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Seasonal Changes in Physiological and Hormonal Profile of Crossbred Cattle at Medziphema, Nagaland

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ABSTRACT: The objectives of this study was to investigate, for the first time in Medziphema, the effects of seasonal variation on physiological and hormonal profile as indicator for physiological status evaluation in crossbred cattle. The study was conducted on ten which were organized according to seasons. The mean THI values for calendar year 2022 were calculated and divided into three seasons such as spring 67.72 (January to April), summer 78.08 (May to August), and winter 72.66 (September to December). Blood samples were collected twice times during this study period. The data with respect to changes in physiological and hormonal included mean rectal temperature (RT), pulse rate (PR), respiration rate (RR), skin temperature (ST) and hormonal profile tri-iodothyronine (T_3), thyroxine (T_4), plasma cortisol levels. The recorded were mean significantly ($P \leq 0.05$) higher summer season rectal temperature (RT), pulse rate (PR), respiration rate (RR), skin temperature (ST) higher during summer as compared to other seasons and as well as tri-iodothyronine (T_3) thyroxine (T_4), plasma cortisol levels, respectively it was higher during summer season as compared to spring, winter seasons. The changes in physiological and hormonal profile of dairy crossbred cattle in response to different climates have affected on production system. The capability of an animal to with stand the rigors of climatic stress under hot conditions has been assessed physiologically by means of changes in body temperature, respiration rate and pulse rate and skin temperatures. Therefore, this study might be useful for assessment providing base line information on hormonal profile status of dairy cattle. The results indicated that blood was positively correlated with temperature of the body parts. This study concluded that, summer stress of physiological changes in crossbred cattle during the summer season cause stress, which is a challenge for dairy farmers, which affects the production in summer season.

Keywords: Cattle, physiological, hormonal profile and THI.

INTRODUCTION

The environmental is major factor that can negatively affect cattle performance, especially in crossbred of high yielding crossbred cattle animals. The effect of seasonal changes in environmental temperature and humidity is seen crossbred cattle then in indigenous cattle animals. Crossbred cattle found in these classes are homoeothermic, or have the ability to be in charge of their body temperature within a narrow range upon big temperature changes. The effects of stress, the animals begin a problems series of physiological and hormonal responsive mechanisms to stressful stimuli, which are controlled by hormones and coordinated by the nervous system and the endocrine mechanism which is responsible for modifiable metabolic, reproductive and growth processes. The endocrine mechanism coordinates and regulates the physiological processes by means of chemical messengers called hormones. These are clear as chemical substances created by specific tissues and conducted by the vascular system to work in any other tissue; however, they only work on target cells with specific receptors capable of responding to them (Cunningham, 2008). The frontline hormone overcoming stressful situation are gluco-corticoids and catecholamines, the secretion of cortisol is a classic endocrine response to stress. Heat stress is associated with significantly depression in thyroid gland activity resulting in lowering of thyroid hormone levels (Rasooli *et al.*, 2004). According to

(Araújo, 2008), highlighted that the effect of environmental conditions can be either directly, reaching the functions of the animal body, or indirectly, that causes fluctuations in the quantity and quality of food or increasing the prevalence of diseases, will cause influence significantly in productivity of animals.

MATERIALS AND METHODS

The present study was conducted at Nagaland university dairy farm, school of agricultural science (SAS) Medziphema campus Nagaland, India. The metrological factors such as ambient temperature and relative humidity values were obtained from the metrological station of ICAR research complex for NEH region, Nagaland center, India located at the experimental stations for calculation of temperature humidity index (THI). Seasons wise THI calculated for calendar year 2022 and year divided in three seasons such as spring (January to April), summer (May to August), and winter (September to December).

The present research was carried out on ten crossbred cattle's with an average age of 1.5 to 3 years and average body weight of 100-300 kg were selected organized dairy farm at Nagaland university school of agricultural science and rural development, Medziphema campus, Nagaland, India and were maintained standard under the same feeding, housing, and natural photoperiod, environmental temperature condition. Blood sample were 5 ml collected from jugular vein two times between monthly interval in each seasons under different environmental condition from all animals for of recorded physiological and estimation hormonal parameters. The blood sample was collected in heparin tubes and immediately stored in ice box for transportation. The experimental data obtained were subjected to statistical analyzed of using randomized block design as per the standard procedure described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Warmer and winter conditions in the Nagaland are likely to raise problems associated with heat stress in dairy cattle. Increased temperatures can influence dairy production by (1) effects on feed production and feed nutritive value, (2) effect on feed intake, and (3) effects on energy supplies animal health, and reproductive efficiency.

