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Profiling of Haematological Indices in Relation to Body Score and Altitude Among Norwegian Goats in Morogoro, Tanzania

Mohamed Hamed Sango Ally

Department of Physiology, Biochemistry, Pharmacology and Toxicology, Sokoine University of Agriculture, Morogoro, Tanzania

Email address:
ally2005mood@yahoo.com

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Abstract: Blood samples were collected from 180 apparently healthy adult Norwegian goats each 90 Norwegian goats, from high altitude and low altitude in Morogoro urban and peri-urban to assess the influence of altitude on their hematological indices. The (RBC) Red blood cells, PCV (packed cell volume), WBC (White blood cells) and HB (Hemoglobin) concentration were determined. Analysis of hematological indices was done using Automated Hematological Analyzer (Msn4s). Data on age, weight, body score, health and nutritional status were recorded for each animal. Epi-info version7.1 was used to analyze data for means, standard deviation and percentages. T-test and Chi-square were used to compare similarities between the groups. Results were compared to normal ranges of the parameters. Most parameters were within normal ranges. However significant increase in white blood cell count and decrease in hemoglobin concentration was observed from blood collected from groups of Norwegian goats located at low altitudes. Whereas the value of RBC (Red blood cells), PCV (packed cell volume) and HB (Hemoglobin) concentration in blood samples from high altitude were significantly high compared to those found at low altitude. These results revealed that, the level of hematological parameters were significantly affected by nature of areas animal located, that is altitude, although other confounding factors such as age, diseases, stress, sex, body weight and climatic condition may result to variations on the blood indices.

Keywords: Hematological Indices, Altitude, Norwegian Goats, Morogoro, Tanzania

1. Introduction

Norwegian goats (The Nigerian Dwarf Dairy goat); Is a dairy goats of West African origin. These goats were used as food and were brought over many years ago as a meat source for the large cats that were in zoos [4]. Some of them survived unharmed and were left as an added attraction. Later there were some distinct differences developing within the herd, some appeared much like the meat goats, these were used for meat, others were showing more dairy characteristics. The goats which were showing the most dairy characters were used by a handful of dedicated breeders to develop a new breed: the Nigerian Dwarf. The Nigerian dairy has become more defined over the last two decades, focusing in more milk production [14]. Sokoine University of Agriculture launched a research project on the evaluation of Norwegian goats and their crosses with indigenous goats at Morogoro (low altitude 600m), Tanzania. Later the study of pure Norwegian goats and their crosses were introduced on-farm in Mgeta (high altitude1600m) [8].

The performance of pure Norwegian dairy goats at the low altitude areas was not viable. However, the F1crosses between the indigenous and the Norwegian goats did well, being able to reproduce and produce moderate levels of milk. The pure Norwegian goats and their crosses at Mgeta which is a high altitude thrived and reproduced well [14]. Goats are highly distributed domestic animals especially in Africa, their wide distribution is defined by their ability to thrive in environments where vegetation is scarce [3]

Blood being defined as a fluid connective tissue is an essential for survive of higher animals [12]. Importance of determining the hematological values of domestic animals

have been reported [16]. Diagnosis, surgical operation and response to treatment can also depend on hematology [21]. Many factors such as sex, breed, physiological, age, genetics, stress, diseases, management system, location and season can influence hematological values in domestic animals [1]

Hematological indices are the parameters related to the blood and blood producing organs [22, 5]. Blood can act as a reflector or indicator of exposure status of animals to toxicant and disease conditions [15]. Animals having perfect blood composition are most likely to exhibit good health and performance [11]. Testing blood in laboratory is vital tools that can be used to detect any deviation from normal in the animal body performance, also blood gives the indicators of the physiological status of animals [13].

