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IMPACT OF VARYING TEMPERATURE HUMIDITY INDEX ON THE PLASMA VOLUME OF CROSSBRED CATTLE AND BUFFALO CALVES

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ABSTRACT

The study was conducted to assess the influence of varying temperature humidity index (THI) prevalent in central midlands of Kerala on the plasma volume of castrated crossbred cattle calves and buffalo calves. The temperature humidity index varied from 76.5 to 82.0 throughout the year. No significant correlation was observed between temperature humidity index and rectal temperature (r = 0.409) in crossbred cattle calves and (r = 0.258) in buffalo calves at P<0.01 level. A positive correlation was observed between THI and plasma volume of crossbred cattle calves (r = 0.913) and plasma volume of buffalo calves (r = 0.914) at P<0.01 level.

Keywords: Temperature humidity index, Plasma Volume, Cattle, Buffalo

INTRODUCTION

Climate change is one of the most important factors affecting the growth and production of livestock. In tropical and subtropical areas, a high ambient temperature is the main impediment on animal productivity. This effect is intensified when elevated ambient temperature is accompanied by high ambient humidity. This will cause additional discomfort and increases the stress level of the animal. Temperature humidity index represents the combined effect of air temperature and humidity associated with the level of thermal stress (Bohmanova *et al*., 2007). Kerala is a tropical state having hot and humid climate with fluctuating weather conditions throughout the year. The present study was undertaken to investigate the adaptation capacity of crossbred cattle calves and buffalo calves to the varying temperature humidity prevalent in central midlands of Kerala using plasma volume as an adaptation parameter.

MATERIALS AND METHODS

Six castrated male crossbred cattle calves and six castrated male buffalo calves between four to seven months of age were selected for the study from the University Livestock Farm and Fodder Research and Development Scheme, KVASU, Mannuthy. The animals were castrated to rule out the effect of reproductive hormones on thermoregulation. The period of experiment was one year. Daily ambient temperature and relative humidity were recorded at hourly intervals, inside and outside the shed using HOBO data logger. Temperature humidity index was calculated using the equation, THI = db°F - (0.55 – 0.55 x RH) x (db°F – 58), where db°F is the dry bulb temperature in Fahrenheit and RH is the relative humidity (RH%)/100 (LPHSI, 1990).

Rectal temperature (RT) was recorded daily at 09:00 am and 15:00 pm. Plasma volume was determined by the method of Kennedy and Millikan (1938) by injecting Evan's blue dye. The data obtained were statistically analysed using a computerized software programme SPSS Ver. 20.0.

RESULTS AND DISCUSSION

The values obtained are summarized in Table 1 and 2. The lowest temperature humidity index of 76.5 ± 0.20 was recorded in the second half of December, while the highest temperature humidity index of 82 ± 0.36 was observed in the month of March. The temperature humidity index recorded throughout the year varied from 76.5 to 82.

There was no significant correlation of THI with RT in buffalo (r = 0.258) and crossbred cattle calves (r = 0.409) at $P < 0.05$ level. The RT in buffalo and in crossbred cattle calves showed similar type of response to varying THI. This was in agreement with the findings of Zecchini *et al.* (2003). This invariable maintenance of RT in varying THI throughout the experimental period observed in the current study might be due to high level of heat tolerance (Alam *et al.,* 2011).

Temperature humidity index was positively correlated with the plasma volume in buffalo (r = 0.914) and crossbred cattle calves (r = 0.913) at $P < 0.01$ level. The plasma volume increased with increase in THI in both buffalo and crossbred cattle calves. The rate of increase in plasma volume with increase in THI was significantly higher ($P < 0.01$) in buffalo calves compared to crossbred cattle calves.

In the current study, THI was positively correlated with the plasma volume of buffalo and crossbred cattle calves which is comparable with the findings of El-Sherif *et al.* (1996), who observed elevated levels of plasma volume in sun exposed Bakri ewes. In the study, the rate of increase in plasma volume was more pronounced in buffalo calves compared to crossbred cattle calves, which was in accordance with the findings of Koga *et al.* (2010).

The increase in plasma volume with increase in THI in the present study might be due to shifting of water from other compartments into the circulatory system for effective evaporative cooling in order to maintain thermal balance (El-Nouty *et al.,* 1990).

