RESEARCH ARTICLE

Adaptability in Buffaloes during Spring and Summer Seasons in Eastern Plane Zone of Uttar Pradesh, India

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Abstract

Adaptability of buffaloes during spring and summer seasons in three districts of eastern plane zone of Uttar Pradesh was studied by different Heat tolerance indices like Ibrea heat tolerance coefficient (IHTC), Gaalaas heat tolerance test, Benezara coefficient of adaptability and Dairy search index. All parameters of heat tolerance indices were calculated by using different physiological parameters like rectal temperature, pulse rate and respiration rate. Temperature humidity index (THI) of all three districts was also calculated by using dry bulb temperature and humidity. There was a significant ($p < 0.01$) difference in THI values in spring and summer seasons in all three districts. The IHTC values and Gaalaas values of buffaloes during spring season were nearer to 100 in comparison to summer season. Overall Means ± SEM of Benezara coefficient of adaptability and Dairy search index were more closure to 2 and 1, respectively, in spring season and summer season, and animals showed more adaptability in spring season in comparison to summer season.

Keywords: Adaptability, Dairy Search Index, Murrah buffaloes, Temperature Humidity Index.

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Introduction

Buffalo (*Bubalus bubalis*) is known as the world's second most important milch animal because it shares more than 95% of the milk produced in South Asia (Javaid *et al.,* 2009). Buffaloes have poor heat tolerance capacity compared to other domestic ruminants due to scarce sweat glands, sparse hair on body surface and black skin which easily absorbs heat. Therefore, they are more prone to heat stress and exhibit signs of distress when exposed to hot environmental conditions (Bombade *et al*., 2017) including loss of productive efficiency (Upadhyay *et al*., 2010). Environmental temperature at which an animal's body is at equilibrium, *i.e.,* neither gains nor loses heat, is called Thermo Neutral Zone (TNZ). During the extreme hot humid or hot dry weather, this thermoregulatory capability of buffalo to dissipate heat by sweating and panting is compromised, and heat stress occurs.

Exposure of buffaloes to the hot conditions causes a series of changes in the physiological functions that include decrease in feed intake efficiency and utilization, disturbances in metabolism of water, protein, energy and mineral balances, enzymatic reactions, hormonal secretions, and blood metabolites. Such changes result in impairment of reproduction and productive performances (Das *et al.,* 2014). A better understanding of the alteration in the buffalo's physiology during extreme environmental conditions can help in preventing heat stress-related economic loss and improving their welfare. To our knowledge, there are very few studies conducted on buffaloes related to heat tolerance in the region mentioned. Therefore, this study was conducted to explore the variation in physiological responses and adaptability of buffaloes during spring and summer seasons in eastern plane zone of Uttar Pradesh.

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Materials and Methods

The study was conducted on randomly selected eighteen lactating Murrah buffaloes (6 per district) following approval of Institutional animal ethics committee vide letter no.-IAEC/CVSc/P-10/2020. The age of buffaloes was between 6 and 10 year and body weight 450-600 kg. The experiment was conducted during the year 2021 in spring (March) and summer (June) seasons on six buffaloes each at three districts, *viz.,* Ayodhya, Mau and Bhadohi of Eastern plane zone of Uttar Pradesh. All the climatic variables were recorded twice daily at 7:30 am to 2:30 pm in both the seasons. The buffaloes

were maintained under standard managemental condition at Livestock Farm Complex of the College at Kumarganj, Ayodhya and also at different private dairy farms/field conditions of Mau and Bhadohi districts.

The physiological parameter like rectal temperature, pulse rate and respiration rate were recorded at weekly interval during the study period in spring and summer seasons. Meteorological parameters like maximum and minimum environmental temperature and relative humidity were recorded in both seasons. To evaluate heat tolerance capacity of animals the following tests were applied.

Iberia Heat Tolerance Test (IHTC, Rhoad 1944)

$$HTC = 100\text{-}10\ (RT\text{-}101)$$

HTC= Heat Tolerance Coefficient

RT= Average rectal temperature of six reading.

101° F= Average temperature of cattle

Interpretation: If the calculated value of test is nearer to 100 then the particular animal is more heat tolerant than others. When the two particular animals have the same heat tolerance coefficient, than the animal, which has higher respiration rate is less heat tolerant.