Investigation of the blood damage and diseases diagnosis can be done by using hematological indices [20]. Hematological indices are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment [17, 7] and could be used in the selection of animals that are genetically resistant to some diseases and environmental conditions [11, 9]. Also hematological indices can be used to analyze the presence of different metabolites and other constituents in the body of animals; it plays a vital role in indicating the physiological, nutrition and pathological status of animals [6]. Examining blood for their constituents can provide important information for the diagnosis and prognosis of diseases in animals [15]. Blood constituents change in relation to the physiological conditions and health [20]. The changes are important in assessing response of animals to various physiological situations [13]. Changes of hematological indices are used to determine various status of the body and to determine stresses due to environmental, nutritional and/or pathological factors. [2, 10].

Changes in composition of blood when compared to normal values could be used to interpret the metabolic state of the animal as well as the quality of feed offered to the animal.

2. Materials and Methods

2.1. Study Area and Sample Size

Study was conducted between January to July 2019 at the Department of Physiology, Biochemistry, Pharmacology and Toxicology; Sokoine University of Agriculture. Samples were collected from Mgeta high altitude and Sokoine University of Agriculture farm, low altitude.

2.2. Sample Size

A total of 180 blood samples were collected from Morogoro; whereby 90 blood samples were collected from Mgeta and 90 blood samples from Sokoine University of Agriculture farm.

2.3. Study Design and Data Collection

Cross sectional study design was used. Blood samples were collected from goats which were grouped into two groups based on their locations. One group from high altitude and other from low altitude. Using digital weighing balance, weight was taken, sex, age, health and nutrition status was also examined and recorded.

Handling of animals induces a change in blood indices, hence blood was collected from the animals at rest with minimum disturbance; this was done by letting rest at for two minutes of an acclimatization. To avoid the effect of diurnal variation, sampling time was adjusted for all goats around 8:00-10:00 am to. 2ml of jugular vein blood was collected into ethylenediamine tetraacetic acid (EDTA) treated bottles to prevent coagulation. Immediately tipped back and forth two times to dissolve the anticoagulant. The mixing of blood was done gently to avoid rough handling and/or (blood cells lysis).

2.4. Measurement of Body Weight

The body weight of each goat from both high and low altitude were measured using weighing balance (kg) and recorded.

2.5. Assessment of Body Score

Body score was measured by feeling the fat cover of goats using hands, score was1.0-5.0

Whereas, 1→weak/emaciated; 2→slightlyweak; 3→normal; 4→fat and5→obesy

2.6. Laboratory Analysis

Laboratory analysis was done by using Automated Hematological Analyzer (Msn4s).

2.7. Data Analysis

Data storage was done by using Excel 2007. Analysis of data was done using Epi-info software version7.1, for analysis of means, percentage and standard deviation. Comparison between groups was done using t-test and chi-square.

3. Results

Table 1. *The RBC (Red blood cells) indicesofNorwegiangoatsfoundinlowandhighaltitudesareasinMorogoro region.*

Blood index	Normal range	Mean±SDV. at high altitude	Mean±SDV. at low altitude	p-values
RBC (m/mm^3)	8.0-18.0	15.84±2.62	13.85±2.57	0.00914
PCV (%)	22.0-39.0	24.63±8.78	26.54±7.10	0.40164
HB (g/dl)	8.0-12.0	8.40±1.97	6.26±1.15	0.00002
MCV (g/dl)	16.0-25.0	19.87±2.33	17.01±1.61	0.00001
MCHB (g/dl)	5.20-8.0	5.172±1.15	4.70±1.01	0.1342
MCHC (g/dl)	28.0-42.0	26.19±5.04	27.60±4.07	0.2817

