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EFFECT OF NATURALLY INFECTED WITH HAEMOPARASITE TRYPANOSOMES AND AGE ON HAEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF INDIGENOUS WESTERN HIGHLAND GOAT, ETHIOPIA

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ABSTRACT

In study area Gerura, South Western Shewa, Oromia Regional State of Ethiopia, goats are considered as one of the most important livestock. There is luck of information on effects of blood parasite Trypanosomes and age on some hematological and biochemical parameters of goat breed in the study area Gerura, therefore, the main purpose of this study was to determine the effects of Trypanosomes and age on some hematobiochemical parameters values and the reference baseline data of hematological and biochemical values of Gerura goat breed for clinical interpretation. The study included 141 indigenous goats aged from 1 to 6 years of both sexes naturally infected with Trypanosomes. In naturally infected Western highland Ethiopian goats breed with Trypanosomes, age had significant effect on RBC and WBC ($p< 0.05$). However, in those goats treated from Trypanosomes, RBC and Hb significantly increase for goats at yearling stage while the Monocytes significantly increase for adult goats ($P< 0.05$). There was no significant age difference for serum biochemical values in goats naturally infected with Trypanosomes. But, non-significant differences were also observed for AST and ALP ($P> 0.05$). There were significant age differences for total proteins in this goat breed treated from Trypanosomes. Younger to adult had significantly higher total protein ($P< 0.05$) than yearling and older adult stage. There were also non-significantly differences seen in serum ALP at different age ($P> 0.05$). The values determined in the present study contribute to the knowledge of the reference ranges for the study goat and can be used for monitoring health and disease diagnosis.

KEYWORDS: Age, Goat, hemoparasite, hematological, serum biochemical parameters, Gerura

INTRODUCTION

The small ruminant population of Ethiopia is about 18.1 million sheep and 14.8 million goats.[17] Small ruminants are important contributors to food production in Ethiopia, providing 35 % of meat consumption and 14 % of milk consumption.[57]

Goats are believed to be the second animal domesticated following the dog. Goat population is estimated to be about 861.9 millions in the world, of which about 33.8% of goat population is found in Africa. Ethiopia contains about 15% of the sheep and goat population of the African continent. With approximately 16.7 million goats, Ethiopia ranks the highest in Africa and in the world.[22] Goats are also a source of other valuable non-food products such as skin used as raw materials for various traditional household products manufactured in local cottage industries. In Ethiopia it is estimated that 14.6 million skins are produced annually, of which 90% of sheep and 70% of goat skins are recovered from the local market.[63]

Goats are particularly valuable livestock species in developing countries because of their ability to utilize many types of forages and tolerate unfavorable climates.[53] Goats are considered as ideal animals to keep due to their high ability to survive under severe conditions and due to their ability to produce high-quality meat and milk.[50]

Cattle, sheep and goats in sub-Saharan Africa may be infected with a wide variety of parasites most importantly vector-borne prokaryotic and eukaryotic haemoparasites such as the Rickettsiae: Anaplasma and Ehrlichia (Cowdria), and the protozoan parasites: Theileria, Babesia and Trypanosoma.[17, 32] The tropical environment is for various reasons suitable for the development of these parasitic diseases.[38]

Haemoparasites have generally been shown to cause destruction of red blood cells resulting in anaemia, jaundice, anorexia, weight loss and infertility.[6] Parasitic diseases have debilitating impact on human and animal health worldwide particularly in developing countries.[20] Haemoparasites courses reduction of productive potential which include decreased growth rate, weight loss in young growing animal and late maturity of slaughter stock.[24] Farmers may not appreciate the effects of these haemoparasites on their animals,

perhaps due to the subclinical nature of presentation and chronic nature on the affected animals.[26]

The high incidence of haemoparasites in the tropics could be as a result of the favourable environmental conditions that promote the survival and proliferation of the arthropod vectors responsible for the transmission of these parasites.[4]

Adejinmi et al.[4] reported that anaemia as a reliable indicator for the severity of haemoparasitic infections. However, the effect of haemoparasites on the mean PCV is more deleterious in younger animals.[21] The ability of trypanosome species alone or in combination with other parasites to cause a significant reduction of PCV of infected animals lend credence to the fact that animal Trypanosomosis is still a serious challenge to profitable production in sub Saharan Africa.[21]

