



## Hematological indices and serum mineral profiles of Beetal Goats in Khyber Pakhtunkhwa at different altitudes

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### Abstract

This study reported the effect of different altitudes on heamatology and serum mineral profile of beetal goats. Sixty (60) beetal goats of more than 1 year age and body weight of 25-40 kg were divided into three groups on the basis of altitude from sea level: Peshawar 1177 feet (Altitude 1), Kabal 2863 feet (Altitude 2) and Margazar 4200 feet (Altitude 3). To stabilize the health condition and to evaluate body condition goats were reared in sheds at each point for 15 days. Blood samples collected on 16<sup>th</sup> day in the morning were evaluated for heamatology. The level of serum calcium, chlorine, potassium, phosphorus and iron were determined. Statistical analysis (one-way analysis of variance (ANOVA), followed by Post Hoc test (Tukey Test), showed that there were significant ( $P < 0.05$ ) differences found in heamatology, calcium, chlorine, potassium, phosphorus and iron level. The results contribute to the reference ranges for the beetal goat can be used for monitoring health and disease diagnosis at different altitudes.

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## Introduction

Goats are used for production purpose in areas having lower financial levels and the milk, meat and wool products are primarily used for self-consumption (Gallegos *et al.*, 2005). Pakistan is the third largest goat producing country after China and India. Currently goat population in Pakistan is 53.8 million and increasing at the rate of more than 3% per year, Government of Pakistan (2006).

The competence of livestock is majorly dependent on their health and well-being. Blood is a significant and authentic medium for assessing the health status of individual animal (Ramprabhu *et al.*, 2010). The hematological values are mainly used for indicating the stress and welfare of the animal and to evaluate the physiological status of the animal. There is a vast variation in the haematological and biochemical indices found between different breeds of goats (Azab and Abdel-Maksoud (1999); Tambuwal *et al.* (2002).

In small ruminants minerals and mineral-hormone interactions in the serum have not been considered particularly in developing countries where mineral deficiencies are one of the more substantial consequences than infectious diseases (Soetan *et al.*, 2010). Lack of minerals are associated to a variety of clinical signs, which includes pale coat, spontaneous fractures, anemia, myocardial degeneration, hypomyelination of the spinal cord, poor capillary integrity, impaired reproductive performance and reduced resistance to infectious disease. Also the hypophosphatemia and hypocalcaemia are the predisposing factor for uterine prolapsed, retention of fetal membranes and dystocia (Heidarpour *et al.*, 2008). Numerous studies completed on the mineral status of sheep and cattle (Dominguez and Huerta (2007); Morales *et al.* (2007) but there is very less information shared about goats due to which it is difficult to assess their mineral status, or to determine a mineral supplement (Meschy, 2000). The hematological indices and mineral content in sheep blood may be affected by altitude and season (Soch *et al.*, 2011). Many investigators have studied the effect of altitude on erythrocytic values and is now a well-

founded fact that in highland region the low oxygen pressure which results to an increased production and release of erythropoietin and in this manner leads to increase in erythropoiesis which is an adaptive mechanism to reduced oxygen levels in such environments (Storz and Moriyama, 2008). Pakistan has altitudes that vary from sea level to 8,611 (K2 height) meters. There is lack of availability of baseline hematological data in relation to altitude in Pakistan.

The normal physiological indices of various blood parameters are influenced by a number of factors such as sex, breed, age, altitude, climatic conditions, and season, nutrition and life habits of the species (Tripathi *et al.*, (2008); Frelich *et al.*, (2006). Although in terms of haematology the Caprineis the less studied systematic group of domestic animals, and there is a huge difference observed in the haematological markers within and between different breeds of goats and is quite difficult, to present a worldwide complete blood count for that animal (Daramola *et al.*, 2005); (Iriadam, 2007). Trace mineral element assessment is economically important effects on production and health status of animals and can be affected by trace element deficiencies even before clinical signs are evident (Kincaid, 1999).

