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Hematological Parameters of Goats: An Aid in the Diagnosis of Gastrointestinal (GIT) and Respiratory Diseases

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ABSTRACT: The present hematological study was conducted on Goats to assess the hematological parameters of apparently normal and diseased goats as a diagnostic tool for GIT and Respiratory infections. For this study, a total of 36 blood samples were collected from 12 apparently normal Goats (6 from each sex) and 24 diseased ones. In the latter case, 12 Goats (6 from each sex) were sampled for GIT diseases; whereas the other 12 Goats (6 from each sex) were sampled for respiratory diseases. The blood samples collected were subjected to laboratory analysis to determine ESR, Hb, PCV, TEC, TLC and DLC. Erythrocytic indices were calculated from the values of Hb, PCV and TEC. In apparently normal Goats, the mean values of Hb, PCV and TEC were significantly higher in males than females and it was observed statistically significant. Sex had significantly ($P<0.05$) influenced the mean values of Hb, PCV and TEC. In goats infected with GIT, the mean values of Hb, PCV in males and MCHC in females were decreased, but the value of ESR in both sexes and TLC in females were significantly increased ($P<0.05$) when compared to apparently normal ones. In case of respiratory infections, the values of ESR, TLC and nuetrophils in males were increased, where as lymphocyte were decreased. The mean values of ESR, TEC, LTC and neutrophils in females were significantly increased ($P<0.05$), but lymphocytes were found to be decreased as compared to apparently normal ones.
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1. INTRODUCTION

The world goats' population has been estimated to be about 459.5 million occupying largely the difficult environments for agriculture, particularly the mountainous, arid and semi arid areas. Goats traditionally had a strong influence on the socio-economic life of human populations, especially in rural and less favored regions of the world. (Dubeuf et al 2004).

Special attributes of Goats over other livestock resources include that they are more adapted to broad ranges of environment, have short generation cycles and reproductive rate which lead to high production efficiency and poor people can afford them with less cost than cow. They provide meat, milk and other products as main products for their keepers. Although there is still a major role for traditional systems as efficient converters of range land and by products, circumstances are changing in many respects (Seare, 2007).

In Ethiopia Goats are representing an important component of livestock production system, providing 12% of the value of live stock products consumed at the farm level and 48% of the cash income generated. In Tigray region, the population of goats are estimated approximately to be 1,465,741(BoANR, 1999) and of the same animals population in Mekelle it could be estimated to 2798 (BoANR, 2005). According to BoANR, in this region there are four breeds of sheep namely: Degua, Abergalle, Begait and Elle and also four breeds of goats namely Abergalle, central high land, Adal, Begait, respectively.

Hematological examination or analysis of blood is a powerful diagnostic tool. Veterinary technicians provide a valuable service by acquiring the skills necessary to perform this analysis. Only through practice and attention to detail can the veterinary technicians develop the confidence and proficiency to perform these procedures (Margi, 2004). The hematological changes are mostly in the form of either increase or decrease of various blood constituents. A significant increase in erythrocyte number occurs in

polycythaemia and disturbed tissue fluid balance such as dehydration and certain other states dehydration and other similar derangements of tissue fluid balance give rise to elevated erythrocyte counts because of a decreased in circulating plasma volume.

Routine hematological testing in the laboratory could include determination of, erythrocyte sedimentation rate (ESR), hemoglobin concentration (Hb), packed cell volume (PCV), total erythrocyte count (TEC), total leukocyte count (TLC) and differential leukocyte count (DLC) (James and Dennis, 2000). Therefore, the objective of this study was to compare the hematological parameters of diseased and apparently normal Goats as a diagnostic tool for GIT and respiratory diseases.

2. MATERIALS AND METHODS

Study area

The study was conducted in Mekelle town, the capital city of Tigray regional state, Ethiopia. It is geographically located in between 33° 24′ 30″ to 13° 36′ 52″ latitude and 39° 25′ 30″ to 39° 38′ 33″ longitudes. It lies in altitudinal range of 2150 -2270 m above sea level. The average temperature of the town is 11.11°c to 24.1°c per year, but some studies show there is high temperature fluctuation.