Trypanosomosis disease, not only causes millions of livestock deaths, but also reduces calving rates, milk yield and work efficiency of draft animals.[29] Trypanosomoises caused anemia in both sheep and goat, and those whose PCV fell below 15% rarely recovered, even with trypanocidal drug treatment. The peak transmission period was between one and three months after the peak tsetse fly density, which raises the possibility of effective strategic prophylaxis.[30] The most important trypanosome species affecting livestock in Ethiopia are Trypanosoma congolense, T. vivax and T. brucei in goats, sheep and cattle.[1]

The anaemia is as a result of haemolysis of the red blood cell which is typical of the trypanosomes. However, it is known that most of blood protozoan parasites cause anemia by inducing erythrophagocytosis.[10] Adejinmi et al.[4] reported anaemia as a reliable indicator of severity of haemoparasitic infection. Anemia in trypanosomiasis may be due to extracellular hemolysis and erythrophagocytosis, and also erythropiosis in chronic infections.[28]

Abnormally low numbers of red blood cells may indicate anemia as a result of blood loss, bone marrow failure and malnutrition such as iron deficiency, over-hydration, or mechanical damage to red blood cells, and abnormally low number of white blood cells may indicate liver or spleen disorders, bone marrow disorders, or exposure to radiation or toxic substances.[27]

Infected goat revealed a significant decrease in blood glucose and albumin, in addition to a non-significant decrease in total protein and creatinine concentrations when compared to the uninfected group. On the other hand, a significant increase of urea, total bilirubin, AST in addition to a non significant rise in triglyceride, cholesterol, ALT, ALP and creatine kinase levels was found in infected goat in comparison to control group.[12]

Goats have great economic potential because of their high fertility and early maturity as well as their adaptability to humid environment.[5] The milk production from goats was particularly important to poor smallholder farmers in the highland and semi-arid mixed farming systems. These farmers have neither the financial nor physical resources to maintain large numbers of ruminants. However, the benefits derived from these animals were far below the expected due mainly to low productivity and numerous factors, of which the major one is disease (Zelealem and Fletcher.[62]

The livestock of Ethiopia was also commonly affected by haemoparasites both in terms of quantity and quality. Besides affecting the quantity and quality of livestock products, the prevalence of infectious diseases such as trypanosomiasis, babesiosis, anaplasmiosis and theileriosis in Ethiopia excludes the country from profitable international markets. The most apparent diseases are caused by blood parasites that are found in the blood of mammals. Such parasites include Anaplasma, Babesia, Theilleria and Trypanosoma species. Their effects on the susceptible hosts vary from reduced productivity to death.[55]

Determination of the main hematological and serum biochemical parameters of animals helps veterinarians to confirm clinical diagnoses, estimate the severity of cases, administer ppropriate treatment, and evaluate outcomes (Rubino *et al.*, 2006).[43]

Western highland goats of Ethiopia are known to be related to the Central highland and Keffa goats of Ethiopia. These types of goats are widely found in the Highlands of South Gondar, Gojam, Wollega and West Shewa including Gerura area, Ethiopia. The Western highland goat is relatively tall and has a concave facial profile. Their body is covered with coarse hair, forming along coat. Their milk is not consumed in this area.[58]

Variations in blood parameters of animals are due to several factors such as altitude, feeding level, age, sex, breed, diurnal and seasonal variation, temperature and physiological status of animals.[11]

Hematological and serum biochemical tests are widely used for the diagnosis of serious animal diseases which can lead to economic losses in animals like reduced fur, wool and milk production (Bani IZA et al., 1999).[15] Analyses of hemoatological and serum biochemical value in small ruminants are helpful to confirm clinical diagnosis of some metabolic disorders and disease.[61, 14]

The biochemical and hematology profiles can also be used to assess the immunity status in goats.[8] These profiles could be altered during pregnancy (Waziri et al., 2010) and seasonal variations had also an effect on these profiles.[2] Finally, nutrition, stress, reproductive status, age, sex, genetics, management, housing and other environmental factors (temperature, relative humidity etc.) are known to have a profound effect on the hematological and biochemical profiles of small ruminants.[13, 33]

Biochemical parameters of infected invertebrate animal showed relatively significant increase in the AST and ALT may be due to indirect damage of liver, kidney tissue and myocardium; change indicated to a possible damage to the liver, kidney tissue.[60]

The aim of this study was to carry out a comparative study to investigate the hematological and serum biochemical profile of goat and sheep and to report the effect of age and gender, if any, on hematological and serum biochemical profile of goats breed. Information on the effect of haemoparasites Trypanosomes and age on hematological and serum biochemical parameters of indigenous goats breed, which are required for appropriate research and development intervention, was not available in the study area, where goats are important assets to the local farmers. Hence, the researcher of this study were initiated first in the area to find out the effect of naturally haemoparasites Trypanosomes and age on hematological and serum biochemical values of indigenous Western Ethiopian highland goats. Therefore, the objectives of this study were to identify the effect of haemoparasites Trypanosomes and age on hematological and serum biochemical parameters of goat breed under the study area, to determine the influence of age on hematological and serum biochemical parameters, and to determine reference values for hematological and serum biochemical parameters of the apparently healthy indigenous goats breed in Gerura district of Oromia Regional State around Waliso town, in South Western Shewa, Ethiopia.

