The Pharma Innovation Journal 2019; 8(8): 315-319

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(8): 315-319

www.thepharmajournal.com
Received: 28-06-2019
Accepted: 30-07-2019

Effect of automated intermittent wetting and forced ventilation on the physiological parameters and milk production of Murrah buffaloes in humid tropics

Sruthi S, Manju Sasidharan, Anil KS, Harikumar S and Shibu Simon

Sruthi S
M. V. Sc. Scholar, Department of Livestock Production Management, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

Manju Sasidharan
Assistant Professor, Department of Livestock Production Management, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

Anil KS
Professor and Head, Department of Livestock Production Management, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

Harikumar S
Assistant Professor, Department of Livestock Production Management, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

Shibu Simon
Assistant Professor, Department of Animal Reproduction, Gynaecology and Obstetrics, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

Correspondence
Sruthi S
M. V. Sc. Scholar, Department of Livestock Production Management, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

Abstract

A study was conducted to compare the effect of automated intermittent wetting and forced ventilation on the physiological parameters of Murrah buffaloes in humid tropics. Twelve lactating Murrah buffaloes were randomly selected from University Livestock Farm and Fodder Research Development Scheme, Mannuthy and grouped into two treatments with six animals each namely, T1 as control, T2 was provided with automated wetting and forced ventilation and were studied under two seasons with different THIs (low – 76.93 ± 0.53 and high – 82.55 ± 0.35). The mean rectal temperature (°F) was 102.04 ± 0.02 and 100.89 ± 0.02 in T1 and T2 respectively during high THI season. The mean pulse rate (beats per minute) was 57.92 and 55.23 ± 0.15 in T1 and T2 respectively during high THI season. The mean respiratory rate (breaths per minute) was 17.92 ± 0.15 and 15.28 ± 0.15 in T1 and T2 respectively during high THI season. The respiratory rate, pulse rate and rectal temperature were found to be significantly lower in T2 when compared to control group in both the seasons. Even though there was no significant difference, a substantial increase in milk yield was found in T2 when compared to control group in both the seasons. It may be concluded that animals in T2 experienced relatively mild heat stress compared to control group which was evident by the lower values in physiological parameters and a relatively higher milk yield. So, it could be suggested that in tropical humid climate, automated wetting and forced ventilation with respect to the relative humidity may be preferred when compared to the other thermal stress alleviating measures.

Keywords: Heat stress, THI, automated wetting, forced ventilation, Murrah buffaloes

1. Introduction

An important role is played by livestock in the Indian economy. Livelihood of about 20.5 million people is based upon livestock and around 8.8 per cent people are employed in the livestock sector. According to the 19th Livestock Census, India is world’s highest livestock owner at about 512.05 million and ranks first in the total buffalo population in the world (108.7 million). Buffaloes (*Bubalus bubalis*) are more prone to heat stress due to the thick black skin that absorbs solar radiations and the sparse hair coat which is inadequate for insulation. They also have fewer sweat glands seated deep in the skin that compromise heat dissipation through evaporative heat loss. Increased respiration rate, pulse rate and rectal temperature occur due to summer stress that in turn imposes higher energy demand on the animal body. Hence, they must be provided with a suitable environment for better production. Many direct and indirect thermal stress alleviating methods are used throughout the country. So, this study focusses on the effect of automated intermittent wetting and forced ventilation on the physiological parameters and milk production of Murrah buffaloes in humid tropics.

2. Materials and Methods

2.1 Experimental details and data

The research work was conducted at the Buffalo Farm, University Livestock Farm and Fodder Research Development Scheme, Mannuthy under Kerala Veterinary and Animal Sciences University, Kerala located at 10º 31’ 37” N 76º 15’ 49” E. The period of study was four months from January 2019 to May 2019 during which high and low thermal stress was experienced.

Twelve Murrah buffaloes were selected for the study. Six animals each were randomly allotted to two groups. Both the treatment groups were housed in the same shed in head to head arrangement. The groups were: control (T1) and an automated intermittent wetting and forced ventilation system was set up (T2). The sprinklers worked for 20 seconds and fans for 25 minutes based on dynamic THI variation. When the relative humidity was above 85 per cent only the fan activated for 25 minutes to prevent further increase in the environment (Prasad, 2014) [7]. The routine feeding and full hand milking schedule was followed in both the treatments.

