International Journal of Veterinary Sciences and Animal Husbandry

ISSN: 2456-2912
VET 2024; 9(2): 07-09
© 2024 VET
www.veterinarypaper.com
Received: 16-11-2023
Accepted: 29-12-2023

Dr. MI Syed
Ph.D Scholar, Livestock Production Management Section, ICAR-NDRI, Karnal, Haryana, India

SS Lathwal
Principal Scientist, Livestock Production Management section, ICAR-NDRI, Karnal, Haryana, India

Pawan Singh
Principal Scientist, Livestock Production Management section, ICAR-NDRI, Karnal, Haryana, India

GJ Panchbhai
Assistant Professor, Livestock Production Management, PGIVAS, Akola, Maharashtra, India

Corresponding Author:
Dr. MI Syed
Ph.D Scholar, Livestock Production Management Section, ICAR-NDRI, Karnal, Haryana, India

Effect of cool roof technology on physiological and production performance of Sahiwal zebu cows

Dr. MI Syed, SS Lathwal, Pawan Singh and GJ Panchbhai

DOI: https://dx.doi.org/10.22271/veterinary.2024.v9.i2a.1162

Abstract
This study aims to investigate the effect of a cool roof technology on performance of Sahiwal zebu cows during hot-humid summer months. Sixteen lactating Sahiwal cows were selected in their early lactation for a period of 8 weeks. Animals were divided into two groups of 8 cows each and housed in two different sheds. The control group was housed in the shed with asbestos roof while the treatment group was housed in a modified shed having white acrylic paint on the roof. The mean maximum temperature inside the treatment shed was lower (32.07±0.30) than that of control shed (33.37±0.30). The afternoon THI in control (85.46±0.28) and treatment shed (84.42±0.28) also found to be significantly different. The inner ceiling temperature of control shed was higher in control shed (51.67±0.41) than in treatment (47.65±0.31) shed. In addition, Sahiwal cows housed under white painted roof shed found to have significantly ($p<0.05$) lower respiration rate and skin temperature. However, it did not affect the mean dry matter intake, milk production, milk fat and SNF percentage in Sahiwal cows. Painting the roof white lowers the inner air temperature of shed and may have synergistic effect if combined with other strategies to ameliorate heat stress in dairy animals.

Keywords: Heat stress, Sahiwal cow, shelter management, cool roof technology

1. Introduction
The average milk yield per animal per day for exotic/crossbred cow in India is 8.55 Kg/day/Animal and for indigenous cow it is much lower i.e. 3.44 Kg/day/ Animal (BAHS, 2023) [2]; thereby indicating that more focus should be on to improve performance of indigenous cows for getting better production results. Sahiwal cow is well known as one of the best dairy breeds in India and Pakistan and popularly known for its productive and reproductive abilities under tropical conditions (Ilatsia *et al.* 2012) [8]. However, the Sahiwal population has been dwindling in the country due to crossbreeding with exotics and small population size (Thakur and Kumar, 2016) [16]. Since the zebu cows are assumed to be heat-tolerant, the effects of heat stress and ameliorative measures on their productivity have not been studied much on these cows.
The amelioration of heat stress and its effects through shelter and environmental modification involves reducing heat gain via solar radiation and ambient air temperatures. However, successful cooling measures for dairy cows are based on augmenting available routes of heat exchange, convection, conduction, radiation, and evaporation (Collier *et al*., 2006) [4]. Hence, the present study was contemplated to find out the effect of cool roof technology on productive and physiological performance of Sahiwal zebu cows in a hot and humid summer.

2. Materials and Methods
The experiment was conducted at the Livestock Research Centre of ICAR-National Dairy Research Institute, Karnal, Haryana, India for 60 days duration during hot-humid summer (July-August). Sixteen lactating Sahiwal cows were selected and divided into two groups with 8 cows in each group and were kept loose in closed shed having concrete walls with windows. Control group was housed in the existing shed which has a provision of asbestos roof.

While, the treatment group was kept in a modified shelter by painting asbestos roof with white acrylic paint (COOLROOF®). The dry matter intake was calculated for the whole group of cows at weekly intervals. Milk yield was recorded daily and milk fat and SNF percent were recorded weekly for individual cow.

Microclimatic data recording was done at animal level to measure the microenvironment prevalent around the cows. Minimum and maximum temperature, dry and wet bulb temperature was recorded by installing respective thermometers (OMSONS™) in the covered area of experimental sheds. The THI was calculated by using the formula given by Bianca (1962) [3] as under,

$$THI = (0.35 \times T_{db} + 0.65 \times T_{wb}) \times 1.8 + 32.$$

Physiological parameters viz. RR, RT and PR were recorded using standard methods i.e. flank movement, clinical thermometer and coccygeal artery, respectively. The skin temperature and internal roof temperature was recorded using non-contact infrared thermometer, keeping the thermometer 6 inches away from the skin and roof, respectively. The Cortisol hormone was estimated in heparinized plasma samples using 'Bovine Cortisol ELISA Test Kit' (MyBioSource, Catalog # MBS701325) supplied by CUSABIO.

