values	Neonatal <1 month Mean $\pm$ SD (n=13)	Nursing 1 to 4 months Mean $\pm$ SD (n=14)	Juvenile 4 to 8 months Mean $\pm$ SD (n=19)	Adult male >8 months Mean $\pm$ SD (n=12)	Adult female >8 months Mean $\pm$ SD (n=14)
<b>PROTEINS</b>					
Total proteins (g/dl)	63.24 $\pm$ 2.20 <sup>d</sup>	67.53 $\pm$ 2.48 <sup>c</sup>	72.85 $\pm$ 2.14 <sup>b</sup>	76.45 $\pm$ 2.28 <sup>a</sup>	75.76 $\pm$ 2.33 <sup>a</sup>
Albumin (g/dl)	33.20 $\pm$ 0.18 <sup>a</sup>	31.68 $\pm$ 0.38 <sup>b</sup>	29.28 $\pm$ 0.64 <sup>c</sup>	27.45 $\pm$ 0.50 <sup>d</sup>	27.67 $\pm$ 0.48 <sup>d</sup>
<b>METABOLITES</b>	n=13	n=14	n=19	n=12	n=14
Glucose (mg/dl)	42.34 $\pm$ 2.32 <sup>a</sup>	37.28 $\pm$ 1.64 <sup>b</sup>	34.66 $\pm$ 1.03 <sup>c</sup>	31.66 $\pm$ 1.06 <sup>d</sup>	31.08 $\pm$ 1.64 <sup>d</sup>
Cholesterol (mg/dl)	45.34 $\pm$ 2.32 <sup>d</sup>	55.28 $\pm$ 2.85 <sup>c</sup>	58.29 $\pm$ 2.23 <sup>b</sup>	70.36 $\pm$ 2.11 <sup>a</sup>	71.18 $\pm$ 2.04 <sup>a</sup>
Creatinine (mg/dl)	0.56 $\pm$ 0.02 <sup>d</sup>	0.68 $\pm$ 0.02 <sup>c</sup>	0.76 $\pm$ 0.015 <sup>b</sup>	0.84 $\pm$ 0.03 <sup>a</sup>	0.83 $\pm$ 0.02 <sup>a</sup>
Urea (mg/dl)	18.31 $\pm$ 1.12 <sup>d</sup>	26.42 $\pm$ 2.46 <sup>c</sup>	29.64 $\pm$ 2.24 <sup>b</sup>	32.82 $\pm$ 2.11 <sup>a</sup>	33.01 $\pm$ 2.22 <sup>a</sup>
Total bilirubine (mg/dl)	0.1	0.1	0.1	0.1	0.1
Triglyceride (mg/dl)	32.18 $\pm$ 2.41 <sup>d</sup>	36.42.8 $\pm$ 1.80 <sup>c</sup>	45.62 $\pm$ 2.38 <sup>b</sup>	57.96 $\pm$ 3.42 <sup>a</sup>	58.11 $\pm$ 3.10 <sup>a</sup>
LDL (mg/dl)	12.34 $\pm$ 1.31 <sup>d</sup>	16.38 $\pm$ 1.54 <sup>c</sup>	24.13 $\pm$ 2.46 <sup>b</sup>	28.13 $\pm$ 2.34 <sup>a</sup>	28.10 $\pm$ 2.22 <sup>a</sup>
HDL (mg/dl)	41.24 $\pm$ 3.16 <sup>d</sup>	47.50 $\pm$ 3.40 <sup>c</sup>	55.66 $\pm$ 3.34 <sup>b</sup>	64.80 $\pm$ 4.12 <sup>a</sup>	65.10 $\pm$ 4.40 <sup>a</sup>
<b>ENZYMES</b>	n=13	n=14	n=19	n=12	n=14
ALT (IU/L)	25.22 $\pm$ 2.10 <sup>d</sup>	32.16 $\pm$ 13.26 <sup>c</sup>	41.22 $\pm$ 3.34 <sup>b</sup>	49.25 $\pm$ 3.85 <sup>a</sup>	49.28 $\pm$ 3.32 <sup>a</sup>
AST (IU/L)	65.34 $\pm$ 4.68 <sup>d</sup>	76.00 $\pm$ 4.67 <sup>c</sup>	108.16 $\pm$ 5.71 <sup>b</sup>	116.45 $\pm$ 6.43 <sup>a</sup>	115.89 $\pm$ 6.88 <sup>a</sup>
ALP (IU/L)	309.62 $\pm$ 26.34 <sup>d</sup>	235.56 $\pm$ 20.22 <sup>b</sup>	167.34 $\pm$ 16.43 <sup>c</sup>	105.1 $\pm$ 14.6 <sup>d</sup>	103.22 $\pm$ 15.10 <sup>d</sup>
GGT (IU/L)	18.80 $\pm$ 2.24 <sup>d</sup>	22.43 $\pm$ 2.34 <sup>c</sup>	36.23 $\pm$ 2.45 <sup>b</sup>	52.83 $\pm$ 3.44 <sup>a</sup>	53.27 $\pm$ 4.0 <sup>a</sup>

a,b,c,d Within each serum biochemical variable, a different superscript (a,b,c,d) indicates the age and sex groups differ ( $p=0.01$ ). Findings are presented as mean  $\pm$  SD.

