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Original Article

The Effect of the Seasonal Variation and Sexual Dimorphism on the Erythrocytic Indices of Black Bengal Goats (*Capra aegagrus hircus)* in Nadia, West Bengal

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Abstract

Goat is a multipurpose animal and it is capable of producing meat, milk and hide. Nadia has a good number of Black Bengal goat populations, which has a vital role in the lives of local goat rearers in Nadia. The intention of the present study is to find out the effects of altering seasons on blood elements in Black Bengal goat (*Capra aegagrus hircus*) in Nadia district of West Bengal. The highest mean value of temperature (ºC) has been reported during the month of April and May in the pre-monsoon. The lowest mean value of temperature (ºC) has been reported during the month of December and January in the post-monsoon season. The parameter studied here are concentration of Hb, RBC count, PCV, MCV, MCH and MCHC. Data has been analyzed for the effect of seasonal variation among both the bucks and does. The present findings imply that seasonal variation plays the major role to influence the erythrocytic indices.

Keywords: Black Bengal Goats; Erythrocytes; Pre-Monsoon; Post-Monsoon; Nadia.

Introduction

Goat is a multipurpose animal; it can produce meat, milk and leather. According to All India Livestock census, the total goat population of the Nadia district is about 952143 [1]. Black Bengal goats or *Capra aegagrus hircus* [2] are among the best meat producer of India and are reputed as good meat producer of West Bengal and Bangladesh. 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 [3].

Blood sample composition studies are essential to assess of health status and predict a number of diseases. The monitoring of blood constituents in a regular interval can predict the unnatural physiological condition and respective necessary action may prevent sudden mass destruction in goat husbandry from any sort of physiological changes due to pathogens or climatic factors. The present study was carried out to study seasonal variation in erythrocytic indices of Black Bengal goat in Nadia. The data is needed for physiological characterization of Black Bengal goat and helps to interpret the influence of ambient temperature on physiological condition of the Black Bengal goat [4].

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Materials and Methods

Animals: The animals used in this study were clinically healthy and physically normal looking Black Bengal goat (both Bucks and does) of 1 – 3 years of age and has an average body weight of 15 kg. The animals were taken from the Gayeshpur farm (KVK) ($22^0$57'19''N, $88^0$28'45'' E) and Mohanpur farm (WBUAFS research and extensions) ($22^0$56' N, $88^0$31' E) in Nadia district of West Bengal and there are no

feed restrictions to the goats [5].

Study Area

Nadia, fall under Lower Gangetic Plains region of India [6]. About 68% of the land is cultivated. The soil of this sub-zone is deltaic alluvial and the climate is per humid to humid. Annual rainfall ranging between 1200 mm to 1700 mm. The zone has a tropical climate with a short spell of winter season. The hot season lasts from mid-March to mid-June, with the day temperature ranging from 38°C to 45°C in different parts of this region. The monsoon arrives by the month of middle June. Winter extends about three months; the average minimum temperature not goes down below 10°C. Average rainfall of this area is 1,435.8 mm [6].

Climatological Measurement

The last five year data on temperature of the study area has been collected from the state meteorological department and the mean of the five years with standard deviation was calculated (Table 1) using MS-Excel 2013 and shown here in a tabular form.

Table 1: Mean temperature of last three years of Nadia district

Temperature (°C)	Pre-Monsoon			
	March	**April**	**May**	**June**
Max (ºC)	37 ± 2.45	38 ± 1	39.2 ± 1.5	36 ± 4.7
Min (ºC)	16 ± 3.9	19.4 ± 3.3	23.4 ± 1.5	23.6 ± 1.3
	Post-Monsoon			
	November	**December**	**January**	**February**
Max (ºC)	31.6 ± 1.2	28.75 ± 0.5	28.6 ± 1.5	32.2 ± 3.6
Min (ºC)	14.4 ± 2.8	11.5 ± 1.3	10.2 ± 1.6	12.6 ± 3

Blood Collection and Clinical Analysis

Data on blood parameters have been collected on apparently healthy goats using purposive sampling technique [7] for the year and categorized into two seasons. The season includes pre-monsoon and post-monsoon. About 6 ml of blood was collected by jugular venipuncture from each goat between 12 o'clock to 2 pm under the intense sun using standard method. The collected blood has been dispensed into di-potassium ethylene diamine tetra acetic acid (K_2EDTA) vials and labeled accordingly. The anticoagulants mixed blood then used to analyze for the packed cell volume (PCV), red blood cell (RBC), haemoglobin (Hb). Total erythrocyte count (TEC) or the RBC count has been done with the help of improved Neubauer counting chamber. The total hemoglobin (calculated in 10^6/µl) concentration in blood has been determined by the methods adapted from Jain et al. [8]. Determination of Hematocrit value or PCV (in %) has been done by hematocrit tube method and *mean corpuscular volume* or *mean cell volume or* MCV *(in* femtoliter per cell or fl), *mean corpuscular hemoglobin or* MCH *(*in picogram per cell or pg) and *mean corpuscular hemoglobin concentration or* MCHC *(in %)* have been calculated from the values of PCV, RBC and Hb [9].