Animal population and study design

The study was conducted to evaluate the different hematological parameters of the diseased and apparently normal Goats. Animals (particularly those supposed to be diseased) were selected by purposive sampling. The apparently normal animals could also be selected for comparison of the different hematological values with that of the diseased animals. The Goats for the study were those presented to the clinic manifesting clinical conditions of respiratory and GIT infections. They were grouped based on the symptoms and sex categories. Accordingly, a total of 36 Goats were included in the study consisting of 12 apparently normal (6 from each sex) and 24 diseased Goats. In the latter case, 12 of them, with GIT diseases, were sampled comprising 6 from each sex. Similarly, 12 Goats with respiratory diseases were sampled constituting 6 from each sex.

Study methodology and procedures

Blood Sample collection

Whole Blood samples were collected from animals, not being treated with any antibiotic and anthelmentic drugs, at an appropriate site of the vein (jugular vein). The blood (5ml) was collected into vacutainer tubes which contained 0.5 ml of Ethylene diamine tetra acetate (EDTA) and the collected blood was gently mixed by slow rotatory movements. The blood smear was made from the fresh sample on a clear, dry and non oily slide and fixed with methanol for 3-5 minutes for differential leukocyte count (Coles, 1986).

Hematological Parameter Determination procedures:

Total Red Blood Cells:

The total red blood cells and white blood cells count were done by Haematocytometer method. For RBC, the sample collected with anticoagulant was carefully mixed by swirling movement of the vial. The sample was drawn by erythrocyte diluting pipette (identified by the 101 mark above the bulb and red color of bead in it) exactly to the 0.5 mark using gentle suction on the mouth piece and excess blood past the line was expelled by stroking the tip of the pipette with the finger. The diluting fluid (isotonic salt solution) was drawn in to the pipette up to 101 marks above the bulb and the pipette was shaken for 3 minutes holding horizontally between the thumb and middle finger. The fluid filled the space between the counting chamber and the cover glass and then the hemocytometer was charged with fluid. Under high power magnification of microscope, all the erythrocytes in 5 of the 25 small squares in the central area were counted. Each of the 5 small squares contains other 16 smaller squares and a total of 80 of these small squares were counted (Schalm *et al.,* 1986).

White Blood Cells Count:

The same methodology was applied for WBC count with some differences of indication. In this case the sample was drawn by leucocyte diluting pipette (identified by 11 mark above the bulb and white color of bead in it) exactly to the 0.5 mark and the blood was diluted by WBC diluting fluid to the 11 mark above the bulb so that 1:20 dilution was made. Number of cells in each of the four large corner squares was counted under low power magnification (x10) (Schalm *et al.,* 1986).

Measuring Packed Cell Value:

The hematocrit (packed cell volume, PCV) value was determined by using microhematocrit method. A capillary hematocrit tube was filled by the blood sample, containing anticoagulant, through capillary action. The opposite end of the tube was sealed by plastic caps, then the tube was placed in the centrifuge keeping the open end towards the hub and sealed end to the rim of the head and centrifuge for 5 minutes at 10,000 rpm. PCV was read by a hematocrit reader as percent (Benjamin, 1978).

Hemoglobin Determination:

Acid hematin method was used to determine hemoglobin (Hb) concentration using Sahli Helling's

hemoglobinometer. The graduated tube of hemoglobinometer was filled with decinormal solution of hydrochloric acid to mark 10. The blood was sucked using a clean and dry Hb pipette from the vial containing anticoagulant up to mark 20. The blood was expelled directly in to the graduated tube containing HCl acid solution. The content was mixed by swirling and allowed to stand for 8 minutes and then the mixture in the graduated tube was diluted with distilled water, drop by drop. The contents become mixed thoroughly with the stirrer after every addition so that the colour becomes matched with the standard. The corresponding reading was taken and the concentration of Hb was recorded as g/100ml of blood (Benjamin, 1978).

