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Blood Chemistry, Hematological and Parasitological Profile of Local Sheep Breed Reared in Dedo District, Jimma Zone

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Abstract

A study was conducted to determine the parasitological, biochemical and hematological parameters of sheep in Dedo district, Jimma zone, Oromia region, southwest Ethiopia from August 2023 to April 2024. There were 384 Dedo sheep in the various physiological conditions. The results reveal no significant difference ($p > 0.05$) in blood chemistry such as AST (52.9±1.0 U/L),ALT (19.3±0.3 U/L), Calcium (2.29±0.04 mg/dL), Sodium (148.13±2.2 mmol/L), Chlorine (105.37±4.4 mmol/L), Magnesium (3.11±1.7 mg/dL), Potassium (4.71±0.5 mmol/L), total bilirubin (0.43±1.7 mg/dL), direct bilirubin (0.028±0.04 mg/dL), cholesterol (66.92±4.5mg/dL), triglycerides (29.18±1.7 mg/dL), LDL (22.22±0.4 mg/dL), glucose (41.29±3.8 mg/dL), and total protein (7.28±0.1 mg/dL). However, significant difference ($p < 0.05$) was obtained in the ALP (189.3±6.9 U/L), creatinine(1.09±0.04 mg/dL), HDL (41.04±1.1 mg/dL) and globulin (2.79±0.1 mg/dL). The results of the study showed that significantly the total leukocyte count ($6.82 \pm 0.9 * 10^3/\mu L$) was high in young sheep and lactating ewes; lymphocyte% (65.77±1.7%) was high in rams, while neutrophils% (29.19±1.6%) was high in pregnant female sheep ($p < 0.05$). There was not any significant physiological impact on packed cell volume (30.78±0.9%), RBC ($10.07 \pm 0.1 * 10^6/\mu L$), hemoglobin (11.64±0.3 g/dL), MCV (43.55±7.4 fL), MCH (19.98±2.2 pg), MCHC (42.71±2.5 g/dL), monocyte% (4.58±0.3%), eosinophil% (0.25±0.1%), and basophil% (0.21±0.1%) ($p > 0.05$). Fecal egg counts (FEC) were significantly higher in pregnant and lactating ewes ($p < 0.05$), with *Trichostrngylid* eggs (1703±243 epg), *Strongyloides*species eggs (297±72 epg), *Monezia*species eggs (58±11 epg) and *Eimeria* species eggs (157±22 epg).Considering that biochemical and hematological parameters are indicators of the animal's pathological or physiological state, for a correct interpretation of the results, the use of reference values based on animals with similar racial characteristics and subjected to similar environmental conditions is recommended.

Keywords: Biochemistry, Dedo sheep, Health status, Hematology, Parasitological profile

Introduction

In Ethiopia, sheep are reared mainly by smallholder farmers and are grazed in small flocks on communal open natural pastures. Ethiopia's sheep population is estimated to be 23.6 million (Sheriff *et al.,* 2022), is the third largest in Africa with more than 18 breeds or populations (Gizaw *et al.,* 2013). The increase in mutton consumption has required greater production efficiency. Therefore, it is necessary to improve the management of herds through detailed characterization of breeds, breeding systems and critical phases, taking into account the different production regions. Nutritional and health problems are the main cause of the limited efficiency of ruminant production (Hernandez *et al*., 2019).

Sheep are vulnerable to a range of infectious diseases, such as those caused by bacteria, viruses, and parasites. Foot rot, pneumonia, mastitis, enterotoxemia, and internal and external parasites like ticks and worms are among the common ones (Odetokun*et al*., 2024). The environment has an effect on local sheep, and bad weather can have an adverse effect on their health. They may be more prone to illnesses and stress-related problems if they experience heat stress, cold stress, or exposure to extreme weather conditions. For their wellbeing, adequate shade, ventilation, and shelter are necessities (Wanjala *et al*., 2023).

The hematological and biochemical properties of blood are used to track and assess the physiological, nutritional, and overall health of ruminant animals. These tests are frequently used to identify serious illnesses in animals, which can lead to reduced development, productivity, immunity, fur, wool, and milk production, among other financial losses (Ibeagha-Awemu and Yu, 2021). Year-round temperature fluctuations are thought to be physiological stressors that affect animal biological systems (Rashamol *et al*., 2020). It has been demonstrated that these stressors significantly affect the hematological characteristics of farm animals' blood (Barsila *et al*., 2020). Globally, helminthes and other gastrointestinal tract (GIT) parasites are regarded as significant factors limiting sheep productivity (Sharma *et al*., 2020). The host's fitness would benefit from any behavioral reaction to parasites that lowers the likelihood of encounter (Barron *et al*., 2015).