MATERIALS AND METHODS

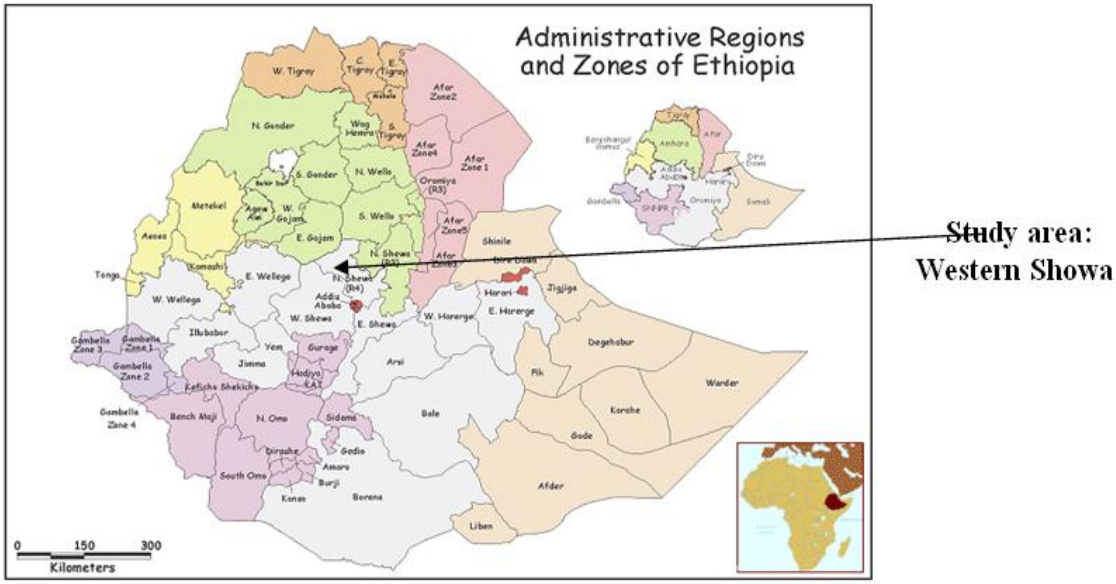
Study Area

The study was conducted from December 2011 to May 2012 at Gerura area of Oromia regional state around Waliso town, in South Western Shewa, Ethiopia. The study area (Gerura) is located at 116 km Southwest of Addis Ababa and situated at a latitude and longitude of 8°32′N and 37°58′E, respectively. It has an altitude of 2063 meters above sea level with a bimodal unevenly distributed rainfall. Waliso is the administrative center of this zone. An unpublished 10 years data of Sebeta National Animal Health Diagnostic and Investigation Center (NADIC) of Ethiopia shows that average annual rainfall was 1650 mm and consisted of short rainy season (February to April) and long rainy season (July to September). Minimum and maximum mean temperatures were 15 °C and 22.26 °C, respectively, with a relative humidity of 66%. Natural pasture, the major feed resources of livestock, is composed of predominantly grasses (Pennisetum, Cenchurus, Sporobulus, Aestida, and Hyperhenia) and legumes (*Crotalaria spp*.).

Study animals

The totals of 141 indigenous goats of both sexes naturally infected with haemoparasites Trypanosomes were selected based on purposive (non probability) sampling procedure for this study by assessing their physiological parameters and haemoparasites Trypanosomes examination. The total information of those indigenous goats ages ranging from 1 to 6 years were recorded two weeks before the experimental day. The age of the selected goats was determined using the incisor eruption times and wear according to.[18] All sampling units were tagged and sampling carried on after de-worming with broad spectrum Albendazole 300mg (Ashish Life Science Ltd, Mumbai, India) at a dose of 7.5mg/kg of body weight and sprayed with ecto-parasitic drug, Deazinol 60%.

