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Original Article

The Influence of Seasonal Variation on the Testosterone Hormone of Black Bengal Bucks (*Capra aegagrus hircus)*

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

Abstract

The Black Bengal bucks of Indian sub-continent generally show a noted seasonal variation during in reproductive activity. India has a good number of Black Bengal goat populations, which has an important role in the lives of the goat rearers. The objective of thepresent study is to comprehendthe influence of seasonal variation on the testosterone hormone of Black Bengal bucks(*Capra aegagrus hircus*) in two different agro-climatic zones in India. The highest mean value oftemperature (42.6 ± 1.5 ºC) has been reported during the month of April or May in the season of pre-monsoon in Purulia. However, the lowest value of temperature (8.6 ± 0.9 ºC) has been reported during the month ofDecember or January in the season of post-monsoon again in Purulia.Serum testosterone was analyzed in blood samples collected once a week. It has been observed that, from January to April for both of the regions of Purulia and Nadia and the month May has the lowest serum testosterone level in Purulia (1.22 ± 0.18 ng/ml) and the serum testosterone levels stayed approximately the same from January to March in Purulia and more or less similar in Nadia.However, the serum testosterone level reached to its peak level in November in both the region Nadia (8.79 ± 1.3 ng/ml) and Purulia (6.59 ± 0.41ng/ml) respectively. It can also be presume thatthe early periods of the post-monsoon season can be taken as an alternate breeding seasons for Black Bengal breeds.

Keywords: Testosterone; Bucks; Purulia; Nadia; Pre-Monsoon; Post-Monsoon.

Introduction

Seasonality of reproduction mayhave a major role on the production rateof farm animal species such as goat, cattle and sheep. The levels of the different hormones which have major effects on reproductive system canundergo changes very much depending upon the photoperiodic variation[1]. The androgens have a significant effects on the reproductive capabilities in most of the male farm animals.The testosterone hormone in a male is much more effective as well as vital than other androgens found in an animal body. Excepttestosterone other androgen present are androstenedione and 5 alpha-dihydrotestosterone. They altogether induce a constructive effects on physiological development through the nitrogen build-up in cells [2]. Some goat breeds from temperate latitudes exhibita seasonal variation in reproductive activityduring the year[3]. Although, in Indian sub-continent it is known that monsoon is the ideal season for reproduction of most of the animals, especially farm animals[4]. So, in this present study it is an initialeffort to establish aperiod of time except the season of monsoon as an alternate period for reproduction of Black Bengal goats. Different studies have been revealed thatthere are other environmental factors, suchas availability of food and the presence of male and female [3 and 5] mayinfluence the season of reproduction.

The objective of the present study is tocomprehendthe influence of seasonal variation on the testosterone hormone of Black Bengal bucks (*Capra aegagrus hircus)[6]* in two different agro-climatic regions in West Bengal, India. Moreover, this will be a probable contribution to this field of research on Black Bengal goats where inadequate researches have been available and these results can be useful to the

**Author's Affiliation: ***Department of Environmental Science, University of Kalyani, Kalyani, Nadia-741235, West Bengal, India. Telephone +919051821957. **Department of Veterinary Physiology, West Bengal University of Animal & Fishery Sciences, 37 Khudiram Bose Sarani, Kolkata-700037. West Bengal, India.

Reprint's Request: Debasish Das, Department of Environmental Science, University of Kalyani, Kalyani, Nadia-741235, West Bengal, India.
E-mail: ddas_kly@rediffmail.com

determine the best possibleseason of reproduction alternate to monsoon.

Materials and Methods

Animals

The animals have beentaken for these studies have been clinically healthy and sexually matureBlack Bengal bucksof 2 – 4 years of age and has an average body weight of 20Kg showing no parasitic infestation. The animals were taken from the local rearers of Jaharhatu (23°21´6´´N, 86°2´36´´E) village Purulia district and from the Mohanpur farm (22°56´ N, 88°31´ E) of Nadia district, both from the state of West Bengal but in two different agro-climatic regions, there are no feed restriction to the goats. Animals were maintained in its ambient condition for four weeks prior to blood sampling [7].

Study Areas

Planning Commission of India,during 2006has demarcated the geographical area of India into 15 agro-climatic regions. The present studies have been carried out into two agro-climatic zones of India. These are as follows:

Purulia, fall under Eastern Plateau and Hills region of India [8]. This agro-climatic zone is Located at the southern tip of Bihar. Thirty per cent of the area is classified as forests and only about a quarter of the area is cultivated. It receives about 1,200 mm of rainfall annually. The climate is moist sub-humid to sub-humid and the soil is red loamy, red and yellow. Average annual rainfall is varies from 1100 to 1500 mm. The humidity is high in monsoon season, from 75% to 85%. But in hot summer it goes down from 35% to 25%. Temperature varies over a wide range from 7°C in winter to 46.8°C in the summer(Table 1). Due to undulated topography just about fifty percent of the total rainfall flows away as run off [8]. The total goat population of Puruliahas been recorded as 813191 [9].