Statistical Analysis

The statistical analysis of the data was performed using SPSS 21.01 [10]. Analysis of variance (ANOVA) test was used to determine the effects of season on the parameters studied here [11]. Mean separation was performed using MS-excel 2013.

Results

Effect of the Sexual Dimorphism

In the season of pre-monsoon there are no significant difference in the studying parameters between the bucks and does, this is happened may be due to the severe heat stress where both the sexes are respond similarly to the environment, so the parameters studying here has not been showing significant difference (Table 2). On the other hand in the post monsoon season where the mean temperature is lower, there are significant differences in the studying parameters between two sexes (Table 3) has been observed. Hb concentration has been significantly higher in bucks ($p < 0.05$). RBC count not significantly ($p > 0.05$) but higher in does. PCV, MCV and MCH have been significantly higher in bucks ($p < 0.05$) whereas MCHC has not been differing significantly.

Effect of the Seasonal Variations

There are significant differences between two

seasons (Table 4) in the bucks. Hb concentration is count significantly higher ($p < 0.01$) in pre-monsoon than in post-monsoon on the other hand RBC count is much lower ($p < 0.01$) in pre-monsoon than post-monsoon. PCV and MCV is significantly higher ($p < 0.01$) in pre-monsoon than the other season. MCH is significantly higher ($p < 0.01$) in pre-monsoon whereas MCHC has not been significantly ($p > 0.05$) differs between the two seasons.

In the case of does (Table 5) besides MCHC ($p > 0.05$), all the parameters are showing significant difference between the season of pre and post-monsoon. Hb concentration, PCV and MCV are significantly measured low during post monsoon than pre monsoon ($p < 0.01$) while on the other hand total erythrocyte count is higher in post monsoon ($p < 0.01$).

When we compile all the above findings in a single table (Table 6), we have been found that there was a significant difference between the parameters of pre-monsoon and post-monsoon. Hb concentration shows a significant difference ($p < 0.01$) between two seasons. RBC count was significantly low ($p < 0.01$). in pre-monsoon than post-monsoon. PCV and MCV has been significantly higher ($p < 0.01$) in pre-monsoon than post-monsoon. MCH count has been significantly goes down in post-monsoon ($p < 0.01$) and MCHC count has not been significantly differs ($p > 0.05$) between two seasons. Although in pre-monsoon MCHC value has been higher than post-monsoon like other above findings.

Table 2: The one-way ANOVA showing the effects of **sexual variations** on the erythrocytic indices of Black Bengal goats during in the season of pre-monsoon in Nadia

Parameters (unit)	Buck	Doe	Over all	*P-value*
Hb (g/dl)	12.64 ± 0.064	12.72 ± 0.25	12.7 ± 0.63	0.341^{NS}
RBC (millions/ mm^3)	7.22 ± 0.42	7.08 ± 0.51	7.15 ± 0.98	0.222^{NS}
PCV (%)	37.12 ± 0.22	36.98 ± 1.8	37.05 ± 1.86	0.311^{NS}
MCV (fl)	52.43 ± 3.54	52.54 ± 5.1	52.48 ± 6.02	0.968^{NS}
MCH (pg/ cell)	18.06 ± 1.3	17.93 ± 1.58	18 ± 2.02	0.49^{NS}
MCHC (%)	33.28 ± 0.58	33.54 ± 0.46	33.91 ± 0.61	0.455^{NS}

NS: not significant

Table 3: The one-way ANOVA showing the effects of **sexual variations** on the erythrocytic indices of Black Bengal goats during in the season of post-monsoon in Nadia

Parameters (unit)	Buck	Doe	Over all	*P-value*
Hb (g/dl)	9.04 ± 1.51	8.06 ± 0.62	8.45 ± 1.5	0.034*
RBC (millions/ mm^3)	8.35 ± 2.2	10.03 ± 1.9	9.19 ± 2.79	0.231^{NS}
PCV (%)	27.08 ± 3.46	25.06 ± 2.29	26.07 ± 4.02	0.045*
MCV (fl)	31.44 ± 4.84	28.36 ± 4.26	29.9 ± 6.78	0.039*
MCH (pg/ cell)	10.4 ± 1.38	9.34 ± 1.37	9.87 ±2.16	0.01*
MCHC (%)	33.38 ± 0.54	33.14 ± 0.6	33.26 ± 0.82	0.481^{NS}