Map of the study area



In the study area, goats were not restrained inside the pen. They were kept under an extensive system of management and fed in free grazing form together with cattle and sheep. They were mainly used for meat and economic incomes. Most of the owners kept their goats in open housing system that does not protect them from extreme weather conditions and vectors that transmit haemoparasites Trypanosomes. The goats were housed in wood paved floors without bedding and their manure and feed remains were not regularly cleaned. The available feed resource for goats in these areas constituted natural pasture, shrubs and crop residues. They were given access to water adlibitum. During the study, they were screened for the presence of haemoparasites by taking their blood samples for laboratory analyses.

Study design and Data collection

Goats were grouped into four age groups (>1yr to≤2yr; > 2yr to ≤ 3yr; > 3yr to ≤5 and >5yr to ≤6yr) for each sex categories. For each sampled goats, four age categories (>1 to ≤ 3yr, n= 43; > 2yr to ≤ 3yr, n= 38; > 3yr to ≤5, n= 34; >5yr to ≤6yr, n= 26), which were used to study the effects of Trypanosomes and age on hematological and serum biochemical parameters of goats.

As handling of animals induces changes in blood parameters, blood was drawn from the animals at rest, with minimum disturbance or excitement by allowing animals to rest at least 4 minutes of an adaptation time before sampling.[25] Some normal physiological parameters

were also checked to identify those sampled goats whether infected with parasites or not. The sampling time was adjusted for all goats from 9:00-11:30 a.m.

About 4ml of jugular blood was drawn in a dry, cleaned and heparinized vacutainer tube; and immediately tipped back and forth a dozen times to dissolve the anticoagulants. The mixing of blood was done gently to avoid any undesirable rupture of erythrocytes. Blood samples were also collected in a 10ml sterile plain vacutainer tubes. The blood was handled gently to avoid haemolysis and kept in a slant position at room temperature until the serum starts to separate. Then the specimen was immediately tilted and untouched until the serum was formed. The serum was preserved at -20^{0}C until analysis.

Sample size determination and sampling method

The study area, Gerura, one of the most populated areas where haemoparasite found, was selected and the infected goats with trypanosomiasis were the sampling units for this study. Of the total, 141 infected goats were sampled purposively from goat breed to investigate the effect of trypanosomiasis on the hematological and biochemical parameters. These were selected based on normal physical and clinical examination findings, and those goats naturally infected with trypanosomiasis were selected for the study. Naturally infected goats with haemoparasite Trypanosomes were selected for the first screening were de-wormed as well as sprayed with ecto-parasitic drug, Deazinol 60%, by Oromia regional animal health center. Then, those goats were also used as the second sampling units after treatment for haemoparasite Trypanosomes with anti-haemoparasites drug, Veribn and Ancotrypes, at 3.5 mg/kg body weight. The desired sample size for the study was calculated using the formula:

$$n = \frac{1.96^2 \text{ X P expected (1-P expected)}}{d^2}$$

(Thrusfield, 2005), with 95% confidence interval and at 5% absolute precision.

Determination of age and body condition scoring

Since the majority of small ruminant owner farmers do not usually keep record. Age and body condition scoring of every sampled goat were determined according to Crane[18] and conveniently grouped as yearling, young, adults and older adult.

Blood sample collections

The whole blood and serum samples of 141 naturally infected goats with haemoparasites trypanosoma were taken at the same time early in the morning a day after one week of de-

worming and spraying with an ecto-parasites drug to exclude their effect on hematological and serum biochemical parameters, and each sampled goats were treated from haemoparasite Trypanosomes with anti-haemoparasitic drug. Then, after two weeks of first sample collection, the second cycle of blood sample was collected in the same procedure from those experimental goats treatment for Trypanosomes.

About 4 ml of blood were taken aseptically from the jugular vein using a 10 ml syringe and 18 gauge x $1^1/_2$ inch sterile needles from each animal. Each blood sample for determination of hematological parameters was immediately poured into a test tube, containing an anticoagulant disodium salt of ethylene diaminetetra-acetic acid (EDTA) at the rate of 2 mg/ml of blood.[37]

Blood was collected by jugular vein puncture using 10ml plain vacutainer tubes approximately at the same time of the day (9:00am) for the determination of blood parasites and biochemical parameters. Two blood samples were taken from each animal into plain glass tubes and EDTA coated glass tubes by the jugular vein puncture for determination of blood parasites detection and some heamatological values respectively.