Erythrocyte Sedimentation Rate Determination:

Erythrocyte sedimentation rate (ESR) was determined by using Westergren method. The blood sample was drawn in to the tube up to the 0 mark and the tube was placed in an upright position in rack with rubber at the bottom so that the tube was sealed when inserted. The upper level of sedimenting erythrocytes was read on the left scale and the result was expressed as the fall of RBC in mm/hr (Benjamin, 1978).

Differential Leukocyte Count:

The blood smear was done by mixing blood sample properly by gentle agitation and then with the help of applicator stick, small drop of the blood placed near one end of the slide. Other slide was put on the slide with a drop of blood at an angle of 30o and the blood got spread with the spreader slide forward with a steady and even motion so that the blood made a thin film. The smear fixed with methanol was stained with Giemsa's stain to evaluate the differential leukocyte count. A total of 100 leukocytes were counted under oil immersion by using battlement method. This can be done through examination along the outer margin of the smear for about 3 fields, move in ward a short distance (3 fields), parallel the margin for 3 fields and then moved back to the edge of blood smear. The value for leucocytes was obtained by multiplying the percent by the total leucocyte count and dividing by hundred (Vahaneik, 1985).

Measuring Erythrocytic Indices:

Erythrocytic indices namely mean corpuscular volume, (MCV), Mean corpuscular hemoglobin (MCH) and Mean corpuscular hemoglobin concentration (MCHC) were calculated from the values of RBC count, PCV percentage and Hb concentration by conventional method (Schalm *et al*., 1986).

Data analysis

Data entry and analysis was made through SPSS statistical software. The mean values, standard deviation and mean errors were calculated and the results were statistically done by using analysis of variance (two ways ANOVA). The parameters analyzed were ESR, Hb, PCV, TEC count, MCV, MCH, MCHC, TLC, neutrophils, eosinophils, basophils, monocytes and lymphocytes. All values were reported as statistical significant if p value was less than 5% (Steel and Torrie 1980; Cervenka, 1975).

3. RESULTS

The present hematological study was conducted to determine the different hematological parameters in apparently normal and diseased (respiratory and GIT infections) goats as an aid of diagnosing the diseases. The different hematological parameters presently evaluated were erythrocyte sedimentation rate (ESR), total erythrocyte count (TEC), hemoglobin concentration (HB), hematocrit determination (PCV), total and differential leukocyte count (TLC and DLC respectively). The values of mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated from the values of HB, PCV and TEC. The results of these different hematological parameters of Goats are explained in table 1.

Sex-wise comparison of Hematological parameters in apparently normal Goats:

Higher mean value of ESR was recorded in males (2.5±0.4mm/24hrs) than in females (2.4 ± 0.4mm/24hrs). However, it was not statistically significant ($p>0.05$). The mean value of Hb recorded in males (13.0±1.1g/dl) was higher than in females (9.3±1.2 g/dl) and this showed that the difference was statistically significant ($p<0.05$). The present study revealed that higher mean value of PCV was obtained in males (31.5±1.2%) than in females (22.9± 2.0%) which showed statistical significant ($p<0.05$). The mean value of TEC in males and females were 14.2±1.1x10^6/µl and 6.5± 0.6x10^6/µl respectively; however, the statistical analysis showed significant variation ($p<0.05$). Even though the mean value of MCV recorded in males (22.8±3.6fl) was higher than in females (21.9±1.4fl), the value obtained didn't show statistical variation ($p>0.05$). The mean value of MCH in males (9.2±1.4pg) was higher than the value in females (8.9±0.6 pg) without showing significant variation. The study indicated that higher mean values of MCHC and TLC were obtained in males (41.3±2.3g/dl); (9.3±1.2x10^3/µl) than in females (40.6 ±2.7g/dl); (8.2±2.0x10^3/µl) respectively. However, there was no statistical variation of the parameters. The mean values of DLC were 32.0±2.6%, 6.8±0.9%, 1.6±0.5%, 3.6±0.8%, 56.1±2.4% and 31.6±2.4%,

6.8±0.7%, 1.5±0.5% 4.0±0.5% and 55.5±3.9% for neutrophils, eosinophils, basophils, monocytes and lymphocytes in males and females respectively; hence, the significant analysis didn't show significant variations in different leukocytes.

