

## The Influence of Ambient Temperature on Thyroid Activity, Erythrocytic Indices and Some Biochemical Parameters of Black Bengal Goats (*Capra aegagrus hircus*)

Mihir Bhatta\*, Debasish Das\*\*, Probal Ranjan Ghosh\*\*\*

### Abstract

India has a good number of Black Bengal goat populations, which has an significant role in the lives of local goat rearers. The aim of the present study is to find out the effects of changing seasons on some biochemical parameters of Black Bengal goat (*Capra aegagrus hircus*) in two different agro-climatic zones in India. The highest mean value of temperature ( $42.6 \pm 1.5^\circ\text{C}$ ) has been reported during the month of April and May in the season of pre-monsoon. However, the lowest value of temperature ( $8.6 \pm 0.9^\circ\text{C}$ ) has been reported during the month of December and January in the season of post-monsoon. The parameter studied here are T3 and T4 hormones as well as blood pH, blood glucose level, concentration of Hb, RBC count, PCV, MCV, MCH and MCHC. Data has analyzed for the effect of seasonal variation and the current findings implies that seasonal variation plays the major role to influence the thyroid activity, erythrocytic indices as well as biochemical parameters of Black Bengal Goats.

**Keywords:** Goats; Pre-monsoon; Post-monsoon; Purulia.

### Introduction

Goat production in India makes a major contribution to the agrarian economy. According to 18<sup>th</sup> All India Livestock census, the total goat population of Purulia is 813191 (Livestock Population West Bengal Hand book, 2009). Black Bengal goats or *Capra aegagrus hircus* (Arnaudov, 2012) are among the best meat producer of Eastern India and are reputed as good meat producer. Although goats are known to be adapted to harsh environments but their productivity is affected adversely by extreme climatic conditions. Lowering of food intake and decreasing in meat as well as milk production are commonly observed in heat stressed goat. Proper understanding of how the way climate plays a significant role in the physiological response of the goats gives us a proper idea for improving the husbandry and health status of goats (Silanikove, 2000).

The monitoring of blood constituents in a regular interval can predict the unnatural physiological condition and respective

**Author's Affiliation:** \*&\*\*Dept. of Environment Science, University of Kalyani, Kalyani, Nadia-741235, \*\*\*Dept. of Veterinary Physiology, West Bengal University of Animal & Fishery Sciences, 37 Khudiram Bose Sarani, Kolkata-700037, West Bengal, India.

**Reprint's request:** Debasish Das, Dept of Environmental Science, University of Kalyani, Kalyani, Nadia-741235, West Bengal, India.

E-mail: ddas\_kly@rediffmail.com

necessary action may prevent sudden mass destruction in goat husbandry from any sort of physiological changes due to pathogens or climatic factors. Proper thyroid gland functions as well as activity of thyroid hormones (TH) are considered crucial to maintain the productive performance in domestic animals (growth, milk, hair fibre production) and circulating TH can be considered as indicators of the metabolic and nutritional status of the animals (Riis and Madsen, 1985; Todini *et al*, 2007).

Changes of blood TH concentrations are an indirect calculation of the changes in thyroid gland activity. It has been reported that marked seasonal variation in thyroid activity

and blood TH concentration. These hormone variations are particularly important in the free-ranging and grazing animals, whose main physiological purposes (i.e. feed intake, reproduction, hair growth) are distinctly seasonal.

## Materials and Methods

### Animals

The animals used in this study were clinically healthy and physically normal looking Black Bengal does of 1 - 3 years of age and has an average body weight of 10 kg. The animals were taken from the different houses of local rearers of Lakshmipur village (23° 21'N, 86°5'E) of Purulia. Animals were maintained in its ambient condition for four weeks prior to blood sampling.

### Study areas

Planning Commission of India has demarcated the geographical area of India into 15 agro-climatic regions. The present studies have been carried out into Purulia, under Eastern Plateau and Hills region of India (Pandey, 2006). Thirty per cent of the area is classified as forest land and only about a quarter of the area is agriculture land. It obtains about 1,200 mm of rainfall annually. The typical weather is moist sub-humid to sub-humid and the soil is red loamy, red and yellow. Average annual rainfall of this district is varies from 1100 to 1500 mm. The humidity generally is higher in monsoon season, from 75% to 85%. But in hot summer it goes down

from 25% to 35%. Temperature varies over a wide range from 7°C in winter to 46.8°C in the summer. Due to undulated topography just about fifty percent of the total rainfall flows away as run off (Pandey, 2006).

