PHYSIOLOGICAL RESPONSE OF CROSS-BRED CALVES TO PRE-MONSOON, MONSOON AND POST-MONSOON SEASONS OF KERALA*

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Abstract

A study was conducted to assess the adaptability of crossbred female calves inhabiting Mannuthy, Thrissur, Kerala. Seven crossbred female calves of six to twelve months of age were randomly selected from University Livestock Farm and Fodder Research and Development Scheme, Mannuthy, Thrissur. Physiological responses such as Rectal Temperature (RT), Respiratory Rate (RR), Heart Rate (HR) and Pulse Rate (PR) were recorded at 08:00-09:00 h and 13.00-14:00 hin pre-monsoon, monsoon and post-monsoon seasons. Meteorological data were also recorded on all the days of the experiment. There is a significant ($p<0.05$) increase in diurnal variation as indicated by elevated ambient temperature, relative humidity and THI from 08:00-09:00 h and 13.00-14:00 h in all the three seasons. Similarly RT, RR, HR and pulse rate increased significantly ($p<0.05$) with diurnal variation from 08:00-09:00 h and 13.00-14:00 h in all the three seasons. This study indicates that all the animals were under heat stress in all the three seasons as evidenced by significant increase in RT, RR, HR and PR from forenoon to afternoon. It is concluded that the animals are trying to cope up with the heat stress by altering their physiological responses. But elevated RT during afternoon in all the three seasons indicates low thermal adaptability of the animals to the existing ambience.

Key words: *Physiological responses, Adaptability, Crossbred calves, Season*

Like all other mammals cattle are homeotherms with a narrow range of thermo-neutral zone where no additional energy is required to maintain their body temperature (Yousef, 1987). Heat stress induces numerous behavioural and physiological responses where an appreciable portion of energy is deviated for thermoregulation compromising the production behind. High respiratory rate (RR), sweating, accelerated heart rate (HR), depressed dry matter intake, increased water intake, and altered endocrine profile were some of the physiological responses operated under heat stress to reduce the strain inflicted (West, 1999). Interestingly it was found that the heat stress responses were less pronounced in *Bos indicus* compared to *Bos taurus* owing to its evolutionary process and were better adapted to hot and humid tropic (Cartwright, 1955). On this light, assessment of physiological responses such as RT, RR, HR and pulse rate (PR) to

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varying ambient temperature, relative humidity or temperature-humidity index (THI) may help us to assess the adaptability of the animal inhabiting hot and humid-tropics. Thrissur, a district of Kerala, India, situated 22.25m above the mean sea level, at 10'32" North latitude at 76'16" East longitude experiences hot and humid tropical climate with temperature-humidity index (THI) crossing 72 for many a days in a year and it was assumed that the animals were under significant heat stress (Girish Varma *et al.,* 2013). No studies had been conducted so far to assess the adaptability or physiological responses of crossbred calves to pre-monsoon, monsoon and post-monsoon seasons prevailing in Kerala. On this basis the present study was undertaken to assess the physiological responses of crossbred calves to pre-monsoon, monsoon and post-monsoon seasons of Kerala which was primarily aimed to assess the adaptability of the animals.

Materials and Methods

Seven crossbred female calves of six to twelve months of age were randomly selected from University Livestock Farm and Fodder Research and Development Scheme, Mannuthy, Thrissur, Kerala. The animals were fed concentrates as per ICAR feeding standards (Ranjhan, 1998). Roughages were fed in house and also by subjecting the animals to grazing. While subjecting the animals for grazing, the animals were also exposed to heat stress.

The study was conducted in three different spells of 30 days each in pre-monsoon (May), monsoon (July) and post-monsoon (November) seasons. Same seven crossbred female calves were used in all the three seasons to record the physiological responses. Ambient temperature (AT) and relative humidity (ARH) from out-house atmosphere and in-house temperature (IT) and in-house relative humidity (IRH) from shed were recorded on all days of the experiment using HOBO data logger (HOBO U 12 Temp/RH/Light/Ext). Temperature Humidity Index (THI) was calculated using the equation THI = (0.8 X Tdb) + [(RH/100) X T bb – 14.4] + 46.4 (Mader *et al.,* 2006) from daily recordings of temperature and relative humidity.