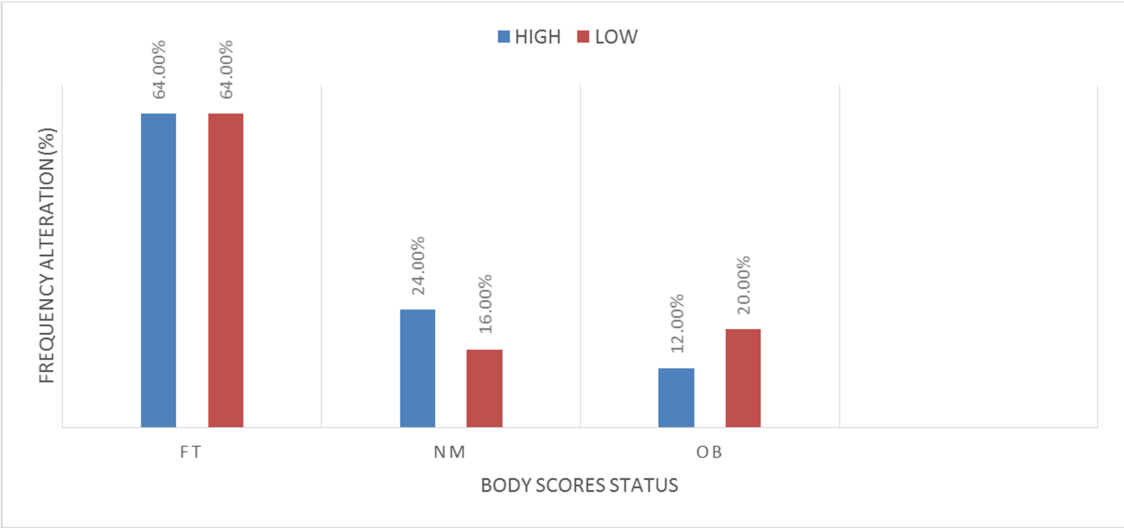

Figure 1. *Altitude versus body score.*

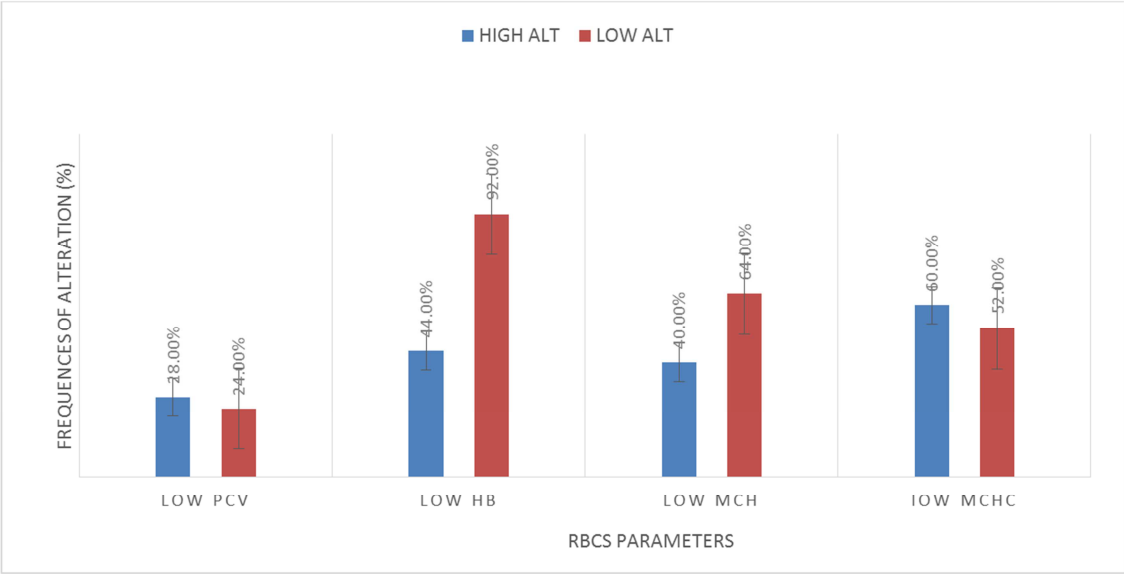

Figure 2. *Frequency alteration RBCs (red blood cells) versus altitude.*

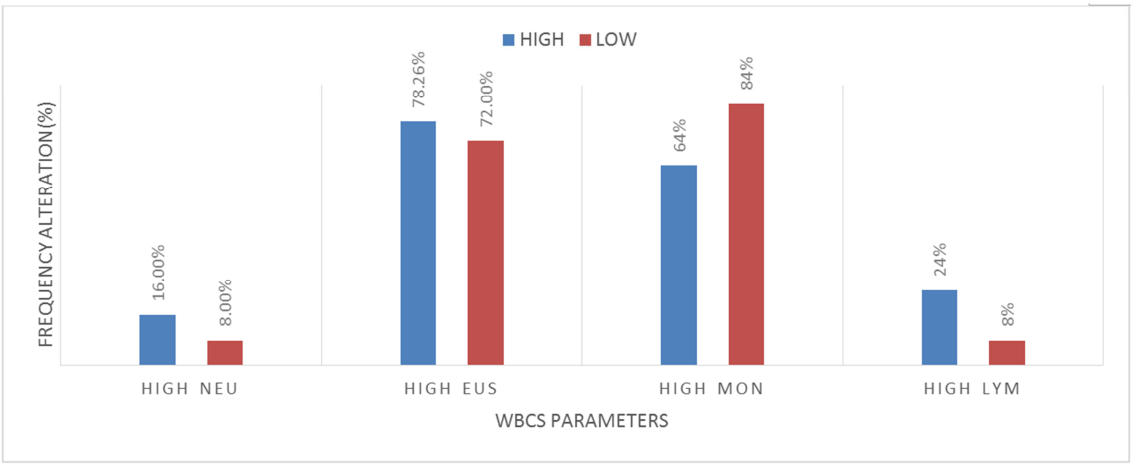