Gaalaa's heat tolerance test (Gaalaas, 1947)

Gaalaa's heat tolerance coefficient = 100-14 (RT-101)

Interpretation of results is similar to Iberia heat tolerance test.

Benezara's coefficient of adaptability (BCA, Benezara 1954)

$$BCA = \frac{RT}{38.33} + \frac{RR}{23}$$

Where, RT= Rectal temperature RR= Respiration rate/min.

38.33= Normal RT (°C) 23= Normal RR/min.

Interpretation: A calculated value of 2 shows maximum adaptability and values over 2 indicate a state of lower adaptability.

Dairy search index (DSI, Thomas *et al*. 1973)

$$\frac{0.5\ X_1}{X} + \frac{0.3\ Y_1}{Y} + \frac{0.2\ Z_1}{Z}$$

Where: X_1, Y_1 and Z_1 are rectal temperature, pulse rate and respiration rate after exposure and X, Y and Z the same parameters before exposure, respectively.

Interpretation: If calculated value is nearer to 1 then the animal is more heat tolerant than the animal deviating more from one.

Temperature Humidity Index (THI) was calculated by the formula (National Research Council, 1971)

$$THI = (1.8XTdb + 32) - (0.55 - 0.0055\ X\ RH)\ X\ ((1.8\ X\ Tdb - 26)$$

Where, Tdb= dry bulb temperature in Celsius, RH= Relative humidity

Statistical analysis of data was conducted to find the mean ± SE. Paired 't' test was done to find significant differences between groups and their interaction by using Prism-5 software. The correlations among the various parameters were also calculated (Snedecor and Cochran, 2004).

Results and Discussion

Different physiological parameters, heat tolerance indices were estimated during experiment. The mean values of THI calculated during spring and summer seasons of three districts are presented in Table 1. The THI values of summer were higher than the spring season, which concurred well with the earlier observations of Li *et al.* (2020).

The results of Iberia heat tolerance coefficient during spring and summer seasons in Murrah buffaloes are presented in Table 2. Iberia heat tolerance indices (IHTC) values were significantly ($p < 0.01$) higher in spring season as compared to summer season in all the three districts. An IHTC value nearer to 100 indicates better adaptability (Mandal and Tyagi, 2008). In the present investigation IHTC values of buffaloes during spring season were nearer to 100 in comparison to summer season, thus thermo-adaptability of buffaloes was better in spring season in comparison to summer season. Our observations agree with Mandal and Tyagi (2008).

The values of Gaalaas heat tolerance coefficient (GHTC) of buffaloes during spring and summer seasons presented in Table 2 revealed significantly ($P < 0.01$) higher values in spring season as compared to summer season in all the three districts. However, there was not any appreciable variation in weekly values of IHTC or GHTC (Table 2). The Gaalaas value nearer to 100 indicates better adaptability (Gaalaas, 1947). In the present investigation Gaalaas values of buffaloes during spring season was nearer to 100 as compared to summer season. Hence, the thermo-adaptability of buffaloes was better in spring season than in summer season.

The values of Benezara coefficient of adaptability (BCA) are presented in Table 3. The value of BCA nearer to 2 indicates better thermal-adaptability (Mandal and Tyagi, 2008). In our study, BCA value of buffaloes was nearer to 2 in spring season as compared to summer season in all three districts of Uttar Pradesh. This indicates thermo-adaptability of buffaloes during spring season is better in comparison to summer season. Our findings concurred with those of Mandal and Tyagi (2008), who reported less adaptability of bulls during summer season in comparison to other seasons.

The values of Dairy search index (DSI) presented in Table 3 are identical in all three districts in both the season with higher values in summer than spring. Similarly, the weekly values of BCA or GHTC during spring were identical in all three

Table 1: Mean (± SE) THI during spring and summer season in Ayodhya, Bhadohi and Mau district of Uttar Pradesh

THI	*Ayodhya*	*Bhadohi*	*Mau*
Spring (March)	78.21 ± 0.86	79.62 ± 0.96	77.39 ± 0.70
Summer (June)	83.98 ± 0.44	85.28 ± 1.12	83.07 ± 1.28

Table 2: Mean (± SE) Iberia Heat Tolerance Coefficient and Gaalaa's Heat Tolerance Coefficient during spring and summer season in buffaloes in Ayodhya, Mau and Bhadohi district of Uttar Pradesh

