RESEARCH ARTICLE
Open Access

Journal of Veterinary and Animal Sciences
ISSN (Print): 0971-0701, (Online): 2582-0605
https://doi.org/10.51966/jvas.2022.53.1.89-93

Effect of seasonal variation in Temperature Humidity Index on milk production and its composition in Murrah buffaloes

U. P. V. Kalyan[1], S. K. I. Vasantha[2*] and J. Nikhil Kumar Tej[2]
Dept of Veterinary Physiology
NTR College of Veterinary Science, Gannavaram -521102
Sri Venkateswara Veterinary University, Tirupati

Citation: Kalyan, U.P.V., Vasantha, S. K. I. and Tej, J.N.K. 2022. Effect of seasonal variation in Temperature Humidity Index on milk production and its composition in Murrah buffaloes. *J. Vet. Anim. Sci.* **53**(1): 89-93
DOI: https://doi.org/10.51966/jvas.2022.53.1.89-93

Received: 09.08.2021 *Accepted: 15.11.2021* *Published: 31.03.2022*

Abstract

The present study was aimed to evaluate the effect of seasonal variation in Temperature Humidity Index (THI) on milk production and composition in Murrah buffaloes. Eight adult lactating Murrah buffaloes of 3-5 years of age and in second to fourth lactation were selected in summer and winter season. Meteorological variables such as ambient temperature and relative humidity were recorded and THI was calculated during the period of study. Milk samples were collected from Murrah buffaloes and evaluated for the concentration of milk fat, protein, SNF, lactose and salt. The data was analyzed using SPSS v.20. The results indicated that average milk production, milk fat, protein and SNF decreased significantly (p<0.05) in summer in comparison to winter, while lactose and salt did not differ significantly (p>0.05) in between seasons. From the present study it was concluded that high THI imposes significant heat stress and negatively affects milk production and composition in Murrah buffaloes. 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.

Keywords*: Milk, buffaloes, lactose, seasonal stress, THI*

Dairying in India is of paramount importance particularly through supporting rural livelihood with milk, dung and draft power (Dash, 2010). Within the livestock sector, buffalo population occupies special ecological niche as they contribute significantly to Indian GDP with 49 per cent of total milk in India (Livestock census, 2019). There are numerous factors that influence milk production like genetic potentiality, age, number of previous lactations and pregnancy. The calving season and interval along with nutrition status and disease management are also equally important factors affecting the same (Bernabucci *et al*., 2002). Among all such factors that are

1. *V BVSc& AH, NTR College of Veterinary Science, Gannavaram, A.P*
2. *Assistant Professor*
** Corresponding author::vasuinjarapu@gmail.com, Ph : +918897094734*

said to affect milk production, the season of calving is reported to have marked effect (Pawar *et al*., 2012). The high environmental temperatures negatively affect milk production and composition in lactating buffaloes (Singh *et al*., 2005; El-Khashab, 2010; Vasantha *et al.,* 2021). The nutrient availability in a season along with lactational stage also play a crucial role and subsequently affect the milk products' quality (Ravikala *et al.,* 2014). There is a negative correlation between environmental temperature and the amount of milk fat and protein (Ozrenk and Sebnem, 2008). Moreover, lactating buffaloes under high heat load have reduced milk production and shortened lactation length (Upadhyay *et al*., 2007).

The intensity of seasonal stress can be measured by temperature humidity index (THI). It is a combined effect of ambient temperature (AT) and relative humidity (RH) that represents heat load intensity. This method to measure the intensity of heat stress in dairy cattle is considered to be the best practical one (Grewal *et al.,* 2019). It also determines the impact of seasonal stress on animal productivity. The effect of THI on Milk production was nil when THI was between 35-72, while it significantly reduced when THI was 72-76 (Johnson *et al.,* 1963). Previous studies reported significant effect of season on milk production (Ahmad *et al.,* 2013; Claeys *et al.,* 2014; Patbhandha *et al.,* 2015). However, the information pertaining to the effect of season on milk constituents of Murrah buffaloes of the hot and humid tropics of Andhra Pradesh is scanty. Hence in the present study, the seasonal effect (summer *vs* winter) on milk production and its constituents of lactating Murrah buffaloes has been studied.

Materials and methods

Eight lactating Murrah buffaloes of 3-5 years of age in second to fourthlactation in a local farm at Tanuku, East Godavari, Andhra Pradesh were selected for the study. The animals were kept in shed with appropriate facilities for feeding and watering with floor space of 8 m^2 open area and 4 m^2 closed area per animal. The animals were stall fed with concentrates and roughage as per ICAR feeding standards (Ranjhan, 1998).