Macroclimatic and microclimatic data from exterior and interior of the shed were collected during the study period. Interior ambient temperature (ºF) and relative humidity (%) was measured using electronic digital logger (HOBO pro V2, Onset Computer Corporation, USA) every hour throughout the day.

In this study Livestock Poultry Heat Stress Index **(**LPHSI, 1990**)** [6] was taken as the Temperature Humidity Index and calculated using the following formula:

$$THI = T_{(db)} - \{(0.55-0.55RH)\,(T_{(db)}-58)\}$$

Where,
$T_{(db)}$ = Dry bulb temperature (ºF)
RH = Relative humidity (%)

Rectal temperature (ºF) was taken as core body temperature and measured daily using the digital thermometer. Pulse rate (beats per minute) was recorded daily by manual palpation of middle coccygeal artery. Respiratory rate (breaths per minute) was measured daily by counting the flank movements for one minute, from a distance without disturbing the animals. Full - hand milking was done twice a day and the production was recorded daily.

2.2 Statistical Analysis

The data obtained on various parameters were statistically analysed as per the method of Snedecor and Cochran (1994) [10] using repeated measures of analysis of variance (ANOVA). The whole data were analysed using computerized software programme SPSS V. 24.0.

3. Results

3.1 Ambient temperature

The mean interior ambient temperature of the shed during the study period was recorded at hourly intervals and fortnightly mean is depicted in Table 1. The mean temperature of interior showed an increasing trend from January to April. Towards the end of April and beginning of May (F8 and F9), it was slightly lower than that of March. Significant difference between interior temperatures was observed during F3, F4, F5 and F8. The highest micro environment temperatures experienced by animals in T1 and T2 groups were 87.66ºF (F7) and 86.53ºF (F7) respectively.

Table 1: Fortnightly interior temperature, ºF (Mean ± SE)

Fortnightly interval	Control (T1)	Automated wetting and forced ventilation (T2)
F1	80.26 ± 0.35	79.43 ± 0.29
F2	82.14 ± 1.15	81.00 ± 1.20
F3	85.38 ± 0.71^{a}	84.23 ± 0.28^{b}
F4	85.07 ± 0.01^{a}	84.10 ± 0.035^{b}
F5	85.89 ± 0.07^{a}	84.90 ± 0.05^{b}
F6	87.47 ± 0.52	86.52 ± 0.60
F7	87.66 ± 0.70	86.53 ± 0.67
F8	86.44 ± 0.59	85.50 ± 0.60
F9	86.58 ± 0.08^{a}	85.46 ± 0.16^{b}

Means with different superscripts (a-b in rows) differ significantly ($p<0.05$)

3.2 Relative humidity (RH)

Relative humidity of interior of the shed was recorded continuously at hourly intervals (Table 2). No significant difference was observed between the treatments. Throughout the study periods, highest relative humidity was recorded in T2 group.

Table 2: Fortnightly interior relative humidity, % (Mean ± SE)

Fortnightly interval	Control (T1)	Automated wetting and forced ventilation (T2)
F1	62.55 ± 4.11	62.18 ± 4.16
F2	70.96 ± 4.78	71.67 ± 5.46
F3	70.92 ± 1.56	71.83 ± 2.48
F4	70.99 ± 4.96	71.69 ± 5.39
F5	75.33 ± 3.40	75.99 ± 3.70
F6	76.77 ± 0.20	77.55 ± 0.03
F7	79.17 ± 0.03	80.69 ± 0.12
F8	82.00 ± 1.05	83.42 ± 1.28
F9	80.88 ± 0.37	81.05 ± 0.63

3.3 Temperature Humidity Index (LPHSI, 1990) [6]

The mean THI during the period is shown in Table 3. No significant difference was observed between the treatments. The highest THI was observed during F7 in both the treatments – 83.89 ± 0.63 (T1) and 82.20 ± 0.59 (T2).