### Climatological measurement

The three year data on temperature of the study area has been collected from the state meteorological department and the mean of the three years with standard deviation was calculated (Table 1) using MS-Excel 2007 and shown here in a tabular form (Table 1).

### Blood collection and clinical analysis

Data on blood parameters have been collected on apparently healthy goats using purposive sampling technique (Tongco, 2007) for the year and categorized into two seasons. The season includes pre-monsoon and post-monsoon. About 4 ml of blood was collected via jugular venipuncture from each goat between 12 o'clock to 2 pm under the intense sun using disposable Vacutainer needles and tubes (Coles, 1980). The collected blood has been dispensed into di-potassium ethylene diamine tetra acetic acid (K<sub>2</sub>EDTA) vials and labeled accordingly. The serum was separated by centrifugation at 4000 rpm for 15 min and stored at -20 °C until analysed. Serum tetraiodothyronine (T4) and tri-iodothyronine (T3) were assayed using ELISA kits obtained from Sigma-Aldrich. Serum T3 and T4 were performed using competitive ELISA technique. (Polat *et al*, 2014) The anticoagulants mixed blood then used to analyze for the packed cell

**Table 1: Mean maximum and minimum temperature of last three years**

Seasons	Months	Max (°C)	Min (°C)
Pre-Monsoon	March	40.4 ± 2.3	21.6 ± 10.9
	April	42.6 ± 1.5	21 ± 0.7
	May	42.6 ± 1.5	22.4 ± 1.1
	June	38.6 ± 5.0	23.2 ± 0.8
	November	32.0 ± 1.0	13.6 ± 1.1
Post-Monsoon	December	30.8 ± 2.2	9.4 ± 1.7
	January	30.0 ± 2.5	8.6 ± 0.9
	February	34.6 ± 2.5	11 ± 2.5

**Table 2: Effect of the seasonal variation on the thyroid hormones**

Parameters (Units)	Pre-monsoon	Post-monsoon	Overall	P value
T3 (ng/ml)	1.29 ± 0.005	1.87 ± 0.17	1.63 ± 0.4	0.032*
T4 (µg/dl)	4.13 ± 0.63	5.4 ± 0.1	5.02 ± 0.52	0.025*

\*: P < 0.05; \*\*: P < 0.01; NS: not significant

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volume (PCV), erythrocyte or red blood cell (RBC), haemoglobin (Hb). Total erythrocyte count (TEC) or the RBC count (calculated in 106/µl) has been done with the help of improved Neubauer counting chamber (Jain, 1986; Dacie and Lewis, 1990). The total hemoglobin (calculated in g/dl) concentration in blood has been determined by the Drabkins method (cyanmethaemoglobin method)

used to determine the effects of season and the two different agro climatic regions studied here on the parameters (McDonald, 2008). Mean separation has been performed using MS-Excel 2007.

### Results

**Table 3: Effect of the seasonal variation on the erythrocytic indices**

Parameters (Units)	Pre-monsoon	Post-monsoon	Overall	P value
Hb (g/dl)	9.76 ± 0.5	8.54 ± 0.7	9.15 ± 0.9	0.0004**
RBC (millions/mm <sup>3</sup> )	7.5 ± 1.5	9.59 ± 1.4	8.5 ± 1.8	0.005**
PCV (%)	28.65 ± 1.8	25.61 ± 2.1	27.31 ± 2.5	0.0008**
MCV (fl)	39.55 ± 7.9	27.28 ± 4.7	33.63 ± 8.9	0.003**
MCH (pg/cell)	13.45 ± 2.6	9.1 ± 1.6	11.28 ± 3.1	0.003**
MCHC (%)	34.08 ± 0.8	33.35 ± 0.8	33.52 ± 0.8	0.34 <sup>NS</sup>

sult obtained from the present study that in Purulia, T3 and T4 level are significantly (p < 0.05) decreases during on of pre-monsoon according to the of ambient temperature (Table 2).

el in black Bengal goats significantly ; with concomitant decrease of TEC onsoon season. PCV, MCV and MCH o show significant (p<0.01) increase onsoon. Here MCHC value shows no significant difference between the two seasons (Table 3).

