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Muthuramalingam T

Assistant Professor, Livestock Farm Complex, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Meenakshi Sundaram S

Professor and Head, Livestock Farm Complex, TANUVAS, Chennai, Tamil Nadu, India

Tensingh Gnanaraj P

Registrar, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Sivakumar T

Dean, Veterinary College and Research Institute, Orathanadu, Tamil Nadu, India

Vairamuthu S

Professor and Head, Centralised Clinical Laboratory, Madras Veterinary College, Chennai, Tamil Nadu, India

Rangasamy S

Assistant Professor, Department of Veterinary Gynaecology and Obstetrics Madras Veterinary College, Chennai, Tamil Nadu, India

Rachel Jemimah E

Graduate Assistant, Livestock Farm Complex, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Corresponding Author:

Rachel Jemimah E

Graduate Assistant, Livestock Farm Complex, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Seasonal variation in body condition and haemato-biochemical parameters of Tellicherry does in semi-arid summer climate

Muthuramalingam T, Meenakshi Sundaram S, Tensingh Gnanaraj P, Sivakumar T, Vairamuthu S, Rangasamy S and Rachel Jemimah E

Abstract

The objective of the study is to assess the seasonal variation in the body condition and haemato-biochemical parameters of Tellicherry does under semi-arid summer climate. 40 Tellicherry does age around 2 – 2 ½ years were utilized for the study. Bodyweight, body condition and blood samples were collected from the does at fortnight intervals during the summer, rainy and winter season. The does exhibited better body weight and body condition during the monsoon and winter season ($P < 0.01$). The highest Hb and PCV concentration were recorded during the monsoon season ($P < 0.01$) followed by winter. The RBC count was lower during the summer season ($P < 0.01$) while the WBC count was found elevated during the winter season ($P < 0.01$). BUN was elevated during the winter season ($P < 0.01$). AST was elevated during both summer and winter season ($P < 0.01$). TP, Ca and P were elevated during the summer season ($P < 0.01$). Na concentration remained unchanged during all the season while K concentration was lowest during the winter season ($P < 0.01$). However, all these changes were within the reference range for goats. The results indicate that the Tellicherry does were better adapted to the varied seasons of Tamil Nadu.

Keywords: Season, body condition, haematological parameters, biochemical parameters, Tellicherry doe, semi-arid summer

Introduction

Among all species of farm animals, goats have the widest ecological range playing a significant role in providing supplementary income and livelihood to millions of resource-poor and landless farmers of rural India. Besides meat and milk, goats also produce good quality skin, valuable pashmina fibre and manure [1]. In the present scenario of changing agro-climatic conditions, this small ruminant farm animal has tremendous potential to be projected as the 'Future Animal' for rural and urban prosperity. India occupies the first position in goat milk production (5.75 million MT), the second position in terms of goat population (135.17 million) and goat meat production (1041.11 thousand tons) in the world [2, 1, 3]. The goat sector contributes Rs. 14,453 crores to the agricultural economy of the country through meat, milk, skin, etc., which accounts for around 8 per cent of the Gross Domestic Product (GDP) from the livestock sector. Besides, the goat sector generates about 4 per cent rural employment and about 20 million small and marginal farmers' and landless labourers' families depend on goats for their livelihood partially or completely. The main factor that influences the productivity of goats is climatic seasonality [4]. Climatic parameters affect the performance and productivity of goats directly by interacting with their physiology and indirectly by affecting their physical (feed resources, grasslands, housing conditions), biological (microorganisms, parasites, water) and chemical (toxins, gases) environment [5]. Physiological and biochemical parameters act as biological markers to study the impact of various stressors such as season and environmental temperature on goats [6]. Tellicherry goats which are native of Kerala state are introduced and widely reared in Tamil Nadu state for meat purpose. Though the hemato-biochemical parameters of Tellicherry goats after adaptation into Tamil Nadu climatic condition have been reported [7], no study has been done on the seasonal variation in hemato-biochemical parameters of Tellicherry goats especially does under Tamil Nadu condition. Hence, this study was carried out to assess the seasonal variation in body condition, biochemical and haematological parameters in Tellicherry does under Tamil Nadu condition.

