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EFFECT OF HEAT EXPOSURE ON PHYSIOLOGICAL PROFILE IN GROWING SWAMP BUFFALO CALVES UNDER AGRO-CLIMATIC CONDITION OF ASSAM

T. K. SAIKIA[1], J. GOSWAMI, B. C. SARMAH, B. K. SARMAH, G. C. DAS[2] AND R.S. BORAH[3]
Department of Veterinary Physiology, College of Veterinary Science,
Assam Agricultural University, Khanapara, Guwahati-781022

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ABSTRACT

Ten swamp buffalo calves were selected irrespective of sex and divided into two groups comprising of 5 nos of animals in each group. The physiological parameters that are related to thermal stress viz. body temperature, pulse rate and respiration rate were recorded twice daily for a period of 6 months. During morning hours, the average body temperature of the experimental calves was found to be 100.4°F in pre-monsoon months as compared to 101.1°F in monsoon months. During evening hours, the average body temperature of the experimental calves was found to be 101.4°F in pre-monsoon months as compared to 102.2°F in monsoon months. The pulse rate ranged from 55 to 62 per minute in the pre-monsoon months in comparision with to 57 to 65 per minute in the monsoon months. The lowest mean respiration rate was recorded as 17.0 ± 0.31 and the highest mean respiration rate was found to be 18.8 ± 0.41 per minute in the pre-monsoon months. The recorded respiration rates for the monsoon months were almost similar to those which observed in the pre-monsoon months. The average Temperature-Humidity Index (THI) of different months in the place of study was found to be 74.72, 76.75, 77.00, 78.00, 78.25 and 78.55 for the months of March, April, May, June, July and August, respectively. The present experiment revealed that there was a positive correlation between THI and physiological parameters. The body temperature showed strong correlation with THI in comparision to pulse rate as well as respiration rate.

Key Words : Temperature-Humidity Index, Body temperature, Pulse rate, Respiration rate.

Among the livestock, cattle and buffalo play a major role in Indian economy. Buffalo plays a significant role in the economy of farmers in India being the highest milk producing animal. The local swamp buffaloes of Assam are semi-wild type of animal with low productive and reproductive efficiency. In Assam the rising mercury level accompanied with high relative humidity afflict the buffalo population during the pre-monsoon (March-May) and monsoon seasons (June to August). During pre-monsoon and monsoon seasons (March to August), the mercury level rise beyond 37°C with relative humidity as high as around 85 per cent. Therefore, all livestock in Assam especially buffalo population greatly suffer from thermal stress during these months. Temperature-Humidity Index (THI) is a suitable climatic marker [2] to correlate climatic stress on physiology and productivity of animals and also a reliable tool for effective management of livestock under different climatic condition. The comparision of physiological response to climatic conditions in swamp buffaloes and cattle were studied by earlier researcher[1]

[1]Corresponding Author
E.mail: drtarunsaikia@gmail.com
[2]PINWP on "Swamp Buffalo",
[3]Associate Professor,Department of LPM.
*Part of MVSc research of the first author.

where they observed that the body temperature of buffaloes was correlated significantly with seasonal changes of air temperature. Very meager quantum of studies on the environmental stress level and thermo-adaptability have been carried out so far in swamp buffalo under agro-climatic condition of North-Eastern region of the country. Therefore, a study in this aspect is required to generate baseline data on heat tolerance of this animal by taking into consideration of physiological parameters especially in calves. Therefore the present study was carried out to assess the changes of physiological parameters in young growing swamp buffalo calves.

MATERIALS AND METHODS

The study was conducted at the ICAR sponsored "Network Project on Swamp Buffalo", College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22. The study was conducted in two different seasons *ie*. pre-monsoon (March-May) and monsoon (June-August) seasons. Ten (10) nos. of swamp buffalo calves were selected irrespective of sex and divided into two groups comprising of 5 nos of animals in each group. All the experimental animals were reared under semi-intensive system. The physiological parameters that are related to thermal stress viz. body temperature, pulse rate and respiration rate were recorded twice daily at 7.00 AM and 3.30 PM by conventional methods for a period of 6 months. Temperature-Humidity Index was calculated for the entire period of study using the data obtained from the Automatic Weather Station of Assam Agricultural University, College of Veterinary Science, Khanapara, Guwahati-22. The statistical analysis of all the data was carried out by using ANOVA [6].