Hematological parameters findings in clinically diseased Goats:

Respiratory infections

The study revealed that the mean value of ESR in females (8.2±1.2mm/24hrs) was obtained higher than in males (7.3±1.7mm/24hrs). However, the finding showed that higher value of ERS was recorded in diseased goats of both sexes as compared to apparently normal ones; hence, it was statistically significant variation ($p<0.05$). The mean value of Hb in males (9.7±1.5g/dl) and in females (11.5±1.3g/dl) did not statistically reveal any significant variation when compared to apparently normal ones. The recorded mean value of PCV in males and females was 25.7±6.6% and 23.3± 3.6% respectively; however, statistical analysis indicated that there was no significant change in PCV ($p>0.05$). Lower mean value of TEC in males (12.5±4.3x10^6/µl) was recorded than in females (14.7±1.5x10^6/µl). This finding showed that the mean value of TEC was higher in diseased females' goats than apparently normal ones (6.5± 0.6x10^6/µl); hence, the difference was statistically significant ($p<0.05$). The mean value of MCV in males (21.2±3.1fl) and females (22.2+2.3fl) didn't show statistical variation when compared to apparently normal animals. The mean values of MCH in males and females were 8.3±2.3 pg and 9.2±1.5 pg respectively. However, no significant variation was observed in MCH in diseased ones as compared with the respective apparently normal animals. The value of MCHC in males was 38.5±6.3g/dl and in females 40.3±4.3g/dl. Statistical analysis revealed that there was no significant change in MCHC in the infected animals when compared to apparently normal ones. The study demonstrated that the recorded mean value of TLC in males (15.6±2.3 x10^3/µl) and females (13.7±4.7x10^3/µl) of diseased animals was higher than that of apparently normal ones. Thus, statistical analysis revealed that there was significant variation ($p<0.05$) of TLC in diseased animals as compared to apparently normal ones. The mean values of DLC in males and females were 44.5 ± 3.6% and 42.5± 4.7%, 7.3± 1.2% and 7.5± 1%, 1.5± 0.5% and 1.8± 0.7%, 4.6±1% and 4.5±0.8% and 42.1±2.1% and 43.4±5.1 % for neutrophils, eosinophils, basophils, monocytes and lymphocytes respectively. However, the finding revealed that the value of neutrophils increased; whereas the value of lymphocytes decreased in diseased animals when compared to apparently normal animals. This indicated that there was significant variations ($p<0.05$) obtained. Statistical analysis verified that the value recorded in eosinophils, basophils and monocytes in diseased animals of both sexes didn't show significant variation when compared to the apparently normal ones.

Gastro intestinal infections

The mean value of ESR and Hb in males and females were 7.8±1.9 mm/24hrs; 9.1+1.9mm/24hrs and 7.0±1.7g/dl; 6.3±1.2g/dl respectively. The finding showed that higher value of ESR in diseased animals on both sexes was recorded; whereas lower value of Hb was obtained with the same condition on both sexes when compared to apparently normal ones; hence, it was statistically significant in male($p<0.05$). The mean value of PCV in males and females were 20.8±4.7 % and 22.2±3.4 % respectively. When the PCV value of diseased males compared with that of apparently normal ones, higher value was recorded. Thus, this data revealed that there was statistically significant variation on the value. The mean value of TEC obtained in males (12.7± 4.5 x10^6/µl) and females (10.0± 2.3 x10^6/µl) didn't show any significant variation when compared to apparently normal ones. The statistical analysis revealed that the value of MCV and MCH in males (17.0±2.8fl) and females (22.2± 2.4fl) in diseased Goats didn't show any significant variation when compared to the apparently normal ones. The study found that the mean value of MCHC in males was 35.0±2.5g/dl; whereas in females 28.8±5.3g/dl. The value recorded in diseased females showed that there was statistically significant decrease ($p<0.05$) in MCHC as compared to apparently normal ones. The mean value of TLC was registered 13.5±3.3x10^3/µl and 13.3±3.1x10^3/µl in males and females respectively; however, higher value of TLC was recorded in diseased females than apparently normal ones. This indicated that it was statistically significant ($p<0.05$). The present study demonstrated that the mean values Differential Leukocyte Count (DLC) were (31.0±5.6% and 33.3±4.0%); (7.3±1.2% and 9.6±1.5%); (2.0±0.6% and 1.5±0.5%); (5.3±1.5 % and 4.8±0.7%); (54.3±6.4% and 50.6±5.6%) in males and females for neutrophils, eosinophils, basophils, monocytes and lymphocytes respectively. Hence, the recorded values of DLC in diseased animals of both sexes indicated that there was no statistical significant variation when compared with apparently normal animals.