Materials and Methods

Experimental location

The study was carried out at Livestock Farm Complex, Madhavaram Milk Colony, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India, located between latitudes 12° 9' and 13° 9' N and longitudes 80° 12' and 80° 19' E with an altitude of 22 m above MSL. As per the approach of Thomthwaite^[8], the climate of the state has been classified as "Semi-arid" summer.

Experimental animals

40 Tellicherry does age around 2 – 2 ½ years were utilized for the study. All the does were maintained under intensive system of management with similar feeding, housing and health care.

Experimental design

Bodyweight, body condition and blood samples were collected from the does at fortnight intervals during the summer (March – June), rainy (July – October) and winter (November – January) season.

Bodyweight and body condition

Bodyweight was recorded using a weighing balance. Body condition was assessed as per the protocol given by Villalquiran *et al.*^[9] with 0.5 increments.

Blood collection

Does were properly restrained and maintained at minimal disturbance or least excitement state before blood collection. Blood samples were collected from the does by jugular venipuncture in both EDTA vacutainers and clot activating tubes for haematological and biochemical studies.

Haematological analysis

Haematological parameters like haemoglobin (Hb), Packed cell volume (PCV), Red blood cells count (RBC) and White blood cells count (WBC) were analyzed using the automated haematology analyzer (Mindray – BC – 2800 VET, Shenzhen Mindray Bio-Medical Electronics Co., Ltd., China).

Serum biochemistry

Blood samples collected in clot activating tubes were centrifuged at 3,000 rpm for 15 minutes for serum separation. Serum obtained after centrifugation was utilized for biochemical analysis. Biochemical parameters like Blood Urea Nitrogen (BUN), Total Protein (TP), Aspartate transaminase (AST), Calcium (Ca), Phosphorus (P), Sodium (Na) and Potassium (K) were estimated using semi-automated biochemical analyzer (A-15 Biosystem Random Access Analyzer, Biosystem, Barcelona, Spain).

Weather data

The maximum and minimum temperature (°C), relative humidity (RH %) and rainfall (mm) for the study period were obtained from the Gramin Krishi Mausam Sewa (Integrated Agromet Advisory Services) scheme functioning in the Department of Livestock Production Management, Madras Veterinary College.

Statistical analysis

The collected body condition and haemato-biochemical data were subjected to statistical analysis by one – way ANOVA using SPSS software. Treatment differences were considered significant at $P < 0.05$. If significance was determined, Turkey's HSD was performed to differentiate between seasons. Weather data was presented as mean±S.E. for each season.

Results

The mean maximum and minimum temperature, relative humidity and rainfall for each season during the study period are given in table 1.

Table 1: Season wise weather parameters during the study period (Mean±S.E.)

Season	Temperature (°C)		Relative humidity (%)	Rainfall (mm)
	Maximum	Minimum		
Summer	34.50±0.69	28.25±0.49	65.75±0.92	14.90±2.39
Monsoon	31.25±0.61	26.00±0.45	71.00±1.16	220.30±4.23
Winter	27.75±0.49	24.25±0.35	72.50±1.04	154.73±6.03

Bodyweight and body condition

The season had an impact on the body weight and body condition of Tellicherry does (Table 2).

Table 2: Body condition of Tellicherry does during different season

Parameters	Summer	Monsoon	Winter	F value
Body weight	20.71±0.25 ^a	24.46±0.35 ^b	23.89±0.31 ^b	43.77 ^{**}
BCS	2.38±0.03 ^a	2.74±0.03 ^c	2.56±0.03 ^b	31.36 ^{**}

** Significant at $P < 0.01$; Means bearing different superscript in the same row differ significantly

The does exhibit better body weight during the monsoon and winter season ($P < 0.01$) than summer. Does exhibited better body condition during monsoon ($P < 0.01$) followed by winter. Bodyweight and body condition of does were lowest during the summer season compared to monsoon and winter.

Haematological parameters

Haematological parameters of Tellicherry does during the different season is given in table 3.

