INTERNATIONAL JOURNAL OF APPLIED AND PURE SCIENCE AND AGRICULTURE
E- ISSN: 2394-5532 P- ISSN: 2394-823X
Scientific Journal Impact Factor: 3.762

Influence of temperature humidity index on the physiological parameters and growth rate of crossbred cattle calves

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Abstract

The present study was conducted to assess the adaptation capacity of castrated crossbred cattle calves to the varying temperature humidity prevalent in central midlands of Kerala using physiological and growth parameters. The temperature humidity index recorded throughout the year varied from 76.5 to 82. Rectal temperature remained invariable throughout the experimental period but respiratory rate and pulse rate exhibited a significant correlation (P<0.01) with temperature humidity index. A negative correlation was observed between temperature humidity index and relative growth rate of the experimental animals at P<0.01 level.

Keywords-temperature humidity index; physiological response; growth rate; cattle; thermoregulation

I. INTRODUCTION

One of the emerging and most important challenges facing the livestock throughout the world is climate change. Livestock face a potential risk in the growth and production due to variation in climatic variables like temperature, humidity and radiations. High ambient temperature combined with elevated air humidity causes additional discomfort and increases the stress level of the animal. The combined effect of air temperature and humidity associated with the level of thermal stress is represented by temperature humidity index [1].

India ventured on crossbreeding programme to increase the production level of indigenous breeds. This has resulted in higher production levels but these crossbred animals are found to be more susceptible to stress condition. Kerala is a tropical state having hot and humid climate with fluctuating weather conditions throughout the year. Crossbred cattle are the main livestock kept by the people for milk and meat. The present study was undertaken to investigate the adaption capacity of crossbred cattle calves to the varying temperature humidity prevalent in central midlands of Kerala

II. MATERIALS AND METHODS

Six castrated male cross bred calves between four to seven months of age were selected from the University Livestock Farm and Fodder Research and Development Scheme, KVASU, Mannuthy, for this study. Ambient temperature and ambient relative humidity inside and outside the shed wererecorded at hourly intervals on all days of the experiment using HOBO data logger(HOBO U 12 Temp/RH/Light/Ext.). Daily averagetemperature humidity index (THI)was calculated using the

equation,THI = db^{o}F - (0.55 – 0.55 x RH) x (db^{o}F – 58), where db^{o}F is the dry bulb temperature in Fahrenheit and RH is the relative humidity (RH%)/100 [2].

Rectal temperature,respiratory rate and pulse rate were recorded daily at 09:00 am and 15:00 pm. till the end of the experiment. Body weightswere recorded on the day of commencement of the experiment and at fortnightly intervals till the end of experiment. Relative growth rate was calculated using the formula: $[(W_2-W_1)/W_1]X$ 100, where W_1 is the initial weight and W_2 is the final weight.

The data obtained on various parameters were statistically analysed as per the method of [3] using Pearson's correlation. The whole data was analysed using computerized software programme SPSS Ver. 20.0.

III. 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.

Table 1 ***Physiological parameters and growth rate of crossbred cattle calves in varying THI***