A. Effects on Rectal Temperature

The mean values of rectal temperature was significantly (P<0.05) highest in summer season (100.25±0.20 ˚F /min) followed by spring season (99.16±0.22 ˚F /min) and lowest in winter season (98.81±0.23 ˚F /min). However, there was no significant difference between spring and winter seasons. Highest rectal temperatures of cross bred cattle due to the highest environmental temperature and relative humidity. Crossbred cattle very susceptible of seasonal variation and changes in rectal temperatures affected by seasons. These finding of the current study were similar with the reports made by Singh *et al.* (2014) who recorded rectal temperature was 102.52±0.25 and 100.68±0.19°C significant improved (P<0.05) during summer as followed by winter. Sailo *et al.* (2017) recorded that rectal temperature inclination in Sahiwal was significantly (P<0.05) highest in summer season as followed by spring season, lowest in winter season, respectively in Sahiwal and KF cows.

B. Effects on Pulse Rate

The mean values of pulse rate was significantly (P<0.05) highest in summer season (65.57 ± 1.16 beats /min) followed by winter season (57.32 ±2.04 beats /min) and lowest in spring season (56.00±1.48 beats/min). However, there was no significant difference between winter and spring seasons. The probable reasons of highest pulse rate of cross bred cattle due to their highest temperature. Crossbred cattle very sensitive of changes in THI were pulse rate affected by season variation. This was because cattle body temperature raise, heart rate increased as well as pump more blood maintained order to body temperatures. These finding of the present study was well corroborated with the observation of Sawankumar *et al.* (2017) reported that the pulse rate significantly (P<0.05) highest during summer season followed by winter season. Singh and Upadhyay (2009) reported that the pulse rate of growing and adult Sahiwal cattle increased during afternoon the pulse rate increased by 4.83, 8.00 beats/min respectively, during summer as followed by spring and other season.

Table 1: Local climatic parameters during different seasons of experimental period (THI Values).

Seasons	Air Tempreature (°C)			Relative humidity (%)			THI Value
	Max.	Min.	Mean	Max	Min.	Mean	Mean
Spring	27.25 (22.7-32.2)	13.77 (9.6-19.9)	20.51	92.75 (90 - 96)	53 (40 - 68)	72.87	67.72
Summer	32.2 (30.5-33.0)	23.62 (21.9-24.6)	27.51	93.25 (92 - 95)	70.5 (69 - 72)	81.87	78.08
Winter	29.4 (25.7-33.0)	17.9 (11.7-23.8)	23.65	94.25 (91 - 96)	62.25 (53 - 69)	78.25	72.66

[a, b, c] Mean bearing different superscripts in a column varied significantly (P<0.05).

C. Effects on Respiration Rate

The mean values of respiration rate was significantly (P<0.05) highest in summer season (28.64±0.45 breaths/min) followed by spring season (25.48±1.29 breaths /min) and lowest in winter season (24.32±1.24 breaths/min). However, there was no significant difference between winter and spring seasons as well as spring, summer season, respectively. The probable reasons of increased in respiration rate in summer followed by winter, might due to the more heat stress

and require of oxygen by the tissues in stressful condition. These finding of the present study was well corroborated with the observation of Lopez *et al.* (2012) reported that the respiration rate was significantly highest in the summer followed by the winter, with signify respiratory rate of 40.7 breaths per minute in the summer and 28.2 breaths per minute in the winter. Das *et al.* (1999) reported that increase in respiration rate in immature buffalo calves exposed to solar radiation.

D. Effect on Skin Temperatures

The mean values of skin temperature was significantly (P<0.05) highest in summer season (96.57 ±0.93 ˚F /min) followed by spring season (89±1.16˚F /min) and lowest in winter season (86.14±1.09˚F /min). However, there was significant difference between summer, spring and winter seasons. The possible reason of highest skin temperatures of cross bred cattle due to their highest blood flow and pressers rate and heat stress with ambient temperature. These finding of the present study was well corroborated with the observation of Koga *et al.* (1999) who found in buffaloes and cattle highest skin temperature during summer followed by other seasons. Fadden and Bickhart (2021) reported that the connection between skin temperature and rectal temperature in dairy cows. Porto *et al.* (2019) reported that skin temperature was significantly influenced by ambient temperature, relative humidity and solar radiation.

E. Effects on Tri-iodothyronine (T_3)

The mean concentration of tri-iodothyronine was significantly (P<0.05) highest in summer season (4.24±0.22 ng/ml) followed by winter season (3.47±0.09 ng/ml) and lowest in spring season (2.99±0.06 ng/ml). However, there was significant (P<0.05) difference between summer, winter and spring seasons. An increased during summer season of tri-iodothyronine concentration was observed might due to the effect of heat stress during summer higher metabolism activity of maintain body temperature, heart rate which affected of tri-iodothyronine concentration in crossbred cattle during summer seasons. The normal increased in thyroid hormone is regulation of higher metabolic rate during summer as well as increased protein synthesis and breakdown heat stress condition. Tri-iodothyronine is iodinated amino acids secreted into the thyroid bloodstream. About one third of total iodine in the thyroid is in the form of tri-iodothyronine. These finding of the present study was well corroborated with the observation of Kumar *et al.* (2016) found that concentration of tri-iodothyronine was significantly (P<0.05) highest level of T_3 hormone in Karan Fries followed by Sahiwal heifers due to highest basal metabolic rate of crossbred heifers in tropical condition. These findings were in contrast with Rasooli *et al.* (2004) reported that the high concentration of serum tri-iodothyroxine (T_3) in various species in winter followed by summer season.

