Original Research

Comparative Adaptability Reflected by Haematological Parameters and Serum Minerals-Electrolytes Level of Black Bengal Goats in Coastal Areas of Sundarban, West Bengal

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Abstract

The main objective of this study was to find out the adaptive changes of hematological parameters and mineral profile of Black Bengal goats in coastal areas of Sundarban in comparison with New Alluvial zone of West Bengal. For this purpose, whole blood and serum samples were collected form Ayeshpur village (New Alluvial zone or zone-1) located at Mohanpur of Nadia district and villages of Gosaba block (Sunderban coastal area or zone-2) of 24-Parganas district of West Bengal. The mean value of Hb, PCV, TEC, TLC and MCV in New Alluvial plains is higher than the values in coastal saline area. Highly significant difference ($p<0.01$) was observed within two agro-climatic zones and in coastal saline area, increased values were recorded in eosinophils and monocytes than alluvial plains. The concentration of serum minerals viz. Ca and P were recorded were almost similar (non-significant, $P>0.05$) in coastal zone and Alluvial plains. The difference in the level of serum electrolytes potassium and chloride were found to be higher in zone-2 than zone-1 whereas sodium value was observed as higher in zone-2 than zone-1 resulting a highly significant difference in sodium and potassium level.

Key words: Alluvial Zone, Black Bengal Goat, Haematological Parameters, Serum Mineral, Sunderban

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Introduction

The goat has the greatest adaptations ability among all domestic animals and can thrive well on incidental vegetations grown on poor agricultural lands. In arid and semi-arid areas where vegetation is scanty and

unsuitable for crop cultivation, goats graze widely than other ruminants. They browse on weeds and natural vegetations those neglected by other livestock. They are tolerant than other livestock to feed deficient in crude protein and certain minerals. Goat feeds well the vegetation like tree leaves and small bushes, grasses etc. that are naturally grown in coastal areas. As other livestock, goats are remained as an integral and important part of the crop -livestock symbiotic system of production in rural India and participate in the shareholding of country's livestock wealth creation. Goat living in harsh environments represents a climax in the capacity of domestic ruminants to adjust to such areas. Low body mass and low metabolic requirements of goats may be regarded as an important asset to minimize their maintenance and water requirements, in areas where water sources are widely distributed and food sources are limited by their quantity and quality. An ability to reduce metabolism allows goats to survive even after prolonged periods of severe limited food availability. A skillful grazing behaviour and efficient digestive system enable goats to attain maximal food intake and food utilization in a given condition.

Goats are well adapted to tropical and subtropical conditions (Finch *et al.* 1980, Goyal and Ghosh, 1987), due to their ability to withstand high ambient temperatures (Finch *et al.*, 1980). Goats maintain homoeothermy through a balance in heat loss and heat production through behavioural mechanisms and physiological changes (Ogebe *et al.*, 1996; Al-Tamimi, 2007). As an economic venture, goat husbandry as of late picked up a recognizable momentum in all the states of India including West Bengal.

Materials and Methods

At the inception, the study for the above parameters was done by taking the blood samples from one village under each zone. Blood samples were randomly collected from Ayeshpur village of Haringhata block (New Alluvial zone) and Gosaba village of Gosaba block from coastal zone at each month for a continuous period of six months. At each month, equal number of blood and serum samples (48 numbers each and so total 288 samples) was randomly collected from Black Bengal goats (either sex) above 6 months of age. There was equal bifurcation of collection of blood samples (24 from each village) all along the research period. All related laboratory works were performed at Department of Veterinary Physiology and Department of Biochemistry at West Bengal University of Animal and Fishery Sciences, Kolkata. The sub-region is under the project work of "All India Co-ordinated Research Project on Goat Improvement", Black Bengal field unit.

About 8 ml of blood from a minimum of five animals in each group was carefully drawn by jugular venipuncture in 10 ml disposable plastic syringe, out of which 3 ml whole blood was collected in 5 ml sterilized plastic vial containing the requisite quantity of Ethylene-Di-amine Tetra Acetate (EDTA) for the estimation of haematological parameters. Efforts were made to complete the estimation of haematological parameters on the same day. However, when it could not be completed the samples were preserved at 4˚C

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in a refrigerator for estimation of the left-over parameters on the next day. The remaining 5 ml of the blood was allowed to clot in a slanting position to clot for 4 hours for collection of serum. The collected samples were then brought to the laboratory and stored overnight at 4˚C in a refrigerator. After overnight storage the syringes containing the clotted blood were kept in room temperature for one hour, after which the separated serum was transferred to 15 ml sterilized centrifuge tube, spinned at 1500 r.p.m. for 10 minutes in a clinical centrifuge and the clean serum was collected in 4.5-ml sterilized plastic vials and preserved at - 20˚C a deep freezer after proper labeling. Following parameters were under taken in the present study-

1. Haemoglobin Percentage (Hb gm %).
2. Packed Cell Volume (PCV).
3. Total Erythrocyte Count (TEC).
4. Total Leucocytes Count (TLC).
5. Differential Leucocytes Count (DLC).
6. Mean Corpuscular Volume (MCV).
7. Mean Corpuscular Haemoglobin (MCH).
8. Mean Corpuscular Haemoglobin Concentration (MCHC).