The majority of smallholders and the rural poor in Ethiopia, including households led by women, keep small ruminants. Goats and sheep provide smallholder households with a variety of benefits, including cash, meat, milk, skins, manure, insurance against emergencies, and cultural and ceremonial benefits that vary depending on the area, socioeconomic status, agro-ecology, and culture (Sheriff and Alemayehu, 2018). Therefore, this study aimed to investigate the blood chemistry, hematological and parasitological profile in local sheep reared in Dedo district, Jimma zone.

Materials and Methods

Description of the Study Area

This study was conducted in Dedo district which is one of the district found in Jimma zone, Oromia region, southwest Ethiopia from August 2023 to April 2024. Astronomically, the Dedo district is situated between 7°13'–7°39' North latitude and 36°43'–37°12' East longitude, making it one of the 21 woredas in the Jimma zone (Kechero *et al*., 2013). The total area of the district is 797.8 square kilometres or 79,780 hectar. The district has 33 rural kebeles and 3 urban kebeles, a total of 36 kebeles. Dedo District is located between 880 and 2400 meters above sea level. Additionally, the mixed crop-livestock agricultural production method in this district is well-known (Abdela*et al*., 2017).

Study Animal Population and Sampling Method

The target population in the study area was all sheep counted and participating in the current community-based breeding program for sheep in the three kebeles; Elala, Sola, and Gera. A multi-phase sampling strategy was used, with potential PAs and villages being identified after study animals are chosen by random sampling techniques where local sheep breed in their separate production systems.

Study Design and Sample Size Determination

A cross-sectional study was conducted in three kebeles of Dedo district (Elala, Sola and Gera) to evaluate health status profile of local sheep breed reared. Using 95% confidence interval and 5% absolute precision, the sample size for this particular study was determined by the formula given by Thrusfield (2018). Since there was no similar work done in the study area previously, the sample size of local sheep breeds from different farmers will be 384.

Analysis of Blood Biochemistry

Moreover, 2 mL of blood from each sample was centrifuged at 3000× *g* for 10 min at 4°C to obtain plasma for biochemical studies. Biochemical parameters, including total bilirubin (TBIL), direct bilirubin (DBil), albumin (ALB), cholesterol (CHOL), creatinine (CREA), glucose (GLU), total protein (TP), triglycerides (TRIG), high density lipoprotein (HDL), low density lipoprotein (LDL), aspartate transaminase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), Calcium (Ca), Potassium (K), Magnesium (Mg), Chlorine (Cl), and Sodium (Na) will be analyzed using an automated HITEC 7100 according to the manufacturer's instructions (Elarabany, 2018).

Hematological Analysis

Hematological parameters were analyzed for each blood sample using an ADVIA® 2120i Hematology System according to the manufacturer's instructions. The measurements to be included were white blood cells (WBCs), lymphocyte percentage, neutrophil percentage, eosinophil percentage, monocyte percentage, basophil percentage, red blood cells (RBCs), packed cell volume (PCV), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular hemoglobin (MCH) (Pinter *et al*., 2016).

Total Fecal Egg Count

The Modified McMasters technique was used to obtain a total fecal egg count. The number of eggs per gram of feces was calculated by multiplying the total egg count (for both chambers) by a factor of 50 (Porter and Kaplan, 2011).

Data Management and Analysis

All data was first entered and managed using Microsoft Excel and analysis of data was made through SPSS version 25. Data was subjected to a univariant analysis, include summary statistics to estimate distribution; means, median and standard deviation. The bivariant correlation between two variables will be measured. Descriptive statistics was employed to summarize common sheep diseases in the study area. While Chi-square (x^2) test was employed to measure the effect of risk factors on common sheep diseases in the study area.