F. Effects on Thyroxin (T_4)

The mean concentration of thyroxin was significantly (P<0.05) highest in summer season (20.24±0.50 ng/ml) followed by winter season (19.48±0.44 ng/ml) and lowest in spring season (16.61±0.59 ng/ml). However, there was no significant (P<0.05) difference between summer and winter seasons. An increased during summer season of thyroxin concentration was observed might due to the effect of heat stress during summer higher metabolism activity of maintain body temperature, heat rate which affected of thyroxin concentration in crossbred cattle during summer. Thyroxin is a function free hormone that is soluble cellular protein, liver and mitochondria. The reason of increased of thyroid in summer season might due to decreased in iodine- rich feeding in the feed, due to which RBC formation affected. These finding of the present study was well corroborated with the observation of Kumar *et al.* (2016) found that concentration of thyroxin was significantly (P<0.05) highest level of T_4 hormone in Karan Fries followed by Sahiwal heifers due to highest basal metabolic rate of crossbred heifers in hot tropical condition. These findings were in contrast with Rasooli *et al.* (2004) who had also observed the highest concentration of thyroxin during winter seasons followed by summer and spring in cattle. *G. Effects on Plasma Cortisol Levels*

The mean concentration of cortisol was significantly (P<0.05) highest in summer season (42.05±2.83 ng/ml) followed by winter season (42.05±2.83 ng/ml) and lowest in spring season (30.63±3.24 ng/ml). However, there was no significant difference between summer, winter seasons as well as winter and spring seasons, respectively.

Table 2: Effect of physiological parameters (Mean ± SE) during different seasons.

Parameters	Spring	Summer	Winter
Rectal temperature (°F)	101.64 ± 0.12^{b}	102.01 ± 0.13^{b}	101.04 ± 0.13^{a}
Pulse Rate (beats/min)	56.00 ± 1.48^{a}	65.27 ± 1.16^{b}	57.32 ± 2.04^{a}
Respiration rate (breaths/min)	25.48 ± 1.29^{a,b}	28.64 ± 0.45^{b}	24.32 ± 1.24^{a}
Skin temperature (°F)	89.97 ± 1.16^{b}	96.57 ± 0.93^{c}	86.14 ± 1.09^{a}

$^{a, b, c}$ Mean bearing different superscripts in a column varied significantly (P<0.05).

Table 3: Effect of Hormonal profile parameters (Mean ± SE) during different seasons.

Parameters	Spring	Summer	Winter
Tri-iodothyronine (T_3)	2.99 ± 0.06^{a}	4.42 ± 0.22^{c}	3.47 ± 0.09^{b}
Thyroxine (T_4)	16.61 ± 0.59^{a}	20.54 ± 0.50^{b}	19.48 ± 0.44^{a,b}
Plasma Cortisol level	30.63 ± 3.24^{a}	42.05 ± 2.83^{b}	36.81 ± 3.39^{a,b}

$^{a, b, c}$ Mean bearing different superscripts in a column varied significantly (P<0.05).

An increased in the concentration of plasma cortisol levels was observed in the higher heat stress affected crossbred cattle during summer seasons. The higher secretion and development of cortisol concentration might due to stress in brain and nerve as well as increased cortisol hormone secretion during summer season due to heat stress higher metabolic activities increased rapidly in crossbred which helps in maintains the balanced of water and salts. These finding of the present study was well corroborated with the observation of Chandrashekhar *et al.* (2017), observed that the highest concentration of cortisol during summer seasons followed by winter and spring**.** Bhan *et al.* (2012) also found similar correlation among plasma cortisol hormone and physiological, enzymatic parameters and THI in Murrah buffaloes exposed to different environmental conditions.

CONCLUSIONS

On the basis of this study, it can be concluded indicated that highest as tri-iodothyronine (T_3) thyroxine (T_4), plasma cortisol levels during summer and spring season due to heat stress climatic condition. RT, PR, RR and ST highest during summer season due to higher stressful temperatures and THI period. This variation in higher levels parameters related to changes in ambient temperature, relative humidity and THI, although within physiological and hormonal parameters for crossbred cattle. Therefore, we can claim that the seasonal changes can impact the metabolic activates.

FUTURE SCOPE

The physiological and hormonal profile obtained for correct interpretation of normal physiology behavioral crossbred cattle in particular medziphema Nagaland region. Variation in these parameters due to seasonal changes may helpful improved better health management practices crossbred cattle and designing strategies for combating stress maximum production in Nagaland.

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Conflict of Interest. None.

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