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Table: Mean ±SD of different hematological parameters of apparently normal and diseased goats

Conditions	Sex	ESR/24hrs	Hb(g/dl)	PCV (%)	TEC(10^6/µl)	MCV(fl)	MCH(pg)	MCHC(g/dl)	TLC(10^3/µl)	N%	E%	B%	M%	L%
Apparently normal	M(n=6)	2.5±0.4	13.0±11.1*	31.5±2.5*	14.2±3.1*	22.8±3.8	9.2±1.4	41.3±2.3	9.3±1.2	32.0±2.6	6.8±0.9	1.6±0.5	3.6±0.8	56.1±2.4
	F(n=6)	2.4±0.4	9.3±1.2	22.9±2.0	6.5±1.4	21.9±1.4	8.9±0.6	40.6±2.7	8.2±2.0	31.6±2.4	6.8±0.7	1.5±0.5	4.0±0.6	55.3±6.4
GIT	M(n=6)	7.8±1.9*	7.0±1.7*	20.8±4.7*	12.7±4.5	17.0±2.8	5.7±1.0	35.5±2.5	13.5±3.3	31.0±5.6	7.3±1.2	2.0±0.6	5.3±1.5	54.3±6.4
	F(n=6)	9.1±1.9*	6.3±1.2	22.2±2.4	10.0±2.3	22.2±2.4	6.4±1.5	28.8±5.3*	13.3±3.1*	33.3±4.0	9.6±1.5	1.5±0.5	4.8±0.7	50.6±5.6
Resp.	M(n=6)	7.3±1.7*	9.7±1.5	25.7±6.6	12.5±4.3	21.2±3.1	8.3±2.3	38.5±6.3	15.6±2.3*	44.5±3.6*	7.3±1.2	1.5±0.5	4.6±1.0	42.1±2.1*
	F(n=6)	8.2±1.2*	11.5±+1.3	23.3±3.6	14.7±2.5*	22.0±2.3	9.2±15	40.3±4.5	13.7±4.7*	42.5±4.7*	7.5±1.0	1.8±0.7	4.5±0.8	43.4±5.1*

SD=standard deviation, n=no. of animals, M=male, F=female, *=statistically significant
GIT= Gastrointestinal infections, Resp. =Respiratory infection

4. DISCUSSION

The present study was carried out to determine the hematological parameters of apparently normal and diseased goats to aid in the diagnosis of disease conditions. The values of different hematological parameters of apparently normal animals were compared sex wise; whereas the values of hematological parameters of clinically diseased animals were also compared with that of apparently normal animals. However, regarding this study, there is no adequate information which indicates that the research had been done on hematological parameters of diseased Goats, particularly on respiratory and GIT infections in the country.

In the present study the mean value of ESR in apparently normal animals didn't show any significant differences in both males and females. The mean values of Hb, PCV and TEC in apparently healthy goats were higher in males than in females. This may be due to the activity of estrogen hormone on the erythropoietin processes which leads to relative decrease of RBC production (Coles, 1986). Higher values of Hb, PCV and TEC in males in the current study were observed than the reports of Taiwol and Ogunsanmi, (1999) and Olayemi *et al.*, (2000) in male West African Dwarf Goats. This may be due to environmental, breed, feeding management and altitude factors.