Results

Results Based on Biochemistry

Parameters	Ewe lamb	Pregnant	Lactating	Ram	p-value
ASTL (U/L)	54.1±19.9^{a}	49.8±23.71^{a}	56.7±13.99^{a}	51.1±19.31^{a}	0.072
ALT (U/L)	21.9±10.38^{a}	16.7±9.49^{a}	18.8±31.3^{a}	19.4±2.42^{a}	0.076
ALP (U/L)	281.3±38.55^{b}	184.6±13.63^{a,b}	191.8±21.12^{a,b}	99.4±35.29^{b}	0.045
Calcium (109/L)	2.26±0.07^{a}	2.34±0.17^{a}	2.27±0.06^{a}	2.31±0.05^{a}	0.746
Sodium (mmol/L)	147.99±1.24^{a}	148.20±1.77^{a}	148.01±1.32^{a}	148.31±1.6^{a}	0.895
Chlorine (mmol/L)	104.78±0.71^{a}	105.80±1.62^{a}	105.20±0.8^{a}	105.71±1.67^{a}	0.999
Magnesium (mg/dL)	3.11±0.11^{a}	3.15±0.23^{a}	3.08±0.34^{a}	3.12±0.16^{a}	0.995
Potassium (mmol/L)	4.72±0.14^{a}	4.58±0.17^{a}	4.63±0.13^{a}	4.93±0.22^{a}	0.845
Crea (mg/dL)	0.72±0.08^{b}	1.07±0.02^{a,b}	1.12±0.24^{a,b}	1.46±0.29^{a}	0.002
Dbil (mg/dL)	0.023±0.02^{a}	0.033±0.01^{a}	0.031±0.01^{a}	0.024±0.02^{a}	0.091
TBIL (mg/dL)	0.42±0.12^{a}	0.47±0.13^{a}	0.46±0.13^{a}	0.39±0.10^{a}	0.828
CHOL (mg/dL)	67.11±3.92^{a}	74.22±5.29^{a}	363.83±7.17^{a}	62.64±5.09^{a}	0.443
TRIG (mg/dL)	32.45±3.51^{a}	28.69±7.69^{a}	27.11±3.77^{a}	28.47±3.87^{a}	0.232
HDL (mg/dL)	33.27±8.25^{a,b}	42.33±7.15^{a}	54.41±8.21^{a,b}	34.15±4.27^{a,b}	0.001
LDL (mg/dL)	22.24±2.32^{a}	29.80±9.53^{a}	17.42±2.62^{a}	19.41±3.72^{a}	0.077
Glucose (mg/dL)	44.71±4.09^{a}	37.11±1.68^{a}	38.91±4.97^{a}	44.43±4.71^{a}	0.36
TP (mg/dL)	7.21±0.53^{a}	6.98±1.00^{a}	7.42±0.51^{a}	7.51±0.31^{a}	0.761
Albumin (mg/dL)	3.45±0.44^{b}	3.60±0.22^{a,b}	3.43±0.37^{b}	3.65±0.22^{a}	0.003

^{a,b} The same superscripts in a row were indicative of significant difference ($p < 0.05$).
Crea: creatinine, DBil: Direct bilirubin, BILT3: total bilirubin, CHOL: cholesterol, TRIG: triglycerides, HDL: high density lipoprotein, LDL: low density lipoprotein, TP: total protein, mg/dL: milligram per deciliter

Hematological Results

Parameters	Ewe lamb	Pregnant	Lactating	Ram	p-value
PCV (%)	30.82±0.55^{a}	30.36±1.22^{a}	29.08±1.28^{a}	31.30±0.27^{a}	0.67
Hb (g/dL)	11.74±1.28^{a}	11.41±0.27^{a}	10.82±1.22^{a}	12.41±0.55^{a}	0.16
RBCs (10^6/μL)	10.76±1.22^{a}	9.61±1.28^{a}	9.75±3.72^{a}	9.01±1.49^{a}	0.47
MCHC (g/dL)	48.51±6.87^{a}	30.12±4.42^{a}	33.06±6.87^{a}	59.14±25.79^{a}	0.06
MCV (fL)	41.66±4.21^{a}	43.74±0.97^{a}	42.20±1.06^{a}	46.59±1.49^{a}	0.73
MCH (pg)	21.78±3.08^{a}	14.26±18.21^{a}	15.66±1.91^{a}	32.70±1.55^{a}	0.17
WBCs (103/μL)	7.22±0.27^{a}	7.16±0.55^{b}	7.22±0.19^{a,b}	5.66±0.34^{a}	0.022
Lymphocytes (%)	70.10±4.5^{a}	53.10±3.72^{b}	63.56±3.54^{a,b}	72.29±2.87^{a}	0.031
Neutrophilis (%)	25.78±2.97^{b}	41.37±7.92^{a}	31.51±4.40^{a,b}	22.14±4.81^{b}	0.024
Eosinophilis (%)	0.41±0.17^{a}	0.22±0.05^{a}	0.33±0.12^{a}	0.05±0.19^{a}	0.343
Monocytes (%)	3.54±0.18^{a}	5.11±0..6^{a}	4.32±0.48^{a}	5.37±0.47^{a}	0.262
Basophilis (%)	0.17±0.05^{a}	0.20±0.06^{a}	0.28±0.07^{a}	0.15±0.04^{a}	0.441