Table 3: Hematological parameters of Tellicherry does during different season

Parameters	Summer	Monsoon	Winter	F value	Reference range*
Hb (g/dl)	8.20±0.09 ^a	9.57±0.09 ^c	8.96±0.08 ^b	60.68 ^{**}	8.0 – 12.0
PCV (%)	22.14±0.23 ^a	25.69±0.26 ^c	24.31±0.23 ^b	55.13 ^{**}	22.0 – 38.0
RBC (10 ⁶ /μl)	13.97±0.15 ^a	15.63±0.20 ^b	15.53±0.14 ^b	32.33 ^{**}	8.0 – 18.0
WBC (10 ³ /μl)	18.03±0.46 ^a	17.50±0.60 ^a	20.74±0.54 ^b	10.49 ^{**}	4.0 – 13.0

** Significant at $P < 0.01$; Means bearing different superscript in the same row differ significantly

*Reference range of Radostits *et al.*^[10] for goats

The season was found to have an impact on the haematological parameters of Tellicherry does however all the haematological values were within the reference range

except the WBC count. The Tellicherry does have the highest haemoglobin (Hb) concentration and packed cell volume (PCV) during the monsoon season ($P < 0.01$) followed by

winter. The RBC count remained the same during monsoon and winter season while the WBC count remained the same during summer and monsoon season. The RBC count was lowest during the summer season ($P < 0.01$) on the other hand the WBC count was highest during the winter season ($P < 0.01$).

Table 4: Biochemical parameters of Tellicherry does during different season

Parameters	Summer	Monsoon	Winter	F value	Reference range*
BUN (mg/dl)	21.63±0.46 ^a	20.47±0.36 ^a	23.51±0.52 ^b	11.48 ^{**}	12 - 26
TP (g/dl)	6.68±0.07 ^a	7.40±0.07 ^b	7.89±0.07 ^c	71.97 ^{**}	6.2 - 7.9
AST (IU/L)	118.63±1.80 ^b	102.67±1.56 ^a	116.45±1.67 ^b	26.59 ^{**}	0 - 300
Ca (mg/dl)	11.02±0.19 ^c	10.31±0.18 ^b	9.66±0.19 ^a	13.04 ^{**}	9.2 - 11.6
P (mg/dl)	9.49±0.14 ^b	8.58±0.12 ^a	8.24±0.16 ^a	20.69 ^{**}	4 - 11.2
Na (mmol/L)	148.39±0.38	148.98±0.39	149.70±10.86	1.23 ^{NS}	135 - 156
K (mmol/L)	5.74±0.06 ^b	5.66±0.07 ^b	5.33±0.05 ^a	13.36 ^{**}	3.4 - 6.1

** Significant at $P < 0.01$; Means bearing different superscript in the same row differ significantly

*Reference range of Matthews ^[11] for goats

However, all the biochemical parameters were within the reference range for goats. BUN concentration remained the same during the summer and monsoon season however it was found elevated during the winter season ($P < 0.01$). Total protein (TP) concentration in the Tellicherry does was highest during the winter season ($P < 0.01$) followed by the monsoon. On the other hand, the lowest TP concentration was observed during the summer season ($P < 0.01$). AST concentration was at a minimum during monsoon ($P < 0.01$) and higher during summer and winter season ($P < 0.01$). Calcium (Ca) concentration was at a maximum during the summer season ($P < 0.01$) followed by monsoon and least during the winter ($P < 0.01$) season. Phosphorus (P) concentration remained unchanged during monsoon and winter however it was found elevated during summer. Potassium (K) concentration remained unchanged during summer and monsoon, however; its concentration got lowered during the winter season ($P < 0.01$).

Discussion

Bodyweight and body condition

Seasonal variation in body weight and body condition was noticed in Tellicherry does. The higher body weight and body condition during the monsoon and winter season might be due to the indirect effect of these seasons on the does through the availability of good quality feed resources. On the other hand, the non-availability of good quality feed resources resulted in lesser body weight and body condition during the summer season. However, as per the opinion of Villaquiran *et al.* ^[9], the body condition of the does during all the seasons were almost within the range for healthy goats and are generally ideal for production ^[12]. Cisse *et al.* ^[13] and Nsoso *et al.* ^[14] also reported the same phenomenon where goats lose body condition during the dry season and gain it during the wet season. As body condition score is sensitive to seasonal changes it may be used as a management tool to assess the seasonal effect in farm animals ^[12, 15, 14].