Table 3: Fortnightly interior THI (Mean ± SE)

Fortnightly interval	Control (T1)	Automated wetting and forced ventilation (T2)
F1	75.19 ± 0.22	74.56 ± 0.26
F2	77.77 ± 0.34	76.92 ± 0.33
F3	80.58 ± 0.23	79.81 ± 0.14
F4	80.15 ± 0.92	79.49 ± 0.93
F5	81.56 ± 0.70	80.92 ± 0.69
F6	83.27 ± 0.49	82.61 ± 0.54
F7	83.89 ± 0.63	83.20 ± 0.59
F8	83.27 ± 0.77	82.70 ± 0.80
F9	83.63 ± 0.52	82.89 ± 0.31

3.4 Classification of Seasons Based on Exterior THI

The period of study to assess the thermal stress in buffalo was from January 2019 to May 2019 (Table 4).

Table 4: Weekly mean exterior THI during the study period

Fortnights	Weeks	Mean ± SE
F1	Jan 08 – Jan 14	74.14 ± 0.38
F2	Jan 15 – Jan 21	73.95 ± 0.33
F3	Jan 22 – Jan 28	76.11 ± 0.39
F4	Jan 29 – Feb 04	77.12 ± 0.32
F5	Feb 05 – Feb 11	79.72 ± 0.27
F6	Feb 12 – Feb 18	79.38 ± 0.33
F7	Feb 19 – Feb 25	78.10 ± 0.37
F8	Feb 26 – Mar 04	79.99 ± 0.32
F9	Mar 05 – Mar 11	81.32 ± 0.28
F10	Mar 12 – Mar 18	79.91 ± 0.34
F11	Mar 19 – Mar 25	82.02 ± 0.33
F12	Mar 26 – Apr 01	82.80 ± 0.27
F13	Apr 02 – Apr 08	82.38 ± 0.30
F14	Apr 09 – Apr 15	83.60 ± 0.27
F15	Apr 16 – Apr 22	81.60 ± 0.36
F16	Apr 23 – Apr 29	82.94 ± 0.30
F17	Apr 30 – May 07	81.97 ± 0.26

This period of four months (17 weeks) was classified into two seasons based on exterior THI (LPHSI, 1990) [6]. Low THI (January 08 – February 25) and high THI (February 26 – May 07) (Table 5) and depicted in Fig 1.

Table 5: Classification of seasons based on exterior THI

Classification of seasons based on exterior THI		
Season	**Period**	**THI ± SE**
Low THI	January 08 –February 25	76.93 ± 0.53
High THI	February 26 – May 07	82.55 ± 0.35

Fig 1: Classification of seasons based on exterior THI

3.5 Physiological Changes

3.5.1 Core body temperature

Table 6: Core body temperature of treatments in different seasons, °F (Mean ± SE)

Treatments		**Low THI (76.93 ± 0.53) (Jan 08 – Feb 25)**	**High THI (82.55 ± 0.53) (Feb 26 – May 7)**
T1	Control	101.46 ± 0.01^{aA}	102.04 ± 0.02^{aB}
T2	Automated wetting and forced ventilation	100.01 ± 0.01^{bA}	100.90 ± 0.02^{bB}

Means with different superscripts (a-b in columns, A-B in rows) differ significantly (p<0.05)

Table 6 showed the mean core body temperature in different seasons. Animals in T2 group recorded significantly lower temperature in both the seasons when compared to controls. During low and high THI season, T2 recorded the lowest core body temperature compared to control.

3.5.2 Respiration rate, breaths/min

The mean respiration rates (RR) of animals in two treatments in two seasons are given in Table 7. During low THI and high THI, animals in control group showed a significantly higher respiratory rates.

Table 7: Mean respiration rate of treatments in different seasons

Treatments		**Low THI (76.93)**	**High THI (82.55)**
T1	Control	15.801 ± 0.151^{aA}	17.921 ± 0.151^{aB}
T2	Automated wetting and forced ventilation	12.923 ± 0.151^{bA}	15.280 ± 0.151^{bB}

Means with different superscripts (a-b) differ significantly in columns and (A-B) in a row (p<0.05)

3.5.3 Pulse rate, beats per minute

Table. 8. showed the comparison of pulse rate between treatments and between seasons. Pulse rates of animals in T2 group were significantly lower than control during both the seasons. Comparison of treatments between the two seasons also revealed that pulse rates were significantly different.