In Purulia blood pH significantly (p<0.01) lowers during the pre-monsoon season whereas blood glucose level mildly increases in the post-monsoon season but the increase is here not significant (Table 4)

studied on field using piri meter. blood glucose level (mg/dl) has been analyzed by glucose oxidase method as modified by Gochman and Schmitz (1972).

#### Statistical analysis

The statistical analysis of the data was performed using SPSS 21.01 (IBM. SPSS, 2012). Analysis of variance (ANOVA) test was

**Table 4: Effect of the seasonal variation on the blood bio-chemicals parameters**

Parameters (Units)	Pre-monsoon	Post-monsoon	Overall	P value
Blood pH	7.32 ± 0.24	7.74 ± 0.12	7.48 ± 0.29	0.0002**
Glucose (mg/dl)	45.1 ± 5.75	48.23 ± 5.87	47.05 ± 5.88	0.25 <sup>NS</sup>

\*: P < 0.05; \*\*: P < 0.01; NS: not significant

## Discussion

During the experimental phase, the black Bengal goats have been exposed to noticeable seasonal variations in ambient temperature. Seasonal changes influence the physiological responses of the animals in dissimilar way. We know that each and every individual biological organism is some way different from other individuals of same group. So, their responses to the same environment can be varied from others (Bhatta *et al*, 2014).

Alterations of blood TH concentrations are an indirect measure of the changes in thyroid gland and extra thyreoidal deiodination activity. A lot of factors act simultaneously modulating thyroid gland activity and/or peripheral mono-deiodination. Besides endogenous and environmental climatic factors, nutrition plays a principal role on thyroid gland activity and on blood TH concentrations (Chopra *et al*, 1975).

Al-Haidary (2004) and Ross *et al* (1985) shows the ambient temperature has been associated with the activity of the thyroid gland in sheep. Pratt and Wettemann (1986) reported a decline in thyroid hormone as an acclimation response during heat stress condition.

A high mean value of RBC count during pre-monsoon is obtained in present study. Holman and Dew (1966) has been shown higher values of RBC count as well as PCV and Hb during summer compared to winter is the concord with the results of the present work. Another work by Pospisil *et al* (1987) has been reported lower values of RBC, PCV and Hb in winter than summer for Cameroon goats kept in temperate environment. The current result indicates that MCV and MCH were significantly lower. The decreased MCV value obtained could be related to the negative correlation among size and number of RBC that has been suggested by Holman and Dew (1964). The values obtained in the present study for MCV and MCH during post-monsoon and pre-monsoon are in general concord with the findings of previous work

by Gutierrez-De La *et al* (1971). The virtual steadiness of MCHC level in the present investigation may be recognized to associated increase as well as decrease of Hb concentration, similar to the results of Dainiak *et al*, 1978.

Blood pH values in pre-monsoon are lesser than post-monsoon. It shows that during season of high ambient temperature arterial blood becomes more or less acidic, which may be an outcome of nutritional adjustment happens at that time. Blood pH also has a relation with the different bio-physical parameters like arterial blood pressure, blood gases, rectal temperature, heart rates and respiratory rates (Kaushish *et al*, 1976) and variation among them also cause differences in blood pH values (Afshar *et al*, 2005). The blood glucose level always has been higher in post-monsoon. This is most likely due to the fact that during pre-monsoon season glucose uptake has been higher in the body since there was less forage to intake. To afford more energy to the animal in order to disperse more heat to maintain the body temperature at normal level, and during the season of pre-monsoon, the feed intake is depressed due to high ambient temperature which confirms with the findings of other workers also (Sandabe and Chaudhary, 2000).

Due to broad range of undulated topography in Purulia about fifty percent of the entire rainfall flows away as run off (Pandey, 2006) so during the year there are less forage to graze and in the season of pre-monsoon the condition of animals become severe due to least forage availability and insufficiency of water. These may be the cause behind the significant variation of hormonal, hematological and biochemical parameters of goats between the two seasons before and after monsoon in Purulia. The field of the non-genomic, rapid TH actions needs further research. Knowledge on such topics will possibly allow the monitoring and manipulation of thyroid physiology, in order to improve animal health and production.

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