## DISCUSSION

Although Saanen goats is a prolific breed and a trait of major economic importance, their hematological and biochemical analyses are not searched extensively in animal breeding in Turkey. To interpret data correctly, the results obtained from laboratory must be compared with values corresponding to the reference values of clinically healthy animals, which serve as a guide evaluation to the clinicians.

Age and sex factors can affect the pattern of these values (Piccione et al 2010, Roubies et al 2006).

The results of the present study showed that higher RBC values in adult goats than in young goats were contrast to the study which was carried out by Daramola et al 2005. The results obtained from this study also showed that leukocyte count was gradually decreased with age. Additionally, age-related changes in MCV were observed, but the trend was not similar to that reported in other studies (Mbassa and Poulsen 1993, İriadam 2004), as MCV was the lowest in the neonatal goats and increased with age due to the decrease in the erythrocyte count. Reference values determined in the present study correspond to those described goats by other researchers (Mbassa and Poulsen 1991). Hb and PCV values (Table 1) in

adult goats in this study were significantly higher when compare to the other groups in which the observed difference in adult and young goats and this is an advantage in terms of the oxygen carrying capacity of the blood. Haematological findings were similarly obtained from a study with Kilis goats by Iriadam (2004).

Determination of reference values of serum biochemical variables were important components of this study. Our biochemical results suggest the following considerations:

Serum AST, LDH and GGT levels were higher in adult group than in the youngest group shown in Table 2. The activity of enzymes such as AST, ALP and GGT, used as indicators of physical stress, heat stroke and hepatocellular injury may be evaluated by measuring AST (Temizel et al 2009, Zubcic 2001), because it has high activity in hepatocytes. At the same time, skeletal muscle tissue has also high AST activity. The cytoplasmatic enzyme, GGT, is the first which increases even in the condition of slight hepatic sufferance (Kaneko et al 1997).

Higher values of ALP were found in the first 40 days of life due to the more intense bone remodeling, and leakage of the enzyme from the growing bones and intestines into the blood (Elitok et al 2004, Kaneko et al 1997). In this study, significant differences were also detected due to both sex and age in accordance with the study of Red Sokoto goats (Tambuwal et al 2002, Daramola et al 2005).

In our study, mean creatinine concentration tend to increase progressively with age in both sexes. Similar findings obtained in a study conducted by Mbassa and Poulsen (1991), creatinine levels increased in the oldest goats and urea levels were higher in young goats than in adult goats. Otherwise, Myer and Ehrich (1992), declared that higher creatinin value in adult animals was correlated with protein metabolism associated with their large muscle mass. Blood urea is present in peripheral blood and has been shown to be an indirect indicator of feed protein composition in farm animals (Houpt 1970).

It was reported that change in serum proteins change with age is an important consideration in the interpretation of serum proteins (Kaneko et al 1997). Albumin values progressively decreasing with age was determined in this study (Table 2). According to Myer and Ehrich (1992), hypoalbuminemia results secondary to the hyperglobulinemia, because increased osmotic

pressure of the blood signals the liver to reduce albumin production.

The results of our study showed decreased glucose level with the aging of goats, which is in accordance with the results obtained by Bogin et al (1981). However, glucose level was significantly affected by onset of puberty as puberty probably involves more intensive energy metabolism. All these differences could be related to the differences in the animals metabolism, needs for milk production and metabolic changes related to the development of the fetus (Azab and Abdel 1999). On the other hand rising glycemia, is obtained only during the anabolic phase of lactation period when energy intake is equal or superior to the energy release (Goff and Horst 1997). In our study, similar finding was detected in the animals which were in lactation period.

The highest total cholesterol and triglyceride levels were obtained from adult group when compare to the other groups ( $P < 0.01$ ) (Table 2). Cholesterol is not affected by feeding system it shows an increasing trend after puberty (Zubcic 2001, Kaneko et al 1997). In fact, It is well known that the NEFA which are released at early lactation following intense fat mobilization, are used hepatically for the synthesis of the triglycerides only if the balance between energy absorbed in the diet and that emitted due to production is not especially deficit (Daramola et al 2005, Zubcic 2001, Iriadam 2004).

In this study, no significant differences were observed in bilirubin values according to age or gender in accordance with the study conducted by Piccione et al (2010).

The data obtained from the present study are the first reference values to be published for Saanen goat breed in Afyonkarahisar and Turkey. This study can increase our understanding of this breed's parameters, which will help veterinarians to interpret the laboratory data appropriately. These analytes from the present study can be used for monitoring health status, diagnosing diseases, improving the management and conservation of the breed as well.