Haemoglobin Percentage

Haemoglobin (Hb) was estimated by Sahlis' method as described by Schalm *et al.* (1975) and the value was expressed in gram/deciliter (gm/dl).

Packed Cell Volume

Packed cell volume (PCV) was estimated by Wintrobe's haematocrit method and the value was expressed as percentage (%) of total volume as described by Schalm *et al*. (1975).

Total Erythrocyte Count

The total erythrocyte count (TEC) was estimated by haemocytometer (Jain, 1986) and the value was expressed as millions per cubic millimeter (x 10^6/cmm).

Total Leucocytes Count

Total leucocytes count (TLC) was estimated by haemocytometer according to the method described by Jain (1986) and the value was expressed as thousand per cubic millimeter (x 10^3/cmm.).

Differential Leucocytes Count (DLC)

A blood smear was made immediately on a glass slide taking a drop of blood after collection and air dried. The smear was covered with Leishman's stain and allowed to act for 2 minutes. Then double quantity of distilled water was poured and mixed well by blowing. The diluted stain was allowed to act for 10 minutes. Then the slide was washed with distilled water and dried. The leucocytes counts were performed under oil immersion (100x) power of the microscope. The stained white blood cells was differentiated based on the

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physical cell characteristics like size and shape of the cell, shape and location of the nucleus, position, size, shape and colour of the cytoplasmic granules and appearance of cytoplasm. Then a total of 100 cells were counted and different leucocytes viz. lymphocytes, monocytes, neutrophils, eosinophils, and basophils, present were expressed in terms of percentage.

DLC was determined by using haemocytometer as per the standard method of Schalm *et al*. (1975) and was expressed in terms of percentage. Prior to the calculation of the test of significance the values of DLC were transformed by a resin transformation as per the standard statistical method and retransformed values are presented in Table.

Mean Corpuscular Volume (MCV)

The mean corpuscular volume (MCV), were calculated as per the formula in the book 'Dukes' Physiology of Domestic Animals' (2015).

$$MCV\ in\ femto\ litres\ (fl)\ \frac{Value\ of\ PCV\ (\%)}{RBC\ in\ million/cm} \times 10$$

Mean Corpuscular Heamoglobin (MCH)

The mean corpuscular haemoglobin (MCH), were calculated as per the formula in the book 'Dukes' Physiology of Domestic Animals' (2015).

$$MCH\ in\ Pico\ gram\ (pg) = \frac{Haemoglobin\ (gm\ \%)}{RBC\ in\ million/cm}$$

Mean Corpuscular Heamoglobin Concentration (MCHC)

The mean corpuscular haemoglobin concentration (MCHC), were calculated as per the formula in the book 'Dukes' Physiology of Domestic Animals' (2015).

$$MCHC\ \left(in\ \%\ or \frac{gm}{dl}\right) = \frac{Haemoglobin\ (gm\ \%)}{value\ of\ PCV\ (\%)} \times 100$$

Minerals and electrolytes estimation from collected serum samples were as below-

1. Estimation of serum Calcium Level (Ca).
2. Estimation of serum Phosphorus Level (P).
3. Estimation of serum Sodium Level (Na).
4. Estimation of serum Potassium Level (K).
5. Estimation of serum Chlorides Level (Cl).

Serum Calcium Concentration

Serum calcium (Ca) was estimated by UV- Spectrophotometer by O-cresolphthalin complex method described by Miller (1994) as mentioned in the diagnostic kit (Crest Biosystems) literature. The value of serum calcium concentration was expressed in milligram per deciliter (mg/dl).

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Principle

Calcium is an alkaline medium combines with O-Cresolphthalein complex one to form a purple coloured complex. Intensity of the colour formed is directly proportional to the amount of calcium present in the sample. This complex has an absorbance in the ultraviolet range and is measured at 570 nm.

Calcium + OCPC → Purple coloured complex

Serum Inorganic Phosphorus Concentration

Serum inorganic phosphorus (P) was estimated in UV- spectrophotometer by UV-molybdate method described by Miller (1994) as given in the diagnostic kit (Crest Biosystems) literature and the value was expressed in milligram per deciliter (mg/dl).

Principle

Phosphate ions in an acidic medium react with ammonium molybdate to form a phosphomolybdate complex. This complex has an absorbance in the ultraviolet range and is measured at 340 nm. Intensity of the complex formed directly proportional to the amount of inorganic phosphorus present in the sample.