Figure 3. *Frequency alteration of WBC versus altitude.*

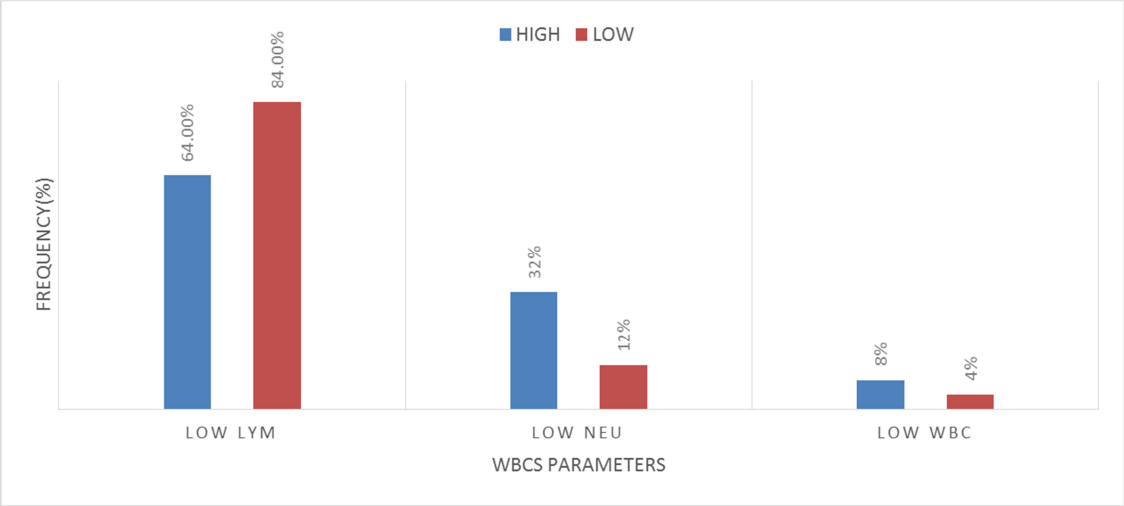

Figure 4. *Frequency alteration of WBC versus normal range.*

Table 2. *WBC indices of Norwegian goats found at low and high altitudes in Morogoro region.*