		Iberia Heat Tolerance Coefficient		*Gaalaa's Heat Tolerance Coefficient*	
District	*Week*	*Spring*	*Summer*	*Spring*	*Summer*
Ayodhya	First	96.17 ± 0.60	95.33 ± 0.49	94.63 ± 0.84	93.47 ± 0.69
	Second	95.33 ± 1.12	94.83 ± 1.38	94.40 ± 1.91	92.77 ± 1.93
	Third	97.33 ± 0.21	96.00 ± 0.37	96.27 ± 0.30	94.40 ± 0.51
	Fourth	96.33 ± 1.20	95.33 ± 0.42	94.87 ± 1.68	93.47 ± 0.59
	Mean ± SEM	96.29^{a} ± 0.78	95.38^{b} ± 0.66	95.04^{a} ± 1.18	93.53^{b} ± 0.93
Mau	First	96.00 ± 1.10	95.33 ± 0.42	94.40 ± 1.53	93.47 ± 0.59
	Second	96.50 ± 1.36	96.00 ± 0.37	95.10 ± 1.90	94.40 ± 0.51
	Third	97.17 ± 0.54	94.83 ± 1.38	96.03 ± 0.76	92.77 ± 1.93
	Fourth	96.83 ± 0.79	95.33 ± 0.49	95.57 ± 1.11	93.47 ± 0.69
	Mean ± SEM	96.63^{a} ± 0.95	95.38^{b} ± 0.66	95.28^{a} ± 1.33	93.53^{b} ± 0.93
Bhadohi	First	97.17 ± 0.54	95.33 ± 0.49	96.03 ± 0.76	93.47 ± 0.69
	Second	97.33 ± 0.67	95.50 ± 0.96	96.27 ± 0.93	93.70 ± 1.34
	Third	97.67 ± 0.33	96.00 ± 0.37	96.73 ± 0.47	94.40 ± 0.51
	Fourth	96.33 ± 1.20	95.33 ± 0.42	94.87 ± 1.68	93.47 ± 0.59
	Mean ± SEM	97.13^{a} ± 0.69	95.54^{b} ± 0.56	95.98^{a} ± 0.96	93.76^{b} ± 0.78

Notes: Means bearing different superscripts differ significantly ($P < 0.01$).

Table 3: Mean (± SE) Benezara Coefficient of Adaptability and Dairy Search Index during spring and summer season in buffaloes in Ayodhya, Mau and Bhadohi district of Uttar Pradesh

		Benezara Coefficient of Adaptability		*Dairy Search Index*	
District	*Week*	*Spring*	*Summer*	*Spring*	*Summer*
Ayodhya	First	1.97 ± 0.01	2.06 ± 0.01	1.03 ± 0.003	1.06 ± 0.003
	Second	1.98 ± 0.01	2.09 ± 0.02	1.03 ± 0.003	1.08 ± 0.005
	Third	1.98 ± 0.01	2.11 ± 0.02	1.03 ± 0.003	1.09 ± 0.007
	Fourth	1.98 ± 0.01	2.17 ± 0.02	1.03 ± 0.003	1.10 ± 0.004
	Mean ± SEM	1.98^{a} ± 0.01	2.11^{b} ± 0.02	1.03^{a} ± 0.003	1.08^{b} ± 0.005
Mau	First	1.98 ± 0.01	2.06 ± 0.01	1.03 ± 0.003	1.06 ± 0.002
	Second	1.98 ± 0.01	2.09 ± 0.02	1.03 ± 0.003	1.08 ± 0.005
	Third	1.95 ± 0.02	2.12 ± 0.03	1.02 ± 0.003	1.09 ± 0.007
	Fourth	1.97 ± 0.01	2.17 ± 0.02	1.02 ± 0.003	1.10 ± 0.004
	Mean ± SEM	1.97^{a} ± 0.01	2.11^{b} ± 0.02	1.03^{a} ± 0.003	1.08^{b} ± 0.005
Bhadohi	First	1.97 ± 0.01	2.17 ± 0.02	1.03 ± 0.002	1.08 ± 0.005
	Second	1.99 ± 0.01	2.12 ± 0.03	1.03 ± 0.003	1.09 ± 0.010
	Third	1.96 ± 0.02	2.09 ± 0.02	1.02 ± 0.003	1.08 ± 0.007
	Fourth	1.98 ± 0.01	2.06 ± 0.01	1.03 ± 0.002	1.07 ± 0.003
	Mean ± SEM	1.98^{a} ± 0.01	2.11^{b} ± 0.02	1.03^{a} ± 0.003	1.08^{b} ± 0.007