Nadia, fall under Lower Gangetic Plains region of India [10]. 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 1,200 mm and 1,700 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 (Table 1). Average rainfall of this area is 1,435.8 mm [10]. The total goat population of Nadia has been recorded as 952143[9].

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) [11].

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

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

The blood have been collected from apparently healthy goats using purposive sampling technique [12]for the year and categorized into two seasons. The seasons include pre-monsoon and post-monsoon. About 4 ml of blood was collected by jugular venipuncture from each goat between 12 o'clock to 2 pm under the intense sun using disposable needles (SRS™ Sterivan) and vacutainertubes (Vacutech)[13]. Blood samples has been collected once in aweek. Blood samples has been collected always at the same time of the day to avoidcircadian variations[14].The collected blood has been dispensed into vials and labelled accordingly.

The Enzyme-Linked Immunosorbent Assay (ELISA)

The serum was separated by centrifugation at 4000 rpm for 15 min and stored at -20 °C until analysed.

Serum testosterone assayed using ELISA kits (abcam® ab108666). Serum testosterone (ng / ml) has been performed using ELISA technique [15].

Statistical Analysis

The statistical analysis of the data was performed using SPSS 21.01 [16]. A one-way analysis of variance (ANOVA) test has been used to determine the effects of seasons on the Black Bengal bucks serum testosterone parameters studied here [17]. Mean separation and standard error has been calculated using MS-Excel 2007.

Results

During in the month of March in the season of pre-monsoon (Table 2), the testosterone hormone level in the serum of Black Bengal bucks has been found lower in Purulia than the data obtained in Nadia, but the difference found has not been significant. Whereas the testosterone hormone level of the buck serum has been higher in Purulia than Nadia during in the month of April (Figure 1), here also the difference has not been significant. During in the month of May the testosterone hormone level in the serum of Black Bengal bucks in Puruliahave been reduced to 1.22 ± 0.18 ng / ml (Table 2), which is the lowest value of the testosterone hormone level obtained in the serum of Black Bengal bucks in the present study (Figure 1). The testosterone hormone level in the serum of Black Bengal bucks obtained during this time in Purulia has been significantly lower (P<0.01) than the value obtained (4.51 ± 0.63 ng / ml) in Nadia. Similar kind of results have been found during in the month of June, here also the testosterone hormone level in the serum of Black Bengal bucks in Purulia have been found significantly (P<0.01) lower than the testosterone hormone level found in the serum of Black Bengal bucks in Nadia (Table 2).

On the other hand, during in the season of post-monsoon (Table 3) the testosterone hormone level in the serum of Black Bengal bucks in Nadia during in the month of November have been found significantly (P<0.01) higher than that of Purulia. The value obtained in Nadia i.e. 8.79 ± 1.3 ng / ml, has been the highest value of the testosterone hormone in the serum obtained during the present study (Figure 1). The value of the testosterone hormone found in Purulia (6.59 ± 0.41 ng / ml), during in the month of November also the highest value among the months studied here in Purulia (Figure 1). More or less similar kind of result has been obtained during the month of December, where the testosterone hormone level in the serum of Black Bengal bucks in Nadia has been found significantly (P<0.05) higher than the testosterone level found in Purulia (Table 3). However the data collected on the testosterone hormone level in the serum of Black Bengal bucks obtained during the months of January and February are more or less similar in Purulia and Nadia and there are no significant difference have been observed between them (Table 3).

Table 2: The influence of seasonal variation on the testosterone hormone of Black Bengal Bucks (*Capra aegagrus hircus) during* in the season of pre-monsoon

Months	Purulia (ng/ml) Mean ±S.E.M	Nadia (ng/ml) Mean ±S.E.M	Overall (ng/ml) Mean ±S.E.M	P-value
March	2.7 ± 0.78	3.16 ± 0.59	2.44±0.59	0.203 NS
April	2.69 ± 0.52	2.39 ± 0.64	2.10±0.41	0.327 NS
May	1.22 ± 0.18	4.51 ± 0.63	2.35±1.00	0.000000001**
June	2.33 ± 0.48	6.09 ± 1.39	3.42±1.48	0.000004**

**: P < 0.01; NS: not significant

Table 3: The influence of seasonal variation on the testosterone hormone of Black Bengal Bucks (*Capra aegagrus hircus) during* in the season of post-monsoon

Months	Purulia (ng/ml) Mean ±S.E.M	Nadia (ng/ml) Mean ±S.E.M	Overall (ng/ml) Mean ±S.E.M	P-value
November	6.59 ± 0.41	8.79 ± 1.3	7.82±1.60	0.0004**
December	3.03 ± 0.65	3.96 ± 1.09	2.63±0.61	0.047*
January	2.86 ± 0.55	2.74 ± 1.19	2.11±0.73	0.784 NS
February	2.48 ± 0.64	2.34 ± 0.64	2.22±0.52	0.669 NS