Phosphorus + Ammonium molybdate → Phosphomolybdate complex

Estimation of Serum Sodium Level (Na)

Principle

Sodium is precipitated as a triple salt with magnesium and Uranyl acetate. The excess of uranyl ions are reacted with ferrocyanide in an acidic medium to develop a brown colour. The intensity of the colour produced is inversely proportional to the concentration of sodium present in the sample. This complex has an absorbance in the ultraviolet range and is measured at 530 nm and the value was expressed in mmol/l.

Uranyl ions + Mg ions + Na^+ → UranylMgNa precipitate

Free Uranyl ions + $K_4Fe(CN)_6$ → Brown coloured complex

Estimation of Serum Potassium Level (K)

Principle

Potassium reacts with sodium tetraphenyl boron in a specially prepared buffer to form a colloidal suspension. The amount of turbidity is directly proportional to the concentration of potassium in the sample. This complex has an absorbance in the ultraviolet range and is measured at 630 nm and the value was expressed in mmol/l.

Tetraphenyl Boron + K^+ → White turbidity

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Estimation of Serum Chlorides Level (Cl)

Principle

Chloride ions combine with free mercuric ions and release thiocyanate from mercuric thiocyanate. The thiocyanate released combines with the ferric ions to form a red brown ferric thiocyanate complex. The intensity of the colour formed is directly proportional to the amount of chloride present in the sample. This complex has an absorbance in the ultraviolet range and is measured at 505 nm and the value was expressed in mmol/l.

$$2\ Cl^- + Hg\ (SCN)_2 \rightarrow HgCl_2 + 2\ (SCN)$$

$$3\ (SCN) + Fe^{3+} \rightarrow Fe\ (SCN)_3$$

Statistical Analysis

All the parameters for each group were compared (Analyze - Compare Means) for the mean value along with standard error (S.E). Then they were analyzed separately by Duncan method (One way ANOVA) and the significance (P value) was recorded at 5% level and 1% level. The complete statistical analysis was done with the help of IBM Statistical Package for Social Scientists (SPSS), Software 21.0 version.

Results and Discussion

Blood is an important and reliable medium for assessing the health status of any animal. Investigations related to haematological as well as minerals and electrolyte values of Black Bengal goats in coastal areas of Sundarban delta are insufficient. Therefore, this work was carried out to evaluate and investigate the values in relation to their adaptive changes in the Coastal saline area (Zone-2) of Sundarban, West Bengal and compared with the New Alluvial plains (Zone-1).

The zone wise haematological values, Differential Leucocytes Count and Serum Mineral Profile of Black Bengal goat are presented in Table 1.

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Zones	Haematological							Differential Leucocytes Count* (%)					Serum Mineral				
Zone 1	Hb (g/dl)	PCV (%)	TEC (10^6/cmm)	TLC (10^3/cmm)	MCV (fl)	MCH (pg)	MCHC (g/dl)	N	E	L	M	B	Ca (gm/dl)	P (gm/dl)	K (mmol/l)	Na (mmol/l	Cl (mmol/l
	14.84^a ±0.23	37.44^a ±0.99	12.67 ± 0.09	8.13^a ± 0.11	30.15^a ±0.41	10.09^a ±0.15	33.78^a ±0.71	43.04 ±0.33	1.57^a ± 0.13	53.07 ±0.27	1.99^a ±0.14	0.45 ±0.07	8.98^a ±0.06	5.46^a ±0.06	5.44^a ±0.07	143.37^a ±0.52	112.94^a ±0.16
Zone 2	12.76^b ±0.08	35.26^b ±0.62	12.43 ±0.17	7.19^b ±0.13	28.62^b ±0.64	12.01^b ±0.22	42.70^b ±1.01	41.33 ±1.14	4.19^b± 0.21	50.71 ±1.19	3.46^b ±0.12	0.31 ±0.08	8.17^b ±0.14	6.75^b ±0.14	6.79^b ±0.18	148.54 ^{b}±0.10	114.43 ^{b}±0.39

**ab Means±SE in the same coloumn with different superscripts are significantly different at (P < 0.01); *N-Neutrophil, E-Eosinophil's, L-Lymphocytes, M-Monocytes, B-Basophills*

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The list of references having similar findings is presented in Table 2. Wide range of values was observed in both the agro-climatic zones. The level of difference was highly significance (P<0.01) in case of PCV, Hb and MCH concentrations in between the two zones.