Rectal temperature (RT) was measured using a clinical thermometer inserted into rectum for one minute. Respiratory rate (RR) was recorded by counting the flank movements for one minute from a distance in order to avoid any disturbance to the animals. Heart rate (HR) was recorded with the help of a stethoscope and pulse rate (PR) by manual palpation of middle coccygeal artery pulse for one minute. These parameters were recorded daily at 08:00-09:00 h and 13.00-14:00h on all the days of the experiment. The mean of these values were calculated as per the method of Snedecor and Cochran (1994) using repeated two way analysis of variance (ANOVA). The whole data was statistically analyzed using computerized software programme SPSS Ver.20.0.

Results and Discussion

The mean±SE values of AT, RHand THI during pre-monsoon, monsoon and post-monsoon seasons for in-house and outdoor ambience were presented in table 1. In the present study the mean AT, RH and THI of indoor and out-house varied from 26.65±0.08 to 29.59±0.12 °C, 73.90±0.51 to 90.99±0.31 %, 78.14 to 82.04 and 26.08±0.09 and 29.14±0.13 °C, 78.64±0.56 to 94.71±0.31 %, 78.08 to 82.14 respectively. Ambient temperature and RH was found to be significantly ($p \leq 0.05$) different between seasons and also between in-house and out-house with highest AT recorded in pre-monsoon followed by post-monsoon and monsoon. Highest RH was recorded in monsoon followed by pre-monsoon and post-monsoon. A significant ($P \leq 0.05$) increase in diurnal variation was noticed from forenoon to afternoon in all the three seasons. The mean±SE values of AT, RH and THI during forenoon and afternoon was shown in Table 2.

Rectal Temperature (RT)

The mean±SE values of RT of the animals during forenoon and afternoon in pre-monsoon, monsoon and post-monsoon seasons were presented in Table 2. There was a significant ($p \leq 0.05$) increase in RT from forenoon to afternoon in all the three seasons. This was in agreement with the study carried out by Bahn *et al.* (2012) on Sahiwal cattle, where significant diurnal variation from forenoon to afternoon was observed in spring, winter, hot and humid and summer seasons. In addition

Table 1. Meteorological data of pre-monsoon, monsoon and post-monsoon seasons (Mean±SE, n=30)

Meteorological Parameters		Seasons		
		Pre-monsoon (Summer)	Monsoon (Rainy)	Post-monsoon (Winter)
Dry bulb temperature (ºC)	In-house	29.59^{Aa}±0.12	26.65^{Ba}±0.08	27.71^{Ca}±0.10
	Outdoor	29.14^{Ab}±0.13	26.08^{Bb}±0.09	27.16^{Cb}±0.12
Relative humidity (%)	In-house	78.91^{Aa}±0.50	90.99^{Ba}±0.31	73.90^{Ca}±0.51
	Outdoor	84.13^{Ab}±0.53	94.71^{Bb}±0.31	78.64^{Cb}±0.56

Means with at least one common superscript (A, B, C) with in a row and (a, b) within a column do not differ significantly at 5% level

Table 2. Diurnal variation in physiological parameters of crossbred female calves during pre-monsoon, monsoon and post-monsoon seasons (Mean±SE, n=7)