RESULTS AND DISCUSSION

Temperature-Humidity Index:

The average THI of different months in the place of study was found to be 74.72, 76.75, 77.00, 78.00, 78.25 and 78.55 for the months of March, April, May, June, July and August respectively. It was observed that THI level started to cross the limit of thermal tolerance from the month of March onwards[4] since THI level of 72.00 was stipulated to be the limit of tolerance. Thus the animals were under thermal stress during the month of March. The month wise average THI level showed gradual increase till the month of August which indicated that the level of stress also increased with the passage of time with the transition of period of observation from pre-monsoon to monsoon months, *i.e.,* from March to August. The increase in THI level with exposure of the animals from pre-monsoon to monsoon months could be consequential to increase in rainfall during the months of monsoon leading to rise in relative humidity along with environmental temperature. It was recorded during the study that environmental temperature rose from 30 to 35.5°C while relative humidity increased from 72 to 86 per cent which is in close agreement with the other workers [5] where increase in THI with increase in monthly temperature and humidity has been documented. It was observed in the study that there was weekwise variation in THI for different months, the highest value being 78.00 during the fourth week in March, 78.00 during the third week in April, 79.00 during the fourth week in May, 82.00 during the second week in June, 80.00 during the second week in July and 80.00 during fourth week in August. However, statistical analysis revealed that there was no significant difference between weekwise and monthwise levels of THI that varied widely from 70.68 to 82.00 during the study period. The present findings suggest that the buffalo calves were exposed to different levels of environmental stress while growing during the pre-monsoon and monsoon period since it was indicated that the THI level beyond 72 was indicative of mild heat stress, THI 75 to 78 denoted stressful condition and that beyond 78 could exert severe stress due to heat and humidity[3]. The calves were found to be on the threshold of severe stress from the fourth week of May (THI 79.00) onwards which could be attributed to elevating maximum relative humidity recorded (80 to 86 %) during the period. Since the animals were reared under semi-intensive system without the facility of wallowing, it could be conjectured

that they had to operate their physiological processes in accordance with the degree of stress they were subjected to.

Body temperature:

The body temperature of buffalo calves (Mean ± SE) recorded weekly for different months in Group I and Group II animals are presented in Table 1. During morning hours, the average body temperature of the experimental calves was found to be 100.4°F in pre-monsoon months as compared to 101.1°F in monsoon months. During evening hours, the average body temperature of the experimental calves was found to be 101.4°F in pre-monsoon months as compared to 102.2°F in monsoon months.The maximum rectal temperature of 103ºF was recorded in the evening hour during monsoon months. The rectal temperature was more during evening as compared to that in the morning for both pre-monsoon and monsoon months. The highest rectal temperature was recorded in the month of July and August. These observations were in agreement with the other workers [7] where maximum temperature was observed during evening hours of the monsoon period. Analysis of variance showed that there was significant difference (P<0.01) in body temperature between different months and between different times of the day in both the groups.

Table 1: Body temperature (Mean ± SE) of buffalo calves during different periods of experiment