The minerals also play an intermediate role in the action of hormones and enzymes at the cellular level in an integrated fashion. Calcium works as a cofactor or activator of various enzyme systems. In many body actions like cellular metabolism, enzyme reactions, muscle contraction and nerve transmission the blood minerals are of vital importance (Piccione *et al.*, 2007b). Significant trace elements which plays a key role in body are calcium, potassium, iron, iodine, chlorine, and phosphorus and its appropriate level is necessary for keeping optimum level of health, performance and body growth (Broucek *et al.* (2009); Solaiman *et al.* (2006b); Kellogg *et al.* (2004); Orden *et al.* (2000). The naturally occurring mineral deficiencies are majorly linked with specific regions and are openly related to soil characteristics and affected by altitude, Broucek *et al.* (2009). The

hematological and biochemical values obtained in one geographical zone cannot be taken as a standard reference value in another zone due to varying climatic conditions, breed variation etc.

The normal range of the most commonly used serum biochemical and hematological parameters that would be obtained in the current project during the different altitudes in beetal goats were used as guideline for the management strategies for goat farming in the province to increase its productivity.

### Material and methods

#### *Universe of the study*

This study was conducted at three different altitudinal groups: Kabal (KBL), Marghazar (MRG) areas of Swat and Peshawar (PSH) in Khyber Pakhtunkhwa from the mid of June to August. The altitude of Peshawar, Kabal and Marghazar is 1177, 2863 and 4200 feet respectively from the sea level. A total of 60 Goats (beetal) were selected (20 in each group) having approximately more than 1 year of age and having body weight of 25-40 kg.

The Goats were reared in sheds at each point for 15 days for evaluation of body condition and to stabilize the health condition of the animal. The animals were given de-wormer Oxafax (GSK®) orally for endoparasites and Tagafon powder (Star Labs®) applied on skin for ectoparasites. All animals were fed 1 type of ration containing wheat offal, maize bran, beans husk, groundnut haulms and tree leaves given ad-libitum. Also mineral mixture and water were given at ad-libitum.

#### *Blood Sampling*

Sampling was done from all the animals on the 16<sup>th</sup> day. Samples were collected in EDTA tubes for hematology and in Gel Clot Activator tube for serum analysis, were separated in eppendorf tubes and were kept in freezer at -20 °C. Samples containing EDTA were processed within 12 hours of collection. The samples were analyzed through Hematology Analyzer (Abacus, Diatron Messtechnik Ges.M.B.H. Wein, Austria) for the complete blood count containing

white blood cells (WBC), lymphocytes count (LYMP), granulocytes count (GRAN), red blood cells (RBC), hemoglobin (Hb), Hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC). Blood samples were processed for the determination of Iron (Fe) in the blood through Spectrophotometer (UVA Lb 280) at 540nm (Drabkin method).

The Serum Samples were then analyzed in 2 weeks for selected serum mineral profile. First of all wet digestion of serum samples were performed. The calcium (Ca) and potassium (K) level was monitored through Flame Photometer (Sedico Ltd AFP-100 Flame Photometer), Serum Chlorine (Cl) level by silver Nitrate titration method and Phosphorus (P) by Spectrophotometer (UVA Lb 280) at 450 nm.

#### *Statistical analysis*

The effect of altitude on the hematology and serum mineral profile of beetal goats was analyzed using one way analysis of variance (ANOVA). P value < 0.05 was considered significant. The multiple comparisons Post hoc, Tucky test was used. All the results were expressed as mean ± standard error of the means. The statistical package for social sciences version 17.00 was used for data entry and analysis.

### Results and discussion

#### *Effect of Different Altitude on Hematology of Beetal Goats*

The hematological parameters of beetal goats at different altitudes showed that there was significant effect of altitude found on the WBC, LYMP, RBC, Hb, HCT, MCV, MCH and MCHC. In contrast no significant effect of altitude on the GRAN was found (table 1).