The mean values TLC and DLC in males and females of apparently normal goats were statistically insignificant. According to the report of Tibbo *et al.*,(2004) on factors affecting hematological profiles in three Ethiopian indigenous goat breeds, the mean values of leukocyte counts (TEC, lymphocytes and eosinophils) were significantly higher in females than males. Conversely, neutrophils were higher in males than females.

The mean value of ESR obtained in both male and females affected with respiratory infections showed significant increase when compared to the value of ESR recorded in apparently normal ones. The significant change in ESR may be due to the abnormal morphological patterns of RBC and the increment of fibrinogen level in localized/ generalized infections (Gupta *et al.*, 2003).

The mean values of hemoglobin and lymphocytes recorded in apparently normal female Goats during the present study is closely similar to the values of hemoglobin and lymphocytes which were reported by S.A. Bhat *et al.,* (2011) on hematological and biochemical parameters of Kashmiri Goats in different climatic conditions.

In the present study the mean value of PCV recorded in diseased male with respiratory infection was lower than that of apparently normal male; whereas higher mean value of PCV was recorded in diseased females Goats than that of apparently normal ones. However, the recorded value of PCV in both diseased and apparently normal animals of both sexes didn't show any significant variation. The mean value of PCV obtained in male of apparently normal Goats was higher than that of females ones and it was significantly different. A.A. Njidda et al., (2013) reported on hematological and biological parameters of three different breeds of Goats of semi arid environment fed on natural grazing range land of Northern Nigeria, namely Kano Brown, Borno white and Sokoto red breeds. The value of PCV obtained in the present finding is in close agreement with the work of this author reported on the Kano Brown breed, but inversely agrees with that of Borno white and Sokoto red breeds.

In respiratory infections, the values of ESR in male and female goats were significantly increased when compared to apparently normal animals; but the values of Hb, RBC and erythrocyte indices in this condition did not show any significant variation. The increment in value of ESR might be due to inflammatory conditions in which tissues become necrosed and the physiochemical properties of erythrocytes ultered and rapidly form aggregation and rouleaux formation (Coles, 1986).

The present study demonstrated that the values of ESR in Goats of both sexes and TLC in females were found to be significantly increased; but the values of Hb and PCV in males and MCHC in females were significantly decreased. The decrement in values of

PCV, Hb and MCHC may be due to GIT parasitic infections that lead to continuous blood loss and probably expose to anemia. Piccione *et al*., (2007) while working on hematological responses to different work load in jumper horses reported that the value of PCV increased during strenuous exercise as horses undergo a variety of physiological changes including cardiac output & increased pulmonary arterial blood pressure.

In the present study the mean values TLC and neutrophils in both sexes of animals affected with respiratory infections were significantly increased, where as lymphocytes decreased significantly when all compared to the values of TLC, Neutophils and lymphocytes in apparently normal animals. The increatment in values of TLC & neutrophils may be due to generalize/localized inflammatory infections, but decreatment in lymphocytes might be due to certain viral diseases associated with lysis of lymphocytes (Gupta *et al*., 2003).

The present study revealed that higher value of ESR was recorded in both sexes of animals infected with GIT infection; whereas lower value of Hb in both sexes was obtained with the same disease condition when compared to apparently normal ones; hence, this indicated that the values of ESR in both sexes and Hb in male were significantly varied.

This study indicated that the mean value of MCHC obtained in males was higher than that of females. The report of J O Daramola *et al.,* (2005) on Haematological and biochemical parameters of West African Dwarf goats revealed that the value of MCHC recorded in Buck was higher that of Doe; this showed that the value obtained in the present study is in close agreement with the finding this author.

5. CONCLUSSIONS

The study conducted on different hematological parameters indicated that values obtained in apparently normal goats were more or less similar. The values obtained in the present study closes to that reported by different authors in different conditions; even though, there are few work has been done on the study of hematological parameters in these and other animals in Ethiopia. However, most of the erythrocytic parameters revealed higher values in males than females. In diseased conditions (both respiratory and GIT infections), the values obtained in diseased animals were resulted in either increase or decrease in some of hematological parameters when compared with the values obtained in apparently normal animals. This variation in these values can be helpful in diagnosing the disease conditions that influence physiological patterns of the blood cells.

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