Parameters	Seasons			
	Time of recording	Pre-monsoon (summer)	Monsoon (rainy)	Post-monsoon (winter)
Ambient temperature (*C)	00.80-00.90 h	28.16^{a}±0.25	25.26^{a}±0.16	26.33^{a}±0.20
	00.13-00.14 h	33.8^{b}±0.27	28.92^{b}±0.26	31.52^{b}±0.15
Relative Humidity (%)	00.80-00.90 h	85.69^{a}±1.10	97.53^{a}±0.55	77.84^{a}±1.22
	00.13-00.14 h	64.98^{b}±1.31	85.00^{b}±1.16	61.39^{b}±0.99
THI	00.80-00.90 h	80.58^{a}±0.31	77.15^{a}±0.23	76.71^{a}±0.31
	00.13-00.14 h	85.87^{b}±0.26	81.70^{b}±0.29	82.12^{b}±0.26
Rectal temperature (ºF)	00.80-00.90 h	101.43^{a}±0.02	101.12^{a}±0.18	100.96^{a}±0.05
	00.13-00.14 h	103.08^{b}±0.18	103.19^{b}±0.10	103.06^{b}±0.04
Respiratory rate (breaths/min)	00.80-00.90 h	36.40^{a}±1.25	31.76^{a}±0.27	29.86^{a}±0.47
	00.13-00.14 h	74.15^{b}±2.36	69.49^{b}±0.92	67.88^{b}±0.72
Heat rate (beats/min)	00.80-00.90 h	73.11^{a}±1.22	72.23^{a}±0.44	71.42^{a}±0.44
	00.13-00.14 h	85.09^{b}±1.90	80.96^{b}±0.75	78.46^{b}±0.59
Pulse rate (pulse/min)	00.80-00.90 h	70.86^{a} ±1.41	67.64^{a}±0.57	66.42^{a}±0.35
	00.13-00.14 h	74.33^{b}±1.15	75.50^{b}±0.65	70.09^{b}±0.32

Means with atleast one common superscript (a, b) in a column do not differ significantly at 5% level

Mcmanus *et al.* (2009) and Nishanth *et al.* (2010) also observed a statistically higher RT during afternoon compared to morning values.

Respiratory Rate (RR)

The mean±SE values of RR of the animals under study were shown in Table 2. A significant ($p \leq 0.05$) increase in RR was noticed from forenoon to afternoon in all the three seasons.This is in line with the observations made by Mcmanus *et al.* (2009) who observed significantly higher RR in afternoon compared to forenoon in naturalized Brazilian cattle breeds. In addition Nisanth *et al.* (2010) also noticed higher RR during afternoon compared to forenoon in crossbred cattle inhabiting Kerala.

Heart Rate (HR)

In the present study, the mean values for HR of the animals under study were shown in Table 2. A significant ($p \leq 0.05$) increase in HR from forenoon to afternoon was observed in all the three seasons. In contrast to our findings Mc manus *et al.* (2009) observed no significant difference in HR from forenoon (07.00 h) to afternoon (14.00 h) in naturalized Brazilian cattle breeds.

Pulse Rate (PR)

The mean±SE values of PR of the animals under study were depicted in Table 2. Statistical analysis of data showed a significant ($p \leq 0.05$) increase in PR from forenoon to

afternoon in all the three seasons. Similar results have been shown by Bhan *et al.* (2012) who noticed a significant increase in PR from morning to afternoon in adult and growing Sahiwal cattle in spring, winter, hot and humid and summer season.

In the present study a significant ($P \leq 0.05$) diurnal variation was noticed in all the three seasons as evidenced by a significant increase in AT, RH and THI from forenoon to afternoon. Marai and Haeeb (2010) reviewed that a THI value below or equal to 72 indicates absence of heat stress, whereas a THI value of 72-74 indicates moderate heat stress and a value of 74-78 and more designates very severe heat stress in cattle. In the present study we observed a THI of82-86 during afternoon in all the three seasons. This indicates that all the animals were under significant heat stress in all the seasons. Similarly physiological responses such as RT, RR, HR and PR also significantly ($P \leq 0.05$) increased from forenoon to afternoon in all the three seasons which is also suggestive of heat stress in all the three seasons. This increase in physiological responses could be a thermoregulatory mechanism to increase heat loss to the surroundings. Increased RR could be a mechanism to dissipate heat via panting and increased HR and PR could be circulatory adjustments to deviate blood flow from centre to periphery to enhance heat loss mechanisms.

The study indicates that the crossbred calves inhabiting Thrissur, of Kerala were experiencing heat stress in all the three seasons. However the animals have the adaptive capability to alter their physiological responses to cope up with the heat stress, but failure to maintain their RT indicates low thermal adaptability. Alteration of micro and macro climates of these animal housing and management practices may help these animals to maintain their homeostasis and the energy expended for thermoregulation may be deviated for production.

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