Int.J.Curr.Microbiol.App.Sci (2021) *10*(04): 252-256

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 10 Number 04 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1004.025

Effect of season on milk production in Murrah Buffaloes: THI a proven marker

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Keywords

Buffaloes; THI; environmental stress; season and milk production

Article Info

Accepted:
12 March 2021
Available Online:
10 April 2021

A B S T R A C T

Thermal stress is of concern for all livestock production systems and its effects have been studied because of the negative impact on production, health and even mortality. Exposure to high ambient temperature is the major constraint on buffalo productivity in hot climatic areas. Hence, the milk productivity is focused in the present study to relate animal stress with productivity of buffaloes. Eight adult female Murrah buffaloes of almost same age and parity were selected in summer and winter season. Metereological variables such as ambient temperature, relative humidity and THI were calculated in summer and winter season. Simultaneously milk production was also recorded in both the seasons. There was a significant increase ($p<0.05$) in temperature, humidity and THI in summer compared to winter. From the present study it was concluded that THI is a proven marker that increases during summer and imposed thermal stress in Murrah buffaloes as evidenced by significantly reduced milk production. Hence, additional feed, shelter and management practices might be adopted to overcome the negative effects of thermal stress and also to optimize milk production of the animals.

Introduction

Buffaloes contribute significantly to Indian GDP with 49% of total milk in India. Although buffaloes have not been considered as seasonal breeders but they do show seasonality in breeding and calving, which reduced milk production ultimately in summer (Himadri, 2007). Milk production is affected by a number of factors like genetic potentiality, age, number of previous lactations, pregnancy, season of calving, calving interval and nutrition status (Bernabucci *et al*., 2002). Among all the factors, the season of calving is said to have marked effect on total production (Pawar *et*

al., 2012). The increase in environmental temperature decreases the milk production during summer. High heat load in lactating buffaloes reduced milk production and has shortened duration of lactation periods (Upadhyay *et al*., 2007). Heat load and intensity of heat stress can be measured by simple indices such as THI.

Temperature is not the only factor of environment that profoundly affects the intensity of heat stress (Nilufar, 2015). The temperature humidity index (THI) measures the combined effects of ambient temperature (AT) and relative humidity (RH) to ascertain the intensity of heat load. The THI is the best, simplest and most practical index to measure the level of heat stress in dairy cattle (Grewal *et al.,* 2019). THI not only measures heat stress but also determines the impact of heat stress on animal productivity. THI is negatively correlated with milk production and reproduction traits in animals. Milk production was not affected when THI values are between 35 and 72, while a rise in THI from 72 to 76 resulted in sharp decline in milk production (Johnson, 1963). The information pertaining to the effect of climate change on milk production of Murrah buffaloes is scanty. Hence in the present study, the milk production of the animals has been taken into account to find the effect of environmental stress during different seasons.

Materials and Methods

Eight Murrah buffaloes in advanced pregnancy near to parturition of four to six years of age were randomly selected from Livestock Farm Complex, NTR College of Veterinary Science and a local farm in Gannavaram. The animals were kept in shed with appropriate facilities for feeding and watering. The animals were fed as per ICAR feeding standards (Ranjhan, 1998) with concentrates and roughage stall fed.

Meteorological data

The experiment was conducted at different days in the month of April -June (summer) and November-January (winter). The meteorological data was recorded daily throughout the experimental period. Temperature humidity index (THI) was calculated using the equation, THI = (0.8 X T_{db}) + [(RH/100) X T_{db}-14.4] + 46.4 (T_{db}= temperature of dry bulb, RH= relative humidity) (Mader *et al.,* 2006) from daily recordings of AT and RH.

$$THI = 0.72 (T_{db} + T_{wb}) + 40.6$$

Where, T_{db} = dry bulb temperature (ºC) T_{wb} = wet bulb temperature (ºC)

Milk Production

The buffaloes were hand milked daily and the milk production was recorded both in the morning and evening from day of parturition to three weeks post calving.

Statistical analysis

The average mean values of the two groups were compared using unpaired t-test (Snedecor and Cochran, 1994). The whole data was analyzed using computerized software programme SPSS Ver.20.0.