Recording of meteorological data

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

Milk collection and evaluation

Milk samples were collected for 30 days each in summer and winter season. The average milk production was also recorded in each season. The samples were analyzed for fat concentration SNF, protein, lactose and salt by Lacto sure ECO milk analyzer (LSE ECO).

Statistical analysis

The data obtained on various parameters were depicted as mean ± SE. The difference between groups was compared using unpaired t-test (Snedecor and Cochran, 1967). The entire data was analyzed using computerized software programme SPSS Ver.20.0.

Results and discussion

The meteorological data recorded during summer and winter seasons are shown in Table 1. The mean THI recorded in summer and winter was found to be 81 and 78 respectively. Based on the THI index, (Helal *et al.*, 2010) a THI of 74 or less is considered as normal, 75-78 as alert, 79-83 as danger and 84 and above as an emergency. According to Payne (1990), THI values more than 72 is stressful, while THI above 78 indicated severe heat stress to buffaloes, while THI values higher than 80 units have been classified in danger zone with regard to the well-being and productivity of cattle (Segnalini *et al.,* 2013). The animals of our study in both the seasons were in danger zone. The increase in THI from winter to summer is indicative that the buffaloes were under severe heat stress in summer compared to winter. Wide variation in the minimum and maximum THI of summer and

Table 1. Mean ± SE values of meteorological parameters during and summer and winter seasons (n=30)

Season of study	T_{max}	T_{min}	RH_{max}	RH_{min}	THI_{max}	THI_{min}	THI_{avg}
Summer (May)	41.16	28.35	70.70	48.49	94.03	68.41	81.22
Winter (January)	32.42	24.87	84.77	81.29	85.38	72.11	78.74

winter is evident from the results as indicated in Table 1. This might be the probable reason for the change in physiological responses between the seasons under study. The present findings were in agreement with the reports of Vasantha *et al*. (2021) where summer THI is extremely higher than winter. The difference in the means of milk production between seasons has been depicted in Fig. 1. The present study recorded significantly higher milk production (L/day) during winter ($p<0.05$) compared to summer. The present findings were consistent with the earlier reports of 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), Akcay *et al.* (2007), Marai *et al.* (2009) and Das *et al.* (2014). Thermally stressed lactating buffaloes depend on glucose as an energy source. They seem to shift their metabolism to preserve glucose for extra-mammary tissues, at the expense of milk synthesis. Despite having greater energy content, more metabolic heat is being generated through oxidizing fatty acids compared to glucose. However, thermally stressed animals are hypersensitive to insulin and this reduces mobilization of the adipose tissue thereby increasing glucose 'burning' to minimize metabolic heat production. As a consequence, glucose from mammary tissue is diverted to other body tissues thereby reducing glucose supply to the mammary gland. This reduces lactose production which is reflected further as reduced milk yield. This could be the primary cause of reduction in milk yield during summer (Baumgard *et al.,* 2006). The decrease in milk production in summer may also attribute to decrease in quality and quantity of available forage and stress (Dora *et al.,* 2021).

The difference in the means of milk protein, fat and SNF between summer and winter were shown in Fig. 2-4. The concentration of total milk protein, fat and SNF were significantly ($p<0.05$) lower in summer compared to winter. These findings were in line with other reports showing seasonal changes in buffalo milk production (Lindmark-Mansson *et al*., 2003; Ozrenk and Sebnem, 2008; El-Khashab *et al*., 2010; Das *et al.,* 2014 and Patbandha *et al.,* 2015). The decline in milk components in summer might be attributed to several reasons including a high THI, seasonal variation in feed and fodder composition (Chen *et al.,* 2014), depressed feed intake, low feed conversion ratio, deviation of nutrients for thermoregulation