^{a,b} The same superscripts in a row were indicative of significant difference ($p < 0.05$).
PCV: packed cell volume; Hb: hemoglobin; RBCs: Red blood cell count; MCHC; mean corpuscular hemoglobin concentration; MCV: mean corpuscular volume; MCH; mean corpuscular hemoglobin; WBC; White blood cell

Parasitological Results

	Ewe lamb	Pregnant	Lactating	Ram	p-value
Trichostro (epg)	1471±211[a]	2224±318[a]	1989±102[b]	1128±411[a,b]	0.049
Strong (epg)	317±47[a,b]	379±88[a]	341±79[a]	151±102[b]	0.038
Monezia (epg)	45±13[a]	71±7[a]	0±0[a,b]	0±0[b]	0.009
Eimeria (epg)	75±27[a]	214±19[b]	182±32[a]	0±0[a,b]	0.022

[a,b] The same superscripts in a row were indicative of significant difference ($p < 0.05$).
Trichostro: Trichostronglidesspecis; Strong: Strongyloidesspecis; epg: eggs per gram

Discussion

This study showed a little variation in the concentrations of the alanine amino transferase (ALT), aspartate amino transferase (AST) and alkaline phosphate (ALP) in the blood of both sexes of dedo sheep. The physiological conditions did not have any significant impact onthe resulting ALT and AST activitiesin this study (p>0.05). However, the physiological conditions had significant impact on the ALP (p<0.05) and the parameter was not as high as that in Tsigai sheep (Antunović *et al.,* 2004). On the contrary, the physiological condition did not have any significant impact (Sarmin *et al.,* 2021a). It was reported that the ALT of Tsigai lactating sheep was high because of the increase in hepatic metabolic activity (Antunovic *et al.,* 2011). The same result has been reported in Rasa Aragonesa sheep (Ramos *et al.,* 1994).AST activity was higher in pregnant Tsigai sheep than in the lactating sheep (Antunović *et al.,* 2004). It indicated that the hepatic metabolic activity was normal. The ALP activity was found to be high in Bighorn sheep (Borjesson *et al.,* 2 000). The ALT, AST and ALP activities were in the range of the reference parameter (Jackson and Cockcroft, 2002).

Current study showed that the physiological conditions did not have any significant impact on the resulting Calcium, Potassium, Chloride, Sodium and Magnesium levels in the study based on the physiological conditions of the animals (p > 0.05). The result of Calcium level was in accordance with Sarmin *et al.* (2021a) in the fat tailed sheep; though other study showed high Calcium level in the sheep of a yearof age (Antunović *et al.,* 2004). The result of Potassium Chloride, and Sodium levels were in accordance with Sarmin *et al.* (2021a) in the fat tailed sheep; Azimzadeh and Javadi, (2020) in the Iranian red sheep; and Mostaghni *et al.* (2005) in the captive wild sheep; though Antunovic *et al.* (2011) suggested that the Potassium of pregnant sheep was higher than that of lactating sheep. The resulting mineral level except Magnesium level in the study was in the range of the chloride of the reference parameter (Jackson and Cockcroft, 2002). It was higher than the reference parameter (Jackson and Cockcroft, 2002), its level in serum depended on the magnesium content of forage and the growing stages of sheep and the production of milk in lactating sheep (Mohammed *et al.,* 2017).

The blood chemistry was identified that the physiological conditions had significant impact on creatinine level and resulted in the high creatinine level of rams, high density lipoprotein level (HDL) and resulted in the high HDL level of lactating sheep, and albumin level and resulted in the high albumin level of rams (p < 0.05),while there was not any significant impact of the physiological conditions on direct bilirubin level, total bilirubin, triglyceride level, cholesterol level, LDL level, glucose level, and total protein lvel (p > 0.05). High creatinine level was found in non-pregnant Tsigai sheep (Antunović *et al.,* 2004). The creatinine served as the main marker of glomerular filtration rate in ruminants (Russell and Roussel, 2007) and was not significantly influenced by external factors (deSouza *et al.,* 2020). High direct bilirubin level was found in non-pregnant Tsigai sheep (Antunović *et* *al.,*2004). The lowest level of total bilirubin was found in the rams as reported in the fat-tailed sheep (Sarmin *et al.,* 2021a). The triglyceride level wasstill in the range of that of cross-bred White Dorperx Suffold sheep (de Souza *et al.,* 2020) and for Bangladesh male sheep and in Bangladesh female sheep (Rahman *et al.,* 2018). High cholesterol level was found in the young fat-tailed sheep (Sarmin*et al.,* 2021a), the pregnant Tsigai sheep (Antunović *et al.,* 2004), young suckling Suffolk and it decreased after weaning (Fernandes *et al.,* 2012) and pure and cross-bred Rambouillet sheep (Cavender *et al.,* 1995). Lower HDL level was reported in Iranian fat-tailed sheep of 2 years of age than that of the sheep of more than 2 years of age (Azimzadeh and Javadi, 2020). High LDL level was found in young Suffold sheep before weaning (Fernandes *et al.,* 2012). Glucose level was consistent with the study of the glucose level of the sheep fed with the CF supplemented with exogenous fibrinolytic enzymes (Beigh *et al.,* 2018). It was reported that among Banglades sheep the total protein was higher in young sheep than adult sheep and it related to protein intake (Rahman *et al.,* 2018). Albumin level was higher than the study of the sheep by Anbarasu *et al.* (2002), and also with the study of the sheep fed with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail by Beigh *et al.* (2018).