## REFERENCES

- Azab ME. Abdel HA. 1999.** Changes in some haematological and biochemical parameters during prepartum and postpartum periods in female Baladi goats. *Small Rum Res.* 34, 77-85.
- Bogin E. Shimshony A. Avidar Y. Israeli B. 1981.** Enzymes, metabolites and electrolytes levels in

the blood of local Israeli goats. *Zbl. Vet. Med. A.* 28, 135-140.

- Daramola JO. Adeloye AA. Fatoba TA. Soladoye AO. 2005.** Haematological and biochemical parameters of West African Dwarf goats. *Livest. Res. Rural Dev.* 17: 95.
- Elitok B. Elitok ÖM. Gündoğan M. 2004.** Hematological and Biochemical Reference Values of Various Age and Sex in Anatolian Water Buffaloes (*Bubalus bubalus*), *Hayvancılık Araştırma Dergisi.* 14, 85-90.
- Goff JP. Horst RL. 1997.** Physiological Changes at Parturition and Their Relationship to Metabolic Disorders. *J Dairy Sci.* 80: 1260–1268.
- Günlü A. Sema Alaşahan S. 2010.** Türkiye’de Keçi Yetiştiriciliği ve Geleceği Üzerine Bazı Değerlendirmeler. *Vet Hekim Der Derg.* 81(2): 15-20.
- Haupt R. 1970.** Trasfer of Urea and Ammonia to the Rumen. In: Phillipson ed. *Physiology of Digestion and Metablism in the Ruminant.* One1 Press Limited, New Castle Upon Tyne, Royaume-Uni. 119-131.
- İnce D. 2010.** Reproduction performance of Saanen goats raised under extensive conditions, *African Journal of Biotechnology.* 9(48), 8253-8256.
- İriadam M. 2004.** Kilis keçilerine ait bazı hematolojik ve biyokimyasal parametreler. *Ankara Üniv Vet Fak Derg.* 51, 83-85.
- Kaneko JJ. Harvey JW. Bruss ML. 1997.** *Clinical Biochemistry of Domestic Animals.* Academic Press, Inc., San Diego, London, Boston, New York, Sydney.
- Mbassa GK. Poulsen JS. 1991.** Haematological profile in neonatal dwarf and landrace kids. *Zentralbl. Veterinarmed. A.* 38: 510-522.
- Mbassa GK. Poulsen JSD. 1993.** Reference ranges for haematological values in landrace goats. *Small Ruminant Res.* 9: 367-376.
- Myer DJ. Ehrich DJ. 1992.** *Veterinary Laboratory Medicine Interpretation and Diagnosis.* Philadelphia:WB Saunders Co., USA.
- Ocak S. Güney O. Önder H. Darcan N. 2006.** Growth and development performances of Cukurova Saanen kids under tropical climate conditions. *J. Anim. Vet. Adv.* 5(11): 985-989.
- Pala A. Savaş T. Uğur F. Daş G. 2005.** Growth Curves of Turkish Saanen Goats’ Kids Grouped for Weight and Body Mass Index, *Arch. Tierz., Dummerstorf.* 48 (2), 185-193.
- Piccione G. Casella S. Lutri L. Vazzana I. Ferrantelli V. Caola G. 2010.** Reference values for some haematological, haematochemical, and electrophoretic parameters in the Girgentana goat. *Turk. J. Vet. Anim. Sci.* 34(2): 197-204.
- Pugh DG. Baird N 2012.** *Sheep and Goat Medicine.* 2. Ed. Elsevier, USA.
- Roubies N. Panousis N. Fytianou A. Katsoulos PD. Giadinis N. Karatzias H. 2006.** Effects of age and reproductive stage on certain serum biochemical parameters of Chios sheep under Greek rearing conditions. *J. Vet. Med. A Physiol. Pathol. Clin. Med.,* 53: 277-281.
- Smith MC. Sherman DM. 2009.** *Goat Medicine.* Second Edition. Wiley Blackwel Inc. USA.
- Tambuwal FM. Agale BM. Bangana A. 2002.** Haematological and Biochemical values of apparently healthy Red Sokoto goats. *Proceeding of 27th Annual Conference Nigerian Society of Animal Production (NSAP),* March, 17-21, FUTA, Akure, Nigeria. pp. 50-53.
- Temizel EM. Senturk S. Kasap S. 2009.** Clinical, haematological and biochemical findings in Saanen goat kids with naturally occurring heat stroke. *Tierärztliche Praxis Großtiere.* 2009 37 4: 236-241.
- Zubicic D. 2001.** Some biochemical parameters in the blood of grazing Germanimproved fawn goats from Istria, Croatia. *Veterinarski Arhiv.* 71 (5), 237-244.