Results and Discussion

The mean of milk production in both the seasons studied has been mentioned in Table 1. The mean of meteorological parameters, for the seasons studied has been mentioned in the Table 2 and 3. Significant difference ($p<0.05$) was evident in minimum, maximum and mean THI of both the seasons.

The present study recorded significantly higher milk production (L/day) during winter ($p<0.05$) (6.77±0.44) compared to summer

(4.66±0.15) season as evidenced in Table 1. The present findings were consistent with the earlier results reported by Catillo *et al.,* (2002); Ahmad and Shafiq (2002); Afzal *et al.,* (2007); Upadhyay *et al.,* (2007) and Pawar *et al.,* (2012) in buffaloes. Parallel to the present findings decreased milk production during summer was also reported in cattle by Bajwa *et al.,* (2004) and Akcay *et al.,* (2007).

Decline in milk yield as a direct result of high environmental temperatures was evidenced by Marai *et al.,* (2009). Lactating buffaloes under heat stress have increased reliance on glucose as a fuel source. Heat-stressed buffaloes seem to change their metabolism to preserve glucose for extra-mammary tissues, at the expense of milk lactose synthesis. Despite having a much greater energy content, oxidizing fatty acids generates more metabolic heat (~2 kcal/g or 13 % on an energetic basis) compared to glucose. Heat stressed animal become hypersensitive to insulin, and will reduce or block adipose mobilisation and increase glucose 'burning' in an attempt to minimise metabolic heat production. This diverts glucose from mammary tissue to other body tissues and reduces glucose supply to the mammary gland for lactose production leading to reduced milk yield. This may be the primary mechanism for reduction in milk yield during summer (Baumgard *et al.*, 2006).

Table.1 Showing comparison of milk production in different seasons under study

Parameters	Season	Mean
Milk Production (L/day)	**Summer**	**4.66^{B}±0.15**
	Winter	**6.77^{A}±0.44**

Table.2 Comparison of THI in different seasons under study

Parameters	Season	Minimum	Maximum	Mean
THI	**Summer**	66.63^{Ab}±1.79	93.05^{Aa}±0.98	**80.38^{A}±1.11**
	Winter	**59.21^{Bb}±1.95**	**83.06^{Aa}±2.08**	**71.03^{B}±1.17**

Table.3 Depicting the mean of Meteorological parameters recorded during the seasons studied Summer (April –June) and Winter (November –January)

Season	MONTH	Tmax 0 (C)	Tmin 0 (C)	RHmax (%)	RHmin (%)	THI_{max}	THI_{min}	Mean THI
Summer (April –June)	April, 2019	38.91	26.03	74.43	46.00	92.07	64.83	**78.45**
	May, 2019	41.26	28.35	70.7	48.49	94.03	68.41	**81.22**
	June, 2019	39.48	28.8	65.2	51.30	89.25	69.74	**79.500**
		39.88	27.72	70.11	48.60	93±0.98	66.6±1.7	**80.3±1.1**
Winter (November – January)	November, 2018	35.47	24.1	82.2	54.43	85.14	61.15	**73.14**
	December, 2018	32.49	21.17	83.5	57.39	80.98	57.25	**69.11**
	January, 2019	29.41	18.46	86.54	56.54	89.36	64.48	**76.97**
		32.45	**21.24**	**84.08**	**56.12**	**83±2.0**	**59.2±1.9**	**71±1.1**

The effect of environment on the health and productivity of the animals is well evidenced in different species of animals. The mean THI in the present study was recorded >80 units that significantly affected the milk production. Hence, necessary microclimatic alterations are necessary to mitigate effects of the higher THI for optimum production and reproduction in buffaloes. Hence, nutritional and summer managemental strategies need to be adopted to ameliorate additive effects of summer stress during transition period for optimum production and well being of dairy buffaloes.

Acknowledgements

This work was done as part of Ph.D. programme. The authors are greatly thankful to Sri Venkateswara Veterinary University. We thankfully recognize the accessibility of the necessary facilities provided by NTR College of Veterinary Sciences, Gannavaram, is duly acknowledged.

Conflict of Interest

The authors declare that there is no any conflict of interest for this manuscript.

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How to cite this article:

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doi: https://doi.org/10.20546/ijcmas.2021.1004.025