Month	1st week				2nd week				3rd week				4th week			
	Group I		Group II		Group I		Group II		Group I		Group II		Group I		Group II	
	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E
March	100.4 ± 0.24$_{a}^{a}$	101.1 ± 0.25$_{a}^{b}$	100.6 ± 0.30$_{a}^{a}$	101.4 ± 0.24$_{a}^{b}$	100.6 ± 0.24$_{a}^{a}$	101.8 ± 0.20$_{b}^{b}$	100.6 ± 0.21$_{a}^{a}$	101.8 ± 0.31$_{b}^{b}$	100.8 ± 0.30$_{a}^{a}$	100.6 ± 0.41$_{a}^{a}$	101.0 ± 0.30$_{a}^{a}$	101.0 ± 0.29$_{ab}^{ab}$	100.4 ± 020$_{a}^{a}$	100.6 ± 0.30$_{b}^{b}$	101.4 ± 0.31$_{a}^{a}$	101.2 ± 0.29$_{a}^{a}$
April	100.2 ± 0.24$_{a}^{a}$	100.2 ± 0.30$_{a}^{a}$	100.4 ± 0.31$_{a}^{b}$	101.5 ± 0.29$_{a}^{a}$	101.4 ± 0.20$_{a}^{a}$	101.6 ± 0.41$^{a}_{a}$	101.5 ± 0.40$^{a}_{a}$	101.8 ± 0.28$_{b}^{a}$	101.4 ± 0.24$^{a}_{a}$	101.5 ± 0.21$_{a}^{a}$	101.0 ± 0.30$_{a}^{a}$	100.3 ± 0.31$_{b}^{b}$	100.3 ± 0.30$_{a}^{a}$	100.4 ± 0.20$^{a}_{a}$	101.2 ± 0.25$^{a}_{a}$	101.8 ± 0.30$_{b}^{a}$
May	100.4 ± 0.24$_{a}^{a}$	100.6 ± 0.25$_{a}^{a}$	100.4 ± 0.31$_{a}^{a}$	101.0 ± 0.30$_{b}^{a}$	101.2 ± 0.28$_{a}^{a}$	101.0 ± 0.20$_{b}^{a}$	101.0 ± 0.21$_{a}^{a}$	100.6 ± 0.30$^{a}_{b}$	100.0 ± 0.31$_{b}^{a}$	100.6 ± 0.41$^{a}_{a}$	100.4 ± 0.47$_{b}^{a}$	100.6 ± 0.37$_{a}^{a}$	100.6 ± 0.30$^{a}_{a}$	100.4 ± 0.25$_{a}^{a}$	100.6 ± 0.20$^{a}_{b}$	100.4 ± 0.21$_{a}^{a}$
June	100.3 ± 0.19$_{a}^{a}$	100.4 ± 0.18$_{a}^{a}$	100.2 ± 0.21$_{a}^{a}$	102.3 ± 0.29$_{b}^{a}$	100.2 ± 0.35$_{a}^{a}$	100.4 ± 0.24$^{a}_{a}$	100.4 ± 0.27$_{a}^{a}$	100.6 ± 0.40$_{a}^{a}$	100.2 ± 0.37$_{a}^{a}$	100.6 ± 0.25$_{a}^{a}$	101.1 ± 0.27$_{a}^{a}$	102.3 ± 0.30$_{b}^{b}$	101.3 ± 0.31$^{a}_{a}$	101.4 ± 0.30$_{a}^{a}$	101.3 ± 0.29$_{a}^{a}$	101.6 ± 0.27$_{b}^{a}$
July	100.4 ± 0.24$_{a}^{a}$	102.6 ± 0.26$_{a}^{b}$	101.2 ± 0.30$^{ab}_{ab}$	102.0 ± 0.40$_{a}^{b}$	100.3 ± 0.41$_{a}^{a}$	102.2 ± 0.29$_{a}^{b}$	101.3 ± 0.30$_{a}^{a}$	101.4 ± 0.31$^{a}_{b}$	101.4 ± 0.24$_{a}^{a}$	102.4 ± 0.26$_{a}^{b}$	101.2 ± 0.29$_{a}^{a}$	101.2 ± 0.31$_{a}^{a}$	100.3 ± 0.32$_{a}^{a}$	102.3 ± 0.30$_{b}^{b}$	100.2 ± 0.28$^{a}_{b}$	102.4 ± 0.27$_{a}^{b}$
August	101.4 ± 0.30$_{b}^{a}$	102.6 ± 0.31$_{a}^{b}$	101.4 ± 0.24$_{a}^{a}$	102.6 ± 0.27$_{b}^{a}$	100.2 ± 0.40$_{a}^{a}$	102.3 ± 0.30$_{a}^{b}$	101.2 ± 0.30$_{a}^{a}$	101.2 ± 0.29$^{a}_{b}$	101.4 ± 0.29$^{a}_{a}$	101.3 ± 0.30$_{a}^{a}$	101.3 ± 0.31$^{a}_{a}$	101.2 ± 0.30$^{a}_{b}$	101.1 ± 0.30$^{a}_{a}$	102.2 ± 0.24$_{b}^{b}$	100.1 ± 0.27$_{a}^{a}$	103.2 ± 0.30$_{b}^{b}$