Table 8: Mean pulse rate/min of treatments in different seasons

Treatments		**Low THI (76.93) (Jan 08 – Feb 25)**	**High THI (82.55) (Feb 25 – May 07)**
T1	Control	47.61 ± 0.15^{aA}	57.92 ± 0.15^{aB}
T2	Automated wetting and forced ventilation	44.57 ± 0.15^{bA}	55.23 ± 0.15^{bB}

Means with different superscripts (a-b) differ significantly in columns and (A-B) in rows (p<0.05).

3.6 Milk Production Characteristics

3.6.1 Daily milk production

Table 9 Showed daily milk yield of both treatments in different seasons. Effect of thermal stress alleviating measures on animals in both the treatments recorded no significant difference in milk yield, whereas animals in T4 group recorded relatively higher milk production in all the seasons.

Table 9: Mean daily milk production in two seasons, kg

Treatments		Low THI (76.93) (Jan 08 – Feb 25)	High THI (82.55) (Feb 26 – May 07)
T1	Control	5.72 ± 0.88^{Aa}	5.627 ± 0.888^{aA}
T2	Automated wetting and forced ventilation	7.419 ± 0.876^{aA}	$6.483\ .888^{aA}$

Means with same superscripts (a in columns and A-B in rows) do not differ significantly ($p<0.05$)

4. Discussion

4.1 Ambient temperature

The highest temperatures at T1 and T2 groups were 87.66 ± 0.70°F and 86.53 ± 0.67°F (F7 – April 2 to April 15) respectively. However, Tej (2015) [11] recorded the maximum ambient temperature 85.26 ± 0.12°F in May and Harikumar (2017) [5] recorded maximum of 94.17 °F in March in Thrissur district. The variations in the maximum temperatures recorded were due to change in the location of study with in the district.

4.1.1 Relative humidity, %

No significant difference was observed in relative humidity between the treatments. During the study period, lowest relative humidity was recorded during F1 in control. This result was in accordance with Zarina (2016) [13] and Harikumar (2017) [5]. Even though intermittent wetting was used as a measure to alleviate thermal stress that did not increase the relative humidity level in the shed.

4.2 Bioclimatic index

4.2.1 Temperature Humidity Index (LPHSI, 1990) [6]

No significant difference was observed in THIs between the treatments. The highest THI was observed during F7 in both the treatments – 83.89 ± 0.63 (T1) and 82.20 ± 0.59 (T2). Throughout the study period, THI of T2 group was lower than T1.

4.2.2 Classification of Seasons Based on Exterior THI

Study period was divided into two seasons based on exterior THI. Low THI (January 08 - February 25) and high THI (February 26 – May 07) are taken as the two seasons. The highest THI season was from February to May which was in agreement with the observations of Prasad (2014) [7] and Harikumar (2017) [5].

4.3 Physiological Parameters

4.3.1 Core body temperature, °F

Animals in T2 group which were subjected to automated intermittent wetting and forced ventilation recorded significantly lower rectal temperature in both the seasons when compared to control. Wetting and forced ventilation increased the evaporative cooling and resulted in relatively lower body temperature in T2 animals. Similar responses with wetting and forced ventilation were observed by Prasad (2014) [7] observed in cows and Ahmad *et al.* (2018) [12] in buffaloes. Singh *et al.* (2014) [8] observed that the rectal temperature reduced on using cooling devices like fan cum mist system.

4.3.2 Respiration rate, breaths/min

During low THI and high THI seasons, animals in T1 and T2 groups exhibited a significantly different respiratory rates between each other. Significantly lower respiratory rate was seen in T2 during both seasons when compared to control. On analysing the respiratory rate in different treatments in the two seasons, it was evident that the respiration rate was significantly lower in T2 when compared to control. This result is in consonance with Singh *et al.* (2014) [9] where fan cum mist system was used and Ahmad *et al.* (2018) [12] where they had used fans and sprinklers and found effective to reduce the respiratory rate. Increase in respiratory rate was found to be the first level of defence to prevent the increase in body temperature.

4.3.3 Pulse rate, beats/min

Pulse rates in animals of T2 were significantly lower than control during both the seasons. There was significant difference between the T1 and T2 in low THI as well as high THI. Comparison of treatments between the two seasons revealed that pulse rates were significantly different. Highest pulse rate was in seen in control in both the seasons. Similar to rectal temperature and respiration rate, pulse rate also showed significant reduction in T2 group of animals during high THI when compared to control group. This was in accordance with the findings of Singh *et al.* (2014) [8] and Ahmad *et al.* (2018) [12]. Harikumar *et al.* (2017) [5] also stated that using of automated wetting and fan reduced the pulse rate which was similar to the present study.