SUMMARY

The study indicated that crossbred cattle calves and buffalo calves were to adapted temperature humidity index from 76.5 to 80.0 in the central midlands of Kerala

Table 1. Rectal temperature and Plasma Volume of crossbred cattle calves and buffalo calves in varying THI

Period	THI	Rectal temeperature(^{0}F)		Plasma volume(ml/kg)	
		Crossbred cattle calves	Buffalo calves	Crossbred cattle calves	Buffalo calves
1st half of January	77.5 ± 0.34	102.0 ± 0.01	102.2 ± 0.02	33.73 ± 0.78	41.27 ± 0.82
2nd half of January	78.5 ± 0.64	102.1 ± 0.01	102.1 ± 0.02	34.18 ± 0.83	41.75 ± 0.75
1st half of February	78.5 ± 0.57	102.1 ± 0.03	102.3 ± 0.01	33.17 ± 1.21	41.63 ± 1.13
2nd half of February	77.5 ± 0.63	101.9 ± 0.03	102.2 ± 0.04	33.17 ± 0.76	41.38 ± 0.59
1st half of March	80.0 ± 0.39	102.1 ± 0.01	102.2 ± 0.04	35.89 ± 0.77	43.81 ± 0.67
2nd half of March	82.0 ± 0.44	102.0 ± 0.04	102.1 ± 0.04	38.24 ± 1.07	47.62 ± 0.29
1st half of April	82.0 ± 0.36	102.0 ± 0.03	102.3 ± 0.03	38.76 ± 1.50	47.51 ± 1.05
2nd half of April	80.0 ± 0.45	102.0 ± 0.03	102.1 ± 0.01	37.50 ± 1.04	44.29 ± 0.37
1st half of May	81.0 ± 0.23	102.2 ± 0.02	102.2 ± 0.01	36.91 ± 0.46	46.78 ± 0.60
2nd half of May	81.0 ± 0.39	102.1 ± 0.02	102.2 ± 0.02	36.43 ± 0.62	46.39 ± 1.42
1st half of June	80.0 ± 0.39	102.1 ± 0.04	102.1 ± 0.05	35.78 ± 0.88	43.63 ± 0.82
2nd half of June	79.0 ± 0.22	101.9 ± 0.01	102.1 ± 0.03	34.62 ± 0.56	42.50 ± 0.57
1st half of July	79.5 ± 0.40	102.1 ± 0.01	102.2 ± 0.03	35.04 ± 0.39	42.71 ± 0.64
2nd half of July	77.5 ± 0.45	101.9 ± 0.02	102.1 ± 0.03	34.13 ± 0.74	41.13 ± 1.09
1st half of August	78.0 ± 0.20	102.0 ± 0.02	102.2 ± 0.01	34.00 ± 0.29	41.22 ± 0.75
2nd half of August	79.0 ± 0.34	102.0 ± 0.04	102.3 ± 0.02	34.87 ± 0.68	41.72 ± 0.34
1st half of Sept.	79.5 ± 0.32	102.1 ± 0.04	102.3 ± 0.01	35.21 ± 0.54	41.83 ± 0.95
2nd half of Sept.	80.0 ± 0.34	102.2 ± 0.04	102.1 ± 0.01	35.99 ± 0.76	43.08 ± 0.38
1st half of October	79.4 ± 0.30	102.1 ± 0.01	102.1 ± 0.03	35.46 ± 0.82	41.97 ± 1.14
2nd half of October	80.5 ± 0.60	102.0 ± 0.01	102.2 ± 0.01	35.89 ± 0.87	43.88 ± 1.76
1st half of Nov.	78.5 ± 0.36	102.0 ± 0.01	102.1 ± 0.02	34.20 ± 0.59	41.35 ± 0.61
2nd half of Nov	78.5 ± 0.40	102.1 ± 0.05	102.1 ± 0.02	34.35 ± 0.83	41.03 ± 0.77
.1st half of Dec	78.5 ± 0.36	102.0 ± 0.02	102.1 ± 0.03	34.11 ± 1.54	40.78 ± 0.63
.2nd half of Dec.	76.5 ± 0.20	101.9 ± 0.02	102.1 ± 0.03	33.62 ± 0.86	40.53 ± 0.29

Table 2. Pearson's correlation coefficients (r) of Rectal temperature and Plasma Volume of crossbred cattle calves and buffalo calves with varying THI

Parameters	Cattle	Buffalo
Rectal temperature	0.409	0.258
Plasma Volume	0.913**	0.914**

Note: ** Correlation is significant at 0.01 level (2-tailed) as the rectal temperature remained constant throughout the period of experiment and alteration in plasma volume might be one of the mechanisms by which the animal tries to maintain thermal balance.

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