Means having similar superscripts and subscripts do not differ significantly
Superscripts - Row wise
Subscripts- Column wise
M-Morning, E-Evening

Pulse rate:

The pulse rates (Mean ± SE) of the experimental buffalo calves being recorded weekly for different months in Group I and Group II animals are presented in Table 2. The pulse rate ranged from 55 to 62 per minute in the pre-monsoon months in comparision with to 57 to 65 per minute in the monsoon months. This might be due to variation of environmental temperature between morning and evening times and in different months. Analysis of variance showed that there was significant difference (P<0.05) between different months and between different times (P<0.01) in both the groups.

Table 2. Pulse rate (Mean ± SE) of group I and group II growing swamp buffalo calves during different periods of experiment

Month	1st week				2nd week				3rd week				4th week			
	Group I		Group II		Group I		Group II		Group I		Group II		Group I		Group II	
	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E
March	55.4 ± 0.60$_{a}^{a}$	51.0 ± 0.40$_{a}^{b}$	57.2 ± 0.30$_{a}^{a}$	60.2 ± 0.40$_{a}^{b}$	57.2 ± 0.40$_{a}^{a}$	60.6 ± 0.41$_{a}^{b}$	57.2 ± 0.37$_{a}^{a}$	60.2 ± 0.40$_{a}^{b}$	60.2 ± 0.47$_{a}^{a}$	60.0 ± 0.51$_{a}^{a}$	60.8 ± 0.52$_{a}^{a}$	57.8 ± 0.35$_{a}^{b}$	60.0 ± 0.51$_{a}^{a}$	60.8 ± 0.52$_{a}^{a}$	62.6 ± 0.40$_{a}^{a}$	57.8 ± 0.41$_{a}^{b}$
April	61.4 ± 0.40$_{b}^{a}$	58.6 ± 0.41$_{a}^{b}$	62.2 ± 0.41$_{b}^{a}$	58.8 ± 0.47$_{a}^{b}$	62.6 ± 0.50$_{b}^{a}$	57.8 ± 0.51$_{b}^{b}$	61.8 ± 0.52$_{b}^{a}$	61.6 ± 0.50$_{b}^{a}$	60.8 ± 0.60$_{a}^{a}$	60.4 ± 0.40$_{a}^{a}$	61.4 ± 0.41$_{a}^{a}$	59.2 ± 0.40$_{a}^{b}$	61.8 ± 0.41$_{b}^{a}$	61.4 ± 0.40$_{a}^{a}$	61.2 ± 0.37$_{ab}^{a}$	58.0 ± 0.40$_{a}^{b}$
May	62.2 ± 0.37$_{b}^{a}$	58.0 ± 0.40$_{a}^{b}$	62.4 ± 0.41$_{b}^{a}$	58.4 ± 0.40$_{a}^{b}$	58.2 ± 0.47$_{b}^{a}$	58.8 ± 0.51$_{b}^{a}$	62.4 ± 0.37$_{b}^{a}$	61.8 ± 0.30$_{b}^{a}$	63.0 ± 0.41$_{b}^{a}$	59.4 ± 0.40$_{ab}^{b}$	60.2 ± 0.51$_{a}^{a}$	59.8 ± 0.52$_{a}^{a}$	62.4 ± 0.50$_{b}^{a}$	58.4 ± 0.60$_{a}^{b}$	60.8 ± 0.61$_{b}^{a}$	58.2 ± 0.50$_{a}^{b}$
June	62.6 ± 0.31$_{b}^{a}$	58.2 ± 0.30$_{a}^{b}$	62.4 ± 0.40$_{b}^{a}$	58.4 ± 0.41$_{a}^{b}$	61.2 ± 0.45$_{b}^{a}$	60.0 ± 0.60$_{b}^{a}$	60.2 ± 0.50$_{b}^{a}$	58.2 ± 0.51$_{a}^{b}$	61.4 ± 0.41$_{a}^{a}$	58.6 ± 0.40$_{b}^{b}$	61.6 ± 0.41$_{a}^{a}$	61.2 ± 0.40$_{ab}^{a}$	61.6 ± 0.38$_{ab}^{a}$	58.2 ± 0.40$_{a}^{b}$	60.8 ± 0.41$_{b}^{a}$	58.6 ± 0.40$_{a}^{b}$
July	61.2 ± 0.32$_{b}^{a}$	58.0 ± 0.39$_{a}^{b}$	62.0 ± 0.40$_{b}^{a}$	58.4 ± 0.41$_{a}^{b}$	61.2 ± 0.50$_{b}^{a}$	58.4 ± 0.51$_{b}^{b}$	61.2 ± 0.37$_{b}^{a}$	58.0 ± 0.40$_{b}^{b}$	62.4 ± 0.42$_{ab}^{a}$	58.4 ± 0.51$_{b}^{b}$	61.8 ± 0.52$_{b}^{a}$	58.0 ± 0.56$_{b}^{b}$	61.8 ± 0.60$_{b}^{a}$	58.0 ± 0.60$_{a}^{b}$	61.8 ± 0.52$_{b}^{a}$	58.0 ± 0.51$_{a}^{b}$
August	61.2 ± 0.30$_{b}^{a}$	57.2 ± 0.47$_{a}^{b}$	60.0 ± 0.48$_{b}^{a}$	57.4 ± 0.50$_{a}^{b}$	61.2 ± 0.50$_{b}^{a}$	57.8 ± 0.50$_{b}^{b}$	58.8 ± 0.51$_{a}^{a}$	58.0 ± 0.50$_{a}^{a}$	61.4 ± 0.40$_{a}^{a}$	59.4 ± 0.41$_{ab}^{b}$	60.2 ± 0.41$_{a}^{a}$	60.1 ± 0.40$_{b}^{a}$	61.4 ± 0.41$_{b}^{a}$	58.3 ± 0.41$_{a}^{b}$	61.2 ± 0.41$_{ab}^{a}$	60.0 ± 0.51$_{b}^{b}$