Haematological parameters

Changes in haematological parameters are considered as indicators of adaptability to heat stress in livestock species ^[16]. High ambient temperature (AT) in combination with relative humidity (RH) compromises the animals' ability to lose heat to the surroundings resulting in heat stress ^[17]. Heat stress is associated with increase cardiac output, distribution of blood to the periphery, peripheral vasodilation with the

Biochemical parameters

The season had a profound impact on the biochemical parameters of Tellicherry does during the study period except for the sodium (Na) concentration (Table 4).

expansion of blood volume and haemodilution ^[18]. The lower Hb, PCV and RBC count observed in the Tellicherry does during summer than monsoon and winter season might be due to heat stress associated with high ambient temperature and relative humidity during that season. This reflects that the Tellicherry does are better adapted to monsoon and winter climatic conditions of Tamil Nadu than summer. However, all the haematological values were within the reference range except the WBC count. Elevated WBC count was noticed during all the seasons with maximum elevation during winter followed by summer and monsoon. As tropical environments are known to be havens of parasites and the does were almost healthy during the study period, the high WBC counts in the does during winter and summer may probably be due to environmental disposition ^[19]. The elevated total WBC in does may also be due to late pregnancy because of ACTH-related hormonal stress reaction ^[20].

Biochemical parameters

Serum biochemical profiles have been used extensively by veterinarians to evaluate nutritional, health, and metabolic status of ruminants ^[21]. Seasonal variation has a profound effect on serum biochemical parameters ^[22] due to altered feed intake ^[23], reduced metabolism ^[24] and changes in the blood plasma concentration ^[25].

Heat stress depresses feed intake in goats however more energy is required by these animals to disperse more heat to maintain their body temperature at a normal level during summer ^[23]. Thus to meet the increased energy requirement despite low dry matter intake during heat stress the animal body responds by producing energy through hepatic gluconeogenesis ^[26] through activation of hypothalamic-hypophyseal-adrenal axis and cortisol release ^[24]. Further, heat stress reduces the secretion of anabolic hormone associated with protein synthesis leading to decreased protein synthesis ^[27]. These physiological alterations are responsible for the decreased protein concentration (due to deprived appetite and protein synthesis) and elevated AST concentration (due to hepatic gluconeogenesis) in Tellicherry does during the summer. Further, prolonged exposure of the goats to direct sun rays results in vasodilatation followed by vasoconstriction leading to reduced plasma volume ^[28] and thus increased calcium and associated phosphorus concentration during summer. Whitebread ^[29] also stated that calcium level increases due to dehydration.

During winter at low ambient temperature, the secretion of

thyroid hormones increases to increase the metabolic rate of goats so that the core body temperature is maintained by increased heat production^[30]. This increase in metabolism may be by non-shivering heat production occurring primarily in brown adipose tissue (BAT)^[31] as well as to a lesser degree in the muscle^[32] and liver^[33]. Non-shivering thermogenesis is the most effective way to adapt to a cold environment^[34]. AST have key roles in gluconeogenesis and formation of urea^[35]. Excessive tissues protein catabolism also causes elevated BUN concentration^[36]. Thus the elevated AST and BUN concentration associated with increased metabolism in liver and muscle due to non-shivering thermogenesis which implies the adaptive capability of Tellicherry does to winter. Cold stress had a remarkable influence on all animals due to the need for more intensive energy metabolism to maintain body temperature^[37]. The decrease in potassium levels during the winter season are due to phosphorylation associated with increased uptake of glucose by tissues to maintain their body temperature^[35]. Although significant seasonal variation in biochemical parameters was observed during the study, the variations were within the reference range for goats as given by Matthews^[11]. This implies that the Tellicherry does were better adapted to the varied climatic conditions of Tamil Nadu state.

Conclusion

Body condition and haemato – biochemical parameters are used as biological markers to assess the health status of the animals. However, these parameters are affected by various stress conditions like changes in climate, physiological status, feed intake etc., The seasonal variation in body condition and haemato – biochemical parameters of Tellicherry does adapt to Tamil Nadu climatic conditions was studied. Though the seasonal variation in the above said parameters were observed during the study, the variations were within the reference range for goats implying the adaptable capability of Tellicherry does to varied seasons of Tamil Nadu.

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Disclosure statement

There are no conflicts of interest among the authors.

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