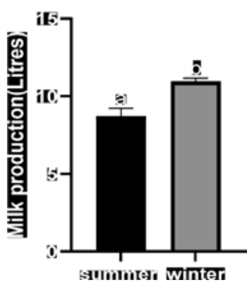

Fig. 1

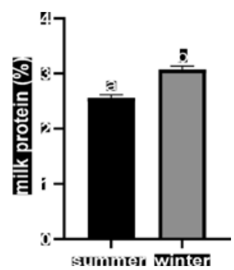

Fig. 2

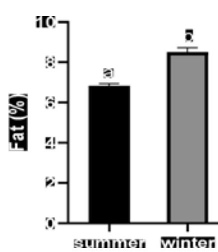

Fig. 3

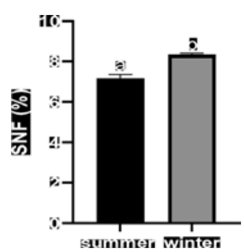

Fig. 4

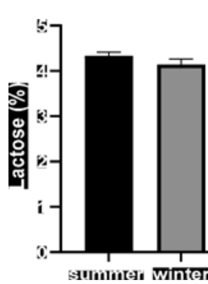

Fig. 5

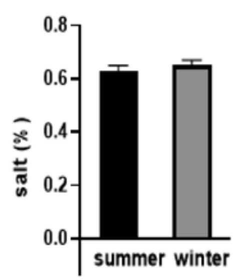

Fig. 6

Fig. 1-6 Effect of season on milk production, protein, fat, SNF, lactose and salt concentration in Murrah buffaloes (n=8). Bars with different superscript (a, b) differ significantly ($p<0.05$).

and lowered metabolism to prevent further heat production. The present study revealed no significant ($p<0.05$) change in milk lactose and salt concentration (Fig 5-6). This effect may be attributed to less sample size which needs confirmation in further studies with large sample size. Overall, the present study indicated that seasonal changes in THI negatively impacts milk production and composition in buffaloes which may lead to severe economic loses which in turn may reflect the livelihood of low and medium scale farmers.

Conclusion

Heat stress management strategies are often neglected assuming that the animals are highly adaptable to hot and humid conditions. In reality, the animals are highly sensitive to unit change in THI. High summer THI imposes significant heat stress and negatively affect milk production and composition in buffaloes. Hence, necessary microclimatic alterations are necessary to mitigate the negative effects of THI for the health and well-being of the animals, along with maintaining optimum production and reproduction in buffaloes.

Conflict of interest

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

References

Afzal, M., Anwar, M. and Mirza, M.A. 2007. Some factors affecting milk yield and lactation length In Nili Ravi buffaloes. *Pak. Vet. J.* **27** (3): 113.

Ahmad, M. and Shafiq. M. 2002. Effect of season on fertility rate and milk production in Nili Ravi buffaloes. 23rd Annual Report, Livestock Production Research Institute, Bahadurnagar, Okara, Pakistan.

Ahmad, S., Anjum, F.M., Huma, N., Sameen, A. and Zahoor, T. 2013. Composition and physico-chemical characteristics of buffalo milk with particular emphasis on lipids, proteins, minerals, enzymes and vitamins. *J. Anim. Plant Sci*. **23** (1), 62-74.

Akcay, H., Ilaslan, M. and Koc, A. 2007. Effects of calving season on milk yield of Holstein cows raised at Dalaman state farm in Turkey. Adnan Menderes Universitesi. Ziraat Fakultesi Dergisi **4** (1-2): 59-61

Bajwa, I.R., Khan, M.S., Khan, M.A. and Gondal, K.Z. 2004. Environmental factors affecting milk yield and lactation length in Sahiwal cattle. *Pak. Vet. J.* **24** (1): 23-27.

Baumgard, L.H., Wheelock, B., Shwartz, G., Brien, M.O., Van Baale, M.J., Collier, R.J., Rhoads, M.L. and Rhoads, R.P. 2006. Effects of Heat Stress on Nutritional Requirements of Lactating Dairy Cattle. Proceedings of the 5th Annual Arizona Dairy Production Conference: 8-17.

Bernabucci, U., Ronchi, B., Lacetera, N. and Nardone. A. 2002. Markers of oxidative status in plasma and erythrocytes of transition dairy cows during hot season. *J. Dairy Sci.* **85** (9): 2173-2179.

Catillo, G., Macciotta, N.P.P., Carretta, A. and Cappio-Borlino. A. 2002. Effects of age and calving season on lactation curves of milk production traits in Italian water buffaloes. *J. Dairy Sci.* **85** (5): 1298-1306.

Chen, B., Lewis, M.J. and Grandison, A.S. 2014. Effect of seasonal variation on the composition and properties of raw milk destined for processing in the UK. *Food Chem.***158**: 216-223.

Claeys, W.L., Verraes, C., Cardoen, S., De Block, J., Huyghebaert, A., Raes, K. and Herman, L. 2014. Consumption of raw or heated milk from different species: An evaluation of the nutritional and potential health benefits. *Food Control* **42**: 188-201.

Das, K.S., Singh, J., Singh, G., Upadhyay, R., Malik, R. and Oberoi, P. 2014. Heat stress alleviation in lactating buffaloes: Effect on physiological response, metabolic hormone, milk production and composition. *Indian J. Anim. Sci.* **84** (3): 275-80.

Dash, M.C. 2010. Environment, energy, and development from Stockholm to Copenhagen and beyond the celebrations. *The Bioscan*. S1: 1-11.