Means having similar superscripts and subscripts do not differ significantly .
Superscripts - Row wise
Subscripts – Column wise

Respiration rate:

The respiration rate (Mean ± SE) of buffalo calves recorded weekly for different months in Group I and Group II animals are presented in Table 3. The lowest mean respiration rate was recorded as 17.0 ± 0.31 and the highest mean respiration rate was found to be 18.8 ± 0.41 per minute in the pre-monsoon months. The recorded respiration rates for the monsoon months were almost similar to that observed in the pre-monsoon months. Analysis of variance showed that there was significant difference in respiration rate ($P<0.01$) between morning and evening times in both the groups which were in agreement with the other workers[7]. In non-sweating species like buffaloes the only mechanism of dissipating of body heat is through acceleration of respiration. It was found that the variation in the respiration rate due to the change in the atmospheric temperature could be utilized suitably to measure the heat tolerance capacity of the animals. A marked increase in respiration rate during monsoon season when the environmental temperature exceeded the critical limit was an indication that the animals were under thermal stress. However, due to variation in temperature when during nights were comparatively cooler, the heat load was not continuous and so the animals were not disturbed physiologically. Greater variation in the respiration rate due to rise in the environmental temperature in any breed or species could be considered as an inferior adaptation or acclimatization under existing regional climatic conditions.