Statistical analysis was performed using the SPSS Software programme by student t- test to compare means of different parameters observed.

3. Result and Discussion

3.1 Microclimatic Variables: The mean maximum temperature and mean THI value (Table 1) in control and treatment shed differed significantly ($p<0.05$) which is similar to the findings of Singh *et al.* (1989) [15] and Patil *et al.* (2014) [13] who observed significantly lower maximum temperature in thatched roof shed than asbestos roof shed. Similar findings were observed by Jat *et al.* (2005) [9] for thatch and mud roof and Patil *et al.* (2014) [13] who recorded lower THI for white painted roof compared to asbestos roof. The mean values of Inside surface temperature of roof (ceiling) during the afternoon hours in control and treatment shed were 51.67±0.41 °C and 47.65±0.31 °C, respectively and it found to be significantly different ($p<0.01$). These observations are in accordance with the findings of Sahu *et al.* (2018) [14] who recoded lower surface temperature of ceilings in thatch roof shed than asbestos roof shed. Application of white paint to the roof might have cooled the roof by augmenting the level of sunlight reflection, thus reducing the amount of absorbed solar radiation and prevented overheating of roof.

Table 1: Means (±SE) of Maximum Microclimatic Temperature, Temperature Humidity Index (THI) and Ceiling Temperature of experimental sheds

Parameter	Control	Treatment
Maximum Temperature Mean (±S.E)	33.37±0.30	32.07±0.30
THI Mean (±S.E)	85.46±0.28	84.42±0.28
Ceiling Temperature Mean (±S.E)	51.67±0.39	47.65±0.31

3.2 Dry matter Intake: Due to high temperature and humidity, the mean dry matter intake was reduced in both the groups. Cows in control group had DMI of 8.645±0.058 and in treatment group it was 8.71±0.062. The DMI in treatment group was numerically higher but the difference was non-significant statistically. In contrary to these findings, Patil *et al.* (2014) [13] observed significant difference ($p<0.05$) between the dry matter intake of Crossbred cows kept under simple asbestos roof and white painted asbestos roof. Reason behind this contradiction may be the breed difference in experimental animals.

3.3 Milk production and composition: Mean daily milk yield of control and treatment group was 7.02±0.548 and 7.72±0.731, respectively. Treatment group had more milk yield than control group but statistically it did not differ significantly. In accordance with this result, Madke *et al.* (2010) [10] reported no significant difference between mean milk yields of crossbred cows kept under conventional roof (10.27±0.33 Kg) and thatched roof (10.45±0.53) during hot-humid season. In the present investigation, treatment did not affect the dry matter intake of Sahiwal cows. Since the change in milk yield is attributed to the change in dry matter intake of the animal, no difference was observed in milk yield of both the groups.

The mean values of milk fat per cent of control (4.31±0.062) and treatment (4.37±0.053) and the mean SNF per cent of control (8.75±0.026) treatment (8.74±0.025) did not found to be significant. Similarly, Armstrong *et al.* (1986) [1], Mihina *et al.* (1988) [11], Muller and Both (1995) [12] did not report any significant effect of shelter on milk composition.

3.4 Physiological parameters (Table): The respiration rate and skin temperature of cows in control group was found to be significantly different than the treatment group. It might be due to the fact that white painted roof in summer season worked as a good reflector of solar radiation and provided cooling effect in shed. Similar results were recorded by Madke *et al.* (2010) [10] that the thatched shed was suitable compared to asbestos roof shed as skin temperature of crossbred cows in hot-dry and summer season was lower than control group. Patil *et al.* (2014) [13] recorded significantly ($p<0.05$) higher average respiration rate /min in crossbred cows kept under asbestos roof (64.33±0.08) than white painted roof (61.49±0.09). Similarly, Sahu *et al.* (2018) [14] also observed highly significant ($p<0.01$) values for respiration rate in crossbred cows kept in thatched roof shed compared to asbestos roof shed. However, the values of rectal temperature and pulse rate of Sahiwal cows in control and treatment group did not differ significantly which is in accordance with the findings of Sahu *et al.* (2018) [14] who reported no significant difference between the rectal temperatures of crossbred jersey cows kept under thatched roof shed and asbestos roof shed.