Dora, D.S., Chourasia, S.K., Sahu, S.S. and Paikra, D. 2021. Effect of season on milk constituent in Gir cattle. *The Pharma J.* **10** (6):26-27.

El-Khashab M.A. 2010. Physiological and productive responses to amelioration of heat stress in lactating buffaloes under hot summer conditions in Egypt. http:// www.spsa-egy.org/? p=835.

Grewal, S., Aggarwal, A. and Alhussien, M.N. 2019. Seasonal alterations in the expression of inflammatory cytokines and cortisol concentrations in periparturient Sahiwal cows. *Biol. Rhythm Res. 1*-11. DOI: 10.1080/09291016.2019.1670971.

Helal, A., Hashem, A.L.S., Abdel-Fattah, M.S. and El-Shaer, H.M. 2010. Effect of heat stress on coat characteristics and physiological responses of Balady and Damascus goats in Sinai, Egypt. *Am. Eurasian J. Sustain*. **7**:60-69.

Johnson, H.D., Ragsdale, A.C., Berry, I.L. and Shanklin, M.D. 1963. Temperature-humidity effects including influence of acclimation in feed and water consumption of Holstein cattle. Univ. Missouri Res. Bull (846).

Lindmark-Mansson, H., Fonden, R. and Pettersson, H.E. 2003.Composition of Swedish dairy milk. *Int. Dairy J.* **13** (6): 409-425.

Livestock Census, 2019. Government of India, 20th Livestock Census-2019.Ministry of Fisheries, Animal Husbandry & Dairying; Department of animal husbandry and dairying, Krishi Bhawan, New Delhi.

Mader, T.L., Davis, M.S., and Brown-Brandl, T. 2006. Environmental factors influencing heat stress in feedlot cattle. *J. Anim. Sci*. ***84*** (3): 712-719.

Marai, I, Daader, A., Soliman, A. and El-Menshawy, S. 2009. Non-genetic factors affecting growth and reproduction traits of buffaloes under dry management housing (in sub- tropical environment) in Egypt. *Livest. Res. Rural. Dev.* **4** (4): 6.

Ozrenk, E. and Sebnem, S. 2008. The Effect of Seasonal Variation on the Composition of Cow Milk in Van Province. *Pakistan J. Nutr*. **7**(1): 161-164.

Patbandha, T.K., Ravikala, K., Maharana, B.R., Marandi, S., Ahlawat, A.R. and Gajbhiy, P.U. 2015. Effect of season and stage of lactation on milk components of buffaloes. *The Bioscan* **10** (2): 635-638.

Pawar, H.N., Kumar, G.R. and Narang, R. 2012. Effect of year, season and parity on milk production traits in Murrah buffaloes. *J. Buffalo Sci.* **1** (1): 122-125.

Payne, W.J.A. 1990. An introduction to animal husbandry in tropics, Longman, Science and Technology, 195-421.

Ranjhan, S.K. 1998. *Nutrient Requirements of Livestock and Poultry*, Indian Council of Agriculture Research, New Delhi.

Ravikala, K., Patbandha, T.K. and Vataliya, P.H. 2014. Nutritional management of dairy animals through milk yield and its component evaluation. In: *Compendium of 21st Annual Convention of Indian Society of Animal Production and Management*, 28th-30th, January, AAU, Anand, Gujarat, India. pp. 137-144.

Singh, G., Kamboj, M.L. and Patil, N.V. 2005. Effect of thermal protective measures during hot humid season on productive and reproductive performance of Nili-Ravi buffaloes. *Indian Buffalo J*. **3**: 101–04.

Segnalini, M., Bernabucci, U., Vitali, A., Nardone and Lacetera, A. 2013. Temperature humidity index scenarios in the Mediterranean basin. *Int. J. Biometeorol*. **57**: 451-458.

Snedecor, G.W. and Cochran, W.G. 1967. Statistical Methods. Iowa State University Press, Ames, Iowa.pp: 44-51.

Upadhyay, R.C., Singh, S.V., Kumar, A., Gupta, S.K. and Ashutosh. 2007. Impact of climate change on milk production of Murrah buffaloes. *Ital. J. Anim. Sci*. **6** (2): 1329-1332.

Vasantha, S.K.I., Srinivasa Prasad, Ch., Rambabu Naik, B., Aswani Kumar, K., Venkata Seshaiah V.Ch. and Nikhil Kumar Tej, J. 2021. Effect of season on milk production in Murrah Buffaloes: THI a proven marker. *Int. J. Curr. Microbiol. Appl. Sci.* **10** (04): 252-256. doi: https://doi.org/10.20546/ijcmas.2021.1004.025. ■