Notes: Means bearing different superscripts differ significantly ($P < 0.01$).

districts, but the values in summer season showed ascending trend in Ayodhya and Mau, while decreasing trend in Bhadohi district (Table 3). The value of DSI nearer to 1 indicates better thermo-adaptability (Mandal and Tyagi, 2008). In our study, the DSI value of buffaloes is nearer to 1 in spring season as compared to summer season in all the three districts. This indicates thermo-adaptability of buffaloes during spring season is better in comparison to summer season, and agreement with the findings of Yousef (1985) and Mandal and Tyagi (2008).

Conclusion

The THI value of summer was higher than the spring season. Rectal temperature, pulse rate and respiration rate of buffaloes were higher in summer season in comparison to spring season. Heat tolerance capacity of animals studied

by Iberia heat tolerance coefficient, Gaalaas heat tolerance coefficient, Benezara coefficient of adaptability and Dairy search index indicated better thermo-adaptability of buffaloes during spring season as compared to summer season. It can be concluded that heat stress has unfavorable effect on adaptability of buffaloes.

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References

Benezara, M.V. (1954). A new index for measuring the adaptability of cattle to tropical conditions. *Journal of Animal Science*, *13,* 1015.

Bombade, K., Kambo,j A., Alhussien, M.N., Mohanty, A.K., & Dang, A.K. (2017). Diurnal variation of milk somatic and differential leukocyte counts of Murrah buffaloes as influenced by different milk fractions, seasons and parities. *Biological Rhythm Research, 49*(1), 151-163.

Das, K.S., Singh, J., Singh, G., Upadhyay, R., Malik, R., & Oberoi P. (2014). Heat stress alleviation in lactating buffaloes: effect on physiological response, metabolic hormone, milk production and composition. *Indian Journal of Animal Science*, *84*(3), 375-380.

Gaalaas, R.F. (1947). Study of heat tolerance in Jersey cows. *Journal of Dairy Science, 30,* 79.

Javaid, S.B., Gadahi, J.A., Khaskeli. M., Bhutto, M.B., Kumbher, S., & Panhwar, A.H. (2009). Physical and chemical quality of market milk sold at Tandojam, Pakistan. *Pakistan Veterinary Journal, 29*(1), 27-31.

Li, M., Hassan, F.U., Guo, Y., Tang, Z., Liang, X., Xie, F., Peng, L., & Yang, C. (2020). Seasonal dynamics of physiological, oxidative and metabolic responses in nonlactating Nili-Ravi buffaloes under hot and humid climate. *Frontiers in Veterinary Science 7,* 622.

Mandal, D.K., & Tyagi, S. (2008). Studies on thermoadaptability in Frieswal bulls. *Indian Veterinary Journal*, *85,* 864-868.

National Research Council (1971). A guide to environmental research on animals. *National Academy of Science*, Washington, DC, USA.

Rohad, A.O. (1944). The Iberia Heat Tolerance Test for cattle. *Tropical Agriculture*, *21*(9), 162-164.

Snedecor, G.W., & Cochran, W.G. (2004). *Statistical Methods*, 7th edn. Oxford & IBH Publishing Company, New Delhi, India.

Thomas, C.K., Sharma, K.N.S., Razdan, M.N., & Georgie, G.C. (1973). A new heat tolerance index for cattle. *Indian Journal of Animal Science*, *43*, 505.

Upadhyay, R.C., Singh, S.V., Kumar, A., Gupta, S.K., & Ashutosh, A. (2010). Impact of climate change on milk production of Murrah buffaloes. *Italian Journal of Animal Science, 6*, 1329-1332.

Yousef, M. (1985). Thermal environment. In: *Volume 1: Stress Physiology in Livestock. Basic Principles,* Florida: CRC Press, Inc, pp.9-14.

ANNOUNCEMENT: SVSBT-NS-2022

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