#### *Effect of different altitude on serum mineral profile of beetal Goats.*

The serum mineral profile of beetal goats at different altitudes showed significant effect of altitude on the Calcium, Chlorine, Potassium, Phosphorus and Iron profile of the beetal goats (table 2).

**Table 1.** Effect of Different Altitude on Haematology of Beetal Goats.

Parameters	Peshawar 1177 Feet (Altitude 1)	Kabal 2863 Feet (Altitude 2)	Margazar 4200 Feet (Altitude 3)
WBC Count ( $10^3/\mu\text{L}$ )	10.48 <sup>b</sup> ±0.34	8.33 <sup>a</sup> ±0.13	11.52 <sup>b</sup> ±0.52
LYM Count (Percent)	28.90 <sup>ab</sup> ±0.46	28.55 <sup>a</sup> ±0.60	31.15 <sup>b</sup> ±0.99
GRAN Count (Percent)	65.10±0.85	65.89±1.41	67.23±1.87
RBC count (million/ $\mu\text{L}$ )	10.98 <sup>a</sup> ±0.22	11.65 <sup>a</sup> ±0.15	14.62 <sup>b</sup> ±0.26
Hb count (g/dL)	5.16 <sup>a</sup> ±0.19	7.23 <sup>b</sup> ±0.10	10.96 <sup>c</sup> ±0.26
HCT (percent)	29.14 <sup>a</sup> ±0.39	28.94 <sup>a</sup> ±0.42	30.69 <sup>b</sup> ±0.48
MCV (femtoliter)	28.83 <sup>a</sup> ±0.43	31.06 <sup>b</sup> ±0.37	35.94 <sup>c</sup> ±0.39
MCH (picogram)	5.27 <sup>a</sup> ±0.12	5.73 <sup>b</sup> ±0.10	6.78 <sup>c</sup> ±0.09
MCHC (g/dL)	29.82 <sup>a</sup> ±0.49	32.10 <sup>b</sup> ±0.57	34.32 <sup>c</sup> ±0.39
PLT Count ( $10^3/\mu\text{Liter}$ )	270.90 <sup>a</sup> ±3.81	294.95 <sup>b</sup> ±3.61	283.50 <sup>ab</sup> ±5.28

Means<sup>a-b-c</sup> ± SE within a row lacking a common superscript differ significantly from one another (P < 0.05).

The results obtained in the present study are in the normal physiological range of hematology and serum mineral profile of goat breeds, Feldman *et al.* (2002). The values determined in the present study on the basis of different altitude can be used as a reference values for the future studies for beetal goats.

#### White Blood Cells

The Results revealed in the study that the highest WBC counts were found at the altitude of 4200 feet and the lowest at the altitude 2863 feet (Table 1). The differences among individual groups were found significant. Similar study was reported in Chittagong, Bangladesh which is 7m above the sea level and found white blood cells count 12.16±2.54 thousand/ $\mu\text{L}$  in goats, Shaikat *et al.* (2013). Egbe-Nwiyi *et al.* (2000) conducted a study in arid zone of Nigeria to check the influence of age and sex on the hematology of goats. Nigeria is 1115 feet above the sea level and WBC count were found 12.78±0.25 thousand/ $\mu\text{L}$ . All the above results are in line with our findings.

#### Granulocytes Count

In the results the highest number of granulocytes was found at the altitude 4200 feet and the lowest at 1177 feet (Table 1). There was no significant difference between the groups. Similar results were observed in Chittagong, Bangladesh on the hemato-biochemical profile of indigenous goats and found the

granulocytes count as 69.32 % in goats, Shaikat *et al.* (2013).