Each serum blood sample was handled gently to avoid hemolysis and was allowed to clot at room temperature by keeping it in a slant position. After whole blood and serum collection, all samples were transported as quickly as possible in ice box to Armauer Hansen Research Institute (AHRI) laboratory, Addis Ababa, and stored at -20ºC for subsequent analyses.

Examination for haemoparasites

Blood from EDTA coated vacutainer tube was used for haemoparasites examination. Thin blood smears were prepared from drops of blood taken from the jugular vein, air dried and fixed in the field in 100% methanol within 2–3 minutes. They were stained for 35-45 minutes in Giemsa's stain (diluted 1:3 in buffer, PH 7.2). Each smear was examined, with through coverage of the smear, under oil immersion microscope to determine the blood parasite.

Hematological analysis

All the samples were analyzed after collection to determined the levels of total Red blood cells count (RBC), total and differential White blood cells count (WBC), and Hemoglobin. The Erythrocytes counts and total Leukocytes count were determined with the aid of Neubaur counting chamber (Haematocytometer) after the blood was diluted 1:200 Hayem's solution

and 1:20 WBC diluents (1ml Glacial acetic acid and 1ml methylene blue, both diluted to 100ml with distilled water) respectively. The blood values were estimated through standard hematological techniques according Jain.[25] Hemoglobin concentration was determined by Sahl's (acid haematin) method and differential leukocyte count was also determined as described by Schalm *et al*.[45]

Serum Biochemical analysis

The samples were left to clot and then centrifuged at 3000 rpm for 15 min and the serum is collected. Serum was kept frozen at −20°C until it was used for the biochemical analysis. Serum samples obtained from plain vacutainer tubes of both infected and treated goats from haemoparasites trypanosomiasis were subjected to standard biochemical procedures using Spectro-photometers Humanstar 80 (Germany) and commercially available kits to determine normal values of clinically important serum biochemical's including AST, alanine aminotransferase (ALT), alkaline phosphatase (ALP), creatinine and total protein.

The level of serum AST and ALP were determined using kits (Biocon Diagnostic, Germany), where as the level of serum ALT was obtained using commercial (Human, Germany) kits. The level of serum enzymes was expressed in iu/L. The absorbance of ALP was read at 400 nm wavelength, while that of AST and ALT were read at 340 nm wavelengths.

Colorimetric test using kits (Human, Germany) were performed to determine the levels of serum total protein (g/dl). Serum creatinine concentration (mg/dl) was determined by kinetic colorimetric assay using a kit (Biocon Diagnostic, Germany). The absorbance was read at 492 nm wavelength.

Data management and analysis

All computations were performed using computer software Microsoft Excel (2007) and SPSS (Version 15.0, 2012). Descriptive statistics of each data on hematological and serum biochemical parameter were separately calculated for infected goats as well as those goats free from haemoparasite Trypanosomes by treatment. Comparison of mean values of both hematological and serum biochemical parameters of the same goat before and after treatment with anti-haemoparasitic drugs were separately conducted. For comparison between infected goats and those free from haemoparasite Trypanosomes, all parameters were checked for normality distribution, and those parameters that are normally distributed was compared with

one-way ANOVA whereas those parameters from the same goats were compared with paired T test. The p value significant were determined ($p<0.05$).

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Conflicts of Interest

The author has no conflicts of interest.

RESULTS

As the area of sampling was in tsetse belt zone and according to morphological and morphometric induces, many species of trypanosome were diagnosed. In combined analysis, least squares means of hematological parameters of Western Ethiopian highland goats breed are presented in table 1, 2, 3 and 4. Overall estimates of naturally infected goats with trypanosomes were as follows: RBC= 9.78±1.28 x $10^6\mu L^{-1}$; Hb=7.59±1.34 gdL^{-1}; MCH=7.91±1.49pg; WBC=11.36±0.91x$10^3\mu L^{-1}$; Lymphocytes=55.03±2.95%; Neutrophils=38.37±2.63%; Eosinophils=3.48±1.05%; Monocytes= 2.49±0.75%; and Basophils=0.44±0.50%. For goats treated from trypanosomes, the overall estimates were as follows: RBC=13.25±1.57 x $10^6\mu L^{-1}$; Hb=7.59±1.34 gd L^{-1}; MCH= 8.16±0.95pg; WBC=12.18±0.98x$10^3\mu L^1$;Lymphocytes=50.29±1.9%;Neutrophils=42.81±2.02%;Eosinophils=4.31±1.04%; Monocytes=2.28±0.67%; and Basophils=0.51±0.59%.