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

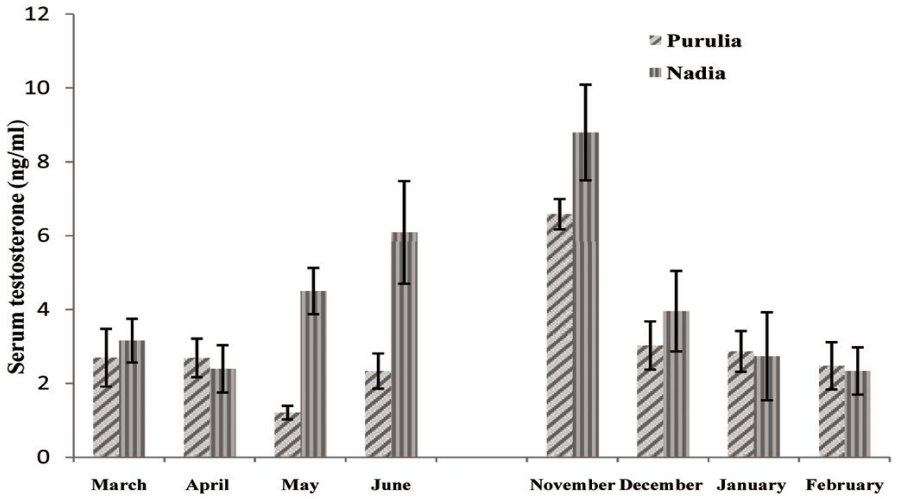

Fig. 1: The diagram itself depicted the influence of seasonal variation on the testosterone hormone of Black Bengal Bucks (*Capra aegagrus hircus) during* in the different months of Pre-monsoon and post-monsoon seasons.

Discussion

The present study demonstrated that the Black Bengal bucks maintained under two different agro-climatic region show noticeable seasonal variation of testosterone secretion. These variations have beenobserved despite of the animals have been feeding with a similar diet. The results indicate that season strongly influences testosterone secretion of these animals. Like sheep, photoperiod or the daylight duration is the principle factor forthe goats' reproduction [18]. The levels of the male or female hormones (hypothalamus to pituitary and subsequently to gonad axis) go through changes depending on the basis of photoperiod [19]. Like other mammals, the production of testosterone hormone in goats has beendirectly under the control of Gonadotropin releasinghormone (GnRH) and luteinizing hormone (LH). However the testosterone hormonelevel in blood generally increases during the breeding period of the bucks. In general all over the worlddoesshow reproductive activities mainly in the late monsoon while the sexual activities stop in pre-monsoon seasons[20].

During this present study the serum testosterone levels stayed approximately the same from January to March in Purulia and more or less similar in Nadia. However, the serum testosterone level reached to its peak level in November in both the region Nadia (8.79 ± 1.3 ng/ml) and Purulia (6.59 ± 0.41ng/ml) respectively. Delgadillo *et al*.[21] has been reported that the testosterone level in Creole bucks in Mexico,has been 0.1 ng/mL in January and February and 10 ng/mL in July and in August. Low level of testosterone hormone in serum of Black Bengal bucks may be due to the peak ambient temperature of the pre-monsoon seasons in the both of the region.Although it is known that, the reproductive functions of buckshave been generally least dependent on the seasons with respect to the does. So, that during in pre-monsoon season in May and June where the testosterone hormone level in the serum of Black Bengal bucks in Nadia has been increasing contrasting to the result observed in Purulia. It has been known that the seasonal productionand secretion models are generally parallel for most of the goatbreeds, changes in the quantity of the hormone productionhappensmostly due to the latitude and longitude and may be dueto other factors like genotype, feeding habit and feeding leveletc [22].

The seasonal influence on plasma testosterone and the traits of testosterone secretion model had been studied on Verata and Malaguena bucks and were showed an increase in plasma testosterone levels during pre-mosoon and late monsoon, during declining photoperiod[23], this result is however gone differ from our present findings.

Conclusions

During the present study it has been observed the lowest testosterone levels were observed from January to April for both of the regions of Purulia and Nadia and the month May has the lowest level of the testosterone hormone level in the serum of Black Bengalbucks in Purulia (1.22 ± 0.18 ng/ml). However, the serum testosterone level reached to its peak level in November in region Nadia (8.79 ± 1.3 ng/ml). In this breed i.e. Black Bengal goat, the higher serum

testosterone levelhas been reached during the decreasing photoperiod and it can be concluded that month of November and December i.e. early the periods of the post-monsoon season can be taken as an alternate breeding seasons for Black Bengal buck, still a lots of experiment has been needed to established this fact.

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Conflict of the Interest Statement

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

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