TABLE 3: RESPIRATION RATE (MEAN ± SE) OF GROUP I AND GROUP II GROWING BUFFALO CALVES DURING DIFFERENT PERIODS OF EXPERIMENT

Month	1st week				2nd week				3rd week				4th week			
	Group I		Group II		Group I		Group II		Group I		Group II		Group I		Group II	
	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E
March	17.2 ± 0.37^a	17.6 ± 0.31^a	17.2 ± 0.30^a	18 .1 ± 0.31^b	17.2 ± 0.31^a	17.6 ± 0.37^a	17.2 ± 0.30^a	18 ± 0.31^b	17.4 ± 0.40^a	18.6 ± 0.30^b	18.4 ± 0.37^a	18.6 ± 0.30^a	17 ± 0.31^a	17.8 ± 0.30^a	17.2 ± 0.36^a	18.6 ± 0.37^b
April	17.6 ± 0.40^a	18.8 ± 0.41^b	18 ± 0.37^a	19.6 ± 0.31^b	17.2 ± 0.30^a	18.0 ± 0.31^b	17.4 ± 0.32^a	19.0 ± 0.29^b	18.6 ± 0.30^a	19.2 ± 0.31^b	17.2 ± 0.37^a	18.6 ± 0.30^b	17.2 ± 0.30^a	18.4 ± 0.31^b	17.8 ± 0.32^a	18.2 ± 0.35^a
May	17.2 ± 0.30^a	18.2 ± 0.31^b	17.2 ± 0.32^a	18.4 ± 0.33^b	17.8 ± 0.34^a	18.8 ± 0.35^b	17.2 ± 0.36^a	18.4 ± 0.37^b	18.4 ± 0.40^a	18.8 ± 0.41^a	17.8 ± 0.40^a	18.2 ± 0.41^b	17.2 ± 0.40^a	18.4 ± 0.41^b	17.2 ± 0.37^a	18.0 ± 0.36^b
June	17.4 ± 0.30^a	17.6 ± 0.31^a	17.2 ± 0.37^a	18.4 ± 0.40^b	17.2 ± 0.41^a	17.6 ± 0.40^a	17.6 ± 0.41^a	17.8 ± 0.31^a	17.2 ± 0.30^a	18.0 ± 0.30^b	16.8 ± 0.29^a	18.2 ± 0.28^b	16.8 ± 0.29^a	18.2 ± 0.30^b	18.0 ± 0.32^a	18.2 ± 0.30^a
July	17.6 ± 0.32^a	18.8 ± 0.30^b	17.2 ± 0.30^a	18.4 ± 0.29^b	17.2 ± 0.27^a	18.4 ± 0.30^b	17.6 ± 0.31^a	18.8 ± 0.30^b	17.2 ± 0.31^a	18.4 ± 0.39^b	17.2 ± 0.27^a	18.0 ± 0.31^b	17.2 ± 0.32^a	18.0 ± 0.29^b	17.4 ± 0.28^a	18.0 ± 0.30^b
August	17.2 ± 0.31^a	18.0 ± 0.30^b	17.2 ± 0.31^a	18.4 ± 0.35^b	17.4 ± 0.40^a	17.6 ± 0.41^a	17.6 ± 0.42^a	18.8 ± 0.35^b	17.2 ± 0.29^a	18.0 ± 0.29^b	17.8 ± 0.30^a	18.2 ± 0.31^b	16.8 ± 0.30^a	18.2 ± 0.31^b	18.0 ± 0.30^a	17.4 ± 0.39^b

Means having similar superscripts do not differ significantly
Superscripts - Row wise

CONCLUSION

The average Temperature humidity index (THI) in 10 swamp buffalo calves aged 6 to 18 months ranged from 74.72 to 78.55 during the period March to August. In the present experiment it was found that there was an increasing trend of physiological parameters with increasing temperature humidity index. Therefore, the stress level for the animals also increases with the advancement of environmental temperature. The figures were indicative to suggest that the animals suffered from thermal stress and grew amidst decreased thermal adaptability and reduced heat tolerance efficiency.

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