PERIOD	THI	PARAMETER			
		RECTAL TEMPERATURE (0F)	RESPIRATORY RATE (BREATHS/MIN)	PULSE RATE (PULSE/MIN)	RELATIVE GROWTH RATE (%)
1st half of January	77.5 ± 0.34	102.0 ± 0.01	23.27 ± 0.58	55.25 ± 0.92	9.78 ± 1.08
2nd half of January	78.5 ± 0.64	102.1 ± 0.01	24.55 ± 0.73	56.81 ± 0.65	10.08 ± 0.50
1st half of February	78.5 ± 0.57	102.1 ± 0.03	24.41 ± 0.67	56.67 ± 0.56	10.51 ± 0.54
2nd half of February	77.5 ± 0.63	101.9 ± 0.03	23.78 ± 0.31	55.43 ± 1.34	11.23 ± 0.62
1st half of March	80.0 ± 0.39	102.1 ± 0.01	25.46 ± 0.42	58.24 ± 1.05	9.30 ± 0.70
2nd half of March	82.0 ± 0.44	102.0 ± 0.04	27.13 ± 0.67	65.71 ± 0.77	4.55 ± 0.78
1st half of April	82.0 ± 0.36	102.0 ± 0.03	28.93 ± 0.78	66.31 ± 1.43	6.06 ± 0.75
2nd half of April	80.0 ± 0.45	102.0 ± 0.03	25.17 ± 0.37	59.83 ± 0.67	7.80 ± 0.58
1st half of May	81.0 ± 0.23	102.2 ± 0.02	26.73 ± 0.42	62.57 ± 0.73	8.41 ± 0.83
2nd half of May	81.0 ± 0.39	102.1 ± 0.02	26.91 ± 0.61	63.92 ± 1.06	8.91 ± 0.80
1st half of June	80.0 ± 0.39	102.1 ± 0.04	25.84 ± 0.54	59.31 ± 0.84	10.91 ± 0.51
2nd half of June	79.0 ± 0.22	101.9 ± 0.01	24.32 ± 0.75	58.75 ± 0.57	12.36 ± 1.28
1st half of July	79.5 ± 0.40	102.1 ± 0.01	24.55 ± 0.58	58.60 ± 0.32	12.48 ± 0.58
2nd half of July	77.5 ± 0.45	101.9 ± 0.02	23.76 ± 0.29	55.43 ± 0.59	13.10 ± 0.49
1st half of August	78.0 ± 0.20	102.0 ± 0.02	24.92 ± 0.93	56.74 ± 1.57	12.88 ± 0.57
2nd half of August	79.0 ± 0.34	102.0 ± 0.04	25.31 ± 0.47	57.82 ± 0.61	12.73 ± 0.79
1st half of September	79.5 ± 0.32	102.1 ± 0.04	25.49 ± 0.58	58.09 ± 0.89	12.63 ± 0.67
2nd half of September	80.0 ± 0.34	102.2 ± 0.04	26.82 ± 0.64	59.71 ± 1.62	12.41 ± 0.80
1st half of October	79.4 ± 0.30	102.1 ± 0.01	25.76 ± 0.33	58.64 ± 0.67	13.20 ± 0.40
2nd half of October	80.5 ± 0.60	102.0 ± 0.01	24.16 ± 0.26	58.37 ± 0.76	12.13 ± 0.39
1st half of November	78.5 ± 0.36	102.0 ± 0.01	25.85 ± 0.58	56.99 ± 1.04	13.13 ± 0.64
2nd half of November	78.5 ± 0.40	102.1 ± 0.05	24.99 ± 0.47	56.48 ± 0.23	13.50 ± 0.40
1st half of December	78.5 ± 0.36	102.0 ± 0.02	24.76 ± 0.69	55.97 ± 0.65	12.95 ± 0.56
2nd half of December	76.5 ± 0.20	101.9 ± 0.02	23.74 ± 0.57	54.23 ± 0.93	13.73 ± 0.67

Table 2.*Pearson's correlation coefficients (r) of physiological parameters and growth rate of crossbred cattle calves with varying THI*

Parameters	Cattle
Rectal temperature	0.409
Respiratory Rate	0.782**
Pulse rate	0.925**
Growth rate	-0.708**

Note: ** Correlation is significant at 0.01 level (2-tailed)

No significant correlation was observed between temperature humidity index and rectal temperature (r=0.782) in crossbred cattle calves at P<0.01 level. This is in agreement with the findings of [4] and [5]. Temperature humidity index exhibited a positive correlation with the respiratory rate (r=0.869) and pulse rate (r=0.925) in crossbred cattle calves at P<0.01 level which is in accordance to the results of [6, 7, 8].The respiratory rate increased by three breaths per minute and pulse rate increased by 12 beats per minute when the temperature humidity index increased from 76.5 to 82. A consistent rectal temperature and increased rates of respiration and pulse when animals are exposed to a range of temperature humidity index from 76.5 to 82, indicated that the animals had high level of heat tolerance. They maintained thermal balance by removing excess heat through enhanced respiratory rate and pulse rate.

Temperature humidity index showed negative correlation with the relative growth rate (r=0.708) in crossbred cattle calves at P<0.01 level. These findings are comparable to the observations of [9, 10]. The decrease in growth rate with increase in THI might be due to the fact that animals used most of the energy to maintain homeothermy instead of growth.

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