Blood index	Normal range	Mean±SD Vathighaltitude	Mean±SD Vatlowaltitude	p-values
WBC (m/mm^3)	4.0-13.0	12.05±7.18	22.02±15.58	0.005
EO (%)	1.0-8.0	15.83±9.18	13.22±9.26	0.332
BAS (%)	0.0-1.0	0.66±0.62	0.48±0.27	0.182
NEU (%)	30.0-56.0	37.62±17.59	41.16±13.34	0.426
LYM (%)	50.0-70.0	41.84±16.02	37.92±12.02	0.332
MONO (%)	1.0-4.0	5.14±1.31	7.18±2.85	0.002

4. Discussion

Based on data obtained together with statistical analysis, this study gives preliminary information on how geographical location (altitudes), ages, health and nutritional status can affect the hematological indices of Norwegian goats. There was deviation of some hematological indices between high and low altitude as compared to normal reference ranges of Norwegian goats. Most hematological indices were within normal ranges with exception of white blood cells (WBCs), hemoglobin concentration (HB) and Eosinophils. Hemoglobin concentrations were low than normal range in group found at low altitude, the mean plus standard deviation was 6.27±1.154 while the normal range lies between8.0-12.0g/dl. The average hemoglobin concentration for group found at high altitude was high (8.404g/dl) compared to those found at low altitude.

White Blood Cell count was higher in goats located at low altitudes compared to high altitude. The average WBC count in group located at low altitudes was 22.02m/mm^3 (Normal 4.0-13.0m/mm^3) whereas in high altitude was within the normal range (12.05m/mm^3). Likewise, there was an increase in standard deviation from 7.19 of the group located at low altitude to15.58 for group located at high altitude.

Increase or decrease of white blood cell count is an indication of body status of the infection body because it uses them for infection fighting and react against foreign bodies or tissues. There is a tendency for percentages of different types of WBC to shift depending on the type of infection in the body. Decrease WBC, in the body may reflect body has been infections fighting for sometimes. [15, 18]

Red Blood Cell count were within the normal ranges in both group of high altitudes and low altitude, although goats at high altitude showed high values up to18.43 and 25.01m/mm^3. The normal ranges for RBC in goats lies between 8.0-18.0m/mm^3. Many previous study on the effect of altitude on erythrocytic values has well-established that reduced oxygen partial pressure, in high altitude, leads to more production of erythropoietin hormone, thereby, stimulating erythropoiesis as an adaptive mechanism to low oxygen level in such an environment. This study which was carried out at high altitude (1100m and1750m above sea level) could provide evidence of the adaptation of these breeds to low atmospheric oxygen partial pressure. Reduced red blood cell count implies a reduction in the level of oxygen that would be carried to the tissues as well as the level of carbon dioxide returned to the lungs [11, 19]. Both low altitude and high altitude were within the normal range (between 22.0-39%). PCV value below 22% signifies anemia and above 39% polycythaemia, however false results interpretation may occur due to dehydration or hemodilution.

According to the changes observed, these decrease in hemoglobin concentration is due to the effect of altitude while the increase in WBC and Eosinophil were due to reasons such as diseases and parasite infestation like worm, these effect was commonly observed in low altitude compared to high altitude at which the incidence of diseases was low.

5. Conclusion

These results showed that, keeping Norwegian goats at high altitude has more advantageous compared to low altitude, since animal kept at high altitude have less hematological deviation compared to those in low altitude. Hematological indices can be used to assess the health as well as the physiological status deviation of animals. There is variation in the hematological indices as observed between different altitudes, ages, sexes and management systems. Establishment of appropriate physiological baseline values for livestock in Tanzania could help in realistic evaluation of the management practice, nutrition, diagnosis of health as well as in determining the physiological status of animals indices.

Conflict of Interest

The author declare that there is no conflict of interests.

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