4.4 Milk Production Characteristics

4.4.1 Daily milk production, kg

Effect of thermal stress alleviating measures on animals in both the treatments recorded no significant difference in milk yield. A substantial increase in milk yield was evident in animals of T2 group provided with automated wetting and forced ventilation in both low and high THI seasons. There was a substantial difference in the milk production by 1.7 kg in low THI season and 850 g in high THI in T2 group of animals compared to control. Similar reports were given by Collier *et al.* (2006) [4], where there was an increase in milk yield by 0.8kg/head/day with a reduction in body temperature by 1.95 °C in animals provided with sprinklers and fans only. Results by Younas *et al.* (2018) [12] stated that two groups provided with fan and fan with showers and shades exhibited a higher milk yield compared to control. This result coincided with present study and similar findings were given by Armstrong (1994) [3] and Aggarwal and Singh (2008) as they reported that during hot dry environment milk yield was increased in response to water cooling.

5. Conclusion

It could be concluded that the direct and immediate effect of intermittent wetting and forced ventilation had favourable responses on the physiological parameters and milk production of Murrah buffaloes by alleviating the thermal stress. The automated device for controlled wetting and forced ventilation with respect to the level of humidity will definitely help to reduce thermal stress and also saves water, electricity and labour expenses.

6. References

1. Aggarwal A, Singh M. Hormonal changes in heat-stressed Murrah buffaloes under two different cooling systems. Buffalo Bull. 2010; 29:1-6.
2. Ahmad M, Bhatti JA, Abdullah M, Ullah R, Ul Ain Q, Hasni MS *et al*. Different ambient management intervention techniques and their effect on milk production and physiological parameters of lactating Nili Ravi buffaloes during hot dry summer of subtropical region. Tropical Anim. Health and Prod. 2019; 51:911-918.
3. Armstrong D. Heat stress interaction with shade and cooling. J of dairy sci. 1994; 77:2044-2050.
4. Collier RJ, Dahl GE, Van Baale MJ. Major advances associated with environmental effects on dairy cattle. J. of dairy sci. 2006; 89:1244-1253.
5. Harikumar S. Behavioural, physiological and biochemical stress response of crossbred cows to varying thermal indices in different management systems. PhD thesis. Kerala Veterinary and Animal Sciences University, 2017, 118p.
6. LPHSI. Livestock and poultry heat stress indices. The livestock and poultry heat stress indices foe cattle, sheep and goats. In: the agriculture engineering technology guide, Clemson University, Clemson, SC, USA, 1990.
7. Prasad A, Jijo PT, Kannan A. Development of automatic climatic stress ameliorating system for livestock. In: Proceedings of National Environmental and Climate Change Congress; 20 to 22 November, 2018, Thiruvananthapuram. Directorate of Environment and Climate Change (DOECC) and Energy Management Centre, 2018, 1-8p.
8. Singh AK, Devi R, Kumar Y, Kumar P, Upadhyay RC. Physiological changes and blood flow in Murrah buffaloes during summer and winter season. J Buffalo Sci. 2014; 3:63-69.
9. Singh SV, Hooda OK, Narwade B, Baliyan B, Upadhyay RC. Effect of cooling system on feed and water intake, body weight gain and physiological responses of Murrah buffaloes during summer conditions. Indian J of Dairy Sci. 2014; 67:426-431.
10. Snedecor GW, Cochran WG. Statistical Methods. (8th Ed.). The Iowa State University press, Iowa, 1994, 564p.
11. Tej JNK. Assessment of stress response and supportive role of vitamin- E in crossbred female calves. MVSc thesis. Kerala Veterinary and Animal Sciences University, 2015, 109p.
12. Younas U, Abdullah M, Bhatti JA, Pasha TN, Ahmad N, Junaid M. Effect of different housing management strategies on production and behavioral response of buffaloes during dry hot summer. JAPS: J of Anim. & Plant Sci, 2018, 28.
13. Zarina A. Adaptability profile of male cattle and buffalo calves to varying Temperature Humidity Index (THI) in Kerala. PhD thesis. Kerala Veterinary and Animal Sciences University, 2016, 135p.