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

Table 4: The one-way ANOVA showing the effects of **seasonal variations** on the erythrocytic indices of Black Bengal bucks in Nadia

Parameters (unit)	Pre-monsoon	Post-monsoon	Over all	*P-value*
Hb (g/dl)	12.64 ± 0.064	9.04 ± 1.51	10.84 ± 2.12	0.0001**
RBC (millions/ mm^3)	7.22 ± 0.42	8.35 ± 2.2	7.79 ± 1.61	0.29^{NS}
PCV (%)	37.12 ± 0.22	27.08 ± 3.46	32.05 ± 5.68	0.0000014**
MCV (fl)	52.43 ± 3.54	31.44 ± 4.84	41.94 ± 11.34	0.000000004**
MCH (pg/ cell)	18.06 ± 1.3	10.4 ± 1.38	14.22 ± 4.04	0.0000000000064**
MCHC (%)	33.28 ± 0.58	33.38 ± 0.54	33.33 ± 0.45	0.74^{NS}

**: $P < 0.01$; NS: not significant

Table 5: The one-way ANOVA showing the effects of **seasonal variations** on the erythrocytic indices of Black Bengal does in Nadia

Parameters (unit)	Pre-monsoon	Post-monsoon	Over all	*P-value*
Hb (g/dl)	12.72 ± 0.25	8.06 ± 0.62	10.28 ± 2.52	0.0000000003**
RBC (millions/ mm^3)	7.08 ± 0.51	10.03 ± 1.9	8.555 ± 2.03	0.009968999**
PCV (%)	36.98 ± 1.8	25.06 ± 2.29	31.02 ± 6.25	0.000000000060**
MCV (fl)	52.54 ± 5.1	28.36 ± 4.26	40.45 ± 13.02	0.00000000014**
MCH (pg/ cell)	17.93 ± 1.58	9.34 ± 1.37	11.64 ± 4.57	0.0000000000033**
MCHC (%)	33.54 ± 0.46	33.14 ± 0.6	33.32 ± 0.52	0.25^{NS}

**: $P < 0.01$; NS: not significant

Table 6: The one-way ANOVA showing the effects of seasonal variations on the erythrocytic indices of Black Bengal goats in Nadia

Parameters (unit)	Pre-monsoon	Post-monsoon	Over all	*P-value*
Hb (g/dl)	12.7 ± 0.63	8.45 ± 1.5	10.58 ± 2.45	0.000000045**
RBC (millions/ mm^3)	7.15 ± 0.98	9.188 ± 2.79	8.17 ± 2.28	0.14^{NS}
PCV (%)	37.05 ± 1.86	26.07 ± 4.02	31.56 ± 6.4	0.00000017**
MCV (fl)	52.48 ± 6.02	29.9 ± 6.78	41.23 ± 13.11	0.00000069**
MCH (pg/ cell)	18 ± 2.02	9.87 ±2.16	13.84 ± 4.73	0.00000012**
MCHC (%)	33.91 ± 0.61	33.26 ± 0.82	33.59 ± 0.78	0.061^{NS}

**: P < 0.01; NS: not significant

Discussion

During the period of experiment the animals were gone through a marked seasonal variation of ambient temperature. The goat body temperature is rises along with the rising of ambient temperature, which secondarily increase the uptake of the water. The enormous drinking of water reduces the feed intake in extreme heat condition in pre-monsoon. In the tropical condition of India water intake by goat is relatively high in pre-monsoon than any other season [12]. Such variations in food habit influence the composition of blood in goat. Moreover, increased ambient temperature, and increased heart rate are linked with expansion of blood volume [13]. Feed intake of goat is lowers with the increase of ambient temperature [14]. Hemodilution can observe both well fed and non fed goats [15].

A high mean value of RBC count during pre-monsoon is obtained in present study. Holman and Dew [16] has been reported higher values of RBC count as well as PCV and Hb during summer compared to winter is the concord with the result of the present work. Another work by Pospisil et al. [17] reported lower values of RBC, PCV and Hb in winter than summer for Cameroon goats kept in temperate environment. The current findings indicate that MCV and MCH were significantly low. The low MCV value obtained could be related to the negative correlation between size and number of RBC that has been suggested by Holman and Dew [18]. The values obtained in the present study for MCV and MCH during post-monsoon and post-monsoon are in general concord with the findings of previous work by Gutierrez-De La *et al*. [19].

The virtual constancy of MCHC level in the present investigation may be recognized to associated increase as well as decrease of Hb concentration [20 - 21].

So we can conclude that, it is seasonal variation not the sexual one which influenced the erythrocytic indices of Black Bengal goat.

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Conflict of the Interest Statement

None of the authors has any financial or personal relationships that could inappropriately influence or bias the content of the paper.

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