Table 2: Means (±SE) of different physiological parameters of experimental cows

Parameter	Control	Treatment
Rectal Temperature (^{0}F) Mean (±S.E)	101.97±0.03	101.93±0.02
Respiration rate per min. Mean (±S.E)	26.00±0.20	25.23±0.24
Skin Temperature (°C) Mean (±S.E)	38.06±0.11	37.16±0.10
Pulse rate per min. Mean (±S.E)	62.06±0.35	61.59±0.33
Plasma Cortisol (ng/ ml) Mean (±S.E)	7.105±0.21	7.028±0.21

The mean values of plasma cortisol in control and treatment cows were 7.105±0.21 ng/ml and 7.028±0.21 ng/ml, respectively and these values did not differ significantly. Similarly, Dikmen *et al.* (2008) [6] too reported non-significant differences for cortisol level in heat stressed animals.

4. Conclusion

Application of white acrylic paint to the asbestos roof significantly reduced roof ceiling temperature ($p<0.01$) and microclimatic temperature ($p<0.05$) of the shed. Sahiwal cows housed under white painted roof shed found to have significantly ($p<0.05$) lower respiration rate and skin temperature. However, there was no effect on dry matter intake, milk yield, and milk fat percentage and SNF percentage of Sahiwal cows. Painting the roof white lowers the inner air temperature of shed and may have synergistic effect if combined with other strategies to ameliorate heat stress in dairy animals

5. References

1. Armstrong DV, Wiersma F, Wise ME, Huber JT, Marcus KM, Ammon DS. Effect of refrigerated air conditioning and evaporative cooling on milk production. J Dairy Sci. 1986;(Suppl. 1)69:161.
2. BAHS. GOI. Ministry of Agriculture and farmers welfare. Department of Animal Husbandry, dairying and Fisheries, Krishi bhavan, New Delhi; c2023.
3. Bianca W. Relative importance of dry-and wet-bulb temperatures in causing heat stress in cattle. Nature. 1962;195:251-252.
4. Collier RJ, Dahl GE, VanBaale MJ. Major advances associated with environmental effects on dairy cattle. Journal of dairy science. 2006;89(4):1244-1253.
5. Curley Jr KO, Neuendorff DA, Lewis AW, Cleere JJ, Welsh Jr TH, Randel RD. Functional characteristics of the bovine hypothalamic–pituitary–adrenal axis vary with temperament. Hormones and behavior. 2008;53(1):20-27.
6. Dikmen S, Alava E, Pontes E, Fear JM, Dikmen BY, Olson TA, *et al*. Differences in thermoregulatory ability between slick-haired and wild-type lactating Holstein cows in response to acute heat stress. Journal of dairy science. 2008;91(9):3395-3402.
7. Herskin MS, Munksgaard L, Andersen JB. Effects of social isolation and restraint on adrenocortical responses and hypoalgesia in loose-housed dairy cows 1. Journal of animal science. 2007;85(1):240-247.
8. Ilatsia ED, Roessler R, Kahi AK, Piepho HP, Zárate V. Production objectives and breeding goals of Sahiwal cattle keepers in Kenya and implications for a breeding programme. Tropical animal health and production. 2012;44(3):519-530.
9. Jat RP, Gupta LR, Yadav BL. Effect of roof modifications in loose house on intake and utilization of nutrients in buffalo calves during rainy season. Indian journal of dairy science. 2005;58(1):54-57.
10. Madke PK, Lathwal SS, Yajuvendra S, Anil K, Vinay K. Study of behavioural and physiological changes of crossbred cows under different shelter management practices. Indian Journal of Animal Sciences. 2010;80(8):771-774.
11. Mihina S, Brestensky V, Szabova G. The effect of milking technology and housing system on milk composition. Zivocisna Vyroba-UVTIZ (Czechoslovakia); c1988.
12. Muller CJC, Botha JA. Effect of shelter on the performance of Friesian cows during winter in a Mediterranean climate. South African Journal of Animal Science. 1995;25(2):52-56.
13. Patil SM, Bharambe VY, Khirari PB. Effect of shelter management on lactating crossbred cows during summer under the agro-climatic condition of Konkan region of India. Journal of Animal Research. 2014;4(1):9.
14. Sahu D, Mandal DK, Champak B, Chatterjee A, Mandal A, Mandal M. Effect of roof ceiling and flooring on microclimate of shed and physiological indices of crossbred jersey cows. International Journal ofAnimal Research. 2018;8(4):272-280.
15. Singh K, Kumar P, Saini AL, Bhattacharyya NK. Micro-climate within three types of literoof sheds in hot semiarid zone [Goats]. Indian Journal of Animal Sciences (India), 1989.
16. Thakur A, Kumar A. Sahiwal cattle: A unique genetic resource of India. Indian Farmer. 2016;3(5):344-347.