Least squares means of biochemical parameters of Western Ethiopian highland goats are presented in table 5, 6, 7 and 8. Overall estimates of naturally infected goats with trypanosomes were as follows:AST=68.20±11.02iuL^{-1};ALT=27.80±6.96iuL^{-1};ALP=84.64±31.08iuL^{-1};Creatinine=0.72±0.22 $mgdL^{-1}$; and total protein=6.74±0.63gL^{-1}. For goats treated from trypanosomes, the overall estimates were as follows: AST=61.04±10.54iuL^{-1}; ALT=22.11±7.50 iuL^{-1}; ALP=84.64±31.08iuL^{-1}; Creatinine=0.62±0.20$mgdL^{-1}$; and total protein=4.66±0.46gL^{-1}. This result also revealed that the serum biochemical parameters of Western Ethiopian highland goats before and after treatment from haemoparasite trypanosomiasis were varied. These results showed that the change in on haematological and biochemical parameters of Western Ethiopian highland goats before and after treatment from trypanosomiasis. This change could be due to the effect of Trypanosome on the vital organ (liver and kidney) of the study goats.

Table 1: Least square Means (and SD) of hematological parameters of naturally infected goats with Trypanosomes.

Source of variations		RBC, $10^6 \mu L^{-1}$	Hb, gd L^{-1}	MCH, Pg	WBC, $10^3 \mu L^{-1}$	Lymphocyte, %	Neutrophils, %	Eosinophils, %	Monocytes, %	Basophils, %
Overall		9.78±1.28	7.59±1.34	7.91±1.49	11.36±0.91	55.03±2.95	38.37±2.63	3.48±1.05	2.49±0.74	0.44±0.51
Age group:	>1-≤2yr	10.20±1.26	7.83±1.55	7.80±1.77	11.09±0.88	54.83±3.03	38.66±3.01	3.44±0.98	2.34±0.73	0.37±0.49
	>2-≤3yr	9.83±1.12	7.78±1.40	8.15±1.54	11.66±0.90	55.11±2.68	37.83±2.36	3.54±1.12	2.61±0.77	0.42±0.50
	>3-≤5yr	9.73±1.24	7.41±1.05	7.79±1.02	11.27±0.86	55.31±2.95	38.41±2.51	3.38±1.02	2.62±0.62	0.59±0.57
	>5-≤6yr	9.04±1.35	7.12±1.10	7.91±1.43	11.46±0.91	54.91±3.32	38.65±2.28	3.61±1.20	2.39±0.84	0.43±0.51

In naturally infected Western highland Ethiopian goats with Trypanosomes, age had significant effect on RBC and WBC ($p< 0.05$). The RBC had increased significantly for yearling stage of goats while the WBC significantly increases for younger goats (Tables 1).

Table 2: Least square Means (and SD) of hematological parameters of goats treated from Trypanosomes.

Source of variations		RBC ($10^6 \mu L^{-1}$)	Hb (gd L^{-1})	MCH (Pg)	WBC ($10^3 \mu L^{-1}$)	Lymphocyte (%)	Neutrophils (%)	Eosinophils (%)	Monocytes (%)	Basophils (%)
Overall		13.25±1.57	7.59±1.34	8.16±0.95	12.18±0.98	50.29±1.98	42.81±2.02	4.31±1.04	2.28±0.67	0.51±0.59
Age group:	>1-≤3yr	13.98±1.40	11.24±1.18	7.94±0.43	11.96±0.99	49.95±2.04	42.90±2.02	4.51±1.08	2.32±0.65	0.61±0.59
	>3-≤4yr	13.34±1.44	11.06±1.33	7.99±0.35	12.45±0.91	50.11±1.55	43.25±1.76	4.14±0.93	2.11±0.75	0.39±0.55
	>4-≤5yr	12.90±1.42	10.59±1.33	9.28±1.52	12.08±0.98	50.62±2.35	42.45±2.28	4±1.23	2.59±0.57	0.41±0.57
	>5yr-≤6yr	12.27±1.71	10.01±1.24	9.28±1.99	12.26±1.01	50.78±1.95	42.43±2.04	4.61±0.78	2.09±0.06	0.65±0.60

In those goats treated from Trypanosomes, RBC and Hb significantly increase for goats at yearling stage while the Monocytes significantly increase for adult goats ($P< 0.05$) Table 2.

Table 3: Least square Means (and SD) of biochemical parameters of Western Ethiopian highland goats infected with trypanosomes.