#### Lymphocytes Count

In our results, the highest level of lymphocytes count was found at the altitude 4200 feet and lower at the altitude 2863 (Table 1). The difference among individual groups was found significant. In Italy the hematological parameters of 348 goats from 1-6 year of age group was evaluated and the lymphocytes value found was similar to our results, Piccione *et al.* (2010). The above result is in line with our findings. A study conducted by Soch *et al.* (2010) on cows at four different altitudinal groups (400 feet, 550 feet, 675m and 910m) and he found the highest amount of lymphocytes at the altitude 550m. The results are different from our study and totally beat our results. This difference may be due the difference in the altitudinal groups and the specie of the animal.

#### Hemoglobin Count

The lowest concentration of hemoglobin was monitored at the altitude 1177 feet and the highest amount of hemoglobin was found at the altitude of 4200 (Fig No 1). A similar study was conducted in south bohemia by Soch *et al.* (2010) in which they grouped the animals into three groups on basis of altitude, he selected sheep as a study animal and monitored its physiological parameters in different

season and three different altitudes. He found the lowest hemoglobin count at his lowest altitude area and found highest hemoglobin count at his highest altitude. The results mentioned in study falls completely in line with our findings.

#### Red Blood Cell Count

In the study the RBCs count was found higher at the altitudinal group 4200 feet and lower at 1177 feet. Between the groups the altitude 1177 and 2863 were found non-significant and a significant relation was

found between the groups with the 4200 feet group. A study conducted in Chittagong, Bangladesh on goats by Shaikat *et al.* (2013) in which he found high RBC concentration and the results were in level with our study. In a study conducted by Waziri *et al.* (2010) on Sahel goats and he found lower results then our findings and this variation may be due to the difference in animal area and study animal condition as his study was on gestation period effect on the hematological parameters.

**Table 2.** Effect of different altitude on serum mineral profile of beetal Goats.

Parameters	Peshawar	Kabal	Margazar
	1177 Feet (Altitude 1)	2863 Feet (Altitude 2)	4200 Feet (Altitude 3)
Ca level (mg/dL)	8.79 <sup>a</sup> ±0.23	9.44 <sup>b</sup> ±0.16	9.80 <sup>b</sup> ±0.16
Cl level (mΣq/L)	102.91 <sup>a</sup> ±0.39	104.08 <sup>ab</sup> ±0.42	105.50 <sup>b</sup> ±0.57
P level (mg/dL)	3.98 <sup>a</sup> ±0.02	5.52 <sup>b</sup> ±0.08	6.34 <sup>c</sup> ±0.08
K level (mΣq/L)	3.98 <sup>a</sup> ±0.04	4.61 <sup>b</sup> ±0.06	4.93 <sup>c</sup> ±0.04
Fe level (µg/dL)	87.12 <sup>a</sup> ±0.97	97.44 <sup>b</sup> ±0.67	106.35 <sup>c</sup> ±0.87

Means<sup>a-b-c</sup> ± SE within a row lacking a common superscript differ significantly from one another (P < 0.05).

#### Hematocrit Percent

In our study we find the highest Hematocrit percent at altitude 4200 feet and lower at altitude 1177. The altitude base results were fall in line with the results of Soch *et al.* (2011) who conducted a study in which he found the highest percent of Hematocrit at the high altitude (950m) group and lowest at the 550m. In the study conducted by Piccione *et al.* (2010) on goats he found same results as in our study at the altitude 1177 and 2863 feet but our results at the altitude 4200 feet varies from his findings and this variation may be due to the difference in the altitudinal position.

#### Mean Corpuscular Volume

In our study the higher level of MCV was found at the altitude 4200 feet and lowest at the altitude 1177 feet. A highly significant difference was found between the groups. In a study conducted by Waziri *et al.* (2010) on Sahel goats and he found similar results with our findings but at altitude 4200 feet the results were lower than our results and this variation may be due to the difference in animal area and study animal

condition.

#### Mean Corpuscular Hemoglobin

In our study the highest concentration of MCH was found at the altitude 4200 feet and lowest at the altitude 1177 feet. The results found by Piccione *et al.* (2010) who conducted his study to find the reference values for some hematological parameters of Girgentana goats and their results falls completely in line with our findings.