Table 2: List of references in agreement with present findings

References	Elitok, B. (2014	Al-Bulushi et al (2017)	Akinrinmade and Akinrinde (2012)	Bhat et al (2011)	Habibu et al (2017)	Waziri et al (2010)	Njidda et al 2013
Hb (g/dl)	12.05±1.1	10.4±1.92	11.12±2.77	-		-	12.3±0.2
PCV(%)	35.44±1.4	-			34.00±4.77		36.00±0.1
TEC(10^6/cmm)		12.69±0.78	11.12±2.77	11.5±0.4	11.47±0.63	12.54 ± 0.64	
TLC(10^3/cmm)	-	11.58±3.50	11.5±0.4	-	-	11.54 ± 1.19	
MCV (fl)	-	30.08±2.42	28.81±4.82	-	-	28.78 ± 1.52	-
MCH (pg)	-	8.14±1.53	8.79±0.98	-	7.38±0.39	8.31 ± 0.29	-
MCHC (gm/dl)	33.53±1.3		32.20±0.86	33.1±0.1	33.29±0.03	33.47 ± 0.50	35.2±0.26
Calcium(gm/dl)			8.87±0.46			8.94 ± 0.27	
Phosphorus(gm/dl)						-	
Pottasium(mmol/ml)			4.97±0.88	5.3±0.1		4.56 ± 0.12	6.5±0.06
Sodium(mmol/ml)						143.6 ± 1.66	148.0±2.11
Chloride(mmol/ml)						-	108±2.33
Neytrophills(%)			-				45.00±2.2
Eosinophills(%)			1.35±0.22				1.0±0.02
Lymphocytes(%)			-				
Monocytes(%)			0.80±1.20				3.0±0.02
Basophills(%)			0				0

The higher values in these parameters could be due to adaptation (Pampori *et al*., 2010) to the existing agro-climatic condition and high saline content in water and vegetation they usually consumes in the coastal saline areas. In the study, higher values (highly significant, P<0.01) of MCH and MCHC were recorded in Coastal saline area than in New Alluvial plains. On the other hand, non-significance (P>0.05) difference was noticed in values of TEC in zone-2 and TEC zone-1 where as highly significant difference (P<0.01) was recorded among these two agro-climatic zones. Haematological values are widely used to determine systematic relationship and physiological adaptation including the assessment of general health condition of animal. Haematological values of farm animals are also influenced by geographical location, time of day, life habit of species, nutritional status, physiological status of individual animal and other non-genetic factors (Etim *et al.*, 2014). Significant increase in PCV in Zone 1 might be due to increasing environmental temperature as it is evidenced by Isidahomen *et al*. (2010). Adejumo (2004) reported that the parameters particularly PCV and Hb were correlated with the nutritional status of the animal. So there may be chances of influences of nutritional status of animals on haematological parameters. The higher values of the TLC in Zone 1 may attribute the extensive management practices that make the goats to fight against the microbes as suggested by Njidda *et al*. (2013) and the same author also analysed that an elevated significant

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MCH and MCHC values are due to the increased activity of bone marrow and deficiency of some haematopoietc factors.

In present study, the Differential Leucocytes Count (DLC) shows wide variations in between the two agro-climatic zones. The mean values of neutrophils, lymphocytes and basophils in new alluvial plains was found comparatively higher than coastal saline area and found to be non-significant ($P>0.05$). Highly significant difference ($P<0.01$) was observed within two agro-climatic zones and in coastal saline area, increased values were recorded in eosinophils and monocytes than alluvial plains. In goats like other ruminants, percentage of lymphocytes number is highest than the other WBC cells constitute highest percentage (Olusanya *et al*., 1976). Eosinophills are more prevalent in the mucosa of the gastrointestinal tract gastrointestinal tract, respiratory tract and urinary tract where they defend against parasites (Ganong, 2005) and this hypothesis buys the finding of higher significant values in eosinophil's in Zone 2. Serum mineral concentration varies with the availability and type of fodder in a particular locality. Low Dietary Ca elevated the serum Ca concentration in goats (Mohammed *et al.,* 2007) who also ruled out the effect of deworming on P level in blood. So the significant difference between the two zones regarding Ca and P level might adhere to the above assumptions. Vilallonga (2012) reported that mineral content in soil also influences the mineral profile in serum of goats which varies from different climatic regions which is also signified by the recent research.

The analysis of micronutrients reveals mean values of minerals viz. calcium (8.98±0.14) was found higher ($P<0.01$) in zone-1 than zone-2 (Ca, 8.17±0.06) and whereas the Phosphorus level in zone-2(P, 6.75±0.06) was (highly significant, $P<0.01$) lower (5.46 ± 0.14) than in zone-1. Level of serum electrolytes viz. sodium, potassium and chloride were found to be (highly significant, $P<0.01$) higher in mean value in coastal saline area than values in New Alluvial plains.

Conclusion

The comparative analysis of blood and mineral profile in both the regions of West Bengal signifies the adaptable capabilities of the native Black Bengal goats. The citation of significant high values of data in coastal area never interprets the physiological malformation of the goats rather it deliberates physiological adaptation by the goats.

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Conflict of Interest

The authors have no conflict of interest.

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