Source of variations		AST (iuL^{-1})	ALT (iuL^{-1})	ALP (iuL^{-1})	Creatinine ($mgdL^{-1}$)	Total protein (gL^{-1})
Overall		68.20±11.02	27.80±6.96	84.64±31.08	0.72±0.22	6.74±0.63
Age group:	>1-≤2yr	70.44±12.45	28.76±6.37	86.41±31.41	0.74±0.21	6.64±0.70
	>2-≤3yr	66.08±9.36	27±7.43	91.33±34.30	0.69±0.22	6.79±0.49
	>3-≤5yr	69.55±8.31	27.34±7.12	80.93±25.02	0.70±0.22	6.63±0.67
	>5-≤6yr	64.78±12.89	27.91±7.25	75.65±31.23	0.77±0.25	6.96±0.59

There was no significant age difference for serum biochemical values in goats naturally infected with Trypanosomes. But, non-significant differences were also observed for AST and ALP (P> 0.05) Table 3.

Table 4: Least square Means (and SD) of biochemical parameters of Western Ethiopian highland goats treated from trypanosomes

Source of variations		AST (iuL^{-1})	ALT (iuL^{-1})	ALP (iuL^{-1})	Creatinine ($mgdL^{-1}$)	Total protein (gL^{-1})
Overall		61.04±10.54	22.11±7.50	84.64±31.08	0.62±0.20	4.66±0.46
Age group:	>1-≤2yr	62.80±10.79	22.54±6.68	78±27.14	0.60±0.17	4.63±0.40
	>2-≤3yr	60.19±9.36	21.75±7.85	84.17±32.404	0.65±0.21	6.70±0.62
	>3-≤5yr	61.07±9.33	21.14±6.77	74.28±24.309	0.59±0.20	6.79±0.65
	>5-≤6yr	59.17±12.55	23.13±9.32	67.83±24.56	0.68±0.23	4.71±0.53

There were significant age differences for total proteins in this goat breed treated from Trypanosomes. Younger to adult had significantly higher total protein (P< 0.05) than yearling and older adult stage. There were also non-significantly differences seen in serum ALP at different age (Table 4).

DISCUSSION

According to this study, different species of Trypanosome were observed in naturally infected Western highland Ethiopian indigenous goats. Therefore, hematological values of the naturally infected goats with Trypanosome are shown in Table 2. Significant decreases in RBC and Hb level were observed in both naturally infected goats when compared to those goats treated from haemoparasites Trypanosome (p< 0.05). These results were in accordance with the findings by Sevinc *et al.*[49]; Razmi *et al.*[42] and Aktas *et al.*[7] These results were also consistent with previous findings by Hadadazadeh *et al.*[23] and Radostitis *et al.*[39] and this might be due to intravascular hemolysis of erythrocytes.

The observed anemia may be attributed to immune-mediated phenomena by auto antibodies directed against component membrane of infected and uninfected erythrocytes, production of toxic hemolytic factors of the parasite and mechanical damage by trophozoite intra-erythrocytic binary fission.[43] Anemia which is regarded as the most reliable finding in trypanosomosis of man and domestic animal has been reported in *T. brucei* infected goats, sheep and rabbits.[52] The non-significantly decline in MCH observed in this result could be caused by decrease in the level of hemoglobin because of a deficiency of iron.

The significant decrease in WBC was observed in goats infected with trypanosome when compared to goats treated from that trypanosome (p< 0.05). Leucopenia which developed during infection was the major hematological changes observed in the study. The leucopaenia was characterized by neutropaenia, eosinopaenia and lymphocytosis. The non-significant decrease in neutrophil in the result was in accordance with the finding by Stephens[51] which reported severe neutropenia during trypanosomiasis infection is thought to increase susceptibility of infected hosts to concurrent infections. The eosinophlia observed in infected goats with haemoparasites could be associated with immediate type of hypersensitivity reactions.

There were no appreciable changes in monocyte and basophil counts in those goats infected with haemoparasites Trypanosome and this is in agreement with Rajkhowa *et al.*[40] who

found out that during naturally occurring trypanosomosis the values of monocytes and basophils are only slightly affected.

The significant decrease in the WBC of infected goats with trypanosomiasis observed in this study also agrees with the findings of Sadique *et al*.[44] in cattle infected with *T. Congolese*. Leucopaenia in animal trypanosomiasis has been reported to be due to ineffective or depressed granulopoiesis in the bone marrow.[9] In this study, the occurrence of leucopenia may be related to factors such as leucophagocytosis as a result of trypanosomal antigen coating of leucocytes and depression of leukocyte production.