#### Mean Corpuscular Hemoglobin Concentration

In our study the highest concentration of MCHC was found at the altitude 4200 and lowest at the altitude 1177. The results were highly significant among the groups. The results found by Waziri *et al.* (2010) in Sahel goats at gestation conducted their study to find the reference values for some hematological parameters of Girgentana goats and their result were found similar with our findings.

#### Platelets Count

In our study the highest count of platelets were

monitored at the altitude 2863 feet and lower at 1177. The platelets count is high in the second altitude group 2863 feet and it may be due to the lesser environmental stress upon this group as compare to the other altitudinal groups. No similar study was reported on the effect of altitude on the platelets count to which the study may be discussed.

#### *Calcium level*

In our study the serum calcium level was found higher at the altitude 4200 feet and lower at the altitude 1177 feet. The values found in our study are in range with the normal values reported for goats, Feldman *et al.* (2002). Similar results are found by Broucek *et al.* (2009) in South Bohemia in which he grouped the animals on the basis of altitude and season and he found highest level of calcium on the top most group of his study.

#### *Chlorine level*

In our study the highest amount of chlorine was found in the serum at the altitude of 4200 feet and lower at the altitude of 1177 feet. The values found in our study are comparable with the normal values reported for goats, Feldman *et al.* (2002). In a study conducted by Piccione *et al.* in (2012) on the Seasonal variations of some serum electrolyte concentrations in sheep and goats and found similar values in the Goats and his results falls in line with our findings.

#### *Phosphorus level*

The level of phosphorus in our study was found higher at the altitude 4200 feet and lower at the altitude 1177 feet although the serum concentrations found were in normal range of phosphorus in serum of goats, Feldman *et al.* (2002).

In a recent study by Yattoo *et al.* (2013) on the Evaluation of serum mineral status and hormone profile in goats and some of their inter-relation. In their study they grouped the animals in 3 areas of Kashmir and he found highest level at District Budgam (5281 feet) and lowest at district Srinagar (4500 feet) the results are similar and completely fall in line with our findings.

#### *Potassium level*

The level of Potassium was found higher at the altitude 4200 feet and lower at the altitude 1177 feet. The values found were in line with the normal range of Potassium in the serum, Feldman *et al.* (2002). In a study conducted by Piccione *et al.* (2012) in which they investigated the Seasonal variations of some serum electrolyte concentrations in sheep and goats and throw out the year monthly serum potassium level was checked and our results were found completely in line with their findings. In another study conducted by Piccione *et al.* (2010) in Italy on the Reference values for some haematological, haematochemical, and electrophoretic parameters in the Girgentana goat and he found the potassium level in different age groups and his results were similar with our findings.

#### *Iron level*

The level of iron in the present study was found higher at the altitude 4200 feet and lower at the altitude 1177 feet. The values observed in the study were found in the normal range of iron in the blood, Feldman *et al.* (2002). In a recent study on the hematological and serum profile of goat in different districts of Kashmir valley was conducted by Yattoo *et al.* (2013) they evaluated serum for iron analysis and observed that the serum iron level increases with the increase in the altitudes of different districts from sea level and their results were found similar with our finding on the altitude basis.

### **Conclusions and recommendations**

This study generated a better understanding that hematology and serum mineral profiles have been affected as an increase occurs in the altitudes and it reflects that increase in RBCs, Hematocrit and hemoglobin level at different altitudes also the serum mineral level goes high as there is an increase in the altitudes shows the adaptation of animal to the environmental condition and this study will be helpful in disease investigation and management of animals at different altitudes and different stress conditions. Further studies are been required to evaluate the effect of altitude, feed intake, nutrition,

environmental stress and climatic condition on the hematology and serum mineral profile of different breeds of small ruminants and large ruminants. The values determined in the present study on the basis of different altitude can be used as a reference values for the future studies for beetal goats.

#### Conflict

No conflict of interest.

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