The hematological data was found that the physiological conditions had significant impact on total leukocyte and resulted in the high total leukocyte of pregnant, lactating female sheep and ewe lambs, the high lymphocyte percentage of ram and ewe lamb and the low neutrophil percentage of ewe lamb and ram ($p < 0.05$),while there was not any significant impact of the physiological conditions on PCV, hemoglobin, RBC count, MCV, MCH, MCHC, monocyte percentages, eosinophil percentages and basophil percentages ($p > 0.05$). Equivalent PCV levels were reported for Balami sheep in Nigeria and Wonosobo sheep in Indonesia (Addas *et al*., 2010; Sarmin *et al*., 2021a).The hemoglobin levelwas equivalent to that of the thick-tailed sheep (Sarmin *et al*., 2021). The MCHC level of the Dedo sheep was equivalent to that of the sheep in Capital of Saltaprovince of Argentina (Mazzuca Pizetti *et al*., 2021). The MCV level of the Dedo sheep in the various physiological status was consistent with that of Churra-da-Terra-Quent sheep (Dias *et al*., 2010). The MCH level of the Dedo sheep in all of the physiological conditions was higher than the reference parameter (Feldman *et al*., 2000). The total leukocyte was used to monitor inflammation status physiological mechanism in the adaptation to environment and defense system against infectious agents (Mazzuca Pizetti*et al*., 2021) and theprogress of sheep health (Daramola *et al*., 2005). Lymphocyte percentage was the key in sheep immunity system (Pradhan, 2016). The resulting neutrophils percentage indicates that the sheep were not being infected by any pathogenic organism because neutrophils played an important role in phagocytosis and eliminated microorganism in the body (De Silva *et al*., 2015).The increase and the decrease in the eosinophil level related to immune response to nematode parasitic infestation (Pernthaner *et al.,* 2005; Buddle *et al.,* 1992). The resulting monocyte percentage was alsothe case of Ethiopian sheep (Tibbo *et al.,* 2006), and Iranian red sheep (Azimzadeh and Javadi, 2020).The resulting basophil percentage was also the case of Ethiopian sheep (Tibbo *et al.,* 2006).

Trichostrongylid faecal egg count was, however, significantly higher during lactation and pregnancy than rams and ewe lamb,it was not consistent with the report of sheep in Nova Odessa (David *et al*., 2020). *Strongyloides* species faecal egg count was, however, significantly higher during lactation and pregnancy than rams and ewe lamb, it was not consistent with the report of sheep in Nova Odessa (David *et al*., 2020). *Monezia* species faecal egg count was, however, significantly higher during pregnancy and in ewe lambs than rams and lactating sheep; it was not consistent with the report from the main slaughterhouse of Cairo (Fol*et al*., 2020). *Eimeria* species faecal egg count was, however, significantly higher during lactation and pregnancy than rams and ewe lamb, it was not consistent with the report of sheep in Nova Odessa (David *et al*., 2020).

Conclusion and Recommendations

The components of the hematological, parasitological and serum biochemical parameters in Dedo sheep in this study seem to point out some differences from those obtained for other ruminant species. The observed differences further support the fact that the physiological parameters reported for other ruminant animals may not be applied on Dedo sheep kept in this ecological zone. The physiological conditions of the sheep had significant impact on the *parasitological* faecal egg count. It is recommended from this study that; the Dedo sheep are physiologically well adapted to the humid tropics for setting community based breeding program. Considering that biochemical and hematological parameters are indicators of the animal's pathological or physiological state, for a correct interpretation of the results, the use of reference values based on animals with similar racial characteristics and subjected to similar environmental conditions is recommended. Strategic treatment for parasitic infection is appropriate, effective and broad spectrum anthelmintic should be practiced at the beginning and after the end of the rainy season.

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