In the biochemical analysis values for AST, ALT ALP and total protein level were significantly increase in both infected goats with Trypanosome when compared to goats treated from those haemoparasites ($p < 0.05$). This increment could be a result of tissue breakdown (necrosis and inflammation) in host due to haemoparasites. These results were consistent with previous findings by Orue *et al*.[35] revealed marked elevation in the serum levels of ALT, ALP and AST have been observed in both rabbits and rats experimentally infected with *T. brucei* and *T. congolense*. ALP was also decrease with increasing age, while the converses were true with lymphocytes and AST. The increased serum enzymes probably showed that vital organs (liver and kidneys) could be affected with those haemoparasites.

In this study, serum creatinine levels were significantly increased in goats infected with Trypanosome parasites. This difference probably showed that kidney could be more affected by Trypanosome parasite. The results were in lines with findings by Uilenberg[54]; Seleim *et al*.[48]; Yeruham *et al*.[59] and Crongaj *et al*.[19] Observed elevation in creatinine level might have resulted from kidney dysfunction, catabolism of muscle and colonization of haemoparasite in the renal blood circulation.[54] It may be also related with urethral obstruction and bladder ruptures occur due to infection with haemoparasites Trypanosomes.

The significant increase in total protein was observed in infected goats when compared to those goats treated from haemoparasites ($p < 0.05$). This observation was in agreement with findings of Adeiza *et al*.[3] who reported that total serum protein increased in experimentally infected Savannah brown goats with *T. brucei* and *T. vivax* in contrast to the findings of Sekoni et al.[47]; Opara and Fagbemi[34] who reported decrease in total plasma proteins in bulls experimentally infected with T. vivax and Trypanosomiasis respectively.

It also shown that increase of total protein was related with increase in globulins could be due to elevation in the gammaglobulins, as immunological response against the parasite.[35]

As realized from this study the increased total protein were major signs of the infection in infected Western highland Ethiopian indigenous goats which indicates immune response due to the infection with haemoparasite typanosomiasis. The results were in consistent with findings by Osman *et al*.[36] who reported that hyperproteinaemia was sign of infected goats and ewes with *T. vivax*. It was also shown that the increase in serum total protein may have been due to increased release of tissue specific enzymes and other intracellular proteins secondary to parasite induced cell membrane disruption.[35]

This study also revealed that 91.5% the study goats were infected with trypanosomiasis. This shows that trypanosomiasis is also mechanically transmitted by tsetse and other biting flies through the transfer of blood from one animal to another. The most important mechanical vectors for trypanosomes are flies of the genus Tabanus. But, Babesia cannot transmit mechanically like that of Trypanosomes.

CONCLUSION AND RECOMMENDATIONS

In this study the component of the hematological and serum biochemical parameters in indigenous goats showed remarkable differences between infected goats with haemoparasite Trypanosomes and treated goats from haemoparasite Trypanosomes, and between their ages within the species. Thus, Trypanosome has a prominent effect on the hematological and serum biochemical parameters of goats breed in Gerura, Western parts of Ethiopia, and determining the values of these parameters are important for assessing the physiological status of animals for diagnostic purpose. The relatively high incidence of Trypanosome observed in this study could be due to the favorable environmental conditions for the survival and proliferation of the arthropod vectors responsible for the transmission of the parasites since the goats are reared under extensive management systems. Generally, the finding of this study indicates that the populations of goats that are involved in the study are found to be free from theileria and anaplasma species but most common for trypanosome species. Hence, the obtained results are considered as the first values to be published for the goat breed in Gerura, Western parts of Ethiopia. This study is considered as preliminary study which can be used as a reference for further studies to determine reference values for the studied goats breed to aid the veterinarians in the interpretation of the laboratory data and for the selection of the

appropriate treatment. Therefore, based on the above study results the following recommendations are forwarded:

- An appropriate treatment needs to be given against these parasites in infected goat to improve the living standard of the owners since goats have great economic potential due to their early maturity and high fertility.
- Strategic haemoparasite Trypanosomes control mechanism has to be designed and practically implemented in the study area to minimize their effect on hematological and serum biochemical values that responsible for the poor quality product of goats. Further investigations should be under taken to see the effect of Trypanosome and environmental factors on hematological and serum biochemical parameters of different hosts including other indigenous goats with experimental analysis in depth and width.
- Collaboration between different institutions should be done in order to control those diseases and vectors which transmit Trypanosome of an area.
- The government has to be provoked to put their effort in the control of Trypanosomes diseases that have a serious economical impact on the country economy, farmers at large.

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